

SERVICE INNOVATION TOOLS: A LITERATURE REVIEW

FERRAMENTAS DE INOVAÇÃO DE SERVIÇOS: UMA REVISÃO DA LITERATURA

HERRAMIENTAS DE INNOVACIÓN DE SERVICIOS: UNA REVISIÓN DE LA LITERATURA

 Marcia Beatriz Cavalcante¹

 Antonio Hidalgo²

 Hélio Gomes de Carvalho³

 Gustavo Dambiski Gomes de Carvalho⁴

Cite as – American Psychological Association (APA)

Cavalcante, M. B., Hidalgo, A., Carvalho, H. G., & Carvalho, G. D. G. (2020, May/Aug.). Service innovation tools: a literature review. *International Journal of Innovation - IJI*, São Paulo, 8(2), 276-304.
<https://doi.org/10.5585/iji.v8i2.17409>.

Abstract

Objective of the study: This research aims to systematically review the frameworks (i.e. tools) proposed and applied by the literature on service innovation.

Methodology / approach: The methodology is based on a systematic literature review, which included two main steps. The former revisited the work of Carlborg, Kindstrom, and Kowalkowski (2014), in which 28 articles were fully analyzed, whereas the latter comprised a complete novel bibliography review employing the Science Direct database, in which 109 articles were fully analyzed.

Originality / Relevance: Overall, 87 Service Innovation Tools (SIT) were identified, analyzed, and classified concerning service innovation stages and sector contexts. Besides, the topics of New Service Development (NSD), Service Engineering (SE), and Service Design (SD) were discussed, especially regarding the main stages of the service innovation process.

Main results: Results show that 87 SIT were applied in several sectors such as healthcare, education, tourism, among others.

Theoretical / methodological contributions: This paper contributes to the literature on both services and innovation by examining a common-ground and under-researched topic: service innovation tools.

Social / management contributions: Practitioners may benefit from an overall panorama of service innovation tools available for idea generation, analysis & requirements definition, and conceptual design.

Keywords: New services. Service creation. Service development. Service innovation process.

¹ Universidade Tecnológica Federal do Paraná – UTFPR, Curitiba, Paraná – Brasil. inovaxpress@gmail.com

² Universidad Politécnica de Madrid – UPM, Madrid – Spain. antonio.hidalgo@upm.es

³ Centro Internacional de Tecnologia de Software – CITS, Curitiba, Paraná – Brasil. helio.carvalho@cits.br

⁴ Universidade Tecnológica Federal do Paraná – UTFPR, Ponta Grossa, Paraná – Brasil. gustavo.dambiski@gmail.com

Service innovation management. Models. Frameworks. Instruments. Practices. Methods. Systems.

Resumo

Objetivo do estudo: Esta pesquisa tem como objetivo revisar sistematicamente os frameworks (i.e., ferramentas) propostos e aplicados pela literatura sobre inovação em serviços.

Metodologia / abordagem: A metodologia é baseada em uma revisão sistemática da literatura, que incluiu duas etapas principais. A primeira revisitou o trabalho de Carlborg, Kindstrom e Kowalkowski (2014), em que 28 artigos foram analisados na íntegra, enquanto a segunda constituiu uma revisão bibliográfica completamente nova utilizando a base de dados Science Direct, na qual 109 artigos foram analisados na íntegra.

Originalidade / Relevância: No geral, 87 ferramentas de inovação de serviço (SIT) foram identificadas, analisadas e classificadas em relação aos estágios de inovação de serviço e contextos setoriais. Além disso, foram discutidos os temas desenvolvimento de novos serviços (NSD), engenharia de serviços (SE) e design de serviços (SD), principalmente no que diz respeito às principais etapas do processo de inovação de serviços.

Principais resultados: Os resultados mostram que as 87 ferramentas de inovação de serviço aplicadas em diversos setores como saúde, educação, turismo, entre outros

Contribuições teóricas / metodológicas: Este artigo contribui para a literatura sobre serviços e inovação, examinando um tópico comum e pouco pesquisado: ferramentas de inovação em serviços.

Contribuições sociais / de gestão: Profissionais podem se beneficiar de um panorama geral de ferramentas de inovação de serviços disponíveis para geração de ideias, análise & definição de requisitos e projeto conceitual.

Palavras-chave: Novos serviços. Criação de serviços. Desenvolvimento de serviços. Processo de inovação de serviços. Gestão de inovação de serviços. Modelos. Frameworks. Instrumentos. Práticas. Métodos. Sistemas.

Resumen

Objetivo del estudio: Esta investigación tiene como objetivo revisar sistemáticamente los marcos de referencia (i.e., herramientas) propuestos y aplicados por la literatura sobre innovación de servicios.

Metodología / enfoque: La metodología es basada en una revisión sistemática de la literatura, que incluyó dos pasos principales. El primero revisó el trabajo de Carlborg, Kindstrom y Kowalkowski (2014), en el que se analizaron 28 artículos en su totalidad, mientras que el segundo constituyó una revisión bibliográfica completamente nueva utilizando la base de datos Science Direct, en la que se analizaron 109 artículos.

Originalidad / Relevancia: En total, se identificaron, analizaron y clasificaron 87 herramientas de innovación de servicios (SIT) en relación con las etapas de innovación de servicios y los contextos sectoriales. Además, se discutieron los temas de desarrollo de nuevos servicios (NSD), ingeniería de servicios (SE) y diseño de servicios (SD).

Resultados principales: Los resultados muestran que las 87 herramientas de innovación de servicios se aplicaron en diversos sectores como salud, educación, turismo, entre otros

Contribuciones teóricas / metodológicas: Este artículo contribuye a la literatura sobre servicios e innovación, examinando un tema común y poco investigado: las herramientas de innovación de servicios.

Contribuciones sociales / de gestión: Los profesionales pueden beneficiarse de una descripción general de las herramientas de innovación de servicios disponibles para generar

ideas, analizar y definir requisitos y crear diseños conceptuales

Palabras clave: Nuevos servicios. Creación de servicios. Desarrollo de servicios. Proceso de innovación de servicios. Gestión de la innovación de servicios. Modelos. Marcos de referencia. Instrumentos. Prácticas. Métodos. Sistemas.

Introduction

The service sector has been growing in importance in diverse countries. Only in 2018, it accounted for approximately 61% of world gross domestic product (GDP) (WorldBank, 2020). In a growing pace, many countries started fostering not only innovation in general (Carvalho, Carvalho, Cardoso, & Gonçalves, 2018; Gonçalves, Cardoso, Carvalho, Carvalho, & Stankowitz, 2017; Jones & Basso, 2017), but especially service innovation as a way to face new societal and business challenges (Gallouj, Weber, Stare, & Rubalcaba, 2015; Gallouj & Windrum, 2009), while companies pursue different innovation strategies to become more competitive in the market (Hidalgo & D'Alvano, 2014; Li, Jian, Li, & Yeung, 2018; Rua & Franca, 2017). Economically, services have been linked to longer-term and more stable sources of revenue, which may protect firms during economic downturns or periods of commoditization (Cusumano, Kahl, & Suarez, 2006). Furthermore, service-dominant orientation was found to affect positively firms' marketing and technological capabilities which, in turn, affect not only customers' satisfaction but also firms' performance (Aas & Pedersen, 2010; Ta & Yang, 2018; Wilden & Gudergan, 2017; Xu, Wu, & Jing, 2017).

As stated by López, Niembro, and Ramos (2011), international trade in services has been growing at high rates in the last decade and maintains strong growth potential. Indeed, according to OECD and WTO (2017), services generated more than two-thirds of global gross domestic product (GDP) and provided the highest proportion of new and old jobs in most countries. Therefore, there has been an increasing focus on services in major economies, a transformation named as the 'servitization' of society (Toivonen & Tuominen, 2009).

Service innovation development deals with the significant improvement or development of new services (OECD & Eurostat, 2005) and includes three main research topics, namely, Service Design (SD), New Service Development (NSD), and Service Engineering (SE), which evolved from the previous rationale of new product development. Overall, many papers on these topics propose and apply frameworks (i.e., tools) to create and implement new services, that is, service innovations. Particularly, service innovation is understood in this paper "as the extent to which new knowledge is integrated by the firm into service offerings, which directly

or indirectly results in value for the firm and its customers/clients” (Salunke, Weerawardena, & McColl-Kennedy, 2011, p. 1253). For instance, Andreassen, Lervik-Olsen, and Calabretta (2015) propose trend spotting as a service innovation tool mainly related to idea generation and future customer needs identification.

Besides, several literature reviews have been performed concerning service and/or innovation (Aas & Pedersen, 2010; Carlborg et al., 2014; Carvalho, Cruz, Carvalho, Duclós, & Stankowitz, 2017; Machado Léo & Tello-Gamarra, 2017; Russo-Spena, Tregua, & Bifulco, 2017; Snyder, Witell, Gustafsson, Fombelle, & Kristensson, 2016). However, the aforementioned reviews did not focus specifically on service innovation tools. This research fulfills this gap as it reviews systematically the frameworks (tools) proposed and applied by the literature on service innovation. Thus, this review sought to contribute to the theory on both services and innovation research topics as well as to the practice of service and innovation management by organizing an overall panorama of available tools for new service development.

The systematic review was performed in two main steps, which taken together included 1310 abstracts and 137 full papers. The first step revisited the review on service innovation of Carlborg et al. (2014) while the second step encompassed a novel bibliography review on service innovation tools employing the Science Direct database.

Regarding results, the paper discusses the service innovation topics of Service Design (SD), New Service Development (NSD), and Service Engineering (SE), and identifies the main service innovation stages comprised by them. Furthermore, the service innovation tools were classified in terms of the stages of the service innovation process in which they had been applied/studied. Therefore, this paper contributes to theory as well to practice, considering that practitioners may find the review results as a valuable consolidated source of service innovation tools that could be applied in their companies.

The paper is organized as follows. The second section briefly reviews the topics of service innovation and tools. The third section details the methodology employed in the systematic review. The fourth section discusses the three main topics on service innovation and presents the results concerning service innovation tools identification and classification. The last section concludes the paper.

Service innovation and innovation tools

Service Innovation

Innovation in services and service innovation comprise topics that have been receiving growing attention from researchers in recent years (e.g., Carlborg et al., 2014; Machado Léo & Tello-Gamarra, 2017; Snyder et al., 2016). Although the concept 'innovation in services' had started being analyzed by the lens of innovation in service firms and industries, it has evolved and current investigations focus on how service innovations occur (Machado Léo & Tello-Gamarra, 2017). According to Machado Léo and Tello-Gamarra (2017), the literature on innovation in services could be classified into six main topics, namely, services innovation modes, variables considered in service innovation, resources, performance, actors' relationships in service innovation, and strategies towards innovation.

The service innovation literature has also been progressing in terms of topics and perspectives by focusing on offerings development, strategy, and management, organizing, policy, measurement, customer involvement, review, deployment, service profit, among others (Carlborg et al., 2014). Indeed, Carlborg et al. (2014) contend that the service innovation field continues to diversify and that the concept should become more multidimensional, encompassing diverse factors, functions, and boundaries.

In terms of concept, the definition of service innovation involves four main characteristics, namely, degree of change, type of change, newness, and means of provision (Snyder et al., 2016). Moreover, each characteristic may be classified into one of two opposing categories: radical versus incremental degree of change; product versus process type of change; newness to the market versus to the firm; and technological versus organizational means of provision (Snyder et al., 2016). Particularly, Snyder et al. (2016) stressed that the service innovation concepts should include aspects such as financial success and newness of value co-creation to market (customers), which is in line with the Oslo Manual's guidelines (OECD & Eurostat, 2005).

Furthermore, Snyder et al. (2016) contend that New Service Development (NSD) literature should focus on the development of service innovation, rather than its definition. According to Jong and Vermeulen (2003), NSD has been addressing attention to research on people, procedures, and methods. Nevertheless, little research has been conducted on tools, despite their enabling capacity in innovation service (Jin, Chai, Wu, & Tan, 2012). Therefore, organizations may not explore the whole potential of them, by simply not having the understanding and awareness of their application.

Innovation Tools

The management of service innovation is a process that involves the know-how and core skills to deliver both the functionality and the ability to identify changes to come up with new innovations. This requires frameworks, tools, and methodologies to improve the yield of innovations. The definition of innovation tools came into discussion originally from the research area related to Technology Management Tools (TMT) and was loosely defined by Brady et al. (1997) as documents, frameworks, procedures, systems, methods, techniques which enables a company to achieve or clarify an objective. However, the same authors pointed out that there are no consistent definitions and concepts such as tools, techniques, methods, procedures, frameworks, which were used interchangeably.

In this vein, a research supported by the European Commission called Temaguide (COTEC, 1998), for the promotion of Innovation Management Techniques (IMT) published a guide of tools to support technology management and innovation. The guide has mentioned that the term “tool” was used to indicate a direct practical benefit, once companies would have to adapt them to fit their purposes. In this context, Phaal, Farrukh, and Probert (2006) have defined tools as a range of techniques and methodologies that help companies to adapt to circumstances and meet market challenges.

Within the context of innovation management, particularly regarding the characteristics, trends, and business relevance of the main Innovation Management Tools (IMT), Hidalgo and Albors (2008) have studied IMTs under the parameters of procedures and benefits recognized in the market. In their study, they found that there is no one-to-one correlation between organizations’ specific business problems and the tool that solves it. Complementarily, Edvardsson, Kristensson, Magnusson, and Sundstrom (2012) contributed with a framework for choosing appropriate methods when developing services considering the customer’s perspective. In this sense, this research derives from the literature on general IMT by shifting the focus from general innovation to tools employed in the development of service innovations, which still is an underdeveloped topic in service research.

Research method

The systematic review was performed in two main steps, which taken together included 1310 abstracts and 137 full papers. The first step encompassed a revisit on the systematic review on service innovation of Carlborg et al. (2014), in which 28 articles (from 93 abstracts) were fully analyzed, whereas the second step comprised a complete novel bibliography review

employing Science Direct database, in which 109 articles (from 1217 abstracts) were fully analyzed.

The first review step sought to explore service innovation processes literature relevant to the aim of this research. First, based on the systematic review of Carlborg et al. (2014), 93 abstracts with a focus on offering development, organizing, strategy, and management, and customer involvement were analyzed. Second, a new list of topics was created based on these abstracts analysis identifying the concepts related to New Service Development (NSD), Service Engineering (SE), and Service Design (SD). These topics arose as they were found closely related to service innovation tools proposals and applications. From this total of 93 papers, 28 full-texts were analyzed.

Based on the analysis of the 28 full-texts in the first review step, three main service innovation stages were identified as the focus of most service innovation tools studied/applied, as well as common ground to these different topics, namely, idea generation, analysis and requirements definitions, and conceptual design. These three innovation stages derived from the analysis which contributed to orientate the second review step, which aimed to investigate further these topics and the service innovation tools applied/studied in their context.

The second review step sought to further the contribution on the topic and it consisted of a complete novel bibliography review on Science Direct database, which is a leading full-text scientific search with more than 2500 research journals. The keywords query included a combination of service innovation topics such as New Service Development, or Service Engineering, or Service Design, with service innovation stages (idea generation, or analysis and requirements, or conceptual design), and with tool-related words (such as “tools”, or “methods”, or “practices”), totalizing 27 different keywords combinations. Besides, the research areas included business, management, social sciences, and computer science, and the time frame considered was 2010 to 2014 (the previous five years when the search was undertaken). Particularly, this review was conducted into the context of the service innovation research project within the InnoPro research group at Universidad Politécnica de Madrid, whose financial support was granted during the period of 2014.

Table 1 - Abstracts and full-texts of keywords combinations

Topics	Tools keywords	Stages						Total		Total per Model	
		Idea Generation		Analysis & Req		Conceptual Design		Abs	Full	Abs	Full
		Abs	Full	Abs	Full	Abs	Full				
New Service Development	Tools	28	18	80	17	0	0	108	35	387	45
	Methods	25	0	107	6	2	0	134	6		
	Practices	35	1	110	3	0	0	145	4		
Service Engineering	Tools	11	5	55	4	0	0	66	9	298	25
	Methods	101	15	62	1	1	0	164	16		
	Practices	10	0	58	0	0	0	68	0		
Service Design	Tools	31	6	159	13	277	15	467	34	586	39
	Methods	31	0	7	2	38	2	76	4		
	Practices	35	1	7	0	1	0	43	1		
Total (per stage)		307	46	645	46	319	17	1271	109	1271	109

Source: The authors (2020).

As presented in Table 1, the query resulted in a total of 1217 papers. Then, all abstracts were analyzed and 109 articles were selected for full-text assessment. Table 1 also presents per each keywords combination the number of analyzed abstracts and full-texts. Regarding the topics generated in the first review step, New Service Development included 45 full-texts, Service Engineering 25, and Service Design 39. Similarly, regarding the stages identified in the analysis as common ground to these topics, idea generation included 46 full-texts, analysis and requirements 46, and conceptual design 17. It is worth noting that, in most cases, the embracing concept of tools, methods, and practices yielded repeated occurrences of the same paper.

The analysis of the systematic review was as follows. First, based on an analysis of all 137 full-texts, the topics of Service Design (SD), New Service Development (NSD), and Service Engineering (SE) were discussed, especially regarding the main stages of the service innovation process comprised by each of them, what constitutes the first contribution of this paper. Second, 87 Service Innovation Tools (SIT) were identified, analyzed, and classified concerning service innovation stages and sectoral contexts, which constitutes the second contribution of this paper, both theoretically and practically.

Results and discussion

Service innovation process (sd, nsd & se)

Service Design (SD) literature covers the first stages of the innovation service process, (idea generation, preliminary analysis and definition, and conceptual design) and concerns on how value is created throughout customer interactions. It has emerged as a means to support

service innovation in organizations through problem visualization, formulation, and solution, that is, to transform problems into possible future services (Clatworthy, 2013; Stickdorn, Schneider, Andrews, & Lawrence, 2011). Holopainen (2010) deems service design as the prototype for service and reinforces that it is a critical stage that should involve the needs of customers aligned with the organization's strategy, the so-called "service logic".

Complementarily, Achrol & Kotler (2012) identified marketing emergent topics such as consumer experiences and sensory systems, marketing networks, and sustainability and development, which are in turn aligned with the novel paradigm of the experience economy (Bettencourt, Gwinner, & Meuter, 2001; Patrício, Fisk, Falcão e Cunha, & Constantine, 2011; Prahalad & Ramaswamy, 2004), and could influence the current application of the service design stage as they comprise novel customers' trends.

New Service Development (NSD) has been identified as the overall process of developing new service offerings (Johnson, Menor, Roth, & Chase, 2000). Simply, NSD is a structured development process that is implemented by service organizations to deploy innovation projects and portfolios (Edvardsson & Olsson, 1996; Ford, Edvardsson, Dickson, & Enquist, 2012; Goldstein, Johnston, Duffy, & Rao, 2002). The concept of NSD has evolved from traditional New Product Development concepts (NPD) and includes a set of activities to create a new or enhanced service that moves the project from the idea generation stage to final launch (implementation) (Cooper, 1994; De Brentani, 1991; Fähnrich, 1999; Fähnrich & Meiren, 2007; Fitzsimmons & Fitzsimmons, 1999; Van Riel & Lievens, 2004).

A study by Kim & Meiren (2010) concludes that NSD models discussed in the literature include stages such as opportunity identification (idea generation and evaluation), customer understanding (requirements gathering), concept development (definition of service levels, processes, and resources), refinement and implementation (training and market launch). Johnson et al. (2000) defined four general stages that are shared by most NSD models: design, analysis, development, and full launch. Fitzsimmons & Fitzsimmons (1999) also listed the basic steps of NSD (design, analysis, development, and launch) and contends that the use of Information Technologies (IT) may increase NSD speed and quantity and, consequently, market leadership. In the same vein, there is empirical evidence from Melton & Hartline (2010) that customer and employee involvement in design stages, as well as in full launch, affects positively sales performance through its contribution to improve service marketability and launch preparation. Additionally, customer involvement has been considered more intense during the initial stages (idea generation and screening) and later stages (service design, test

marketing, and commercialization) of NSD (Alam, 2002; Alam & Perry, 2002).

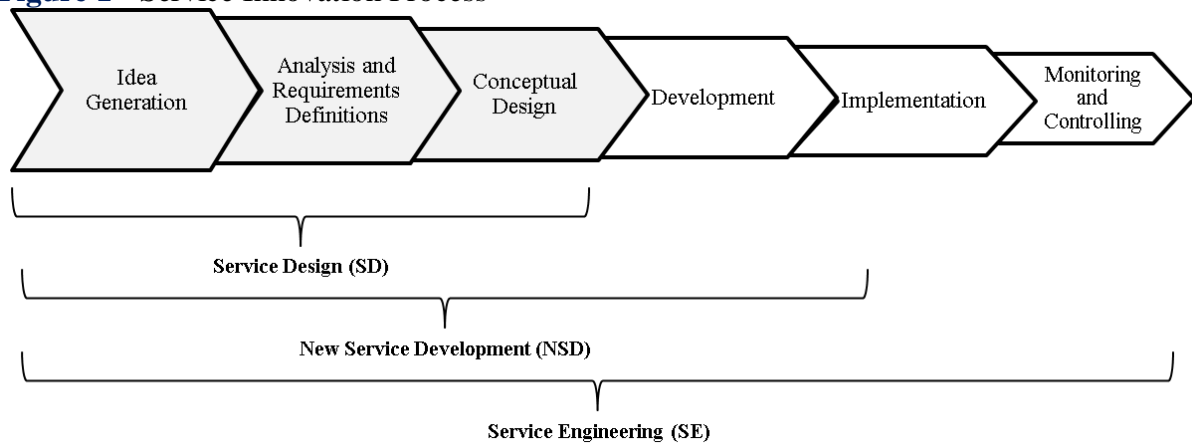
Service Engineering (SE) can be defined as the systematic development of services using suitable models, methods, and tools (Bullinger, Fahrnich, & Meiren, 2003). SE was coined in Germany in parallel to the American work undertaken in the field of NSD (Meiren & Burger, 2010) and it has been attracting more researchers with the increasing use of engineering models (Aurich & Fuchs, 2004; Moser & Edvardsen, 2002; Sakao & Shimomura, 2007; Shimomura & Tomiyama, 2005; Spath & Fähnrich, 2007; Torney, Kuntzky, & Herrmann, 2009).

A study by Kim & Meiren (2010) concluded that SE models documented in the literature include elements such as opportunity identification (e.g. idea generation and evaluation), customer understanding (e.g. requirements analysis), concept development (e.g. definition of service levels, processes, and resources), refinement and implementation (e.g. training, market launch). Still, SE is broader, including more strongly the implementation stage and parts of the monitoring and controlling stage, as it aims at intensifying, improving, and automating the whole framework of service creation, delivery, and consumption (Shimomura & Tomiyama, 2005).

This literature review reveals these three main topics concerning service innovation have some similarities, but also possess some differences, especially in terms of scope. In general, these topics have their foundation in the literature of New Product Development (Cooper & Edgett, 1999), but have been evolving on their own in terms of research and practice (Bullinger et al., 2003).

As shown in Figure 1, Service Design (SD) focuses on the first three stages of the service innovation process (idea generation, analysis and requirements, and conceptual design), New Service Development (NSD) includes the fourth (development) and part of the fifth stage (implementation), whereas Service Engineering (SE) embraces all stages of the service innovation process as it also includes service monitoring and controlling, which may feedback the whole process.

Figure 1 - Service Innovation Process



Source: The authors (2020).

Figure 1 also shows the main service innovation process stages (idea generation, analysis and requirements definition, conceptual design, development, implementation, monitoring, and controlling) addressed by each topic in the literature (Service Design, New Service Development, and Service Engineering). As stated previously, the service innovation tools proposed/studied within these topics focus on the first three stages of the service innovation process.

Service innovation tools and innovation process stages

The following results present the service innovation tools in terms of stages and sectoral (i.e. industrial) contexts in which they were applied/studied. Table 2 lists sixteen Service Innovation Tools identified in the literature applied specifically within the idea generation stage context. From this total, seven were related to the education sector, two to the healthcare sector, one to the ICT sector, and six are not sector-specific.

Regarding the education sector, applied service innovation tools include knowledge maps, thinking aloud, thinking in pictures, forced lateral thinking, speed thinking, synergy design, and idea discussion (Herriott & Jensen, 2013), which aim especially to inspire novel ideas. Regarding the health sector, Kim and Yoon (2014) identified two service innovation tools: agent-based modeling and simulation, in which different agents behaviors are modeled, and customer-concept generation tools, which includes several approaches to collect data from customers past experiences such as customer voice, visits, focus groups, among others. Regarding the ICT sector, Durugbo and Pawar (2014) addressed the unified co-creation model in which ICT service innovations are co-created with customers and suppliers.

It is also worth noting the service innovation tools that are general to any sector. For

instance, Edvardsson et al. (2012) analyzed Customer Integration Methods (CIM) in which customers identify needs and solutions in a natural context that may generate new services. Chang (2011) studied a case wherein virtual teams interacted anonymously and asynchronously in generating ideas. Aguwa, Monplaisir, and Turgut (2012) proposed a data analysis engine process to find out which features need to be improved.

Table 2 - Service Innovation Tools of the Idea Generation stage

Authors	Tool	Description	Sector
Edvardsson et al. (2012)	Customer Integration Methods	They can be divided in: (a) empathic design and (b) the lead-user method. The user identifies the need and solution in its natural context, and the method aims to develop novel ideas that will lead to new services.	Any
Chang (2011)	Virtual Teams with Anonymity and Structured Interactions	It involves participants who interact via electronic means asynchronously. It uses methods to foster team creativity, which consists of combining a multi-round Delphi technique while guiding the collaborative idea creation process.	Any
Lara, Lizcano, Martinez, and Pazos (2013)	Architecture for next-generation service	It enables users without programming skills to build composite web applications. To do this, the architecture wraps current web services adapted to user needs and provides a visual composition model for users to orchestrate, invoke, and tailor services to individual needs.	Any
Aguwa et al. (2012)	VOC	Voice of the customer (VOC) is a critical analysis procedure that provides precise information regarding customer input requirements for a product/service output.	Any
Aguwa et al. (2012)	Customer Satisfaction Index	It is a correlation between the customer outputs to the design input, which provides a tool that will enable management or design engineers to achieve the desired company quality metric outcomes.	Any
Aguwa et al. (2012)	Data Analysis Engine Process	Data Analysis Engine process can be implemented to find out the current product features that need to be improved. The Data Analysis Engine consists of three functional elements, including the Data Mining Phase (DMP), the Data Clustering Phase (DCP), and the Index of Performance Phase (IP).	Any
J. H. Lee and Segev (2012)	Knowledge map Tool	K-map is a knowledge map used for the identification of important ideas. It includes nodes (key-concepts in a specific domain) and links (relations between nodes).	Edu
Herriott and Jensen (2013)	Thinking aloud	It refers to the associations and ideas with others, to inspire each other and build on each other's ideas.	Edu
Herriott and Jensen (2013)	Thinking in pictures	It is given several picture cards that were to work as inspiration.	Edu
Herriott and Jensen (2013)	Forced lateral thinking	The starting point here is to use ideas from a completely different area that has nothing to do with the subject. These ideas are then transferred to problems as solutions or inspiration to new ideas.	Edu
Herriott and Jensen (2013)	Speed thinking	It implies a time limit so that people took turns to come up with as many ideas as possible. It aims to inject dynamics into idea generation.	Edu
Herriott and Jensen (2013)	Synergy design	Build on each other's ideas after swapping them.	Edu
Herriott and Jensen (2013)	Idea discussion	The potential of each idea is discussed, and everybody must find the advantages as well as disadvantages inherent in the ideas. The advantages must then be further developed whereas the disadvantages must as far as possible be eliminated.	Edu
Kim and Yoon (2014)	Agent-based modeling and simulation	The goal is modeling the behaviors of individuals in a diverse population or when agents have dynamic and complicate relationships with other agents.	Health

Kim and Yoon (2014)	Customer-Concept Generation Tools	They are designed to collect new needs and solutions from past data. E.g.: Voice of the customer, customer site visits, focus groups, customer visits, and channeled ideation.	Health
Durugbo and Pawar (2014)	Unified Co-creation Model	It emphasizes the role of customer and supplier domains for selecting co-creation techniques based on situational constraints and agreements that drive decision processes.	ICT

Source: The authors (2020).

Table 3 shows ten service innovation tools applied within the analysis and requirements definitions stage context in addition to the idea generation stage. The first tool, what-if scenarios, and stakeholder relationships are employed to model and analyze diverse stakeholder relationships considering complex service systems to discover the best configurations in terms of value creation (Kieliszewski, Maglio, & Cefkin, 2012).

Table 3 - Service Innovation Tools for Idea Generation and Analysis and Requirements stages

Authors	Tool	Description	Sector
Kieliszewski, Maglio, and Cefkin (2012)	What-if scenarios & stakeholder relationships	It is a service system analysis based on model composition to design and evaluate stakeholder relationships. One can model constellations of complex service systems, such as one that represents a dynamic sociocultural system, to discover which sorts of relationships and configurations are likely to be effective in value creation.	Any
Colombo, Khendek, and Lavazza (2012)	Early design model (blackboard architectural pattern)	It is a design model composed of (1) knowledge source components and (2) the blackboard component, a data structure used to communicate knowledge sources. It reduces the effort required for design by reusing knowledge	Any
Mishra and Bisht (2013)	Conjoint analysis	It has been used to obtain the most desired combination of the attribute levels of a product/service. The central theme is the tradeoffs between attribute-levels and the best possible combination(s) that maximizes one's utility.	Banking
Georgiadou, Hacking, and Guthrie (2012)	Knowledge map for future-proofed building design.	It is a knowledge map, which comprises three key attributes that enhance the 'future-proofing' of energy performance of buildings. It includes criteria for constructing low-energy buildings with varying degrees of future-proofing.	Energy
Lin and Hsieh (2014)	Active theory	AT is suitable for understanding the design and analysis of complex systems, in which it strongly emphasizes the interactions between subjects.	Health
Krska and Mackridge (2014)	Stakeholders involvement in development and evaluation	Involved all relevant stakeholders in designing an acceptable and feasible pharmacy-based alcohol screening and advice service to define important requirements.	Health
Mahr and Lievens (2012)	Lead User Traits	VLUC tools that focus on solving problems through error-tolerant culture, trial, and error, positioning as an innovation community, and makes use of user selection.	ICT
Mahr and Lievens (2012)	Netnography	It uses publicly posts in the Internet to study the contribution behavior of community members.	ICT
Mahr and Lievens (2012)	Consensual Agreement Technique	Uses subjective ratings by individuals or small groups to assess the novelty and relevance of information.	ICT

Manhas and Tukamushaba (2015)	Importance-performance analysis	It aids managers to view which attributes of their firms are important to customers and how the firms are performing from the customers 'perspective. A graphical representation of importance-performance makes it easy to interpret.	Tourism
-------------------------------	---------------------------------	--	---------

Source: The authors (2020).

Concerning the remaining tools in Table 3, application settings vary as these tools were studied in banking, energy, healthcare, ICT, and tourism sectors. Colombo et al. (2012) proposed an early design model employing a blackboard architectural pattern, in which knowledge sources were reused to reduce efforts and accelerate new service designs.

Mishra and Bisht (2013) employed the conjoint analysis to obtain the most desired combination of trade-offs regarding new services' attribute levels. Georgiadou et al. (2012) proposed a knowledge map for future-proofing the energy performance of buildings that includes a set of criteria that should be taken into consideration during buildings design concerning future energy performance considering the full life cycle.

Still regarding analysis and requirements tools within the healthcare sector (Table 3), Lin and Hsieh (2014) adopted activity theory to identify the main factors that impact the sustainability of newly developed services. Krska and Mackridge (2014) involved all relevant stakeholders (pharmacy staff, public, commissioners, alcohol treatment service staff) in designing an acceptable and feasible pharmacy-based alcohol screening and advice service to develop an optimal service design before service commissioning. Manhas and Tukamushaba (2015) employed an importance-performance analysis to help managers within the tourism sector visualize what attributes are deemed important by customers and how their companies are performing.

Table 4 lists eight service innovation tools applied exclusively within the conceptual design stage context. From these, three were applied in a specific sector setting (healthcare, ICT, and parking), and five were not sector-specific. It is worth noting that this stage had the lowest number of unique innovation tools and most of them might be applied in any sector.

Table 4 - Service Innovation Tools of the Conceptual Design stage

Authors	Tool	Description	Sector
Moreno et al. (2014)	Semantic memory retrieval	Develop methods that increase the likelihood of retrieving solutions or ideas they have previously experienced and stored.	Any
Moreno et al. (2014)	Word-Tree/Idea Space System	It provides a structured approach for representing design problems and identifying potential analogies and analogous domains. The identified results (analogies, patents, analogous domains, etc.) are used to refine and develop concept solutions.	Any
Moreno et al. (2014)	Divergent Tree Method	It intends to expand the original solution domain by using divergence. Divergence can be executed considering that artifacts and systems may share characteristics that can be described by associating the characteristics with value or qualitative factors.	Any
Selviaridis, Agndal, and Axelsson (2011)	Service definition methods	Business services are defined and exchanged during the sourcing process including service specification, supplier selection, contract agreement, service implementation, and measurements according to the service definitions modes presented.	Any
Oberle, Barros, Kylau, and Heinzl (2012)	Unified Service Description Language	USDL has been positioned at the conceptual level, free of implementation details, given its UML-based meta-model and abstraction of business to technical aspects.	Any
Dong, McGinley, Nickpour, Cifter, and Inclusive Design Res (2015)	Design for Ageing Network Teaching	A resource folder incorporating comprehensive overview age-related issues into design courses.	Health
C. Lee, Lee, Seol, and Park (2012)	Analytic hierarchy process	It decomposes a problem into several levels making up a hierarchy where each decision element is considered to be independent, widely used in the group decision making context.	ICT
C. H. Lee, Wang, and Trappey (2015)	TRIZ-based service design	TRIZ is a problem-solving analysis and forecasting tool that allows the design of new and inventive services focusing on solving business problems with non-experiential domain background.	Parking

Source: The authors (2020).

As described in Table 4, Moreno et al. (2014) employ several tools that improve the service design stage by design-by-analogy methods, which help designers identify similar cases and scenarios to delineate better service concepts. For instance, semantic memory retrieval works as a memory of learned lessons from previous designs. Also, the word-tree/idea space system provides a structured representation of design problems and potential analogies (similar problems and solutions from other contexts), which are used to refine concept designs. In the divergent tree method, the previous word-tree is expanded to include semantic divergent words (such as antonyms) which, in turn, enrich the analysis and potential outcomes.

Still in the conceptual design stage (Table 4), Selviaridis et al. (2011) employed several service definition methods to project services, such as services specifications, suppliers' selection, contract agreements, and measurements. Oberle et al. (2012) propose a Unified

Service Description Language (USDL) which encompasses a comprehensive service description language supporting services across the human-of-automation continuum. C. H. Lee et al. (2015) employed the Theory of Inventive Problem Solving (TRIZ) and the service blueprint to support and improve the design of an intelligent parking solution.

Finally, Table 5 lists fifty-two service innovation tools that encompass the three first stages of the service innovation process (idea generation, analysis and requirements definitions, and conceptual design). Most of these innovation tools are not sector-specific, thirteen are related to the public sector, three in tourism, and two in ICT sectors. Mele and Russo-Spena (2015) studied intermediary agencies, which are agencies that intermediate innovation by deploying four practices: engaging, exploring, exploiting, and orchestrating ideas. Luo, Shen, Fan, and Xue (2011) developed a novel tool named as Interactive Value Management System (IVMS), which was based on two previous tools, namely, Group Decision Support System (GDSS) and Value Management techniques (VM).

For instance, the S-O-R Model, Business Analytics Services, and Scenario-Based Design are vertical tools that can be used in any of the stages. These methods consider the transition stage between the generation stimuli (input) throughout the service innovation process up to the involvement of customers on testing for decision-making (output), which embraces all the front-end stages, although maintaining their different purposes. The tool S-O-R Mode (Zhang, Lu, Wang, & Wu, 2015), explains customer's behavioral reactions, providing a structured manner to examine the features of social media on customers' co-creation. Business Analytics Services (Chae, 2014) enables the creation and manipulation of digital artifacts in the process of converting input into output, and Scenario-Based Design (McCabe, Sharples, & Foster, 2012) enables different expert profiles to envision and design human-technology systems through an iterative cycle, to develop technology-enabled experiences.

Table 5 - Service Innovation Tools that encompass the first three service innovation process stages

Authors	Tool	Description	Sector
Kohler, Fueller, Stieger, and Matzler (2011)	Second Life™ - Avatar based innovation	It refers to an interactive NPD, in which manufacturers collaborate with virtual worlds' avatars along the innovation process beginning with the identification of new trends and unsatisfied needs and ending with the launch of new products or services.	Any
Mele and Russo-Spena (2015)	Innomediaries Agencies	Innomediary agency enables the deployment of four practices: 1) engaging; 2) exploring; 3) exploiting; and 4) orchestrating ideas. Innomediaries are shaping market innovation through their agency and practices as they create new ways of developing innovations.	Any
Luo et al. (2011)	Group Decision Support System	GDSS are commonly used to improve the process of group decision-making by removing common communication barriers, providing techniques for structuring decision analysis, and systematically directing discussion 's pattern, timing, or content.	Any
Luo et al. (2011)	Interactive Value Management System	IVMS is a web-based GDSS and it was designed with four feature modules: project information center, virtual conference room, electronic cyber forum, and analysis tools. IVMS can provide support in the discussion, information, collaboration, and decision analysis to overcome the identified problems.	Any
Luo et al. (2011)	Value Management techniques	It defines what 'value' means to a client within a particular project context by bringing the project stakeholders together and producing a clear statement of the project's objectives.	Any
Tran and Park (2014)	New generic PSS design methodology	It takes into account all PSS elements (product, service, business model, delivery channel, stakeholders, business model, and organizational structure) to optimize the PSS design process.	Any
McKay and Kundu (2014); Tran and Park (2014)	PSS-CAD systems	Representation tools used in the PSS design process, which results in a modified service blueprint that includes a blend of product and service structure elements. A method to design business models that increase system eco-efficiency from a systemic perspective.	Any
Tran and Park (2014)	Service Model	Focuses on service engineering to design products with a higher added value from enhanced services.	Any
Tran and Park (2014)	Integrated Production and Service Design	Exploits the potential of interrelations between physical products and non-physical services and the development of corresponding design processes.	Any
Tran and Park (2014)	Fast-track Total Care Design	Develops innovative offerings consisting of hardware and services integrated to provide complete functional performance.	Any
Tran and Park (2014)	PSS Design	Assists engineers in the joint development of physical products and interacting services to generate more added values.	Any
Tran and Park (2014)	Heterogeneous IPS ² Concept Modeling	A model-based approach of diffuse borders between products and services that generates heterogeneous Industrial Product-Service Systems (IPS ²) concept models in the early phase of IPS ² .	Any
Tran and Park (2014)	Dimensions of PSS Design	A comprehensive description of PSSs capable of generating new PSS concepts.	Any

Tran and Park (2014)	Integrated Solution	Development of methodological tools to support designers and generate systemic solutions including products and services.	Any
Chibani et al. (2013)	Robot-as-a-service	It refers to robots that can be dynamically combined to execute specific services. E.g.: Heaphy Project: a cloud robotic system that allows controlling a robot remotely by a web browser.	Any
Chibani et al. (2013)	Ubiquitous Robots	Ubirobots integrate robots with web services and ambient intelligence technologies. It targets to create a hybrid physical-digital space rich with a myriad of proactive intelligent services that enhance the quality and the way of our living and working.	Any
Storbacka (2011)	Solution Business Model	It assists firms wishing to design solution business models by categorizing capabilities and management practices.	Any
Mukhtar, Ismail, and Yahya (2012)	DART Model	The blocks for co-creation are made of (D) Dialogue; (A) Access; (R) Risk Assessment and (T) Transparency.	Any
Mukhtar et al. (2012)	Payne's Model	The framework involves three processes: customer, encounter, and the supplier or provider processes.	Any
Mukhtar et al. (2012)	Gronroos's Model	It explores the meanings of the service-dominant logic and it identifies the value fulfillment model.	Any
Mukhtar et al. (2012)	Participatory Method	The end users are treated as experts that jointly create a product or solution.	Any
Mukhtar et al. (2012)	Emphatic Design	Researchers observe the users in their environment to get the latest user needs.	Any
Mukhtar et al. (2012)	Co-designing	It is a mix between participatory and emphatic design, jointly articulating ideas and concepts via mockups, prototypes, or generative tools.	Any
Mukhtar et al. (2012)	Artifacts or Prototypes	They represent a non-existing invention for users to record their experience in using them.	Any
Mukhtar et al. (2012)	Personas and Avatars	Personas represent the voice of the customer in which one can develop their needs and requirements. Avatars are virtual characters that are created by real users.	Any
Mukhtar et al. (2012)	Laddering techniques of interviews	It is a probing type of interview which aims at getting to the user value or goal in using products or services. These maps can be used to develop features.	Any
Mukhtar et al. (2012)	Living Labs	It is a user-centric methodology that involves a business entity, users, and stakeholders that come together to create, prototype and test products, services, businesses or technologies in a real-life context such as large cities or rural areas.	Any
Mukhtar et al. (2012)	Lead User approach	It makes use of virtual communities to recruit lead users to aid in information systems development.	Any
Mukhtar et al. (2012)	Toolkits for Ideas competition	They are types of competition that provide avenues to taps into customers' ideas as input in the product development stages.	Any
Mukhtar et al. (2012)	Community-based innovation	In the communities of users, they are treated as resources for ideas and also co-creators of products or services.	Any
Barquet, de Oliveira, Amigo, Cunha, and Rozenfeld (2013)	PSS Business Model (Use-Oriented Service)	It is a Business Model adaptation to fit with the PSS requirements, based on customer segments, value proposition, customer relationships, distribution channels, revenue streams, key resources, and key activities.	Any
Mina, Bascavusoglu-Moreau, and Hughes (2014)	Open Innovation Practices	Practices that firms are engaged either through contractual arrangements as formal cooperation or in informal exchanges. These include direct interaction with collaborators, participation in innovation networks, or sharing know-how with other firms.	Any

Pineda, Lopes, Tseng, and Salcedo (2012)	Service System Engineering Tools	They are used to a broad spectrum of fields for the development of the hardware, software, information systems, and technology infrastructure components during the different stages of service systems engineering, including modeling, definition, and design.	Any
Aguwa et al. (2012)	Framework of Mobile Learning	The framework has four elements that need to be incorporated into the design of mobile learning (1 requirement and constraints analysis, 2 mobile learning scenarios, 3 technology environment design, and 4 learner support services design).	Any
Zhang et al. (2015)	S-O-R Model	It depicts how the various aspects of the environment as stimuli (S) affect people's internal organisms (O) and in turn behavioral responses (R). The model is useful once it can explain customers' internal reactions and behavioral responses to environmental cues.	ICT
Chae (2014)	Business analytics services	It involves complex data and analytics technologies (e.g., in-memory analytics, parallel programming), enabling "the creation, modification, and manipulation of digital artifacts.	ICT
Nilsson, Peterson, Holden, and Eckert (2011)	DMO process - participatory design techniques	It is a simple four-step model bringing public sector employees, architects, and designers together to understand needs and wishes, which can then be translated into design proposals. The DMO approach brings the aims of participative design together with sustainable design to develop holistic solutions for public sector building projects that help to achieve sustainability targets.	Public
Oberle et al. (2012)	C2G - "Citizen-Sourcing"	Governments have increasingly turned to online citizen consultations through "e-participation" and "e-rulemaking" initiatives to collect input from the public. E.g.: Change.gov (USA); broadband.gov (USA); "e-Petition" (UK/Scotland).	Public
Oberle et al. (2012)	G2C - "Government as a Platform"	In informing, governments equip citizens with data needed to make informed decisions. In "nudging," the government uses behavioral economics to design services in such a way that they preserve freedom of choice but encourage the "socially optimal" option.	Public
Oberle et al. (2012)	C2C - "Do It Yourself Government"	Citizen to citizen "self-organization" occurs when communities govern themselves with little or no interference from the government. E.g.: "Smart mob", community portal, virtual world.	Public
Bonson, Torres, Royo, and Flores (2012)	Web 2.0 technology: Content syndication	Pieces of software in conventional websites or in social network platforms that allow users to automatically receive updates about the state of the resource syndicated. Viral distribution of the content of the official website (news, documents, video, etc.)	Public
Bonson et al. (2012)	Web 2.0 technology: Widgets	It allows for the inclusion of material (text, graph, photos, videos, etc.) on a web page employing a small application that can be installed and executed within a web page by an end-user.	Public
Bonson et al. (2012)	Web 2.0 technology: Sharing and bookmarking	Piece of software in conventional websites or in social media platforms that allows the users to send the content to their friends and contacts automatically by connecting the content to their social media platform. This could increase the visibility of the city council and the material produced by it.	Public

Bonson et al. (2012)	Social media platform: Blogs	Diary where new entries appear over old ones and that allows the users to control the impact of their writings. By using blogs, local governments can collect valuable opinions from their different stakeholders.	Public
Bonson et al. (2012)	Social media platform: Wikis	A network that allows users to share and classify knowledge on a general or specific topic and to correct the content in real-time. Wikis are devoted to knowledge and can be used, to disseminate the heritage of the city with the collaboration of the population.	Public
Bonson et al. (2012)	Social media platform: Social Networks Platform	It allows users to contact several friends, administrates their online communities, and share files, photos, text, and news and give a score to the different contents and files provided.	Public
Devia and Weber (2013)	ABM - Agent-based modeling and simulation	It is an autonomous decision-making entity called agents, each of which individually evaluates its situation and makes decisions based on a set of rules. It generates artificial data that can be used to test different policing strategies in a virtual environment.	Public
Panagiotopoulos, Al-Debei, Fitzgerald, and Elliman (2012)	BM framework for public engagement	It is an integrative framework of a public sector business model concept based on the following dimensions: (a) Offering citizen engagement effects: the value proposition, (b) Involving and aligning actors: building the value network, (c) Configuring resources and creating competencies: the value	Public
Sigala (2013)	SoLoMo Applications	It refers to the integration of Social, Local, and Mobile applications that collects a huge amount of spatial data regarding consumer behavior and response to marketing campaigns.	Tourism
Sigala (2013)	Learning supported by geo-visualization	It integrates approaches from visualization in computing, cartography, image analysis, information visualization, geographic information systems, etc. to provide theory, and tools for visual exploration, analysis, synthesis, and presentation of geospatial data.	Tourism
McCabe et al. (2012)	Scenario-based design	It is one of a range of methods adopted as part of user-centered Systems Design where computer systems developers, topic experts, and potential users work together to envision and design future human-technology systems. SBD examples include technology-enabled experiences such as technology-enabled museum visits.	Tourism

Source: The authors (2020).

Still in Table 5, particularly concerning the public sector, interesting service innovation tools were studied by Bonson et al. (2012); Devia and Weber (2013); Oberle et al. (2012); Panagiotopoulos et al. (2012). Besides, several on-line social media are being increasingly used to enhance and foster innovation “on-the-go”, meaning as the service is being delivered to citizens directly or indirectly.

For instance, Oberle et al. (2012) identified three main types of innovation tools in the government and citizen relationship: C2G (Citizen to Government), which includes e-participation from citizens in government decisions; G2C (Government to Citizen), in which Government works as a platform that informs optimal citizens’ behaviors; and C2C (Citizen to Citizen), in which citizens govern themselves with little government interference. Bonson et al.

(2012) identified several web 2.0 technologies that may support service innovation in the public sector, such as content syndication, widgets, sharing and bookmarking, mashups, blogs, wikis, and social networks platform.

Another noteworthy tool in Table 5 was the Agent-based Modeling and Simulation (ABS) employed by Devia and Weber (2013), in which criminal data was artificially created and agents (citizens, policy-officers, criminals, etc.) behaviors were modeled and simulated to test different policing strategies in a virtual environment. These technologies can even have a higher impact in all perspectives as Big Data progresses to be seamless as it comes from many data sources in high volume, high velocity, and high variety. For example, every complaint registered in any social platform (Facebook, Instagram), any cell phone GPS, as well as any data from smart machines (electricity, water, etc.) can be analyzed to understand, influence, or give dynamic responses as things take place. This data influences directly the service innovation introduction as well as the service “on-the-go”.

Finally, Appendix 1 provides an overall panorama of service innovation tools available. Particularly, Appendix 1 complements the tools detailed in Tables 2 to 5. Thus, practitioners may benefit from this panorama to quickly find tools according to the stage of the service innovation process.

Final considerations

Currently, consumers demand more and more specialized services with a high added value, which means companies feel pushed to improve the innovation processes that allow them to be competitive. This paper contributes to service innovation research discussing how different approaches regarding the service innovation process (SD, NSD, and SE) are related, besides identifying diverse Service Innovation Tools (SIT) and the contexts (stages and sectors) in which they were applied, which is still an underdeveloped topic in service research.

The research carried out has made it possible to identify a total of eighty-seven SIT in the systematic literature review, which included 1310 abstracts and 137 full papers. Sixteen SIT were exclusively related to the first stage of the service innovation process (idea generation), only one was exclusively related to the second stage (analysis and requirements definitions), and eight were exclusively related to the third stage of the service innovation process (conceptual design). On the other hand, many SITs encompassed more than one stage: ten encompassed the first two stages, whereas fifty-two encompassed all the first three stages of the service innovation process.

The majority (78 out of 87) of SIT identified include the Idea Generation stage, which seeks to create new ideas that generate value to customers. Similarly, sixty-three SIT include the Analysis and Requirements Definitions stage, which seeks to refine customers' requirements, while sixty include the Conceptual Design stage, which seeks to design the service as a whole. These figures reveal that most service innovation tools focus on value captured in the use context, as they focus on the idea generation stage.

Regarding theoretical implications, the review reveals the all-encompassing and diversified nature of services, which demand an expansive approach to service innovation (Gallouj & Windrum, 2009), as a great number of SIT (62 out of 87) involve at least two stages of the service innovation process. Besides, the review showed that SITs were applied in several sectors such as healthcare, ICT, education, tourism, parking, banking, besides public-sector and non-specific sectors, thus highlighting that many service innovation tools could be applied to any sector. Another theoretical implication derived from this review is the complexity of the service innovation process that further research will have to account for. For instance, it is challenging to assess in quantitative terms the individual impact of service innovation tools in each stage of the service innovation process, since stages are strongly inter-related and most tools encompass different stages.

Regarding practical implications, the results obtained are also important for practitioners that may also find this systematic review valuable as diverse SIT were identified, summarized, and contextualized in terms of service innovation process stages and sectors. Moreover, Appendix 1 provides a quick panorama of available service innovation tools to service managers or innovation managers in different service industries. This panorama may enhance the innovation opportunities by broadening the view of companies to the whole service innovation development process.

Finally, it is interesting to note that the results must be considered in the context of existing limitations, which is the use of the Science Direct database in the second step of the review, even though it includes more than 2500 journals. This review provides different research venues for future research. For instance, each stage of the service innovation development process could be analyzed separately in future reviews or even quantitative papers by searching the set of innovation tools identified in this review. Further research could also investigate the impacts of the diverse service innovation tools on different indicators of innovation and business performance. Still, further research should account for possible interaction effects as stages are strongly inter-related and tools encompass different stages.

References

- Aas, T. H., & Pedersen, P. E. (2010). The firm-level effects of service innovation: A literature review. *International Journal of Innovation Management*, 14(5), 759-794. doi:10.1142/S1363919610002878
- Aguwa, C. C., Monplaisir, L., & Turgut, O. (2012). Voice of the customer: Customer satisfaction ratio based analysis. *Expert Systems with Applications*, 39(11), 10112-10119. doi:10.1016/j.eswa.2012.02.071
- Andreassen, T. W., Lervik-Olsen, L., & Calabretta, G. (2015). Trend spotting and service innovation. *Journal of Service Theory and Practice*, 25(1), 10-30. doi:10.1108/jstp-09-2013-0178
- Barquet, A. P. B., de Oliveira, M. G., Amigo, C. R., Cunha, V. P., & Rozenfeld, H. (2013). Employing the business model concept to support the adoption of product-service systems (PSS). *Industrial Marketing Management*, 42(5), 693-704. doi:10.1016/j.indmarman.2013.05.003
- Bonson, E., Torres, L., Royo, S., & Flores, F. (2012). Local e-government 2.0: Social media and corporate transparency in municipalities. *Government Information Quarterly*, 29(2), 123-132. doi:10.1016/j.giq.2011.10.001
- Brady, T., Rush, H., Hobday, M., Davies, A., Probert, D., & Banerjee, S. (1997). Tools for technology management: an academic perspective. *Technovation*, 17(8), 417-426.
- Carlborg, P., Kindstrom, D., & Kowalkowski, C. (2014). The evolution of service innovation research: a critical review and synthesis. *Service Industries Journal*, 34(5), 373-398. doi:10.1080/02642069.2013.780044
- Carvalho, G. D. G., Carvalho, H. G., Cardoso, H. H. R., & Gonçalves, A. D. (2018). Assessing a Micro and Small Businesses Innovation Support Programme in Brazil: The Local Innovation Agents Programme. *Journal of International Development*, 30(6), 1064-1068. doi:10.1002/jid.3387
- Carvalho, G. D. G., Cruz, J. A. W., Carvalho, H. G., Duclós, L. C., & Stankowitz, R. F. (2017). Innovativeness measures: A bibliometric review and a classification proposal. *International Journal of Innovation Science*, 9(1), 81-101. doi:10.1108/IJIS-10-2016-0038
- Chae, B. (2014). A complexity theory approach to IT-enabled services (IESs) and service innovation: Business analytics as an illustration of IES. *Decision Support Systems*, 57, 1-10. doi:10.1016/j.dss.2013.07.005
- Chang, C. M. (2011). New organizational designs for promoting creativity: A case study of virtual teams with anonymity and structured interactions. *Journal of Engineering and Technology Management*, 28(4), 268-282. doi:10.1016/j.jengtecman.2011.06.004
- Chibani, A., Amirat, Y., Mohammed, S., Matson, E., Hagita, N., & Barreto, M. (2013). Ubiquitous robotics: Recent challenges and future trends. *Robotics and Autonomous Systems*, 61(11), 1162-1172. doi:10.1016/j.robot.2013.04.003

- Colombo, P., Khendek, F., & Lavazza, L. (2012). Bridging the gap between requirements and design: An approach based on Problem Frames and SysML. *Journal of Systems and Software*, 85(3), 717-745. doi:10.1016/j.jss.2011.09.046
- COTEC, F. C. p. L. I. T. (1998). Pautas metodológicas de la gestión de la tecnología y de la innovación para empresas—Temaguide. *Madri: Cotec*.
- Cusumano, M., Kahl, S., & Suarez, F. F. (2006). Product, process, and service: a new industry lifecycle model. *A research and education initiative at the MIT Sloan School of Management, Working Paper(228)*.
- Devia, N., & Weber, R. (2013). Generating crime data using agent-based simulation. *Computers Environment and Urban Systems*, 42, 26-41. doi:10.1016/j.compenvurbsys.2013.09.001
- Dong, H., McGinley, C., Nickpour, F., Cifter, A. S., & Inclusive Design Res, G. (2015). Designing for designers: Insights into the knowledge users of inclusive design. *Applied Ergonomics*, 46, 284-291. doi:10.1016/j.apergo.2013.03.003
- Durugbo, C., & Pawar, K. (2014). A unified model of the co-creation process. *Expert Systems with Applications*, 41(9), 4373-4387. doi:10.1016/j.eswa.2014.01.007
- Edvardsson, B., Kristensson, P., Magnusson, P., & Sundstrom, E. (2012). Customer integration within service development-A review of methods and an analysis of insitu and exsitu contributions. *Technovation*, 32(7-8), 419-429. doi:10.1016/j.technovation.2011.04.006
- Gallouj, F., Weber, K. M., Stare, M., & Rubalcaba, L. (2015). The futures of the service economy in Europe: A foresight analysis. *Technological Forecasting and Social Change*, 94, 80-96. doi:10.1016/j.techfore.2014.06.009
- Gallouj, F., & Windrum, P. (2009). Services and services innovation. *Journal of Evolutionary Economics*, 19(2), 141-148. doi:10.1007/s00191-008-0123-7
- Georgiadou, M. C., Hacking, T., & Guthrie, P. (2012). A conceptual framework for future-proofing the energy performance of buildings. *Energy Policy*, 47, 145-155. doi:10.1016/j.enpol.2012.04.039
- Gonçalves, A. D., Cardoso, H. H. R., Carvalho, H. G., Carvalho, G. D. G., & Stankowitz, R. F. (2017). Panorama view of Innovation in Brazilian Small Businesses. *International Journal of Innovation*, 5(3), 325-334. doi:10.5585/iji/10.5585/iji.v5i3.239
- Herriott, R., & Jensen, B. G. (2013). Students' responses to inclusive design. *Design Studies*, 34(4), 438-453. doi:10.1016/j.destud.2013.01.005
- Hidalgo, A., & Albors, J. (2008). Innovation management techniques and tools: a review from theory and practice. *R & D Management*, 38(2), 113-127. doi:10.1111/j.1467-9310.2008.00503.x

- Hidalgo, A., & D'Alvano, L. (2014). Service innovation: Inward and outward related activities and cooperation mode. *Journal of Business Research*, 67(5), 698-703. doi:10.1016/j.jbusres.2013.11.030
- Jin, D., Chai, K.-H., Wu, C.-C., & Tan, K.-C. (2012). *A survey of new service development tools*. Paper presented at the Management of Innovation and Technology (ICMIT), 2012 IEEE International Conference on.
- Jones, G. D. C., & Basso, L. F. C. (2017). Innovation Policies: A comparative study Between Brazil and France. *International Journal of Innovation*, 5(1), 47-47.
- Jong, J. P., & Vermeulen, P. A. (2003). Organizing successful new service development: a literature review. *Management Decision*, 41(9), 844-858.
- Kieliszewski, C. A., Maglio, P. P., & Cefkin, M. (2012). On modeling value constellations to understand complex service system interactions. *European Management Journal*, 30(5), 438-450. doi:10.1016/j.emj.2012.05.003
- Kim, S., & Yoon, B. (2014). A systematic approach for new service concept generation: Application of agent-based simulation. *Expert Systems with Applications*, 41(6), 2793-2806. doi:10.1016/j.eswa.2013.10.012
- Kohler, T., Fueller, J., Stieger, D., & Matzler, K. (2011). Avatar-based innovation: Consequences of the virtual co-creation experience. *Computers in Human Behavior*, 27(1), 160-168. doi:10.1016/j.chb.2010.07.019
- Krska, J., & Mackridge, A. J. (2014). Involving the public and other stakeholders in development and evaluation of a community pharmacy alcohol screening and brief advice service. *Public Health*, 128(4), 309-316. doi:10.1016/j.puhe.2013.11.001
- Lara, J. A., Lizcano, D., Martinez, M. A., & Pazos, J. (2013). Developing front-end Web 2.0 technologies to access services, content and things in the future Internet. *Future Generation Computer Systems-the International Journal of Grid Computing and Escience*, 29(5), 1184-1195. doi:10.1016/j.future.2013.01.006
- Lee, C., Lee, H., Seol, H., & Park, Y. (2012). Evaluation of new service concepts using rough set theory and group analytic hierarchy process. *Expert Systems with Applications*, 39(3), 3404-3412. doi:10.1016/j.eswa.2011.09.028
- Lee, C. H., Wang, Y. H., & Trappey, A. J. C. (2015). Service design for intelligent parking based on theory of inventive problem solving and service blueprint. *Advanced Engineering Informatics*, 29(3), 295-306. doi:10.1016/j.aei.2014.10.002
- Lee, J. H., & Segev, A. (2012). Knowledge maps for e-learning. *Computers & Education*, 59(2), 353-364. doi:10.1016/j.compedu.2012.01.017
- Li, M., Jian, Z. Q., Li, L., & Yeung, T. K. H. (2018). Effects of organisational learning on service innovation performance: the mediating effect of supply chain collaboration and the moderating role of interpersonal trust. *International Journal of Services Technology and Management*, 24(1-3), 43-61. doi:10.1504/ijstm.2018.10011483

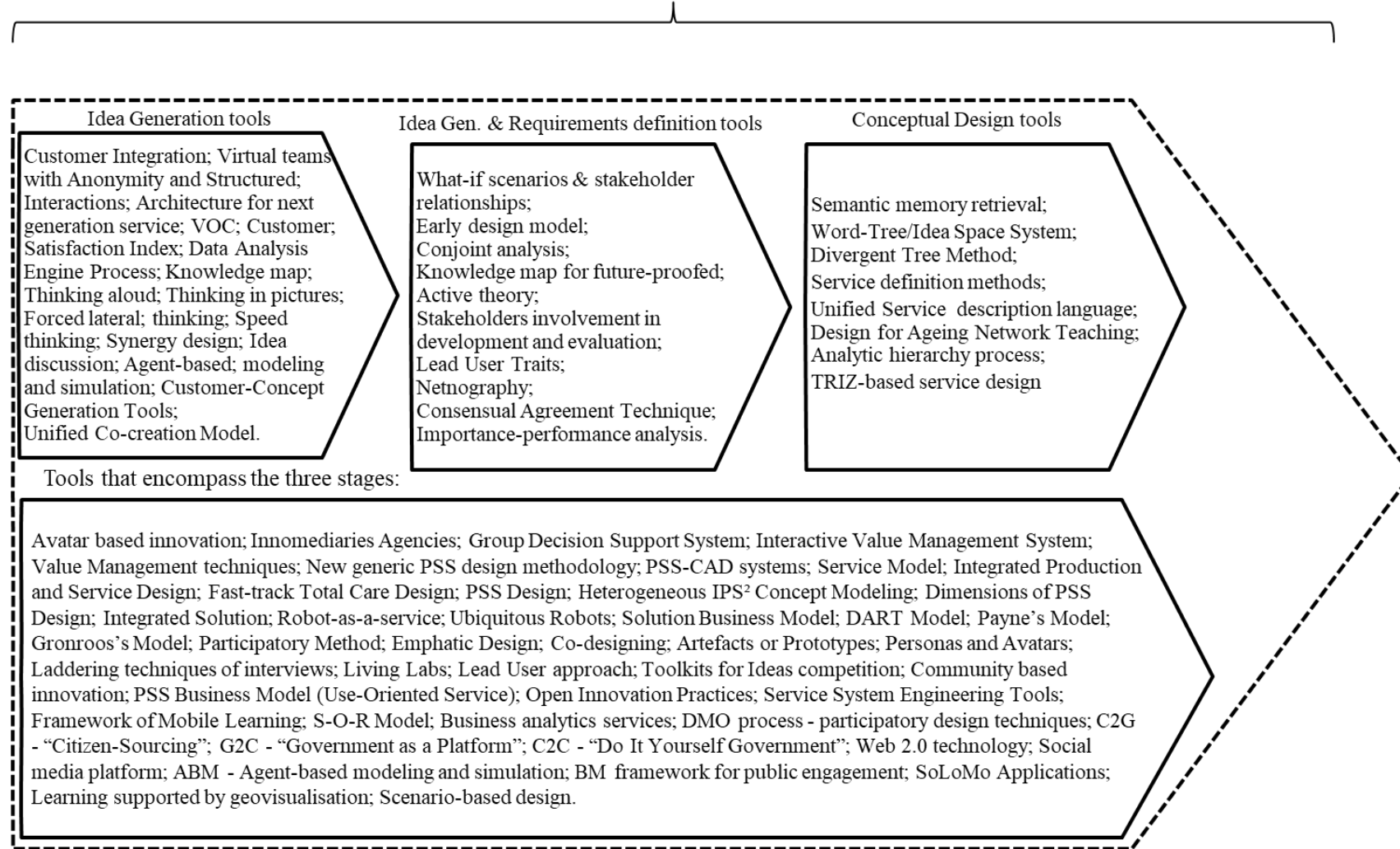
- Lin, F. R., & Hsieh, P. S. (2014). Analyzing the sustainability of a newly developed service: An activity theory perspective. *Technovation*, 34(2), 113-125. doi:10.1016/j.technovation.2013.08.004
- López, A., Niembro, A., & Ramos, D. (2011). O comércio mundial de serviços. *Revista brasileira de comércio exterior, Ano, 25*, 06-18.
- Luo, X. C., Shen, G. Q., Fan, S. C., & Xue, X. L. (2011). A group decision support system for implementing value management methodology in construction briefing. *International Journal of Project Management*, 29(8), 1003-1017. doi:10.1016/j.ijproman.2010.11.003
- Machado Léo, R., & Tello-Gamarra, J. (2017). Inovação em serviços: estado da arte e perspectivas futuras. *Suma de Negocios*, 8(17), 1-10. doi:10.1016/j.sumneg.2017.01.002
- Mahr, D., & Lievens, A. (2012). Virtual lead user communities: Drivers of knowledge creation for innovation. *Research Policy*, 41(1), 167-177. doi:10.1016/j.respol.2011.08.006
- Manhas, P. S., & Tukamushaba, E. K. (2015). Understanding service experience and its impact on brand image in hospitality sector. *International Journal of Hospitality Management*, 45, 77-87. doi:10.1016/j.ijhm.2014.11.010
- McCabe, S., Sharples, M., & Foster, C. (2012). Stakeholder engagement in the design of scenarios of technology-enhanced tourism services. *Tourism Management Perspectives*, 4, 36-44. doi:10.1016/j.tmp.2012.04.007
- McKay, A., & Kundu, S. (2014). A representation scheme for digital product service system definitions. *Advanced Engineering Informatics*, 28(4), 479-498. doi:10.1016/j.aei.2014.07.004
- Mele, C., & Russo-Spena, T. (2015). Innomediary agency and practices in shaping market innovation. *Industrial Marketing Management*, 44, 42-53. doi:10.1016/j.indmarman.2014.10.006
- Mina, A., Bascavusoglu-Moreau, E., & Hughes, A. (2014). Open service innovation and the firm's search for external knowledge. *Research Policy*, 43(5), 853-866. doi:10.1016/j.respol.2013.07.004
- Mishra, V., & Bisht, S. S. (2013). Mobile banking in a developing economy: A customer-centric model for policy formulation. *Telecommunications Policy*, 37(6-7), 503-514. doi:10.1016/j.telpol.2012.10.004
- Moreno, D. P., Hernandez, A. A., Yang, M. C., Otto, K. N., Holtta-Otto, K., Linsey, J. S., Linden, A. (2014). Fundamental studies in Design-by-Analogy: A focus on domain-knowledge experts and applications to transactional design problems. *Design Studies*, 35(3), 232-272. doi:10.1016/j.destud.2013.11.002
- Mukhtar, M., Ismail, M. N., & Yahya, Y. (2012). A hierarchical classification of co-creation models and techniques to aid in product or service design. *Computers in Industry*, 63(4), 289-297.

- Nilsson, B., Peterson, B., Holden, G., & Eckert, C. (2011). Design Med Omtanke: Participation and sustainability in the design of public sector buildings. *Design Studies*, 32(3), 235-254. doi:10.1016/j.destud.2010.11.002
- Oberle, D., Barros, A., Kylau, U., & Heinzl, S. (2012). A unified description language for human to automated services. *Information Systems*, 38(1), 155-181. doi:10.1016/j.is.2012.06.004
- OECD, & Eurostat. (2005). *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data* (r. Edition Ed.). Paris: OECD Publishing.
- OECD, & WTO. (2017). *Aid for Trade at a Glance 2017*.
- Panagiotopoulos, P., Al-Debei, M. M., Fitzgerald, G., & Elliman, T. (2012). A business model perspective for ICTs in public engagement. *Government Information Quarterly*, 29(2), 192-202. doi:10.1016/j.giq.2011.09.011
- Phaal, R., Farrukh, C. J., & Probert, D. R. (2006). Technology management tools: concept, development and application. *Technovation*, 26(3), 336-344.
- Pineda, R., Lopes, A., Tseng, B., & Salcedo, O. H. (2012). Service Systems Engineering: Emerging Skills and Tools. In C. H. Dagli (Ed.), *Conference on Systems Engineering Research* (Vol. 8, pp. 420-427). Amsterdam: Elsevier Science Bv.
- Rua, O. L., & Franca, A. (2017). The linkage between intangible resources and export performance: the mediating effect of innovation. *International Journal of Innovation*, 5(3), 399-410. doi:10.5585/iji.v5i3.190
- Russo-Spena, T., Tregua, M., & Bifulco, F. (2017). Searching through the jungle of innovation conceptualisations System, network and ecosystem perspectives. *Journal of Service Theory and Practice*, 27(5), 977-1005. doi:10.1108/jstp-10-2015-0224
- Salunke, S., Weerawardena, J., & McColl-Kennedy, J. R. (2011). Towards a model of dynamic capabilities in innovation-based competitive strategy: Insights from project-oriented service firms. *Industrial Marketing Management*, 40(8), 1251-1263. doi:10.1016/j.indmarman.2011.10.009
- Selviaridis, K., Agndal, H., & Axelsson, B. (2011). Business services ‘in the making’:(De) Stabilisation of service definitions during the sourcing process. *Journal of Purchasing and Supply Management*, 17(2), 73-86.
- Sigala, M. (2013). Using and measuring the impacts of geovisualisation on tourism education: The case of teaching a service management course. *Journal of Hospitality, Leisure, Sport & Tourism Education*, 12(1), 85-98.
- Snyder, H., Witell, L., Gustafsson, A., Fombelle, P., & Kristensson, P. (2016). Identifying categories of service innovation: A review and synthesis of the literature. *Journal of Business Research*, 69(7), 2401-2408. doi:10.1016/j.jbusres.2016.01.009
- Storbacka, K. (2011). A solution business model: Capabilities and management practices for integrated solutions. *Industrial Marketing Management*, 40(5), 699-711.

- Ta, D. T., & Yang, C. H. (2018). Exploring the impacts of service innovation on customer satisfaction in the telecom industry: A perspective from interactive and supportive service innovations. *International Journal of Innovation Management*. doi:10.1142/S1363919618500536
- Toivonen, M., & Tuominen, T. (2009). Emergence of innovations in services. *Service Industries Journal*, 29(7), 887-902. doi:10.1080/02642060902749492
- Tran, T. A., & Park, J. Y. (2014). Development of integrated design methodology for various types of product—service systems. *Journal of Computational Design and Engineering*, 1(1), 37-47.
- Wilden, R., & Gudergan, S. (2017). Service-dominant orientation, dynamic capabilities and firm performance. *Journal of Service Theory and Practice*, 27(4), 808-832. doi:10.1108/jstp-04-2016-0077
- WorldBank. (2020). Services - value added (% of GDP). Retrieved from <https://data.worldbank.org/indicator/NV.SRV.TOTL.ZS>
- Xu, X. Y., Wu, S. Y., & Jing, H. (2017). Explore the differences between perceived service quality and customer satisfaction based on customer expectation of service attributes. *International Journal of Services Technology and Management*, 23(3), 219-236. doi:10.1504/ijstm.2017.10006357
- Zhang, H., Lu, Y. B., Wang, B., & Wu, S. B. (2015). The impacts of technological environments and co-creation experiences on customer participation. *Information & Management*, 52(4), 468-482. doi:10.1016/j.im.2015.01.008

Appendix 1 – Panorama of service innovation tools

Service Design (SD)



Source: the authors (2020).