

Service Systems Analysis Methods and Components: A Systematic Literature Review

Abstract

The service system has been proposed as the basic abstraction of service science and, as a result, there has been much interest in the study and analysis of service systems in recent years. This paper presents the results of a systematic literature review of recent literature on service systems through which we characterize recent changes in direction and focus in service system research and identify new emphases and areas of focus. We discuss three approaches to service system analysis: descriptive; prescriptive; and, evaluative. We also discuss new research focused on studying the components of service systems. Based on research gaps observed in our review, we identify eight specific opportunities and three broad directions for future research: 1) re-focusing attention on a greater diversity of research designs and analytical approaches; 2) leveraging new perspectives to perform more ontological work on system components; and 3) fostering a better understanding of the role of innovation. We present a framework of our key findings, depicting the overarching logic linking research questions, opportunities, and directions.

Keywords: Service systems, service science, ontology, analysis, literature review

1. Introduction

Service science emerged as a concept in the mid 2000's. It was originally referred to as Services Science, Management, Engineering (SSME) (Maglio, Srinivasan, Kreulen, & Spohrer, 2006) and sometimes Design (SSMED) (Spohrer & Kwan, 2009). The earliest presentations about service science arose from within IBM in 2005 (Spohrer & Maglio, 2005) soon after the service research group was established at the IBM Almaden Research Center in 2002 (Spohrer, 2016). There was

a call to establish an academic discipline called Services Science, Management, and Engineering (SSME) that would bring scientific, management, engineering, and design principles to the increasingly important service industry, create new innovations in service, and develop “service scientists who will study, manage, and engineer service systems, solving problems and exploiting opportunities to create service innovations.” (Maglio, Srinivasan, Kreulen, & Spohrer, 2006, page 85). Since then, the focus on research and innovation has evolved and grown. In 2008, a Hawaii International Conference on Systems Sciences (HICSS) minitrack was established in Service Science, Management, and Engineering (SSME). The name of that minitrack was changed to “Service Science” in 2015 (Lin, Maglio, & Shaw, 2015). In 2009, an online Service Science journal was established under the Informs banner and declared to be, “a humble and hopeful declaration of interdependence” (Spohrer, 2009).

Research in many areas of service science has continued to increase since the mid 2000’s. In this paper, we are specifically focused on the growth and changes in research that addresses methods for analyzing service systems and their components. We note that the “service system” was a key aspect of service science since the early years (Maglio, Srinivasan, Kreulen, & Spohrer, 2006) but was first proposed as a basic abstraction for service science in 2008 (Maglio et al. 2008). Since then, the service system has been widely and varyingly conceptualized as distinct sets of interconnected system components (e.g., operant resources, operand resources, information, technology, people, etc.) and techniques for analyzing and studying service systems have emerged (see for example, Lyons & Tracy, 2013 and Lessard & Yu, 2013).

In their review of pre-2011 literature on service systems and service system components, Lyons and Tracy (2013) synthesized several existing definitions and ontologies of service systems into a single ontological framework that articulates the following components of service

systems: access rights; resources; entities; outcomes; stakeholders; networks; ecology; quality; productivity; compliance; innovation; and, resource integration. We are interested in new methods of analysis of service systems or their components. Starting from the service system analysis and components identified as characteristic of and important to the study of service systems in Lyons and Tracy (2013), we describe the evolution of research in service system analysis and components in search of gaps in the current research and opportunities for future research. We conducted a systematic literature review of research on analysis of service systems and their components published between 2011 and 2016 by posing two research questions for investigation:

RQ1 (*Analysis Approaches*): What new theories and methods of service system analysis have been discussed?

RQ2 (*System Components*): What new research has been done on the service system components?

2. Methodology

The literature review was conducted using the methodological guidelines for systematic literature review set out by vom Brocke et al. (2009). This methodology was chosen for two reasons: 1) it prescribes research design elements and templates which are well-suited for carrying out a systematic conceptual analysis, making it a perfect fit for analyzing service system concepts; and, 2) it brings a high degree of transparency and reproducibility to the research design, enabling other researchers to undertake their own similar literature reviews on the topic or to expand upon this review.

Moreover, the methodology has proven to be effective through repeated use. It has been fully or partially employed in several recent literature reviews on the topic of information systems (Gaffar, Deshpande, Bandara, & Mathiesen, 2015; Küpper, Wieneke, Lehmkuhl, & Jung, 2015; Maschler & Tavakoli, 2015; Shitkova et al., 2015; Steffen & Srinivasan, 2015; Kowalczyk, Buxmann, & Besier, 2013), as well as many literature reviews in other fields such as project management (Svejvig & Andersen, 2015; vom Brocke & Lippe, 2015), business process management (Hofmann, Betke, & Sackmann, 2015), and education (Saadatdoost, Sim, Jafarkarimi, & Hee, 2015). It has recently been used in two literature reviews focused on service modularity (Dörbecker & Böhm, 2013; Dörbecker, Böhm, & Böhm, 2015). The methodology is both rigorous and flexible, and has become something of a gold standard in systematic literature review. While applied in a variety of relevant areas, the literature review method has not been used in the analysis of research on service systems before.

There are five phases to the literature review (vom Broke et al. 2009): 1) scoping the review; 2) conceptualizing the topic; 3) searching the literature; 4) analyzing and synthesizing the findings of the literature search; and, 5) stating the review's contributions to a research agenda. Our approach to each is described below.

2.1 Review Scope

As recommended by vom Brocke et al. (2009), we observed the taxonomy of literature review characteristics first proposed by Cooper (1988): focus, goal, organization, perspective, audience, and coverage. As shown in Figure 1, the *focus* of our literature review is on **theories** and **methods** of service system analysis, as well as theory-building pertaining to the service system components described in Section 2.2. Specifically, the *goal* of the literature review is to gain a better understanding of the **central issues** in recent service systems research pertaining to the

research questions. The *organization* of our results and discussion of the review is **conceptual** and **methodological** rather than historical. The *perspective* taken in presenting the results and discussion is a **neutral representation** of the state of the literature. The main *audience* for the review is **specialized service science scholars** and researchers. The *coverage* of the review is **representative** rather than exhaustive, seeking to glean a high-level understanding of the most prominent trends in service systems research rather than an exhaustive, comprehensive awareness of all recent service systems literature.

2.2 Conceptualization of Topic

The service system components articulated in the service system framework proposed by Lyons and Tracy (2013) provide a natural conceptualization of service systems:

- 1) **Access Rights:** Based on Barile and Polese's (2010, p. 25) definition of access rights as "... social norms and legal regulations that determine access and use of resources" (as cited in Lyons & Tracy, 2013, p. 21).
- 2) **Resources:** "... the things that are exchanged for the purpose of creating value" (Lyons & Tracy, 2013, p. 20).
- 3) **Entities:** "... resource integrators that enable exchange for the purpose of value cocreation within or between service systems" (p. 21).
- 4) **Interactions:** "... the processes involved in the mobilization, exchange, and integration of resources through competence" (p. 21).
- 5) **Outcomes:** Potential end results of an "interaction of entities that seek value cocreation" (p. 22).

- 6) **Stakeholders:** "... a perspective rather than an entity such that a service system entity can maintain multiple stakeholder perspectives" (p. 22).
- 7) **Networks:** "... formed through the exchange that takes place between entities that are connected through value propositions" (p. 22).
- 8) **Ecology:** "... the full universe of service system entities ... as well as their relationships and networks" (p. 22).

In addition, the framework defines *quality, productivity, compliance, and sustainable innovation* as **performance measures**, so we include those measures in our service system conceptualization. **Resource integration**, a cross-component relationship linking entities with resources, is also included.

2.3 Literature Search

Two instantiations of the literature search process were carried out: one addressing RQ1 (*Analysis Approaches*) and the other addressing RQ2 (*System Components*). In adapting the methodological guidelines set out by vom Brocke et al. (2009) for their own research design, Kowalczyk, Buxmann, and Besier (2013) stress the importance of building highly structured search queries through multiple iterations (p. 5). Following their process, the query structures used to conduct this literature review were iteratively developed: first, query terms derived from the service system components (identified above) were experimentally entered into the search engines of Scopus and ProQuest independently and in different combinations; then, once the usefulness of specific query term combinations had been verified, the query terms were experimentally tested with different combinations of logical operators; then, two query structures (one for each RQ) were designed based on the results of the testing (see Table 1).

Table 1: The query structures used in the systematic literature review

	Proquest Query	Scopus Query
RQ1	“service system*” AND “service science” AND “analysis” AND (“theor*” OR “method*”)	{service system} AND {service science} AND "analysis" AND ("theor*" OR "method*")
RQ2	("service system*" AND "service science") AND (("access right*") OR ("operant resource*" OR "operand resource*") OR ("entit*") OR ("stakeholder*") OR ("governance" OR "value cocreation" OR "value co-creation" OR "value proposition") OR ("network*") OR ("outcome*") OR ("ecolog*" OR "ecosystem*") OR ("measure*" OR "quality" OR "productivity" OR "compliance") OR ("innovat*") OR ("resource integration"))	({service system} AND {service science}) AND (("access right*") OR ("operant resource*" OR "operand resource*") OR ("entit*") OR ("stakeholder*") OR ("governance" OR "value cocreation" OR "value co-creation" OR "value proposition") OR ("network*") OR ("outcome*") OR ("ecolog*" OR "ecosystem*") OR ("measure*" OR "quality" OR "productivity" OR "compliance") OR ("innovat*") OR ("resource integration"))

Articles were excluded if they did not adhere to the following six inclusion criteria: 1) written in English; 2) published in a peer-reviewed scholarly journal, trade journal, or conference proceedings; 3) available in full text; 4) published between 2011 and 2016; 5) provides a potential answer to one or both of the research questions; and, 6) defines and/or perceives service systems concepts in a manner which is consistent with the ontology and definitions within the domain of service science. Papers were only included under criteria 5 and 6 if they met 3 sub-criteria: 1) presents an approach to analyzing service systems or analyzes service system components; 2) discusses analysis approaches or components in detail rather than merely referencing or summarizing them; 3) published in a journal with a focus on service science research OR cites other journals and/or papers with a focus on service science OR interprets service systems and their components in a manner similar to that found elsewhere in service science literature. Because criteria 5 and 6 required a degree of personal judgment to properly

apply, the selecting researcher documented their rationale for rejecting specific groups of papers. A random sample of 10% of the excluded and included papers for each RQ/Query pair were identified and a second researcher followed the documented rationale to select papers from the random sample. Agreement ranged from 89-94%.

As the coverage of the review was to be representative and not exhaustive, the review only extracted articles from Scopus and ProQuest (two of the largest databases of scholarly and trade journals and conference proceedings) in careful conformance with a predefined process model (depicted in Figure 2). Both instantiations of the literature search process were carried out over the span of one week in March 2016. The articles were read in increasing detail, those not meeting the inclusion criteria were removed, and counts of articles remaining were maintained in an extraction log. Detailed citation information of the final set of articles was entered into a manifest report, the format of which was adapted from Webster and Watson's (2002) concept matrix template. Two manifest reports were created, one for each RQ (see the Appendix). In Manifest Report 1 (the report corresponding to RQ1, *Analysis Approaches*), the research focus/foci of each article was recorded using the research focus categories from Cooper's (1988) literature review taxonomy (i.e. research outcomes, methods, theories, or applications) and the analytical foci of the articles (descriptive, prescriptive, and/or evaluative analysis) were noted. A descriptive approach to service system analysis provides a detailed abstraction or conceptualization of the nature of the service system and its components which enables analysis, usually in the form of an ontology or theoretical framework. A prescriptive approach specifies methodological instructions or a sequence process for conducting an analysis, rather than simply describing the units of analysis. An evaluative approach stipulates a normative model of an archetypal service system's ideal state, then provides methodological instructions for measuring

the quality of a service system with reference to the normative model. In Manifest Report 2 (the report corresponding to RQ2, *System Components*), the conceptual foci of each was recorded with reference to the service system component concepts under examination.

2.4 Literature Analysis and Synthesis

Steps 4 and 5 of the literature search process were designed to facilitate an analysis and synthesis of the literature. The conceptual organization of the literature reveals insights simply through the patterns and totals observed in the manifest reports, with additional features and patterns emerging after engaging with the content of exemplary articles.

2.5 Research Agenda

The results of the literature review, the answers to the research questions, and the limitations of the review were used to determine the review's implications for the service systems research agenda. Those implications will be elaborated on later in this paper, and in response to them, a roadmap for future research will be offered.

3. Results

Table 2 summarizes the numbers of articles analyzed at each step of the search for each of RQ1 (*Analysis Approaches*) and RQ2 (*System Components*). Ultimately, 42 articles extracted to address RQ1 and 42 articles extracted to address RQ2 met all of the inclusion criteria once their full text had been analyzed.

Table 2: Extraction log of the results counts from the initial query, title/abstract analysis, and full text analysis.

Extraction Log					
Research Question	Database Name	Structured Query Results	Title/Abstract Results	Full Text Results	
RQ1	Scopus	357	43	22	42

RQ1	ProQuest	393	39	20	42
RQ2	Scopus	627	41	28	
RQ2	ProQuest	451	29	14	
		1828	152	84	84

After the research, analytical, and conceptual foci identified in the articles were recorded in the two manifest reports, the foci totals were calculated (see Table 3)—note that it is possible for a single article to have multiple research, analytical, or conceptual foci. The research foci most represented were theories and methods, with 30 and 24 articles respectively. The analytical focus most represented was descriptive analysis, with 36 articles taking a descriptive approach to service system analysis. The conceptual foci most represented in were interactions (33 articles), entities (21 articles), and networks (20 articles). The conceptual foci least represented were access rights (5 articles), quality (5 articles), productivity (4 articles), and compliance (1 article). Complete versions of both manifest reports with the authorship information, publication year, and counts of all of the 84 articles that passed full text analysis can be found in the Appendix.

Table 3: Total research, analytical, and conceptual foci counts from manifest reports 1 and 2.

Manifest Report 1 Totals		Manifest Report 2 Totals	
Research Focus	Article Count	Conceptual Focus	Article Count
Outcomes	2	Access Rights	5
Methods	24	Resources	16
Theories	30	Entities	21
Applications	13	Stakeholders	15
Analytical Focus	Article Count	Interactions	33
Descriptive Analysis	36	Networks	20
Prescriptive Analysis	21	Outcomes	8
Evaluative Analysis	6	Ecologies/Ecosystems	11
		Quality	5
		Productivity	4
		Compliance	1
		Innovation	14
		Resource Integration	15

4. Discussion

4.1 Literature on Service System Analysis

In the 42 articles returned in response to the RQ1-oriented search (*Analysis Approaches*), many articles with a focus on theories appeared. Those include Vargo and Lusch's (2016) update to the foundational axioms of service-dominant logic in light of recent studies involving institutional and sociological theories, as well as Barret et al.'s (2015) theorizing about the nature of information services, service delivery systems, and the relationship between service systems and technology. Examples of articles focused on methods include Wang et al.'s (2016) introduction of a tool for modelling the function, context, behavior, state, principle, and structure of service systems, as well as Karpen et al.'s (2015) method of measuring an organization's service-dominant logic orientation with reference to a series of interaction capabilities.

Comparatively, research focused on applications and outcomes received little attention in the reviewed literature. Thirteen articles focused on applications of service system analysis methods, such as Edvardsson, Skalen, and Tronvoll's (2015) application of a sociologically-grounded theory of resource integration and value co-creation to a case study of a telecommunications company. Only two articles focused on the outcomes of empirical analyses of service systems: Edvardsson et al. (2011) conduct an experiment in which bus travelers plan a journey using two different service systems, finding that the travelers have a better customer experience using the system designed with a service-dominant philosophy than the system designed with a goods-dominant philosophy. Edvardsson et al. (2013) later build upon the findings of that experiment with another outcomes-focused study, using sentiment analysis techniques to dive deeper into the rationale for why one service system design was perceived more favorably than the other, and ultimately proposing design guidelines based on the results of their study.

Research Opportunity 1: The lack of research focused on applying service system theories and methods to specific domains indicates a gap to be filled in future studies. Moreover, only one group of researchers have performed outcomes-focused studies, indicating a major gap to be filled by further empirical studies of the value of different service system theories and methods.

Of the 42 articles returned in response to the RQ1-oriented literature search, 36 include descriptive approaches to service system analysis and, of those, 17 articles describe a purely descriptive approach. Descriptive approaches to analysis tend to be focused on building service system ontologies or introducing new fundamental features of service systems which must be analyzed in order to fully understand any service system. For example, Pombinho, Aveiro, and Tribolet (2015) suggest a method of characterizing enterprises as service systems based on the ontological nature of the enterprise's construction, function, and value contribution; Wang et al. (2014) outline three service subsystems—infrastructure, substance, and management—which can be analyzed together in order to describe the complete service system which the subsystems compose.

Within the 17 articles presenting purely descriptive analyses, there is recurring interest in analyzing service systems with reference to the concepts of service ecosystems and institutions. Vargo and Lusch (2016) propose that recent developments in research on service ecosystems and institutions necessitate new descriptions of some of the foundational premises and axioms of service-dominant logic; thus, there is a need for analysis methods which better describe the ecological and institutional qualities of service systems. Laud, Karpe, Mulye, and Rahman (2015) apply the concept of embeddedness to service systems, claiming that the institutional, cultural, and social contexts of actors are brought to bear on service systems during resource integration. Lusch and Nambisan (2015) offer a framework for describing service ecosystems as

emergent actor-to-actor networks which utilize service platforms in order to co-create value, and ultimately, to catalyze service innovation. Siltaloppi and Vargo (2014) portray value propositions in service systems as institutionalized, socially constructed, and co-created types of shared resources. Demirkan and Dolk (2013) review the analytical, computational, and conceptual modelling techniques that are usually used to describe service ecosystems within the service-oriented architecture paradigm.

There were 21 articles that included prescriptive analyses and, of those, four are purely prescriptive in their analytical focus. Wang, Lai, and Hsiao (2015) prescribe a six-step approach for analyzing service value networks: define the objectives of the analysis, identify actors in the network, determine the interactions among network actors, develop system models, test the models by comparing them to the actual behavior of the system, and design policies and improvements based on the findings of the model testing. Böhmman, Leimeister, and Möslin (2014) claim that analysis in the field of service systems engineering should focus on enabling novel business models and platforms, enhancing collaborative and contextualized value creation in the service system, and mobilizing resources through the use of ubiquitous information systems. Edvardsson, Ng, Choo, and Firth (2013) conduct an empirical study of the performance of service-dominant versus goods-dominant service systems, using a sentiment analysis methodology to determine how the serving process, intangible value, operant resources, information symmetry, conversation, and value propositions influence service system performance. They conclude that factoring service-dominant logic into system design leads to better service systems, and they propose intangible value, operant resources, and information symmetry as differentiating design features. Patricio, Fisk, e Cunha, and Constantine (2011) prescribe a multilevel service analysis and design method which begins with designing service

concepts by using value constellation modelling techniques, then proceeds to designing the service system by using architectural modelling techniques, then ends with designing service encounters by using service blueprinting techniques.

Only six articles offer evaluative analysis approaches. Karpen, Bove, Lukas, and Zyphur (2015) operationalize and empirically validate a service-dominant orientation measure which can be used to evaluate the quality of a service system based on six service-dominant orientation capabilities. Carroll and Helfert (2014) explore methods of evaluating the sourcing process and maturity of service capabilities in open innovation service systems, and Neff et al. (2014) construct their own maturity model for service systems that deliver heavy equipment manufacturing services. Hung and Yuan (2014) develop a model for evaluating, managing, and improving the quality of service productivity by analyzing three drivers of productivity: the ability to empower stakeholders, the ability to adapt to changes in the business environment, and the ability to sustain heightened levels of efficiency, effectiveness, innovation capability, and operational productivity. Lessard and Yu (2013) utilize the evaluation notation of the *i** modelling approach to provide a method of evaluating the outcome of value co-creation interactions based on the resources, value propositions, expected benefits, high-level interests, and entities involved in the interactions. Deb (2012) outlines a method of evaluating service ontologies and suggests that their approach may be translatable to the analysis of service system ontologies.

Out of all of the 42 articles returned in response to the RQ1-oriented literature search, only Hung and Yuan (2014) and Lessard and Yu (2013) exhibit all three of the analytical foci. Alongside their evaluative approach, Hung and Yuan descriptively analyze the drivers affecting value co-creation and value networks within service systems, then prescribe a four-stage process

for analyzing service productivity: establish the nature of service-dominant logic concepts, establish the impact of those concepts on the service system under analysis, demonstrate how the service system integrates a value network, and discuss how modifications to the value network can improve service productivity. In addition to their evaluative methods, Lessard and Yu argue that intentionality is a fundamental component of service system interactions; they provide methods of describing intentionality in service systems and mechanisms for prescriptively modelling value co-creation using the i^* notation.

Research Opportunity 2: The presence of only two articles which exhibit all three analytical foci signals a tremendous opportunity for researchers to create holistic service system frameworks which offer descriptive, prescriptive, and evaluative analysis methods. Although frameworks which offer only one or two of the analysis methods are fully capable of yielding valuable findings, a mixture of all three methods in one framework would provide researchers with a toolkit in which every tool is based on a singular, shared set of philosophies and assumptions about the nature of service systems, how they are best analyzed, and the conditions under which a service system is performing optimally.

4.2 Literature on Service System Components

The most prominent conceptual foci in the articles returned from the RQ2-oriented literature search were interactions (33 results), entities (21 results), networks (20 results), and resources (16 results). The large volume of results pertaining to these aspects of service systems re-affirm their status as indispensable, fundamental components of service systems.

The concept of stakeholders also received a great deal of attention (15 results). It is worth noting that articles which focus on service system stakeholders often exhibit a tenuous

distinction between stakeholders and entities. For example, Frow et al. (2014) portray stakeholders as entities with socially contextualized character attributes, such as police officers, criminals, and activist groups in a police force service system. They also characterize ecosystems as entities (p. 332) and firms as entities (p. 333), but at other points, they apply the term “actor” as though it could describe any entity or stakeholder with agency. Frow, Nenonen, Payne, and Storbacka (2015) afford more attention to entities, at first listing customers, suppliers, and distributors as entity types, but then quickly re-frame entities as actors (p. 464) and use an actor-network theory lens to analyze them. Alter’s (2012) portrayal of customers as stakeholders with typological characteristics (e.g. direct, indirect, paying, nonpaying) resonates with Frow et al.’s (2014) socially grounded interpretation of stakeholders, but compels us to question why customer entities should not be differentiated into a structure of multiple types and sub-types to the same extent as customer stakeholders are in the article. Mele, Colurcio, and Russo-Spena (2014) use the terms actor and stakeholder interchangeably, and Maglio and Spohrer’s (2013) invocation of “stakeholder entities” (p. 667) makes the distinction even less clear. Maglio and Spohrer (2013) do, however, clarify the distinction somewhat in describing entities as having “information-processing and communication capabilities as well as distinct resource-based capabilities” (p. 666) and treating stakeholders as actors with value-processing capabilities (p. 667). It appears, though, that entities and stakeholders are both intentional actors with unique functions and capabilities within the service system. In Golnam, Ritala, Viswanathan, and Wegmann (2012), the capability-based distinction achieved by Maglio and Spohrer is again blurred, with the authors interpreting stakeholders as actors which integrate resources and capabilities to generate value. In that conception, stakeholders have absorbed the information and

resource processing capabilities of entities, added it to their value processing capability, and become the lone actors in the service system.

Research Opportunity 3: The varying interpretations and confluences of the stakeholder and entity concepts signals a need to re-differentiate and re-clarify the concepts, or perhaps more ambitiously, to merge and evolve the concepts. Recent interest in reconciling service systems with actor-network theory in the vein of Vargo and Lusch (2016) has positioned the concept of an actor as a natural successor to the entity and stakeholder components.

The components receiving the least attention in the literature were outcomes (8 results) and access rights (5 results). Encouragingly, there has been a spike in interest in outcomes since 2014, with six of the eight results falling between 2014 and 2016. It is common for the more recent studies of outcomes to consider the impact of institutional and social contexts on outcomes, once again reflecting the growing interest in institutional and sociological perspectives. Frow, Nenonen, Payne, and Storbacka (2015) discuss the role of social innovation in value co-creation outcomes; Laud, Karpen, Mulye, and Rahman (2015) discuss the effect that institutions and structural, relational, and cultural embeddedness have on resource integration outcomes; Pinho, Beirao, Patricio, and Fisk (2014) discuss the effects of social interconnectivity and interdependency on value co-creation outcomes. In comparison to outcomes, the concept of access rights has received very sparse coverage between 2011 and 2016. The low interest in access rights and the alternative conceptualization of access rights as features of resources serve as evidence that access rights are perhaps sub-components or typological features of resources, rather than fundamental, top-level components of a service system.

Research Opportunity 4: Investigate the nature of access rights and their relationship to resources more closely.

With 11 results returned, ecologies/ecosystems received substantial attention in the literature; in fact, there has been tremendous interest in the concept of service ecosystems and the ecological relationships contained within ecosystems since 2014: nine of the eleven articles were published between 2014 and 2016. Vargo and Lusch (2016) suggest that the concept of a service ecosystem expands the scope of the service system towards a broader configuration of actors, a “dyad-to-network-to-systems” (p. 6) perspective which is shaped by institutions and institutional arrangements. Barrett, Davidson, Prabhu, and Vargo (2015) describe service ecosystems quite similarly to service systems, defining service ecosystems as “... relatively self-contained, self-adjusting systems of resource-integrating actors connected by shared institutional logic and mutual value creation” (p. 138), and some authors—especially in the management literature—even use the terms “service system” and “service ecosystem” interchangeably (e.g. Kutsikos, Konstantopoulos, Sakas, & Verginadis, 2014; Mele, Colurcio, & Russo-Spena, 2014; Wan & Zhang, 2013). Laud, Karpen, Mulye, and Rahman (2015) bring some clarity to the concepts by noting that in an ecosystem, actors “are potentially embedded in multiple service systems, and their embeddedness across these systems has implications for their resource integration potential” (p. 511). Frow et al. (2014) add further clarity, arguing that a service ecosystem is a “higher level system” (p. 332) in which the external networks of separate service systems interface with one another, altering their corresponding service systems in the process. Akaka and Vargo (2014) confirm that the ecosystem view is more focused on “... interaction within and among service systems” (p. 371), as well as the influence of institutions and institutional arrangements across separate service systems.

Research Opportunity 5: The distinction between service systems and service ecosystems needs to be explored more thoroughly and established more firmly in future studies such that a clear demarcation between the system and ecosystem levels can be made.

Looking at the results count for each individual performance measure, there are few articles with a conceptual focus on non-innovation measures of quality (5 results), productivity (4 results), and compliance (1 result). Karpen, Bove, Lukas, and Zyphur (2015) introduce a service-dominant orientation instrument which enables providers to better understand their performance quality by measuring their degree of alignment with a service-dominant approach to performance. Hottum, Kieninger, and Brinkhoff (2015) study the factors which influence the relationship between customers and their perception of service quality, and in doing so, advance a bifurcated view of productivity (p. 5): operational productivity, seen from the provider's perspective in factors such as material output, employee output, output time, costs, income, etc.; and, customer productivity, seen from the customer's perspective in factors such as input time, effort, cost, output experience, and benefits. Calabrese (2012) suggests that there is a trade-off between improving service productivity and service quality, but finds that the trade-off can be avoided if customers and/or providers are self-motivated to overperform. Campbell, Maglio, and Davis (2011) explore methods of improving service quality by shifting the service boundary between customers and providers, resulting in self-service and super-service scenarios. Only Khadraoui and Feltus (2012) analyze the service standards compliance measure, describing the features of service compliance and proposing the concept of responsibility as the mediating dimension between actors, rights, business rules, and compliance capabilities.

Research Opportunity 6: The low volume of results pertaining to performance measures should prompt researchers to more closely examine the methods through which service system

stakeholders measure performance, especially the methods through which a service system's authorities measure compliance.

Resource integration is not simply a component of service systems, but rather, a cross-component relationship of vital importance. Fifteen results of the literature search had focus on resource integration, illustrating the level of interest in resource integration and the perceived importance of the concept. There is little uncertainty in the literature as to how to interpret or analyze the concept of resource integration: Sitaloppi and Vargo (2014) define resource integration as a process which "... captures the broad range of interactive behaviors in which an actor or a service system applies knowledge and skills, in conjunction with other available operant and operand resources, to improve the state of others, and reciprocally, the state of oneself" (p. 1279), and that definition is implicit throughout the literature. Given the growing prominence of institutional and social concepts in other facets of service system research, it should come as no surprise that there are many articles forwarding sociological perspectives of resource integration, particularly since 2015 (e.g. Vargo & Lusch, 2016; Edvardsson, Skålén, & Tronvoll, 2015; Laud, Karpen, Mulye, & Rahman, 2015; Lusch & Nambisan, 2015).

Research Opportunity 7: The recent trend of wedding resource integration theory with sociological perspectives signifies that a fruitful new movement in the research is underway, and many possibilities exist for studying existing service system components through the lenses these perspectives offer.

Fourteen of the literature search results exhibited a focus on innovation. The pre-2011 literature search positioned innovation as a performance measure taken by competitor stakeholders, dependent upon three metrics of efficiency, effectiveness, and sustainability (Lyons

and Tracy 2013). More recent service science literature adopts a much broader interpretation of innovation, generally understanding innovation in the context of service systems as the “... rebundling of diverse resources that create novel resources that are beneficial (i.e., value experiencing) to some actors in a given context” (Lusch & Nambisan, 2015, p. 161). Lusch and Nambisan go on to outline a framework for service innovation, contending that actor-network, resource liquefaction, and resource integration processes in service ecosystems, service platforms, and value co-creation interactions operate in different combinations, producing different kinds of context-specific service innovations. Other models of innovation in service systems are similarly centered around the combined effects of service system components. For example: Barrett, Davidson, Prabhu, and Vargo (2015) explain how service system processes provide opportunities for innovation in the areas of service definition and evaluation, client interface, intra-organizational service delivery, inter-organizational service delivery, and technology use; Hautamaki and Oksanen (2015) explain how different combinations of service complexity, interaction intensity, service system scalability, and service commodification can inform a variety of service innovation strategies; and, Maglio and Spohrer (2013) explain how ecological, value proposition, and access rights relationships can be redesigned as part of a business model innovation. Absent from the 2011-2016 literature was any sort of typology of innovations, such as the pre-2011 work of Damanpour, Walker, and Avellaneda’s (2009) that studied of the combinative effects of different types of innovations (e.g. service, technological process, and administrative process innovations).

Research Opportunity 8: The introduction of new typologies and the application of existing ones could help in organizing the many types of innovation produced by service systems which are discussed in the literature we surveyed.

Analyzing research about service system components and concepts has yielded several implications for the service science research agenda which will be further described in the following section.

5. Implications for Researchers

In the previous section, we drew upon the analysis approaches under study as part of RQ1 and the system components under study as part of RQ2 in order to present eight research opportunities: 1) focusing on applications of analysis methods, 2) using a greater variety of analytical approaches, 3) differentiating stakeholders from entities, 4) the nature of access rights, 5) differentiating service ecosystems from service systems, 6) methods through which performance and compliance are measured, 7) the adoption of institutional and sociological perspectives, and 8) the role of innovation and innovation typologies.

Using the gaps discovered in our literature review to provide a logic for linking research questions to opportunities, we constructed a framework of key research findings (illustrated in Figure 3) for use in exploring the eight research opportunities we identified. We propose three broad directions for future service systems research implied by our findings:

Direction 1: Re-focused attention on a greater diversity of research designs and analytical approaches, including approaches that combine descriptive, prescriptive, and evaluative characteristics.

Direction 2: New perspectives leveraged to perform more ontological work on system components. Adopting sociological and institutional perspectives to re-assess the roles of service system components will result in service system ontologies that are more

responsive to the intentionality of actors in the system, as well as the effects of their interactions.

Direction 3: A better understanding of the role of innovation. Little work has been done to link innovation with other components, and pursuing this direction will result in a better understanding of how service systems utilize their components to change and evolve.

These research directions describe overarching trends in the literature and the eight research opportunities identify gaps which have gone largely unexplored. By mapping opportunities to directions in Figure 3, we demonstrate that the opportunities we propose are valuable in moving the existing service systems research agenda forward. Each opportunity could conceivably be addressed by one study, whereas each direction is so broad that it must be addressed through multiple studies. With three research directions and eight opportunities, we offer researchers a detailed roadmap forward.

7. Conclusion

This literature review proposed two research questions for exploration (RQ1 and RQ2) using the components in the service system framework of Lyons and Tracy (2013) as the conceptual foundation for the review. A systematic literature review methodology was described, two literature searches were carried out, articles were extracted from data sources and analyzed, and the results of the literature searches were presented. Key findings from the extracted articles were discussed, with the discussion first reviewing the literature on service system analysis methods, then reviewing the literature on service system components. As a result of the analysis, RQ1 and RQ2 were answered, and opportunities and directions for future research were identified. It is hoped that this review will inspire researchers to consider undertaking similar

literature reviews using our method and to embark on research in areas currently under-examined within service science.

Appendix

Manifest Report 1

Manifest Report for RQ1					
Year	Authors	Focus	Descriptive	Prescriptive	Evaluative
2016	Vargo & Lusch	Theory	x		
2016	Wang et al.	Method, Application	x	x	
2015	Karpen et al.	Method, Application			x
2015	Barrett et al.	Theory	x		
2015	Edvardsson, Skalen, & Tronvoll	Theory, Application	x	x	
2015	Laud et al.	Theory	x		
2015	Lusch & Nambisan	Theory	x		
2015	Nardi et al.	Method, Application	x	x	
2015	Pombinho, Aveiro, & Tribolet	Theory	x		
2015	Wang, Lai, & Hsiao	Method, Application		x	
2014	Böhmman et al.	Method		x	
2014	Carroll & Helfert	Theory, Method	x		x
2014	Hung & Yuan	Theory, Method, Application	x	x	x
2014	Kutsikos et al.	Theory, Method	x	x	
2014	Siltaloppi & Vargo	Theory	x		
2014	Dragoicea et al.	Theory, Method	x	x	
2014	Golnam et al.	Theory, Method, Application	x	x	
2014	Neff et al.	Method, Application		x	x
2014	Wang et al.	Theory	x		
2013	Alter	Theory	x		
2013	Demirkan & Dolk	Theory	x		
2013	Deokar & El-Gayar	Method	x	x	
2013	Edvardsson et al.	Outcome, Method		x	
2013	Salegna & Fazel	Theory	x		
2013	Golnam, Regev, & Wegmann	Theory, Method	x	x	
2013	Lessard & Yu	Theory, Method	x	x	x
2012	Alter	Theory	x	x	
2012	Badinelli et al.	Theory	x		
2012	Barile et al.	Theory, Application	x		
2012	Deb	Method	x		x
2012	Novani & Kijima	Theory, Application	x		
2012	Golnam et al.	Theory, Method, Application	x	x	
2012	Kieliszewski, Maglio, & Cefkin	Theory, Method, Application	x	x	
2012	Lemey & Poels	Theory, Method	x	x	
2012	Pombinho & Tribolet	Theory, Method	x		
2012	Gkekas, Alcock, & Tiwari	Method	x		
2011	Campbell, Maglio, & Davis	Theory, Method	x	x	
2011	Edvardsson, Tronvoll, & Gruber	Theory	x		
2011	Katzan	Theory	x		

2014	Akaka & Vargo		x			x			x				x	x
2014	Mele, Colurcio, & Russo-Spena		x	x	x	x	x	x	x				x	x
2014	Pinho et al.			x		x	x	x						x
2013	Cardoso				x		x							
2013	Chew			x		x							x	
2013	Djellal & Gallouj										x			
2013	Henneberg, Gruber, & Naude			x			x							
2013	Hsieh et al.												x	
2013	Wan & Zhang					x	x		x					x
2013	Westergren & Wennerholm	x	x			x								
2013	Maglio & Spohrer	x		x	x	x			x				x	
2013	Saarijarvi, Kannan, & Kuusela		x		x	x								x
2013	Siltaloppi & Nenonen			x		x								x
2012	Calabrese				x					x	x			
2012	Chae												x	
2012	Golnam et al.			x	x	x	x							
2012	Kieliszewski, Maglio, & Cefkin			x	x	x								
2012	Agarwal et al.				x		x						x	x
2012	Alter			x	x	x	x	x						
2012	Carroll, Richardson, & Whelan		x		x	x	x							
2012	Khadraoui & Feltus	x			x	x						x		
2012	Rubalcaba et al.			x	x	x	x						x	
2011	Campbell, Maglio, & Davis		x	x		x				x				
2011	Danylevych, Leymann, & Nikolaou					x	x	x						
2011	Edvardsson & Enquist												x	
2011	Edvardsson, Tronvoll, & Gruber		x	x		x	x							x
		5	16	21	15	33	20	8	11	5	4	1	14	15

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