# Expectations vs. Reality – Benefits of Smart Services in the Field of Tension between Industry and Science

Simon Hagen[1] and Oliver Thomas[1]

[1] University of Osnabrueck, Chair of Information Management and Information Systems
Katharinenstr. 3, 49074 Osnabrueck, Germany
{simon.hagen,oliver.thomas}@uni-osnabrueck.de

**Abstract.** The term "Smart Service" gains increased interest in science and practice since it promises to significantly improve a company's value offering. However, its publicity might lead to overdrawn expectations, especially between practitioners and scientists working in this field. Therefore, we conduct a mixed-method study comparing the expected benefits of Smart Services in science and industry to help identify and close occurring gaps. The study consists of a literature review for the scientific point of view and a survey among practitioners to capture the benefits of Smart Services in both groups. The results predominantly reveal the same vision of both groups for Smart Services, but indicate slight but fundamental differences.

**Keywords:** Smart Service, Benefits, Literature Review, Survey, Industry

## 1 Introduction

Increasing digitalization of products and services resulted in "today's service world" [1] and the advent of Smart Services [2], which promise to significantly improve a company's service offerings and enable customized service features for customers through information and communication technology (ICT) [1]. Smart Services "raised high expectations on their potentials" [3] and are widely used to describe a company's innovativeness. In contrast, the research domain of Smart Services is still in its initial phase and after first strategies for its exploration were proposed [e.g. 1], it currently seeks for a foundational knowledge base [4]. In addition, a comprehensive insight of customer perceptions is required [1], but "only little is known about the level of user awareness and usage of smart services" [5].

Naturally, the lack of a theoretical foundation of Smart Services as well as missing methods and models for their implementation imposes challenges on both research and practice. On one hand, companies are aware of the topic, but on the other hand they just partly start implementing Smart Services and often fail or hesitate [6] due to their complexity. This results, amongst others, from the number of disciplines which have to be involved in their development and application [4] and leads to "limited empirical evidence […] about how the new markets for these novel services are created" [7]. In addition, different perceptions of Smart Services in science and

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practice in terms of their capabilities and benefits lead to gaps in expectations and thus weaken the joint work on the topic and an industry-wide introduction of Smart Services. Therefore, some scientific papers propose descriptions and structures for the topic [e.g. 8] or analyse barriers for an industry-wide adoption [9], but no common knowledge base in terms of definitions has been established so far. Thus, no structured development methods for such systems are present in practice and the systems cannot be classified accordingly. This can sometimes lead to the misuse of the term, e.g. for a marketing purpose [10].

With this publication, we address the gap between practitioner's expectations and scientific reality by conducting two separate studies, which compare the expectations of practitioners with benefits of Smart Services proposed in scientific literature. Thereby, our research fits into the research agendas of Wünderlich et al. [1] and Larson [4] and answers the following research question: *What are the main perceived benefits and expectations of Smart Services in science and practice and where do they resemble or differ?* The results help understand each other's perspective and thus bring both fields closer together, which is vital for a narrow exchange of knowledge and for an in-depth development of the topic. A common understanding enables an integrated view on the topic and consequently allow a higher value proposition in a shorter period of time. Especially the field of Information Systems (IS) can play a key role, since it aims at design-oriented and integrated development of systems at the interface between different disciplines [11, 12].

Therefore, after defining the term Smart Service (chapter 2), we conducted a structured literature review according to Webster & Watson [13] and identified 32 sources which mention benefits that result from implementing Smart Services in companies (chapter 4.1). In a second step, we conducted a web-based survey among 76 employees of different sized companies and asked them for their expectations by offering or using Smart Services (chapter 4.2). In addition, we had the participants validate the benefits identified in the literature as well (chapter 4.3). Finally, we compare the findings of the literature and the survey in chapter 5 and discuss the results in chapter 6.

## 2 Smart Services

The term "Smart Service" was primarily introduced to a scientific context by Allmendinger and Lombreglia in 2005 [2], but it has become popular in recent years. In the literature the term is explained with many different characteristics, e.g. awareness and connectivity [14] or its pre-emptive nature which is based on a "hard field intelligence" [2]. According to Wünderlich et al. [1] all characteristics fit into three groups: technological, customer oriented and context-specific perceptions. This highlights the nature of Smart Services, which relies on the use of IT to generate customer value according to current or upcoming situations.

Paluch [15] defines Smart Services therefore as "digital services, that are delivered through an intelligent and networked IT-infrastructure and generate value in combination with physical objects/products by continuous data collection and

analysis". In a more generic definition Acatech [16] states that Smart Services are "individually configured bundles of (physical) products and services via the internet". This generic definition highlights the close relationship to Product-Service Systems (PSS), which also aim at fulfilling the customer needs in a holistic view, but do not focus on the technology [6, 17]. Some even state that PSS and Smart Services are the same thing [e.g. 18].

To achieve this holistic solution, Smart Services have to incorporate many different disciplines like engineering, computer science, economics or social sciences for development and application of the system [4]. They influence the business relationship of the provider and customer of a service and "are enabled and influenced by information that different industrial devices and processes generate, store and transmit to enable efficient operation, optimization, analysis and integration of business functions" [9]. Thus, Beverungen et al. [8] argue that Smart Services are enabled *by Smart Products, which* can be defined through core properties like unique identification, connectivity, sensors or actuators. The combination of different entities within a Smart Service is summarized by the term *Service System*, which refers to the same concepts according to Edvardson [19]. Spohrer et al. [20] define Service Systems as "socio-technical configurations of people, technologies, organizations, and information designed to create value by fulfilling the needs of those participating in the system" and Larsson [4] emphasizes the key role of the humans in the system. The National Science Foundation [21] adds in terms of the 'smart' component that a Smart Service System "amplifies or augments human capabilities to identify, to learn, to adapt, to monitor and to make decisions. The system does so through self-detection, self-diagnosing, self-correcting, self-monitoring, self-organizing, self-replicating, or self-controlled functions".

It becomes obvious that many terms are used in the same or likewise context and refer to similar concepts, which makes it difficult to distinct them correctly. Their concept has been applied in diverse industries like science and education, production industry, health sector or for individuals, e.g. in smart homes. This implies yet again the vast opportunities but also the complexity and the manifold obstacles in understanding, defining and developing them.

## 3 Method

To gain insights on both the scientific and practical perceived benefits of Smart Services we conducted a triangulation approach according to the mixed-method research concepts of Greene et al. [22]. Therefore, each method aims at identifying beneficial factors of Smart Services for the receiver or provider of the offering but from different perspectives. The findings of both studies, an extensive literature review and a web-based survey, are aggregated and discussed in section 5 and 6.

For the literature review we followed the approach of Webster and Watson [13] and used the databases *AISeL*, *EBSCOHost*, *ISI Web of Knowledge* and *SpringerLink* with the search term "smart service" in addition with the words advantage, benefit, value, result and their German counterparts. No further limitations regarding year of

publication etc. were made, which led to 1.515 hits in total. After removing duplicates we filtered for title and abstract, which left us with 57 publications for detailed analysis. Interestingly, even though title and abstract sounded promising, less than half of these publications (25) contained useful insights on the beneficial factors of Smart Services. To obtain these, we applied two rules while analysing the publications: First, we only used publications that themselves rely on the term Smart Service. We did not evaluate and classify whether the descriptions in the paper fit to the definition of Smart Service, since there is no common understanding of the topic yet (c.f. Introduction) and therefore it is not clear which concept the authors were relying on. Second, we only considered benefits for companies using Smart Services which were stated as such, no deduction from an open statement (like a characteristic) into a benefit was made. This process was performed according to Mayring's [23] three-step process of content analysis (paraphrasing, generalizing, reducing) and led to the identification of 18 individual benefits, which could be grouped into five categories.

On the other hand, to analyse the perceived benefits of practitioners, we conducted a web-based survey among employees of German enterprises of various sizes. The survey was divided into three parts: (1) demographic data, (2) general concepts and (3) beneficial factors of Smart Services. To obtain unbiased insights on the opinions of the participants, we first asked them about their opinion of beneficial factors in a free text field (in part 3 of the survey). To get additional insights on their thoughts on the results from the scientific perspective, we secondly asked them about the factors identified in the literature review. We used two questions for each superordinate group (c.f. Section 4.1) to keep the survey in an adequate length. The questions had a 5-point Likert-Scale and were aligned to the guidelines of [24]. We chose this order to avoid distorted or biased results. In total 76 people participated, of which 40 fully completed the survey (52%).

# 4 Results of the Studies

## 4.1 Beneficial Factors of Smart Services in the Literature

The different understandings and shapes of Smart Services in the literature lead to various practical examples and therefore beneficial factors. A distinct trend in the topic can be identified when plotting the years in which the papers were published (c.f. Figure 1). By far most papers are from 2017 and this years (2018) number of publications is already (late summer) almost as high as 2005-2016 in total. In addition, we analysed the type of customer relationships (B2B or B2C) of Smart Services that were named in the publications. We did this by evaluating the given examples and for which customer group they are relevant. For each paper we did not count more than one occurrence of B2B or B2C group. As one can see in Figure 2, the term is applied in a B2B context nearly twice as much (19) compared to the B2C sector (11). Interestingly, some papers do not limit their scope to one sector and describe benefits for both.

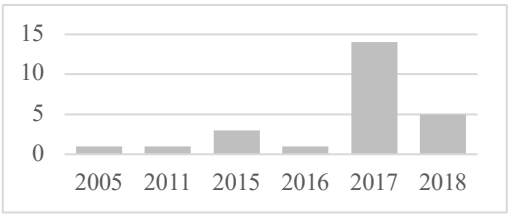


**Figure 1.** Publications per year in the literature review

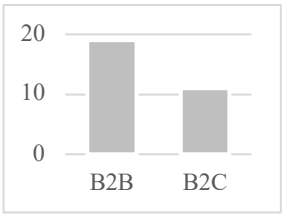


**Figure 2.** Mentioning's of customer segments

For the beneficial factors we identified 18 in total which we grouped into five segments (see Table 1 in the Appendix, chapter 8). In the following we will describe each group and the containing factors briefly. The whole matrix containing all publications and their concepts can be found in the appendix.

*Group one* includes benefits which in general describe effects of Smart Services in terms of **decreasing cost and time effort**. The costs are specified to 'traveling costs' (1 mention), since they are decreased due to opportunities of remote services, and 'search or transaction costs' (4 mentions), e.g. by using "fully automatic marketplaces" [16]. The majority (9 mentions) refers to 'reduced costs' in general, for instance through fewer downtime costs [25]. The 'reduction of time efforts' is usually explained as the receiver of a Smart Service has to spent less time in doing an action, since it is e.g. able to automate more tasks [26].

*Group two* summarizes benefits that in general **improve objects or conditions** through the application of Smart Services. In detail it specifies 'product' (5) and 'quality improvements' (6), 'increased performance' (12), 'higher flexibility' (7) and 'improved service provision' (2). While most of them are self-explanatory, the last one was described as enabling the customer of a Smart Service to benefit from a higher availability of the service providers offerings [1], which is in addition partly linked to flexibility, as the first enables the second.

*Group three* is named **customer related benefits**. Based on the definitions of Smart Services one could argue that they by nature add value to their customers, however some authors stated it explicitly. This group therefore focuses on the customer as a person or institution. It contains the factors 'relationship to the customer' (5), the 'customer experience' (5) which goes together with customer experience and a generic collection of 'values added for the customer' (12). Paluch [15] for example mentions the individual configurability, which implies an increased value for the customer. According to Allmendinger and Lombreglia [2] the relationship to a customer is "own[ed] […] as never before" by the offering company. The convenience that can accompany Smart Services can also lead to an increased customer experience [5]

*Group four*, **monitoring and maintenance**, is the second largest in terms of mentions (27 in sum), even though it contains only the two factors '(real time) monitoring' (17) and '(predictive) maintenance' (10). Monitoring is seen by some as a prerequisite [e.g. 27] and can be with regard to the machine itself, but also to observe the state of the object of interest, e.g. plants in agriculture [28]. In addition it not only

enables maintenance, but for instance also adjusts the object (remotely) [8], which leads e.g. to increased performance (c.f. group two). Predictive maintenance enables providers e.g. to repair machines, which becomes especially valuable in production chains [6].

**Table 1.** Beneficial factors of Smart Services from the literature
*(G=Group, M=Mentions, R=Relative Mentions, S=Sum of Mentions/Group)*

| *G* | *Benefit* | *M* | *R* | *S* |
|---|---|---|---|---|
| 1) Cost/Time Reduction | Cost Reduction | 9 | 7,63% | 20 |
| | Time Reduction | 6 | 5,08% | |
| | Search/Transaction Cost Reduction | 4 | 3,39% | |
| | Reduced Travel Cost | 1 | 0,85% | |
| 4) Monit. & maintenance | (Real time) Monitoring | 17 | 14,41% | 27 |
| | (Predictive) Maintenance | 10 | 8,47% | |
| 3) Customer rel. benefits | Customer Value | 12 | 10,17% | 22 |
| | Customer Relationship | 5 | 4,24% | |
| | Consumer Experience | 5 | 4,24% | |
| 2) Improvements | Increased Performance | 12 | 10,17% | 32 |
| | Increased Flexibility | 7 | 5,93% | |
| | Quality Improvement | 6 | 5,08% | |
| | Product Improvement | 5 | 4,24% | |
| | Increased Service Provision | 2 | 1,69% | |
| 5) Miscellaneous | Safety | 5 | 4,24% | 17 |
| | Information Provision | 5 | 4,24% | |
| | Environmental Benefits | 5 | 4,24% | |
| | Partnerships | 2 | 1,69% | |

*Group five*, **miscellaneous**, holds beneficial factors that do not relate to any other group mentioned so far. It has the least mentions (17) of all groups and contains the factors 'safety' (5), 'information provision' (5), 'environmental benefits' (5) and 'partnerships' (2). Safety can be achieved in different contexts, e.g. in the industry [16], mobility [29] or in the health sector [30] by recognizing events and acting autonomously to prevent or decrease the harm. Through Smart Services information can e.g. be provided context-aware [31] or customized to the user [32]. Environmental benefits, e.g. fewer waste of scarce resources, can also be achieved through Smart Services [33]. Petrie et al. [34] argue that through more standardized services companies can partner in an easier and more efficient way.

### 4.2 Practitioners' Expectations of Smart Services from a Web-Based Survey

In our web-based survey, we asked the participants in an open text field about their expectations and experiences with the benefits of Smart Services in their daily business. 76 practitioners participated of whom 40 finished the survey entirely. Most of the participants work at SMEs: 35% in companies with 101-200 employees, 17,5% have 11-100 colleagues and 10% work in very small firms (<10 employees). 37,5% are employed at big firms (<250 employees). They compete, amongst others, in industries like service (12,5%), mechanical engineering (10%) or forest and woodworking industry (17,5%). Of the 40 participants who completed the survey, 11 are female and 29 male. The majority (75%) is between 20 and 30 years old, the remaining 25% are older. 29 participants (72,5%) stated a job description that

suggests intangible primary or supporting activities like clerk, marketing, sales or project manager. The remaining 20% work in jobs closely related to production or the products themselves, the remaining 7,5% cannot be classified (e.g. “student”).

The answers of the experts from the survey were clustered as well, which resulted in five groups: Alleviation of work, customer satisfaction, time/cost reduction, monitoring and maintenance and miscellaneous (see Table 2). As one can see, they in general go along with the clusters identified in the literature.

**Table 2.** Groups of beneficial factors of Smart Services from the web-based survey

| # | *Group* | *No. of Coding’s (%)* | *Matching group from Literature* |
|---|---|---|---|
| 1 | Monitoring & Maintenance | 31,0 % | 4 - Predictive maintenance 23% |
| 2 | Assistance, Alleviation and Reduced Workload | 21,4 % | 2 - Improvements (partly) 27%<br>3 - Customer rel. benefits (partly)18 |
| 3 | Customer Satisfaction | 16,7 % | 3 - Customer rel. benefits (partly)18 |
| 4 | Reduction of Time and Cost | 16,7 % | 1 - Cost/Time Reduction 17% |
| 5 | Miscellaneous | 16,7 % | None |

The group with most mentions, **monitoring and maintenance**, compares to group four of the literature, which is the second most common there. In this context statements like “capture machine history”, “better/more precise monitoring” and even “predictive maintenance” were made, which are benefits for companies according to the interviewees. This is often linked to benefits resulting from them, e.g. “increased efficiency” of a machine or facility. In some cases also concrete data metrics were named which are valuable for the companies, for instance the feed speed of a machine, its ‘internal’ status or GPS coordinates. Interestingly only few remarks were made on the maintenance, the monitoring and capturing of data was mostly in the foreground.

Another major cluster deals with **assistance, alleviation and reduced workload** for the employees. Participants for example stated that they expect or experienced “simplified processes”, “improved information (flow)”, “less paperwork”, “decision support” and a “seamless production” by using Smart Services. This cluster closely relates to group three of the literature (customer related benefits) and shows that advantages do not only arise from an economic point of view.

Approximately the same amount of statements fit to the cluster **customer satisfaction**, which can be improved significantly by adapting Smart Services according to the participants. It partly also refers to group three of the literature (customer related benefits) and contains improvements for the customers like “better customer relationship” and “better customer satisfaction”, it enables them to provide “offers tailored more specific to customer needs” and to “optimize the services”.

The fourth group summarizing statements that indicate **reduction of time and cost** needed is also the fourth rarest mentioned one in the literature. The participants stated benefits such as “less downtime”, the “optimization of workflows” or an “increased efficiency”.

Lastly, remaining statements were grouped into **miscellaneous**. Despite sharing the same name with group 5 of the literature, in general no common statements were made. Benefits stated primarily refer to “fewer mistakes”, “more efficient machine utilization”, “improved customer acquisition” and “new business areas”.

### 4.3 Validation of Literature Findings from Practitioners in Web-Based Survey

In order to validate the findings of the literature we had the participants of the survey validate each group identified in the literature (c.f. Section 4.1). To prevent biasing their answers of their own expectations the validation took place at the end of the survey. In addition, to keep the survey short and prevent the participants from interrupting, we had two questions per group summarizing the findings of the literature. Each questions was answered on a 5-point Likert-Scale, asking for the consent (1:“Strongly Agree”) or refusal (5: “Strongly disagree”) of the statement. We left out group five (miscellaneous), since it cannot be summarized accordingly.

The following table shows the average of all given answers and the standard deviation for both questions.

**Table 3.** Results of the evaluation of benefits of Smart Services from the literature review (c.f. Section 4.1)

| | | Group 1 | Group 2 | Group 3 | Group 4 |
|---|---|---|---|---|---|
| **Question 1** | **Avg.** | 2,25 | 2,13 | 2,18 | 2,15 |
| | **Std. Dev.** | 0,86 | 0,98 | 0,63 | 0,88 |
| **Question 2** | **Avg.** | 2,73 | 2,23 | 1,98 | 1,93 |
| | **Std. Dev.** | 1,30 | 0,88 | 0,72 | 0,75 |

## 5 Intersections of Expectations and Benefits

In general, the clusters from the literature review and the survey are quite similar in terms of the underlying concepts. However, the answers of practitioners are more specific or concrete and less abstract, probably since they have own experiences or ideas how Smart Services can benefit their company. This infers that both groups are on a similar track regarding their ideas of Smart Services, but on different levels of abstraction.

One topic that stands out is “predictive maintenance”. It ranks second in terms of mentioning’s in the literature and in the survey the group “monitoring & maintenance” is the most mentioned one. This implies that the connection to a physical product seems to be a core element of Smart Services, since it allows an in-depth observation of the object itself or other elements of interest in their surroundings. Besides real-time information this enables forecasting’s or improvements based on statistics and thus becomes essential for the whole system.

The cluster “assistance, alleviation and reduced work” from the survey (second most mentions) refers to the topics mentioned in groups two (improvements) and

three (customer related benefits) from the literature. This is probably due to the different points of view, since the practitioners experience the effects of Smart Services as alleviations and in the literature they are described objectively. However, the "customer satisfaction" was mentioned as a single group in the survey as well, but only matches some of the "customer related benefits" from the literature.

The "reduction of time and costs" was mentioned similarly in the literature and from the practitioners, but only ranks in the lower third in terms of relative number of mentioning's. This group is the only exception to the above mentioned differentiating levels of abstractions between literature and practice. The statements by the practitioners, which otherwise are concrete and contain specific expectations, are more generic in this group. This infers, that the factor is assumed to be prevalent and not a core benefit to practitioners, even though it is a crucial aspect for a widespread dissemination of Smart Services.

The last group, miscellaneous, cannot be compared in a reasonable way, since the containing topics are too different. Also, each domain stated benefits that were not mentioned by the other at all, e.g. 'safety' or 'environmental benefits'. Those were listed in the literature, but not mentioned by the practitioners. Probably due to their increased relevance in the current phase of Smart Service dissemination and adoption.

The validation of the benefits from the literature in the survey (c.f. Section 4.3) mostly confirms these findings and the similarities, since each question (except Group 1, Question 2) scores a value about 2, which refers to "agree" on a 5-point Likert-Scale. The groups with the best scores in average are "monitoring & maintenance" (4) and "time and cost reduction" (3), which exactly matches the results described above. The evaluations of "alleviation of work" (1) and "customer satisfaction" (2) also point out their relevance, but are not that important.

## 6 Discussion, Limitations and Outlook

The term "Smart Service" gains increased interest in science (c.f. Figure 1) and in practice many companies acknowledge the benefits that arise from implementing them. However, the expectations and possibilities from both domains seem to differ and no methods for concrete adoption are present. That is why companies hesitate to implement them in full regard. Thus, we compared the benefits of Smart Services stated in science and practice, which originate from an extensive literature review and a web-based survey with experts from companies. This enabled us to answer our research question in a two step process: The first part of the question ("What are the main perceived benefits and expectations of Smart Services in science and practice […]") is answered in sections 4.1 and 4.2 and allows the comparisons of the findings ("[…] and where do they resemble or differ?") in section 5. In this section we discuss the results in the context of IS-research and derive steps for future research to overcome the identified gaps and to build upon common ideas and experiences.

The findings described in the previous sections, the consensus for benefits of Smart Services between science and practice, appear to be obvious in a first instance. This does not seem to be unexpected, since the term "Smart Service" is attracting increased

interest and the ideas are exchanged between the domains. The differences are predominantly on the different levels of abstraction. For companies the concrete implementation of a Smart Service is most important, thus they derive benefits from the offerings they can supply so far or know about. In a scientific context however the scope is, due to the more generic approach, broader and thus more widespread ideas arise, e.g. the opportunities of a positive impact on ecologic sustainability. However, the practitioners also mention several ideas that have not yet been mentioned in a scientific context. Those ideas are assorted in group 5 five (miscellaneous) and do not match any group or even concrete statement from the literature. This implies that there are still topics that remain uncovered by one of the groups evaluated (science and practice) and leaves room to exchange experiences and ideas in both directions.

Both domains agree that Smart Services have the potential to fundamentally improve or change the way companies generate value for their customers, that's probably the reason why this is the largest group in terms of mentioning's in the literature (32 in total, group two). It is interesting that one of the core elements in both literature and practice is the strong connection to physical products, expressed e.g. by the expected functionalities and benefits of predictive maintenance. Even though only a few participants of the survey are from the machinery industry and no focus or hint on this topic was given in the survey, it is the most mentioned aspect. This supports one of the current streams in IS research, which proposes such strong connection between the physical and intangible components [e.g. 8]. However, substantial adoptions are scarce, which seems to be similar to the adoption of PSS after their introduction in a scientific context. The concepts and benefits of PSS are widely agreed on in science and practice, but practical methods for their development are still not prevalent. In addition, many benefits named by the practitioners, except predictive maintenance, could also be realized by applying "regular PSS" without a "smart component". This verifies the unclear separation of PSS and Smart Services in both domains but at the same time confirms their strong interconnectedness (c.f. Section 2). To simplify adoption in practice it seems to be helpful to highlight the relations and point out the underlying concepts in order to build upon existing knowledge and implementation initiatives. The analysis of the progression from PSS to Smart Services and the development of Smart Services themselves through various scientific iterations can support the adoption in practice as well, by enabling companies to adept the steps of development from science.

Another interesting result is that there is no distinct separation of benefits from participants of the survey working in "intangible" or "tangible" jobs (c.f. Section 4.2). Both groups share the same ideas in terms of product, service or business related features. The same applies for examining the answers across different industries. The participants seem to have rather comprehensive ideas of Smart Services and their concepts and benefits and are not limited to their own perspective. However, we do not find a correlation between the groups. Scientists can build upon this broad view to analyse the often complex structures of Smart Service (Systems) [20]. This goes along with the finding that practitioners from many different disciplines propose beneficial factors of Smart Services despite their relation to information or engineering research. Therefore, from an IS-research perspective, it seems to be valuable to cooperate with

other research disciplines in this field, e.g. product or production engineering [4]. This would also accommodate to the strong relationship of the physical and intangible parts. In addition, a common concept or technology for an in-depth integration of the various disciplines seems to be valuable.

To foster the cooperation of science and practice and to allow sharing of knowledge between the disciplines, we can derive the following future research approaches. Practitioners gave many examples of Smart Service applications, but only few mentioned their importance on generating valuable business model. Scientists can support this change in mind-set by developing frameworks to structure and implement sustainable value offerings. Also, our results reveal benefits which are not common yet, e.g. a building relationships between companies through Smart Service or an improved environmental impact. Research can focus on these benefits to extend the scope of Smart Services beyond the smart product and service perspective solely. The investigation of Smart Service in the pure service sector, e.g. banking, is another topic that needs further consideration in order to prove if the value of Smart Services only realizable in combination with physical products or how the concepts can be transformed and adopted. This matches with the possibilities of substituting the physical and service components in the system and the question, how this affects the conceptualization of Smart Services from a research perspective and the value offering for companies.

This contribution serves as a starting point for future studies of Smart Services and therefore has some minor limitations. The survey does not allow empirical evaluations, since it has not enough participants to guarantee for statistical evidence and practitioners from more industry sectors would improve the results. Participants from “intangible” jobs, which might bias the findings, also dominate the present group. In addition, the validation of the clusters found in the literature with only two questions each is just small indication for its validity. Like every other content analysis (literature and survey), the coding of the benefits and grouping them is a partly subjective task, particularly when the benefits often determine and result in each other. Finally, another data source for insights on practice, like white papers, could have been used.

In conclusion, many streams of Smart Services are similar in science and practice and, even though they are often on different levels of abstraction, they proceed in similar directions. For many research topics stated in prior scientific publications proposals for further investigation were already made, however they need to incorporate the concrete requirements and ideas from practice, to prevent divergence of the perspectives.

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# 8 Appendix

**Table 4.** Concept matrix of beneficial factors of Smart Services in the literature (mapping to benefit-names in table beneath)

| Source | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (Acatech 2015) | x | x | x | x | | | | | x | x | x | x | x | | | | | | 9 |
| (Kampker et al. 2018) | x | x | | | | | | | x | | x | | | | | | | | 4 |
| (Allmendinger and Lombreglia 2005) | x | x | | x | x | | | | x | x | | | | | | | | | 7 |
| (Biehl 2017) | x | | | | | x | | | | x | | | | | | x | x | | 5 |
| (Casillo et al. 2017) | | | | | | | | | | | | x | x | | x | | | | 2 |
| (Petrie et al. 2011) | | | | | | x | | | | x | x | | | | | | | x | 4 |
| (Beverungen et al. 2017) | x | x | | | | x | | | | x | x | | | x | | x | x | | 8 |
| (Demirkan et al. 2015) | | x | | x | | x | | x | | x | | | | x | x | x | | | 8 |
| (Dreyer et al. 2017) | | x | | | | | | | | | | | | | | | | | 1 |
| (Gimpel et al. 2018) | x | x | x | | x | x | | | | | x | | | | | | | x | 6 |
| (Bullinger et al. 2017) | x | x | | | | x | | | | x | x | | | | | x | | | 7 |
| (Huang 2018) | | | | | | | | | | | | x | x | | | | | | 3 |
| (Cedeño et al. 2018) | x | x | | | | | | | x | x | | | x | x | | | x | | 4 |
| (Nezhad and Schwartz 2017) | | | | | | | | | | | | | x | | | | | | 1 |
| (Peng et al. 2017) | | x | | | | | | | x | | | x | x | x | | | | | 5 |
| (Peters et al. 2016) | | | x | | | | | | | x | | | | | | | | | 2 |
| (Pourzolfaghar and Helfert 2017) | | x | | | | | | | | | | | | x | | | | | 2 |
| (Pöppelbuß and Durst 2017) | | x | | x | | | | | x | | | | | | | x | | | 5 |
| (Paluch 2017) | x | x | x | | x | | | | x | x | x | x | | | | x | | | 10 |
| (Wiegard and Breitner 2017) | | | x | | | | | | x | | x | | | | | | | | 3 |
| (Töytäri et al. 2017) | x | x | | | | | | | | | x | | | | | | | | 3 |
| (Jüttner et al. 2017) | | x | | | | | | | | x | | | | | x | | | | 4 |
| (Watanabe and Mochimaru 2017) | | | | | | | | | | x | x | | | | x | x | x | | 5 |
| (Maaß et al. 2018) | | x | | | | | | | | | | | | | | | x | | 2 |
| (Wünderlich et al. 2015) | x | x | x | x | x | x | x | x | | | | | | | | | | | 8 |
| **Sum** | **10** | **17** | **5** | **5** | **5** | **5** | **7** | **1** | **9** | **12** | **12** | **5** | **4** | **5** | **5** | **6** | **6** | **2** | **118** |

| | | | |
|---|---|---|---|
| 1 | (Predictive) Maintenance | 10 | Increased Performance |
| 2 | (Real time) Monitoring | 11 | Customer Value |
| 3 | Safety | 12 | Consumer Experience |
| 4 | Product Improvement | 13 | Search/Transaction Cost Reduction |
| 5 | Customer Relationship | 14 | Environmental Benefits |
| 6 | Increased Flexibility | 15 | Information Provision |
| 7 | Reduced Travel Cost | 16 | Time Reduction |
| 8 | Increased Service Provision | 17 | Quality Improvement |
| 9 | Cost Reduction | 18 | Partnerships |