

Critical Success Factors for Introducing Smart Services: A Supplier's Perspective

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Abstract. Smart services enable providers to win new customers and to strengthen the relations with existing ones. Established companies emphasize the importance of providing smart services in addition to their current portfolio. To be able to offer smart services successfully, various preconditions must be fulfilled. Critical success factors are identified that can be used for companies which want to offer smart services in the future, focusing potential customers and their needs. Implementing smart services in existing business environments to offer added value to customers is a challenge. Due to a systematic literature review, critical success factors for introducing smart services are extracted from academic literature with the objective of an introduction in the interests of customers. Experts from practice evaluated and complemented the success factors. Both a theoretical and a practical perspective is taken to support introducing smart services.

Keywords: Smart service, smart service introduction, smart service implementation, critical success factors, supplier's perspective

1 Introduction

Smart services enable to satisfy individual and continuously changing customer needs [1]. Such services become increasingly important for providers to differentiate from competitors. Although there are companies exclusively focusing on providing smart services, most of the providers are existing companies, e.g. in the field of machine component supply. They aim at using smart services to create new business opportunities. The development of a solution wanted by a specific customer leads to increasing loyalty and relationships [2]. Requirements of customers are highly individual and continuously changing. From a customer's perspective, working with a company that is able to satisfy these needs is predestined to be a long-term partner. Thus, both the provider and the customer benefit from successful smart services. As smart services are complex, integrating their provision in existing sales structures is a practical challenge [3].

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In academic literature, smart services are of growing interest in the last years. The smart service transition from theoretical design to practical implementation is addressed in several publications. Most of the publications emphasize the importance of considering customer's requirements as a critical success factor when implementing smart services. But several preconditions have to be fulfilled to be able to satisfy the needs of the customers and consequently, to implement smart services successfully. Although several publications present success factors for introducing smart services in an existing business environment, there is no systematic overview from a provider's perspective focusing the customer. To address this gap we proposed the following two research questions:

RQ1: What are critical success factors from a provider's perspective for introducing smart services that focus individual customer needs?

RQ2: How do the critical success factors named in academic literature agree with success factors relevant in practice?

To answer these research questions a systematic literature review was conducted based on Webster and Watson (2002) [4]. Using predefined search terms, we searched through different academic databases to identify relevant literature for smart service introduction. With basis on the identified literature, critical success factors for introducing smart services were worked out. Experts that were asked in interviews extended and evaluated the identified success factors.

The remainder of this article is structured as follows: In the second chapter the selected research proceeding is explained. Smart services are defined and existing literature in the field of introducing smart services is presented in chapter three. Experts to verify the results are consulted afterwards. The results are discussed and implications are presented systematically. The article concludes with limitations, approaches for further research and conclusions in the chapters four and five.

2 Research Design

Based on existing literature in the field of smart service implementation and expert interviews, the objective of this study was to identify critical success factors. The article is motivated by a growing interest in smart services, reflected in academic literature. Introducing smart services in an existing business environment is a real challenge in the field. However, there is no systematic overview of critical success factors in literature taking the provider's perspective. Such success factors support organizations to focus the customers and their needs in the smart service implementation process. Additionally, researchers gain knowledge regarding the smart service transition.

With the objective to get an overview of existing literature in the field of smart service introduction, we conducted a systematic literature review. According to Webster and Watson (2002) we searched in six different databases, including AISel, IEEEXplore, JSTOR, ScienceDirect, SpringerLink, and Taylor&Francis, using predefined search terms [4]. To reduce the number of hits, in the first step the results were limited to English articles. We also excluded whitepapers, book chapters and

other non-academic publications. A number of twelve articles were identified to be relevant by reading the titles and the abstracts. If we were not able to decide whether a publication is relevant for our topic, we took a look at the whole text. Both a forward and a backward search were conducted with basis on the identified articles. This led to two further articles that were included in our overview. Finally, we identified 14 articles concerning the introduction of smart services from a provider's perspective with focus on the customer.

The relevant literature was screened afterwards. Critical success factors for introducing smart services were worked out under the precondition that they are explained from a supplier's perspective. Critical success factors are understood as factors that are of particular importance for a successful smart service introduction and consequently, to remain competitive [5]. According to that definition, in this article an in literature named aspect is listed as a critical success factor if it is estimated to be necessary for a successful introduction. In total, nine different success factors were identified. Each publication was screened regarding the considered success factors. It was differentiated between partially considered factors, what means that they were named but not described in detail, and considered success factors, what means that they were discussed, analyzed or critically reviewed. They formed the basis for semi-structured interviews with twelve experts from eight different companies in the fields of IT, electronics, manufacturing and medical technology. All companies have in common that they plan to provide smart services and partially already offer digital services. From literature extracted critical success factors were both critically evaluated regarding their importance in practice and extended. It resulted in critical success factors that can be used as guidelines for the introduction of smart services, ensuring a focus on the customer. Figure 1 shows the research design that was used.

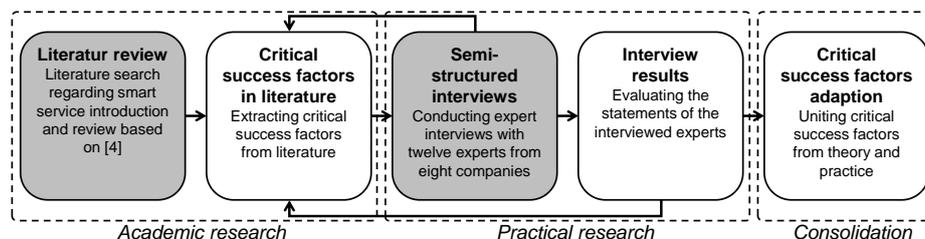


Figure 1. Research design

3 Critical Success Factors for Smart Service Introduction

Smart services are enabled through information and communication technology. The objective of smart services is to address customer-individual requirements [6]. This is realized through both interacting with the customer and data-collection in real-time [7]. In literature, this is called value co-creation. With the help of connected systems and machine intelligence [8], context information are used to offer services adjusted to the requirements of customers [9]. The information that is used concerns the

technology, the environment as well as the social context [10], [11]. Information from several sources is combined and forms the basis for data analyses. Results can be presented in dashboards or used to make suggestions proactively [12]. High dynamics [13] and the use of collaboration technology enables continuous communication and feedback which is also essential for smart services [14]. Allmendinger and Lombreglia (2005) conclude the most important characteristics of smart services [15]. Smart services are enabled through information. Context information, frequently collected in real-time, is used for analyses, e.g. using machine intelligence. Smart services enable to avoid unexpected events and thus create a new kind of value. In the present article, a provider is a company or organization that offers smart services to customers. The customer can be a business or private user [1]. The named aspects are taken as the basis for the following investigations.

3.1 Extracting Critical Success Factors from Literature

According to Priller et al. (2014), cyber security and the accompanying privacy (1) have a great share when introducing smart services [16]. Smart services require a large amount of data and information, partially in real-time. As this data may be sensitive, an effective security concept is inevitable. Demirkan et al. (2015) agree and state that both a security and privacy solution has to be designed before offering smart services [6]. Data and information form the basis for competitive advantages which is why security and privacy concerns are an important aspect for potential customers. In addition, legal bases (2) have to be considered in an early stage of introducing smart services [17], [18]. Referring to the large amount of data and information, transparency is necessary about the ownership and usage permissions. The influence of technology developments on legal issues has to be clarified [19].

Employee qualification (3) is another success factor for introducing smart services that is named in literature. Although the qualification of employees is always important when offering products or services to customers, the way how to train employees changed [20]. The age of digitalization is the reason for changing requirements on the employees of a company that plans to offer smart services and to support the introduction in the customer's company. Competencies are named in this context and summarize knowledge and skills that are necessary for successfully introducing smart services [21]. Smart services are very customer-centric which is why sales training is highlighted as important when talking about employee qualification [18]. This also helps to understand customer needs. Apart from employee's individual competencies the interplay with other employees from different departments (4) is named a success factor. The interplay of different capacities and experiences plays a role [22]. Nevertheless, Pétercsák et al. (2016) point out that the stakeholders have to be selected carefully [23]. It is necessary that they are willing to share their knowledge and to cooperate with the other team members. From a customer's perspective, it is helpful to have a clear contact that is responsible. According to Allmendinger and Lombreglia (2005) it is also important that the management participates (5) on the new developments [15]. Otherwise, the project of offering smart services fails because the provider is not assessed to be

innovative by potential customers. The management level is responsible for creating an innovation culture in companies because an innovative strategy has to be integrated in the overall corporate strategy [19]. Considering the customer needs (6) is the central aspect of successful smart services. This has also to be included in the smart service introduction phase [24]. The motivation why a customer wants to use a smart service has to be reflected in the offer. Klötzer and Pflaum (2017) share the same opinion and emphasize that additional customer value has to be created [21]. The customer is estimated to be more important than the technology [18]. Cooperation with the customers is suggested to successfully introduce smart service offerings. An advantage is that the lifecycle of a smart service (7) can better be understood in the specific application [24]. An integrated lifecycle model considering hybrid products and their services contributes to the usage of the value creation potential [25]. Investigating what kinds of activities a customer carries out enables to adapt a smart service. Requirements can be detected and the way the customer works can be supported [15]. It enables to identify what type of smart service is relevant for potential customers.

Table 1. Literature categorized by named critical success factors

<i>Author</i>	<i>1) Security and privacy</i>	<i>2) Legal basis</i>	<i>3) Employee Qualification</i>	<i>4) Interdisciplinary teams</i>	<i>5) Management involvement</i>	<i>6) Consideration of customer needs</i>	<i>7) Consideration of product lifecycle</i>	<i>8) IT infrastructure</i>	<i>9) Reference model use</i>
Allmendinger, Lombreglia 2005 [15]					●	●	●		
Baars, Ereth 2016 [26]	●		●					●	
Barile, Polese 2010 [19]		●			●	●			
Bullinger et al. 2015 [22]			●	○		●		●	●
Demirkan et al. 2015 [6]	●	●							○
Geum et al. 2016 [24]						●	●	●	
Klötzer, Pflaum 2017 [21]			●	○		●		●	
Lê Tuán et al. 2012 [27]	●							●	●
Lerch, Gotsch 2015 [20]			●					○	○
Lesjak et al. 2014 [28]	○			●					
Pétercsák 2016 [23]			●	●	●			●	
Priller et al. 2014 [16]	●	●							
Theorin et al. 2016 [17]		●						●	
West, Gaiardelli 2016 [18]		●	●		●	●	●		
	● Considered		○ Partially considered						

The compatibility of a new service with the IT infrastructure (8) has a substantial impact on successful implementation [22]. Baars and Ereth (2016) identify several challenges that arise out of introducing smart services [26]. A major point is the data integration. It has to be solved due to an appropriate IT infrastructure. Theorin et al. (2016) describe how an IT infrastructure can look like that is suitable for smart

services [17]. Modern hardware in form of large and high-speed storages are fundamental [26]. This does not only apply for the smart service provider but also for the customer. Looking at the customer's location, an appropriate IT infrastructure is necessary to use the full potential of a smart service. In academic publications, reference models (9) are developed that help to orientate when starting to offer smart services. Bullinger et al. (2015) recommend using a suitable reference model when introducing smart services [22]. This is underpinned by the fact that the introduction of smart services requires comprehensive planning [6]. Table 1 summarizes the identified literature in conjunction with the considered critical success factors.

3.2 Comparing Theoretically Developed Success Factors with Practice

To compare the theoretical results with practical impact twelve experts were asked regarding critical success factors for smart services (Table 2). The experts agreed that smart services enable a better communication with the customer (B, G2). In contrast to selling products, the offer of services means both continuous contact and revenues. Products often have already been exploited which is why services in connection with products are a logical expansion for providers (A2). Additionally, it is a consistent move to stay competitive (D). Although smart services are increasingly in focus, already existing internal processes should be used and adapted (D). Processes carried out by the customer also should be considered when introducing a new smart service. This is especially important for large companies because they often lack agility (F). As a major challenge an expert named the fact that smart services are often location-independent (G1). This means that the services can be performed all over the world.

Table 2. Interviewed experts and their settings

<i>Company/participant</i>	<i>Company characteristics/department</i>
Company A	IT sector, IT service provider
Participant A1	Demand management
Participant A2	Innovation
Company B	IT sector, process optimization
Participant B	Programming
Company C	Electronics industry, communication systems supplier
Participant C1	Consulting management
Participant C2	Technical service
Company D	Manufacturing industry, component producer
Participant D	Technical service
Company E	Manufacturing industry, automotive supplier
Participant E1	Planning
Participant E2	Planning and programming
Company F	Manufacturing industry, automotive and industrial supplier
Participant F	Strategy management
Company G	Manufacturing industry, automation systems producer
Participant G1	Innovation
Participant G2	Product management, technical service
Company H	Medical technology industry, medical instruments producer
Participant H	Programming and development

Security and privacy concerns (1) are considered as important factor when starting to offer smart services because new requirements result. Machines are more and more connected with external networks such as the internet (A1). But not only machines and further technical devices have to be considered when talking about security and privacy but also the people that work in the new environment. Regularly executed trainings are named by an expert as possible solution to increase sensitivity for the topic (E2). The possible future customer has to have confidence in the service provider (A2). This applies especially for smart services as sensible data are exchanged and processed. But experts emphasized that complying security and privacy standards do not add value for a customer (F, G1). Nevertheless, these are prerequisites to be able to offer smart services successfully. Similar considerations apply to legal bases (2). As the whole field of using large amounts of data from the customer is a fast and dynamic development, there is often a lack of clarity regarding the legal framework (E1). An expert highlighted that projects in the field of smart services have to be checked constantly regarding legal compatibility (E2). In contrast, some experts held the opinion that the legal basis is a purely matter of definition which is why it does not take up much time (A1, H). However, legal bases have to be unambiguous, internally in the provider's and customer's company as well as between the involved partners.

The impact of employee qualification (3) regarding the success of introducing smart services is estimated as comparatively low by the experts (A1, C1, C2, G1). Some of them explained that it is important to sensitize for the topic of smart services (F, G2) and to ensure that all employees have the same understanding of it (D). The handling and maintenance of the systems that are necessary for the offer of smart services is carried out by people (E2). Therefore, by some interviewees it is considered important and decisive for the success that employees are integrated in the introduction process of smart services (E2, G1). As processes are partially changing, trainings may help to reduce uncertainties and to increase efficiency (A1). Another tendency is that the systems will be much simpler. Several experts highlighted that smart services have to be structured in such a way that comprehensive trainings are not necessary (F, G1). Only selected employees should go through trainings, such as employees from the sales department. An expert from the electronics industry was of the opinion that capacity often is much more important than qualification (C2). That is why trainings are not always the path to success. However, it has to be ensured that the customer of a smart service has a reliable partner to contact who supports smart service concerns.

By all experts, smart services are estimated as highly complex, which is why decisions of individual employees are assessed to be inefficient (E1). Interdisciplinary teams (4) help to make decisions that satisfy various departments. The process of introducing smart services is estimated to take much longer if there would not be this type of teams (G1). An interviewee of the manufacturing industry pointed out that interdisciplinary teams are not limited to the company but the potential customers should also be involved when making decisions (G2). As smart services always have to be individualized, a cooperation simplifies the introduction in the customer's company. The importance of involving the management (5) is perceived very

differently by the experts. Smart services are a new development direction that has to be exemplified by the management (D). But the project management (10) participates on the operating business and is generally seen as more important (E2). The importance of management involvement depends on the company structure (A2). The consideration of customer needs (6) is regarded the top-ranked critical success factor. Smart services always have to be developed for the customer which is why they play the decisive role in a successful introduction. All already named success factors are connected with the customer. Individually added value has to be created which is why a development away from the customer has necessarily to be avoided (C2). An expert stated that customer requirements are more important than a fast introduction of a smart service (F). In the ideal case the expectations are more than met (C1, C2).

Service lifecycles (7) are usually shorter than lifecycles of classic hardware. Nevertheless, it is recommended to consider the lifecycles of hardware and services together because profitability often results from combining products and services (G2). An expert notes that this only applies for smart services related to products (A1). Completely new smart services have a diverging lifecycle which is why existing lifecycles cannot be applied. In addition, the lifecycle of a smart service is highly externally controlled (C2). Individual circumstances in the company of the customer should be considered. Additionally, already implemented services should be taken into account when introducing a new smart service (D). This facilitates the introduction and the use of the smart service because duplication of work is avoided.

Availability plays a decisive role in the context of smart services. In this, a suitable IT infrastructure (8) forms the basis for a smart service (E2). Although this is a prerequisite for offering a smart service, it is not a top-ranked success factor. Regarding the IT infrastructure there were two diverging opinions. On the one hand it was stated that smart services should follow the existing infrastructure (E2). On the other hand it was explained the other way round, the IT should always follow the solution (A1, F). Which way is selected by the companies often depends on the level of investment. This applies both for the service provider and the customer.

When introducing a smart service for the first time, reference models (9) might be useful. An expert agreed and complemented that it highly depends on the model. The better a reference model goes with the company's settings the better it can be used (F, G1). Therefore, very high-level models offer low added value (E1, E2, H). Smart services are dynamic which is why it is difficult to use static reference models (A1). Requirements are changing continuously and therefore, feedback of the customers is estimated to be much more valuable (F).

Clearly defined requirements not only from the customers but also from internal stakeholders (11) were named by two experts as an additional success factor because they help to avoid department specific problems (E1, E2). A flexible project management is required and named as essential for a successful introduction of smart services (H). As main reason, the dynamic environment of that kind of service was named. Due to the dynamic environment, both in the provider's and the customer's company, a quick adaptation to changes is vitally important. It is decisive how well it succeeds to implement new smart services in existing business models (12) and the corporate strategy (A2, D). In this, it is important to develop a suitable pricing

strategy (A1). The use of smart services usually is linked to additional costs for the customer. This has to be considered in the pricing. The price of such a service has to be justified, otherwise the smart service would not be requested by customers. It is stated that it can only be avoided through a consistent orientation on the requirements of the customers. An exemplary solution for pricing is to reduce the costs of the product related to the smart service.

Table 3. Critical success factors for introducing smart services

<i>Critical success factors</i>	<i>Description</i>
1) Security and privacy	Data that is used for smart services is sensitive. An effective security and privacy concept is inevitable.
2) Legal basis	Transparency is necessary regarding the ownership and usage permissions of data and information.
3) Employee qualification	It is important to sensitize for the topic of smart services. Trainings help to understand customer needs and to improve smart service introduction.
4) Interdisciplinary teams	Smart services are highly complex what requires interdisciplinary teams, both internally and between provider and customer.
5) Management involvement	An innovation culture can only be created when the management exemplifies it. The importance of the management depends on the company structure.
6) Consideration of customer needs	Smart services always have to be developed for the customer. Only services that satisfy customer needs can be successful.
7) Consideration of product lifecycle	The lifecycle of smart services is partially different to those of products. This should be taken into account.
8) IT infrastructure	An appropriate IT infrastructure is a precondition for smart services because data has to be collected, transmitted, processed and analyzed.
9) Reference model use	Reference models that are suitable to the setting of a company are useful as orientation.
10) Project management	A flexible project management enables a quick adaption to the changing environment and contributes to implement smart services in an existing strategy.
11) Consideration of internal requirements	Requirements of internal stakeholders are useful as milestones and should be considered to avoid internal inconsistencies.
12) Business model	New smart services have to be embedded in business models. A suitable pricing strategy has to be worked out as well as suitable cooperation partners.
13) Consideration of the market	Cultural aspects have to be considered when introducing a worldwide applicable smart service. The market positioning is important.
14) Standardization	Smart services should be standardized to be able to adapt them easily and to avoid complications with partners and customers.

The consideration of the market (13) is emphasized to be highly important by several experts from practice (A2, C1, C2, D, G2). On the one hand, cultural aspects do not have to be neglected when introducing a worldwide applicable smart service (G2). The openness towards new kinds of products and services differs across countries and continents. This influences the best way to access a new market. Additionally, aspects such as the suitable marketing strategy derive from this. On the other hand, the positioning on the market is important (G1). A high market presence can enable to win new customers and to establish standards. Standardization (14) is named important to reduce efforts regarding the introduction of smart services (A2, C1, D, G2). The introduction process is shorter and less complicated, especially regarding technical aspects. The consideration of the market and related aspects is proved the most important success factor that is not in focus in literature. Table 3 summarizes all critical success factors from a provider's perspective for introducing smart services that were worked out both from literature and from expert interviews.

4 Limitations and Further Research

Academic literature concerning a smart service implementation from a provider's perspective formed the basis of the investigations. Relevant literature was found through using English search terms. Search terms in other languages were not taken into account. All search terms included the term "smart service". Other terms that might be used as synonyms were not considered. Including search terms in other languages and considering synonyms for smart services might have led to further results. With twelve interviews in eight different companies, the number of experts consulted is not necessarily representative. Asking further experts regarding critical success factors for introducing smart services might lead to additional aspects. This applies especially to experts from not yet considered industries. As smart services are still under development, in most of the companies there are not yet best practice approaches for introducing a new smart service that focuses the customer and how to include them in an existing business environment. Furthermore, it is not evaluated yet what kind of customer is predestined for smart service usage. Finally, it cannot be said whether the critical success factors will change in the future.

5 Conclusions

Critical success factors from a provider's perspective for introducing smart services were worked out. The objective was to provide guidelines that help to provide smart services that satisfy the customer. A smart service can only be introduced successfully when it is implemented in the interests of the customers. A number of 14 publications formed the basis for identifying critical success factors from literature. Nine critical success factors were found and analyzed. Theoretically extracted factors were compared to requirements from the field. Twelve interviews were conducted with experts from eight different companies. The experts came from the IT sector, from the electronics and manufacturing industry and from the medical technology industry. On

the one hand, already extracted success factors were evaluated. It resulted in the finding that all critical success factors extracted from literature in average are estimated to be relevant, apart from the reference model use. On the other hand, the success factors were extended to be practically relevant. A success factor that was named several times to be very important and that was not focused in literature was the consideration of the market. As smart services are often provided worldwide, cultural aspects and market dynamics have to be taken into account. With focus on the potential customers, providers who want to offer smart services have to choose carefully how to access a new market and how to obtain a high market presence. As both a theoretical and practical perspective were taken the elaborated critical success factors are useful as guidelines for companies that want to start offering smart services to customers.

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