The Role of Quality in Sociotechnical Systems

Full Paper

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Abstract

Today, value is co-created in sociotechnical systems in which different stakeholders integrate resources (products and services) in an interactive process. For these systems to be successful, quality is very important. However, existing systems often fail to deliver the right level of quality, and the available quality approaches seem to be insufficient. Therefore, this paper provides insight into the role of quality by applying a service system perspective. We show that a holistic quality perception that reflects the modern expectations of stakeholders is necessary. In addition, different resources for modern services and their interaction need to be taken into account. This results in the need for quality management specific for sociotechnical systems, which integrates different existing approaches to cover these demands. Furthermore, the authors suggest future research on perceived quality and technical support in this context.

Keywords

Quality, sociotechnical system, service system, value co-creation, stakeholder.

Introduction

Today, the service sector is the largest industry sector in developed countries. People, companies and even cities consume and provide services for their own benefit (e.g., logistic services and public transportation services) (Maglio et al. 2009, p. 396–399). Based on technological innovations, new service concepts were developed (Breidbach and Maglio 2016, p. 74). Examples include Smart Home and self-tracking solutions (Fleisch et al. 2015, p. 446). The focus is on the creation of value by combining different elements and stakeholders into comprehensive services and not on isolated devices or products. Such service concepts are created, provided and delivered in and by sociotechnical systems (STSs). The popular paradigm provides common ground in information systems (IS) research and identifies the core concepts of interest (Sarker et al. 2013, p. 2), which are the “social and technical subsystems within organizations” (Alter 2013, p. 90) and the surrounding, environmental aspects (Baxter and Sommerville 2011, p. 3). Service consumers and providers can be part of multiple systems at a time in different roles, which lead to a complex construct of relationships and service provisions (Pinho et al. 2014, p. 471). Therefore, individuals face a dynamic and complex situation when they consume and provide services in the context of STSs.

According to Akter et al. (2016, p. 14), quality is an important factor for these systems to be successful. Quality can be a decision tool for customers to decide whether to use a service (Freund and Spohrer 2013, pp. 4–5). However, companies that offer goods and services in STSs still struggle with quality issues. For example, self-tracking solution manufacturers are not able to reach high customer retention levels due to quality issues (PwC 2016, pp. 5–6). Riedl et al. (2009, p. 219) conclude “service ecosystems pose special requirements on quality management that are insufficiently addressed by existing approaches.”
To help understand why stakeholders in STSs assess the delivered quality as inadequate and why the existing service quality approaches used by providers are insufficient, the aim of this paper is to provide insight into the role of quality in STSs. A service system perspective is applied to focus on the value creation and the interactions in such systems.

In the first step, we examine the value co-creation and overall system quality in STSs by applying a service system perspective. By explaining how and by whom value is created in an STS, we provide a theoretical foundation of the terms, context and dependencies. In the second step, a deeper analysis decomposes the overall quality into specific aspects attributed to specific services by different stakeholders. Thus, the following research questions are used:

1. Value creation in STSs:
   a. How is value created in STSs?
   b. Who creates value in STSs?
   c. How is STS quality defined?

2. Quality for an individual entity in an STS:
   a. Which product and service values are important to entities in STSs?
   b. Is quality part of the identified values?
   c. Are there any mechanisms in value co-creation for increasing quality?

**Perspectives on STSs**

A sociotechnical system is any organizational system viewed as a “multivariate system of four interacting and aligned components – task, structure, actor, and technology” (Lyttinen and Newman 2008, p. 613). These components are used to generate output (e.g., the provision of services and products) for the system itself or for external elements. For this purpose, different resources (e.g., information and skills) are integrated (Alter 2013, p. 75).

The service system approach, which is based on service-dominant logic (S-D logic) and service science (Barile and Polese 2010, p. 22), can be applied to the concept of STSs (Böhmann et al. 2014, p. 74) and provides an interaction- and value-oriented perspective. Service systems are “a value-coproduction configuration of people, technology, other internal and external service systems, and shared information” (Spohrer et al. 2007, p. 72), with the objective of improving the status of the involved systems (Maglio et al. 2009, p. 403). For such systems, the cultural context, including “social, technological, economic, environmental, and political” aspects, is relevant (Freund and Spohrer 2013, p. 5).

In addition to the service system approach, an ecosystem perspective can be applied to STSs, which focuses on the “process of interactions among individuals, organizations, and services” (Zhang and Jacob 2011, p. 147). An ecosystem is a balanced environment that includes “all the living and nonliving processes or objects” (Jørgensen et al. 1992, p. 5), which are loosely coupled by interaction relations and focused on their own benefit (Boley and Chang 2007, p. 398). An adaptable and expandable sociotechnical platform provides the technology and functionality to support the systems’ interactions (Negi and Brohman 2015, p. 3; Tilson et al. 2013, pp. 4625–4633) and the co-creation of value (Negi and Brohman 2015, p. 5).

The service system approach and the ecosystem perspective can be combined into the concept of service ecosystems, which are “a spontaneously sensing and responding spatial and temporal structure of largely loosely coupled, value-proposing social and economic actors” (Vargo and Lusch 2011, p. 185). According to Frow et al. (2014, p. 332), service systems and service ecosystem are the same. Both focus on the value creation within and between the parts of the systems. Maglio et al. (2009, p. 402) also identify interaction as the key concept and differentiate between “service interactions” and “non-service interactions.” Service interactions focus on value co-creation, while non-service interactions can be wanted and positive (e.g., asking for the price of a product), or unwanted and negative (e.g., a criminal act).

The concept of value co-creation is defined and discussed in different research streams with common themes, where many papers focus on the relationship to service science and S-D logic (Galvagno and Dalli 2014, p. 656). Regarding this research, a transition of the concept can be observed. On the one hand, a
customer- or company-centric view is used to describe the relationship between the company as the service provider and the customer as the service consumer (e.g., Bischoffshausen et al. 2015, p. 264). The other system elements are also accounted for but with a minor focus (e.g., Bischoffshausen et al. 2015). On the other hand, a many-to-many perspective is used, “where customer networks interact with supplier networks” and services from different providers are dynamically combined (Pinho et al. 2014, p. 471). With this perspective, all involved elements are (tried to be) considered equivalent.

Research Approach

To answer the identified research questions, a rigorous foundation in the form of the current state of knowledge (Levy and Ellis 2006, p. 183) is needed as service systems and especially quality itself are known concepts. A literature review focuses on these existing concepts and their relationships and not on a specific STS and its concrete challenges, on which an empirical approach would focus. Thus, this foundation is provided by a traditional, qualitative literature review, which further helps to identify weaknesses and research opportunities (Boell and Ceece-Kecmanovic 2015, p. 163) in the current body of knowledge as the basis for further and complementary research. Because the research questions are abstract and heterogeneous and the extraction of evidence in the form of casual relations is not necessary, a systematic literature review does not satisfy the requirements. In addition, no metadata was needed, such as the number of relevant publications per journal (Boell and Ceece-Kecmanovic 2015, p. 169).

As Levy and Ellis (2006) suggest, a three-step process for the literature review was used: We performed a keyword search (1) to identify the initial set of relevant and quality papers. We used and dynamically adapted different keywords and combinations to overcome the problem that defining keywords up front is problematic (Boell and Ceece-Kecmanovic 2015, p. 165). Based on the identified literature, we conducted a (2a) backward and (2b) forward reference and author search (Levy and Ellis 2006, pp. 190–191). As Webster and Watson (2002, p. XV) suggest, we did not focus on specific journals but on relevance and quality (regarding origin, methodology and findings). To select the relevant papers, we checked the abstracts, and if they matched, we analyzed the papers in detail. If they were relevant and high quality, we added them to the database. We stopped the search process when no new insights into the targeted research questions seemed to come up (Levy and Ellis 2006, p. 192). As the last step (3), we processed the identified literature and used it to answer the research questions.

Value Creation in STSs

How is value created in STSs?

In service systems, the focus is not on the production of goods and services but on the creation of value. This S-D logic–based paradigm stands in contrast to goods-dominant logic (G-D logic), in which the company is separate from the customer. The company creates goods and services in isolation, and the customer then destroys them during use. In contrast, S-D logic describes a process of value co-creation, in which the company and customer create value together (Vargo et al. 2008, p. 148). For S-D logic, “service” is a “process of doing something for and with another party” and is different from the perception of G-D logic “services,” which are only some kind of output (like goods) (Maglio et al. 2009, pp. 398–399). Goods and services as resources are still relevant, but they do not build the primary unit of exchange (Vargo and Lusch 2004, p. 7). In S-D logic, they are referred to as operand resources (tangible and static) used as transmitters and instruments for co-creating value by operant resources (intangible and dynamic, e.g., skills and knowledge) (Maglio et al. 2009, pp. 398–399). The operant resources are applied by all individual and economic entities to co-create value (Lusch and Nambisan 2015, p. 159). Using a wearable fitness device can be an exchange of skills and knowledge (“How to get fit”) instead of just the usage and exchange of a hardware device with related software.

This change in focus leads to a different perception of value as in G-D logic goods and services are usually exchanged for money (value-in-exchange), while in S-D logic value is created during the process of usage (Vargo et al. 2008, p. 146). This value-in-use depends on the context and the involved stakeholders and resources (Akaka and Vargo 2014, p. 371) and therefore can be quite different for the individual. The value-in-use cannot be delivered, because it is created in a process between multiple actors (Lusch and Nambisan 2015, p. 159). The value creation is based on a value proposition (Vargo and Lusch 2004, p. 7),
which is accepted by the consumer with the objective of an improved status (e.g., capabilities) during or after the value is co-created (Freund and Spohrer 2013, p. 4).

**Who creates value in STSs?**

Operand and operant resources are key elements of service systems. Maglio and Spohrer (2008, p. 19) differentiate more precisely between elements and resources and identify “resources with rights (people and organizations), resources as property (technology and shared information), physical entities (people and technology), and socially constructed entities (organizations and shared information).” Alter (2013, p. 79) uses a corresponding distinction and defines a service system as a construct of processes, participants, information, technology, customers, and products and services. Entities with rights (e.g., a single person or a company) initiate the value co-creation by offering value propositions and (maybe) accepting them, and then resources are used to create or transmit the value (Maglio et al. 2009, p. 400).

Akaka and Vargo (2014, p. 371) identify four roles for entities in a service system and differentiate between “resource integrators, service providers and recipients, and contributors to value creation.” Freund and Spohrer (2013, p. 4) identify more specific roles for entities that can be a competitor or an employee, for example. Relationships and contributions and therefore role assignments are changing all the time in a dynamic manner (Pinho et al. 2014, p. 488). Entities can act in all possible roles, depending on the situation (Akaka and Vargo 2014, p. 371). As all elements are part of a service system to co-create value, the role of being a contributor to value creation is essential for all entities. Further, a proactive and reactive understanding of one’s role is distinguished by Breidbach and Maglio (2016, p. 77) in a business to business context. Proactive role behavior means that the process or task involving the entity is triggered by the entity itself. Reactive behavior describes the reaction to a process or task, which is not triggered by the entity itself.

**How is STS quality defined?**

Identifying quality in service systems is not a trivial task. Despite the great importance of quality, only a little research has been conducted in this context thus far (Akter et al. 2016, p. 1).

Maglio et al. (2009, p. 402) focus on the quality of the service system itself. Based on their ISPAR model, they define quality as the ratio of all value co-creation interactions to all other outcomes (e.g., non-service interactions or interactions in which the value creation failed). This approach seems to be valid, as service systems are all about value creation. However, the usage of such a ratio leads to a numeric result with only a little information. There is no possibility of gaining insight into the quality of the value that is created compared to the value that could be possibly created. Furthermore, as Maglio et al. (2009, p. 401) identify, there can also be interactions that are positive but do not create value. Depending on the context, there is the possibility of many such interactions, which would negatively influence the ratio. In addition, it seems to be possible to classify positive, non-value interactions as value creation, because they have a positive influence on the stakeholders (e.g., exchange of information).

Freund and Spohrer (2013, pp. 4–5) focus on the meaning of quality for the consumer of a service. They define quality as a decision tool for accepting or declining value propositions. Further, they identify productivity (provider), compliance (authorities), and innovativeness (competitors) as important measures. These measures can be summarized under the term quality. If quality is important for the consumer in the form of service quality (Barile and Polese 2010, p. 33), then quality should also be important for the provider of the service. Details about the conceptualization of quality cannot be found in the mentioned research.

Pinho et al. (2014) provide a practical example and identify additional specific aspects of quality. Because the exchange in service systems can be based on information (Maglio and Spohrer 2008, p. 19), information quality is important for value co-creation. Information quality is based on availability, accessibility, and reliability (Pinho et al. 2014, p. 477). The authors also identify different factors that influence the overall service quality. Although the factors are case specific, they can generally be subsumed in the conception of a higher level of value creation compared with the situation before (e.g., better clinical decisions). The practical example shows that quality is quite different, but a general conceptualization seems to be possible.
Based on previous findings, the conceptualization of service systems and available research, different starting points for quality in service systems can be identified. These starting points can be found in the elements of a service system, as quality is an important aspect for the entities involved and the resources used can be of a certain quality. Furthermore, the different roles entities can take come with different quality perceptions and requirements. In addition, the quality of the exchange is important as an exchange can be based on information, work, risk, or goods (Maglio and Spohrer 2008, p. 19). In summary, quality is an important, but complex, aspect of service systems.

Quality for an Individual Entity in an STS

Which product and service values are important to entities in STSs?

Entities in a service system can act in different roles, reflected by different quality concepts in the literature.

In the past, models, such as the Kano model, linked quality to customer requirements, product functionality, and customer satisfaction. The Kano model suggests that customers’ ideas about quality could be broken down into requirements, which should be fulfilled by product functions. The implemented functional level then influences the level of customer satisfaction (Berger et al. 1993, p. 4). Recent research still suggests that customer satisfaction is important regarding process and product success. However, in contrast to the Kano model, customer satisfaction is seen as influenced by customer expectations, which are “wishes in reference to service quality” (Stavrou et al. 2014, p. 16), such as customer involvement, responsiveness of the contractor, and transparency (Stavrou et al. 2014, p. 20).

Other recent research also suggests that “traditional customer values of price, quality, speed, and customization are of course still essential,” but “today customer demand more than just those such as experience, emotional fulfillment, and the public good” (Lee et al. 2012, p. 826). The latter corresponds to the concept of hedonic value, which is defined, for example, in the context of mobile apps by Hsu and Lin (2016, p. 44) as “the degree to which a user derives pleasure from using an app,” in contrast to utilitarian value, “the degree to which a person believes that using an app enhances his or her task performance.”

According to Im et al. (2015, p. 168) and Hsu and Lin (2016, p. 43), perceived hedonic value as well as perceived utilitarian value impact consumers’ attitude toward products. Attitude, as well as satisfaction, directly or indirectly influences purchase decisions and product success. While attitude focuses on the positive feelings a customer gets from usage, satisfaction focuses on the overall favorable assessment of the product (Hsu and Lin 2016, p. 45). Im et al. (2015, p. 168) also suggest that product meaningfulness influences the perceived utilitarian value and product novelty, and surprisingly, coolness affects a product’s perceived hedonic value. While this comes from the academic research in business, research in the field of human–computer interaction (HCI) also analyzes the coolness of products, because the “perceived coolness of a product does have implications for its success in the marketplace because it is believed to play a role in how users view and use technology” (Sundar et al. 2014, p. 179). In the case of digital devices and interfaces, Sundar et al. (2014, p. 179) suggest that “Attractiveness, Originality and Subcultural Appeal constitute the core perception of coolness.”

Although research on customer values and behaviors is comprehensive, customers are only one group of entities. To include other entities, a stakeholder view seems suitable: A stakeholder is “any group or individual who can affect or is affected by the achievement of a corporation’s purpose,” including customers as well as employees (Freeman et al. 2007, p. 6). As illustrated by Nelson (2005, p. 365), different stakeholder groups, such as project managers, team members, or sponsors, are satisfied by different criteria. Yet research is more limited regarding other stakeholder groups and their values and expectations regarding products and services than customers, although the satisfaction of all stakeholders should be considered in order to be successful (Nelson 2005, p. 364).

In addition, there is more research on concrete expectations, perceptions, and values regarding (physical) products than on services. Although, for example, service models try to explain customers’ expectations and perceptions as abstract concepts in relationships to other variables, studies about concrete expectations independent of models and in relation to temporal changes are scarce. Strombeck and Shu (2014, p. 176), for example, identify 38 service quality expectations, such as being accessible, efficient, and reassuring in the context of airline services.
Is quality part of the identified values?

According to the ISO 9000, quality is the “degree to which a set of inherent characteristics [...] of an object [...] fulfils requirements” (DIN 2015, p. 39). In contrast to this definition of quality, service quality researchers argue for a multi-dimension understanding of service quality comprising “several overarching or primary quality domains that reflect elements of technical quality, functional quality, and environmental quality” (Dagger et al. 2007, p. 125).

In the context of technical products, Lieb et al. (2008, pp. 1–2) differentiate between technical/product quality (objective quality criteria) and perceived quality (subjective quality criteria). While they see technical quality nearly as a commodity on the market, they identify perceived quality as an important influential factor regarding purchase decisions and customer satisfaction. “Perceived quality is the result of a cognitive and emotional comparison process between customer’s conscious and unconscious expectations regarding criteria like price, design, brand image or product experiences and the realised technical product features in specific situations of use” (Lieb et al. 2008, p. 2). Although perceived quality was an element in early service quality models, Seth et al. (2005, pp. 933–934) conclude in an overview of 19 service quality models “that there does not seem to be a well-accepted conceptual definition and model of service quality nor there is any generally accepted operational definition of how to measure service quality.” Nevertheless, they observe that the “majority of models and definitions support the view of evaluating service quality by comparing their service quality expectation with their perceptions of service quality they have experienced” (Seth et al. 2005, p. 934). They also show that almost half of the models are based on the Gap/SERVQUAL model (one of the early service quality models), while the other half is completely different (Seth et al. 2005, pp. 933–942).

Although widely used, SERVQUAL is often criticized. Even recent researchers proposed new models based on the existing criticism: Miller et al. (2013, pp. 258–259) present a causal view of service quality in their model (ISSQUAL) and contribute to the idea of service quality as a surrogate measure for information system effectiveness. From their point of view, the service delivery, service product, and service environment are predictors of overall service quality (Miller et al. 2013, pp. 252–253). Akter et al. (2016, pp. 5–8) proposed two models regarding service system quality. One model describes the three quality dimensions and sub-dimensions: system quality (reliability, efficiency, flexibility, and privacy), interaction quality (responsiveness, assurance, and empathy), and information quality (utilitarian and hedonic). The other model describes the overall relationships among service system quality, service system satisfaction, service system value, quality of life, and continuance intentions. Both Akter et al. models are multidimensional models that describe relationships and dimensions of service system quality addressing individual, social, and economic outcomes from a customer perspective. The models also demonstrate the importance and influence of quality not only on satisfaction but also on the continuance and quality of life itself.

All these definitions and models focus mainly on the customer. Other stakeholders, such as employees, do not seem to be considered often. This is not a problem of service quality models alone. In an analysis of three quality models (Baldrige, EFQM, and SIQ) Enquist et al. (2015, p. 330) identify that “these models have difficulties in responding to the value network of stakeholders” as well. The EFQM and Baldrige models at least include the concept of value, but they focus only on “value creation for rather than with customers” (Enquist et al. 2015, p. 329). This focus is problematic, because these models are also used for certification. In a review of service quality models, Seth et al. (2005, p. 939) argue for differentiation between at least internal and external customers. In a study, Pinho et al. (2014, pp. 488–489) show how important the consideration of other stakeholders especially in service systems is, because service systems are many-to-many value networks, where the roles of stakeholders change dynamically. Yet the idea of considering stakeholders other than customers is not part of (service) quality models and definitions.

Another aspect becomes obvious when service quality models are compared with customers’ values and expectations regarding products and services: Only the most recent model of service quality by Akter et al. (2016) includes a clear differentiation between hedonic and utilitarian value.

Nevertheless, it is obvious that the understanding of quality has evolved over the years from a requirements or functionality understanding to a multidimensional understanding consisting of various variables depending on the underlying model or definition. However, established definitions and models of quality are outmoded.
Are there any mechanisms in value co-creation for increasing quality?

Modern forms of collaboration can be found under different notions in research literature, such as value co-creation, user-led innovation, open innovation, and service-dominant logic of marketing (Arvidsson 2011, p. 262). As previously defined, value co-creation is the interactive process of stakeholders with dynamically changing roles as service providers and service consumers, active or passive, acting on goods and services with skills and knowledge. According to Ranjan and Read’s (2016, p. 290) literature review, value co-creation consists of “two peer, core conceptual dimensions”: co-production and value-in-use. Co-production creates value through knowledge sharing, equity, and interaction, because perspectives are integrated, joint action is possible, and dialog and engagement allow for discourse. Value-in-use creates value through experience, personalization, and relationships. Because customers are empowered, the usage process is unique and can be evaluated (Ranjan and Read 2016, pp. 293–294).

Thus, value co-creation demands the involvement of customers directly in the production process, as in the HCI field, where customer involvement in the development process of information systems is demanded (Benyon 2013, p. 43). The discourse with the customer about his or her expectations through integration in the development process might support higher quality for the services and goods compared with the earlier G-D logics, where goods and service are created in isolation due to the separation between the company and the customer. Nevertheless, the dynamically changing roles again demand the consideration of the expectations and values of all participating stakeholders. Similarly, Galvagno and Dalli’s (2014, p. 658) empirical review of the literature identifies “horizontal co-creation (between customers and/or other stakeholders) as an issue “regarding the development of a co-creation theory.” However, Ranjan and Read (2016, pp. 295–296) identify an “ambiguity around costs and benefits to different stakeholders involved in the co-creation process” in their literature review. They conclude that the conflicting results regarding employees’ and customers’ satisfaction could be “attributable to alternative theoretical foundations” of value co-creation. Thus, further research regarding stakeholder satisfaction is needed.

However, more mechanisms for supporting higher quality in service systems might be possible. As Seth et al. (2005, p. 939) declare, “Technology plays an important role in improving quality of service.” Thus, the authors suggest further research in this area (e.g., “What type of information system architecture is needed for effective delivery of quality service”).

Results

The findings are aggregated to provide three results regarding the role of quality in STSs:

R1: A holistic quality perception including modern values is necessary for co-creation in STSs.

The understanding today regarding quality, especially in STSs such as service systems, is quite different from that in previous definitions and models. Quality is context-dependent and understood as multiple dimensions consisting of different variables. Only the most recent service quality model includes a clear differentiation between hedonic and utilitarian value, although hedonic value is more important to customers than utilitarian value. Further, quality approaches that address isolated product or service quality are not suitable, as there are no production and exchange of goods and services in a traditional way (G-D logic). Instead, value is co-created by different stakeholders by combining goods and services. Therefore, a holistic quality perception of STSs is necessary.

R2: A multi-stakeholder approach is necessary to include all relevant quality perceptions in STSs.

Available service quality models differ a lot from each other, and no well-accepted definition could be identified. Yet they have in common that they do not consider stakeholders other than customers. However, the frequently used distinction between customers as consumers and companies as the providers or producers of goods and services (or more general value) regarding quality is insufficient. All stakeholders should be considered, as the literature suggests. Multiple stakeholders in changing roles co-create value, and the perceived quality further depends on the respective context. Thus, quality is different for every participating entity.

R3: Individual resource quality and interaction quality needs to be considered for the quality management in STSs.
For managing quality in STSs, the created value is important, as perceived quality and perceived value are related. As value is co-created by integrating resources, the quality of these resources is important and influences the overall perceived value and therefore quality. Lieb et al. (2008, p. 4) recommend for products that “every specific component itself has to reveal high quality.” One resource, compared to another one, may provide a higher value, for example, regarding information quality. Further, as STSs depend on interactions, the quality of such should be considered, as interaction problems may influence the co-creation of value. For improving quality, different approaches were identified in the literature, for example by using appropriate technology or integrating the customer in the production or development process. These approaches may function as isolated starting points, but integrated, elaborated methods are needed.

**Conclusion**

The aim of the paper was to provide insight into the role of quality in STSs, because the stakeholders still struggle with inadequate quality. For this purpose, we applied a service system perspective to focus on quality in the context of value and interaction.

Due to the nature of current value co-creation in STSs, a holistic quality perception reflecting the modern expectations of stakeholders is necessary. Current definitions and models of different research areas often focus primarily on customers, whereas a more general stakeholder approach helps to cover the changing roles in the co-creation process. The different resources of modern services and their interaction need to be taken into account as well, in order to prevent inadequate quality. This results in the need for quality management specific for STSs, which integrates different existing approaches to cover these demands. Using such a model, it might be possible for practitioners to cope with the difficulties regarding quality issues.

Based on these results, we suggest that improvements regarding definitions and models for STS quality are necessary. Therefore, we identify the following three opportunities for further research to continue the process of identifying and improving quality in value-oriented STSs. As the concept of STSs is omnipresent, we believe that focusing on quality is an important task.

**O1: Stakeholder-specific definition of perceived quality and value**

Because service systems are value networks with dynamically changing roles, more insight into the perceptions and expectations of stakeholders other than customers regarding quality is necessary to consider these stakeholders in future quality definitions and models for STSs in general. In addition, differentiation between utilitarian and hedonic value should be considered regarding different stakeholders as well.

**O2: Quality definition in the value co-creation process**

Although research about values and behaviors regarding products is comprehensive, more research on expectations and values regarding services is necessary to improve future definitions and models of service quality. Further, the combination of different products (goods and services) in one value co-creation process needs closer examination, especially regarding different stakeholders.

**O3: Technical support for improving the quality of value creation**

(Information) technology plays an important role as a platform supporting STSs and providing opportunities for improvements in quality and new business models. Thus, more research on the possibilities of supporting the improvement of quality using information technology in such systems is necessary.

In accordance with the proposed research method, currently no additional empirical evaluation has taken place. Additionally, the focus is still on an abstract level and thus on general STSs instead of on a specific class of systems. Therefore, complementary research is needed.

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