Which Boundary Objects are Applicable to Service Innovation? A Dynamic Capability Perspective.

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Abstract

Service Innovation has become a focal point of attention for managers. Hence, organizations need to implement a convenient innovation strategy to remain competitive in constantly changing market environments. To identify, design and implement possible service innovation, organizations already successfully cooperate with external partners, suppliers, customers or internally through different functional departments. In so doing, organizational boundaries occur with respect to unequally distributed knowledge. This disparity needs to be overcome by spanning different groups through technology. In this article, we analyze what kind of IT artifact, so called boundary object, can be used within a service innovation. To this end, we conduct an empirical investigation in 500 German SMEs with the aim of identifying suitable boundary objects for each stage of a service innovation process. Drawing from the dynamic capability and boundary spanning theory we identify four boundary object types and reveal an insufficient utilization of them.

1. Introduction

In recent years, service organizations have frequently faced immense pressure from competitors and changing market environments. Innovation in the service sector, referred to as service innovation, is seen as a means of reacting to these conditions. Therefore, it has become a focal point of attention for service organizations and managers to consider it more and more within their organizational strategy [1]. However, the questions remain: How can these organizations benefit from including innovation into their strategy? What is needed to develop a successful service innovation?

From a theoretical perspective, service innovation can be seen as an organizations' dynamic capability [2]. According to Teece, these capabilities are the firm's ability to achieve new forms of competitive advantage. They are implemented to react to changing environments and, in the majority of cases they are not part of the operational day-to-day business (except innovation firms).

To achieve this ability in rapidly changing environments, one important factor that needs to be considered by organizations is complementary knowledge [3]. Manifested in the onward trends of network-based value creation and globally distributed cooperation agreements [4], managers are increasingly aware of the fact that firms are failing in their ability to design and implement remarkable services on their own.

As a consequence thereof, collaborative service innovation comprises further challenges managers need to consider: boundaries between groups or organizations. These boundaries can vary between intercultural, linguistic, interpersonal, or, generally, organizational differences. [5]. Organizational boundaries can appear internally or externally and, hence, describe functional differences and dependencies caused by spatio-temporal distributed collaborative work between departments or organizations. To overcome these boundaries, a collaborative working environment needs to be institutionalized spanning the collaboration between organizations.

These working environments are referred to as boundary objects [6]. Boundary objects are technological and methodical mean to work on the innovation strategy (internally and externally) as they have the purpose of bridging boundaries by facilitating knowledge transfer. According to Basadur and Gelade [7], an innovation process on the one hand involves rather divergent tasks of coming up with new ideas to convergent tasks of selecting particular alternatives. In order to facilitate the knowledge exchange, different types of methods and tools can be utilized supporting both the divergent and convergent tasks of an innovation.

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They are used to "adapt to local needs and constraints of several parties using them yet robust enough to maintain a common identity across sites" [8]. A plethora of methods and tools which can be used as boundary objects exists (e.g. modeling tools, shared databases, etc.). Moreover, they can be classified into different boundary object types. These types are appropriate depending on the different purposes they need to serve within an innovation process. But what is the right type for the right task? How can a dynamic capability like service innovation be supported by the usage of a standardized tool?

In this paper, we therefore try to answer the following research question:

- *RQ: Which boundary object type can be utilized to support the different sub-capabilities of service innovation?*

By answering this research question we expect our research to make a significant contribution to the theory on service innovation literature. Integrating the dynamic capability theory with constructs of the boundary spanning theory leads to an empirically validated theoretical model on the usage of existing boundary objects for service innovation. Thereby, we address an existing gap in the service science literature and present a structured analysis on the utilization of general technologies for the specific domain of service innovation.

Hence, the remainder of this paper is structured as follows: First, we present the theoretical background including related work to service innovation, the dynamic capability theory, as well as boundary spanning and boundary objects. Subsequently, we present the research model and the underlying research methodology. After presenting the results of our empirical investigation, the findings are discussed, limitations are presented and implications for research and practice are revealed.

2. Theoretical Background

2.1 Service Innovation as Dynamic Capability

In the service economy, organizations need to continuously adapt their offerings in order to remain competitive against other market players. Hence, service innovation has become a focal point of attention for these organizations, and issues regarding design and development are recognized as highly relevant by managers [1].

A service is the application of competences to generate value for another [9]. The term 'innovation', on the one hand, refers to changes within the organization that are used to react to internal inefficiencies or that are driven by internal capability evolution. On the other hand, it includes changes that are driven by arising or anticipated developments within the market environment [10]. Thereby, both, the process of incremental changes (e.g. service enhancements or new bundles of already existing services) and radical changes (e.g. development of a new, not yet existing service) are comprised in the term 'innovation' [11–14].

Drawing from the Resource-based view of a firm [15], two distinct types of resources have been differentiated: (1) operational capabilities of a firm are those the organization depends on to conduct its daily business and which are needed to perform basic functional activities of the organization (e.g. order fulfillment, procurement, etc.) ([16], [17]).

(2) Dynamic capabilities, according to Teece ([2], [18]), are the firm's ability to achieve new forms of competitive advantage. The term 'dynamic' refers to the ability to change competences and to align resources with the purpose of achieving congruence with changing market environments. An organization's 'capability' is "the key role of strategic management in adapting, integrating and reconfiguring internal and external organizational skills, resources, and functional competences to match the requirements of a changing environment" [18].

In service organizations successful service provision is daily business, and hence, is an operational capability. By contrast, service innovation enables the organization to react on changing environments by adapting the service processes (renewing them) and is, hence, identified as dynamic capability.

Service innovation as dynamic capability consists of three main abilities: Sensing, Seizing and Transformation [2]. Sensing, Seizing, Transformations capabilities are (lower level) elements of service innovation capability and address specific aspects of service innovation:

a) Sensing is defined as the ability to recognize existing market needs or market opportunities which can be addressed by changing service processes to innovate services. Sensing abilities appear in three main activities: scanning, evaluating, and detailing. Scanning is the activity to constantly discover and screen the market environment for potentially new problems that can be addressed by a service innova-

tion [19]. Evaluating is the process of proofing and assessing whether these identified impulses are relevant and whether an initial detailing is meaningful [20]. In the detailing process the problem and relevant side conditions are specified.

b) Seizing abilities, according to Teece [2], are needed to explore different service alternatives and to select one or more feasible solutions. Like the three main activities relevant for the sensing abilities, seizing abilities are differentiated in the following three activities: solution development, solution evaluation and selection and solution detailing. The solution development describes the process of developing different service alternatives to address the identified problem (e.g. process design [21]). Within the solution evaluation and selection process, decision-making regarding the most adequate service alternative takes place [22]. The detailing of the solution contains the final description of the service process, the infrastructure needed for execution and activities which need to be conducted to successfully realize the service innovation ([23], [24]).

c) Transformation abilities are utilized to realize the final solution by implementing the new or modified service in the organization [2]. Transformation abilities consist of the three main activities: unfreezing, changing and (re-) freezing [25]. With the unfreezing process, existing organizational work processes are disrupted through newly communicated working standards. Subsequently, with the changing activity, the new service process is implemented. Finally, within the (re-)freezing stage the institutionalization of the new service process is accomplished (e.g. by training employees who will work with the new service in future [26]).

2.3 Boundary Spanning and Objects

Boundaries constitute a central phenomenon in management and organizational research. Despite problems with their operational measurement, at their core, organizational boundaries describe "the walls of an organization", most commonly described as the realms of a formal structure: the firm (for a comprehensive theory discussion see [27]). Conceptually, an organization has external boundaries separating it from actors outside of the organization, such as suppliers and customers [28], and internal boundaries that present a demarcation line between departments. As a general rule, they appear in situations where knowledge is distributed unequally [29]. Such situations arise during collaborative work conditioned by the fact that functionally diverse, temporally and spatially separated parts of the team have to work on one specific task [30].

To tackle these challenges, boundary spanning practices are needed. They are defined as "an organization's ability to create, transfer and integrate knowledge across boundaries and [which] are widely seen as a crucial element of organizational design" [31]. Especially when it comes to the purpose of stimulating innovation, boundary spanning is seen as crucial for information gathering activities to link new information to existing knowledge [32].

From a technological point of view, the employment of boundary objects (BO) is one means of realizing the practices of boundary spanning. Their purpose is to bridge existing boundaries by enabling knowledge transfer [6].

According to Carlile [33], in the context of innovation, boundary objects serve as facilitators of knowledge exchange. In order to overcome different boundaries, different types of boundary objects are identified. The taxonomy by Carlile [6] (adapted from Star and Griesemer [29]) differentiates four types: repositories, ideal types, maps, and standardized forms (see Table 1).

Table 1. Boundary object types

BO type	Usefulness	Examples
Repositories	Provision of a common reference point of data, measures or labels across functions.	Cost databases, CAD/CAM databases, library
Ideal types (objects or models)	Observable abstraction across different functional settings.	Sketches, mock-ups, simulations
Maps	Representation of existing dependencies and boundaries between different groups or functions at a more systemic level.	Gantt charts, process maps, workflow matrices
Standardized forms and methods	Provision of a shared format for solving problems across different functional settings.	Standards for reporting findings, problem-solving methods, engineering change forms

First, repositories provide a common database (including data, measures, or labels) which can be used to generate a common understanding of shared definitions and values for cross-boundary problem-

solving. This type of boundary objects is suitable within an innovation process as information, needed within the divergent tasks of impulse recognition (sensing) and solution development (seizing), can be collected by the participating actors and stored in a structured way [33]. Furthermore, during the transformation of a new service concept in the organization, repositories can be utilized documenting the roll-out-process and thereby visualizing existing changes to other actors.

Second, models or objects, referred to as ideal types, are used as simple or complex representations (abstractions) [34]. They aim at demonstrating as-is or to-be "form, fit, and function" of the "differences and dependencies identified at the boundary" [6] but do not detail different local requirements [30]. In the early stages of an innovation process, these boundary object types can be utilized to present and clarify generated ideas or concepts in a comprehensible and abstracted form. In the later stages, when the service is implemented, a general procedure including the main activities for each participant can be illustrated.

The third boundary object type is maps, which is used for illustrating dependencies and existing boundaries between groups, functions or organizations. With such illustrations, dependencies regarding resources, deliverables and deadlines between cross-functional problem-solving efforts are highlighted [6]. In doing so, a detailed description of dependencies within the service innovation process is provided. The importance of this boundary object type increases during the progress of the service innovation development. Especially, aiming at the generation of a consensus between the collaborating actors regarding the design and transformation of new services, a detailed description of all dependencies is needed.

Fourth, standardized forms and procedures are used to establish commonly accepted work practices and a shared format for problem-solving across boundaries [34]. This format is designed in a way that each definition or categorization of differences and potential consequences is understandable, sharable and less problematic across the functional settings [6]. In a collaborative environment as provided within a service innovation developed by different actors across boundaries, standardization parts are needed to discuss and agree upon reached consensus. Each sub-capability can result in and be supported by a standardization form and/or procedure which in consequence can be reused as starting point for further refinement.

The majority of empirical research on boundary objects focuses on their benefits [35], [36] and lacks an analysis of how and why different types can be used to overcome existing boundaries in an innovation process [33]. We try to fill this gap by analyzing the use of different boundary types at different stages of the innovation process.

3. Research Model

Early on, the research on innovation identified the significance of external information gathering and on the linking of it to organizational knowledge to foster the generation of innovation [30]. Hence, service innovation is highly dependent on external knowledge and service organizations need to improve their capabilities in creating, transferring and integrating knowledge across boundaries ([31], [32], [37]).

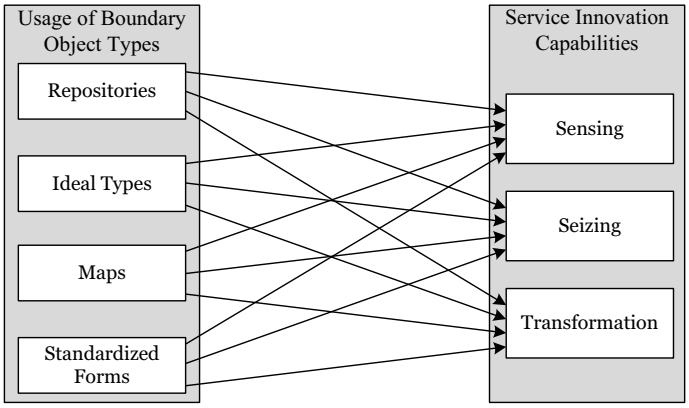

Figure 1. Research model

To accomplish this task, IT-based artifacts in terms of boundary objects are needed to support the development of boundary spanning competences [38].

Based on the aforementioned theoretical background, we now synthesize our research model, addressing the constructs, their measurement and their relationships. We hypothesize that the boundary object usage helps in overcoming organizational boundaries and thus increases the service innovation capabilities: sensing, seizing and transformation. Thus, the dependent variables are the three capabilities. They are measured using three items each. Construct definition and corresponding items are listed in Table 2. The four independent variables refer to the usage of the four boundary object types: repositories, ideal types, maps and standardized forms. Each boundary object type usage is measured using one item. We tested on content validity by asking the participants of the pilot study regarding the representativeness of the items for the measurement. Each item for boundary object type usage was deemed as content valid (Content Validity Index (CVI) above .80). Items and constructs definitions are again listed in Table 2.

Table 2. Constructs and items

Construct	Definition	Items
Sensing Capabilities (SN) ([2], [19], [20])	The service provider is able to perform scanning, evaluating and detailing activities	SN1: We are capable of identifying market opportunities for new services.
		SN2: We are capable of prioritizing market opportunities appropriately.
		SN3: We are capable of elaborating on the most promising market opportunities in detail.
Seizing Capabilities (SZ) ([2], [24])	The service provider is able to perform solution development, evaluation and selection and detailing	SZ1: We are capable of developing alternative service concepts in response to identified market opportunities.
		SZ2: We are capable of selecting the best service concepts for further detailing and transformation.
		SZ3: We are capable of elaborating on selected service concepts in detail.
Transformation Capabilities (TF) ([2], [25])	The service provider is able to perform unfreezing, changing and (re-)freezing activities	TF1: We prepare our organization adequately for the introduction of new services (e.g. by abolishing barriers).
		TF2: We successfully introduced a new service into our organization.
		TF3: After new service projects we assure conformity of service with the original service conceptualization.
Use of Repositories (RE), ([6], [29])	The service provider uses repositories to exchange information with partners.	BO1: To exchange information with our partners we employ shared repositories.
Use of Ideal Types (IT) ([6], [29])	The service provider uses ideal types to create a common understanding between partners.	BO2: To create a common understanding with our partners we employ drawings, models or glossaries.
Use of Maps (MA) ([6], [29], [34])	The service provider uses maps to define the focus of service innovation.	BO3: To define a common focus with our partners we employ project plans or process maps.
Use of Standardized Forms (SF) ([6], [29], [34])	The service provider uses standardized forms to standardize results and coordinate activities.	BO4: To standardize our results and to coordinate joint activities with our partners we employ structured document templates and specific flow charts.

4. Research Methodology

In order to test our hypotheses and compare the impact of the different boundary object type usage on sensing, seizing, and transformation, we conducted a quantitative survey. We created a corresponding questionnaire and tested it with the help of about 10 undergraduate and graduate IS students (pilot study). This initial test led to minor adjustments of the data (Table 2 lists the final items). The questionnaire did contain further questions, e.g. on the demographics of the organization. In 2012, we collected data together with a market research firm using telephone interviews. Different small and medium-sized enterprises from the service industry were contacted and asked for a person responsible for service innovation. This person answered the questions. We focused on small and medium-sized enterprises for three main reasons. First, because small and medium-sized enterprises are an important area of study often neglected up until now. Second, because small and medium-sized enterprises are considered a primary source of growth and innovation [39]. Third, we expected to achieve better results with regards to reliability, since in small and medium-sized organizations one single person is more likely to answer all the questions than in larger organizations.

Our sample contains answers from 500 small and medium-sized enterprises (SMEs) from the service industry. They provide such products as IT services, healthcare services or financial services. The organizations should have fewer than 500 employees in order to qualify as small and medium-sized. The mean size was 159 employees. Respondents were from top management (~35%), middle management (~60%) or other (~5%).

The data set was analyzed using partial least squares (PLS) structural equation modeling to account for potential non-normally distributed data. We used SmartPLS 2.0 (M3) [40]. We employed the centroid weighting scheme to prevent effect overestimation [41] and mean replacement to treat the few missing values in the data set [42].

5. Results

The results of our study can be structured according to three aspects. First, we analyze the outer model (measurement model) to show construct validity and reliability. Second, the inner model is analyzed to study the impact of the independent on the dependent variables. Third, the coefficients of determination are studied to discuss the importance of the independent variables.

Table 3. Item loadings and item weights

Construct	Item	Loading	Significance
SN	SN1	.8087	***
	SN2	.9223	***
	SN3	.9115	***
SZ	SZ1	.8569	***
	SZ2	.8877	***
	SZ3	.8841	***
TF	TF1	.8653	***
	TF2	.8252	***
	TF3	.8405	***
Please note that the independent variables were measured using one item each. *** denotes significance on $p < .001$-level			

The outer model of this study makes use of reflective constructs only. These have to be analyzed in terms of construct validity and reliability. All of the item loadings of the constructs are above .7 and hence significant (Table 3). This argues for indicator reliability. Construct validity can be evaluated using the Cronbach's Alpha (internal consistency reliability (ICR)). Cronbach's Alpha should be above .5 which is the case for all constructs (Table 4). According to the Fornell-Larcker-criterion [43], the square root of the average variance extracted (diagonal elements in Table 4) have to be higher than the correlations between the constructs (off-diagonal elements in Table 4) in order to show convergent and discriminant validity. As this is given for the constructs, they can be considered valid and working as intended.

Table 4. Measurement model

	Mean	SD	ICR	SN	SZ	TF	RE	IT	MA	SF
SN	2.6	1.0	.860	.88						
SZ	2.7	1.1	.850	.75	.88					
TF	2.4	0.9	.805	.38	.42	.84				
RE	4.7	2.1	1	.04	.04	.09	1			
IT	3.3	1.7	1	.11	.16	.12	.39	1		
MA	3.1	1.7	1	.13	.15	.12	.27	.57	1	
SF	2.8	1.6	1	.17	.20	.24	.28	.39	.58	1

With regards to the inner model, it can be observed that the usage of two boundary object types (repositories and maps) has no significant influence on sensing, seizing or transformation abilities (Figure 2).

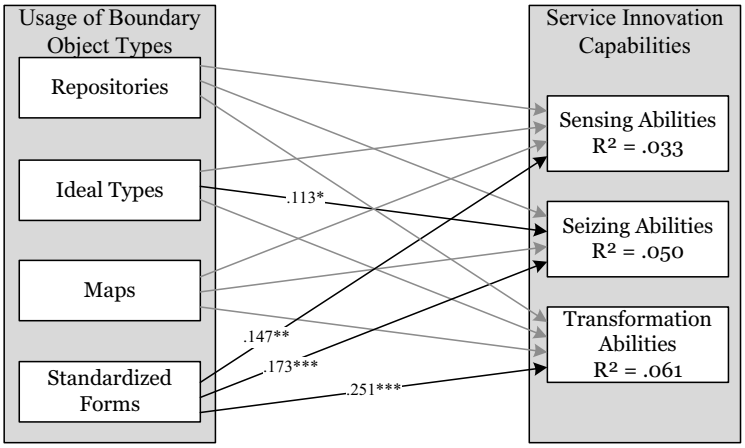

Figure 2. Results

Merely ideal types have a positive impact on seizing abilities and standardized forms on all three abilities. Moreover, the coefficients of determination of the three independent variables are quite low indicating that usage of boundary object types classified in these four types only influences dynamic capabilities to a small extent.

6. Conclusion

6.1 Discussion

In this article, we presented a research model explaining which boundary object type is usable and, hence, suitable for supporting sensing, seizing and transformation abilities during the service innovation process. Therefore, we operationalized the dynamic capability theory. To identify boundary object types relevant for each capability we collected data in an extensive survey of German SMEs from the service sector (n =500).

Our findings are twofold. First, from a boundary object type perspective, we identified that only two types are significant for the service innovation capability of an organization.

The usage of the first boundary object type, repositories, has no significant impact for service innovation capabilities. As shared repositories between different groups are mainly used for operational activities (run mode) a real benefit for the design of new services (create mode) is missing. Repositories lack the support of creative tasks such as jointly searching for existing problems in the market environment, designing and choosing service innovation alternatives and the implementation in an organization. “Repositories function advantageously as a shared resource from which to compare across different functional settings when doing cross-boundary problem solving.” [6] After successfully implementing the new service concept in the organization these functional settings are implemented and this boundary object type can be utilized.

The usage of the second boundary object type, ideal types, could be identified to be significantly relevant for seizing abilities. As this type highlights to-be or as-is forms, fits and functions “of the differences and dependencies identified at the boundary”[6] it becomes obvious that for utilizing objects or maps it needs to be explicit what is going to be innovated. In creative parts of innovation, such as brainstorming, a structured approach is more obstructive [44]. Within the transformation activities of a service innovation process the utilization of a model or an object is not adequate as the task itself is too concrete. In this activity, the process of implementation needs to be supported and, hence, organizations have to act instead of design.

Similar to the first boundary object type, the usage of the third type, maps, could not be identified as being significantly relevant for service innovation capabilities. As maps “represent the dependencies and boundaries [..] at a more systemic level” [6], the utilization of this boundary object type is more suitable for supporting the surgical activities. To overcome organizational boundaries by defining who is responsible for which task an explicit map de-

scribes how "work in different sites and with different perspectives can be conducted autonomously while cooperating parties share a common referent." [34] Similar to the first boundary object type, these activities are conducted within the running mode and, hence, are suitable for the service offering itself instead of for the service innovation design. A further potential reason for no significant results can result from the fact that although employees within an organizations have the opportunity to use this type of boundary objects they do not utilize it for the purpose of service innovation. One reason can be that the ability of the actors to use this boundary object is not provided within a unstable environment [33].

The usage of the fourth boundary object type, standardized forms, could be identified as being significantly relevant for all of the three abilities. Apparently, with the level of concretization the significance level rises. This fact is reasonable as standardization across boundaries becomes more relevant the more detailed the service innovation is elaborated [45]. Especially during the final implementation an overall common form agreement highlighted by a standardization form between the organizations or functional departments is needed to take care of communication and to avoid or solve crashes, failures and arising problems [34], [6]. In seizing, aiming at making ideas comparable standardized forms are utilized to choose the best alternative of the service innovation solutions. Even though the creativity in the sensing activities is limited by standardization and structuring methods, for communication purposes or to design a first structured version they can be useful to keep in mind what is relevant for the service innovation. Nevertheless, the significance level is low compared to others which is a first indication that this boundary object type is not generally appropriate.

From a service innovation capability perspective, each capability (sensing, seizing, and transformation) can be supported by the usage of a boundary object type. Notwithstanding that transformation is supported by standardized forms on a high significant level and seizing is supported by both ideal types and standardized forms the path coefficient level for sensing is low.

To sum up, three main findings arose: First, not all of existing boundary object types are suitable for service innovation capabilities and, hence, are more appropriate for boundaries existing within the service offering process. Second, for seizing capabilities two boundary object types are applicable: standardized forms and ideal types. Thus, combining both boundary object types could be promising to support these capabilities. Third, sensing seems to lack a support through suitable boundary object types as it is only faintly supported by standardized forms. In particular, creative parts (like brainstorming) can only marginally be addressed by such standardized objects. Hence, additional boundary object types are needed to support creativity and knowledge transfer by generating a common "language" and a common environment to scan for, evaluate and to detail potential for service innovations.

6.2 Implications for Theory

Our study offers two main implications for theory. First, we contribute a novel and comprehensive empirically validated model to academic discussions about the influence of the usage of boundary object types on service innovation. By applying the dynamic capability theory to service innovation and integrating this view with constructs of the boundary spanning perspective, we present a novel theoretical construct on utilization of existing technologies in a specific domain. We analyzed phenomena that have not been discovered in previous research on service innovation [39]. In particular, we identified which type of boundary objects can be used for service innovation. This has been rendered a highly important research field in recent years [38]. By adapting and combining two theoretical perspectives (dynamic capability and boundary spanning) we contribute to a better understanding of their theoretical dependencies.

Second, by analyzing the impact of different boundary types we were able to identify, that differences regarding their suitability for supporting service innovation capabilities exist. On the one hand, some boundary object types are rather less applicable to serve as IT support across boundaries during the service innovation process. On the other hand, for some service innovation capabilities (like sensing) further, not yet identified, boundary object types are needed. As the classification scheme used in this empirical investigation by Carlile [6] was presented in 2002 (and, furthermore, adapted from Star and Griesemer from 1989 [29]) potentially new boundary object types (e.g. social media) and their benefits are not figured out. Thus, our investigation reveals potential for future research.

6.3 Implications for Practice

Our study offers two main contributions for the practical use. First, by considering service innovation as a dynamic capability, implications for organizations arise. From our results, we can observe that different boundary object types are useful for

different stages of a service innovation process. The more mature the service innovation process is the more useful standardized boundary objects are. Thus, organizations can use the findings and the classification of the impact of different types to choose the right boundary object for the right stage of a service innovation strategy. Vice versa, they can identify potential misuse of existing boundary objects and find possible explanations for unsuccessful service innovation efforts.

Second, organizations can use our empirical research and the resulting findings. On the one hand, organizations should reflect on whether they are providing their employees with appropriate technologically supported boundary objects so that they can effectively sense, seize and transform new service opportunities. On the other hand, they can use the presented questionnaire for internal assessment purposes (e.g. by evaluating whether the existing boundary object type landscape is used effectively to overcome internal boundaries).

6.4 Limitations

The presented findings are beset with some limitations. First, the findings are the results of a survey including 500 German SMEs. We have chosen SMEs for the reasons that, on the one hand, they are an interesting and relevant field of study and, on the other hand, responsibilities are easy to identify and to access. Nevertheless, the generalizability of our findings to other organizational forms is debatable. Second, our measurement builds upon the classification into four boundary object types. Although they are based upon previous research, further and not explicitly stated types may exist but are not part of this study. Future research needs to expand on this explorative study by analyzing potentially useful boundary object types. Third, within the pilot study we only tested our questionnaire with the help of 10 undergraduate and graduate IS students. Although, practitioners from SME's would have been more appropriate in this setting, we chose these students as they were highly educated in the field of service science and innovation management.

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