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Article

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1 | 2020 **SCHWERPUNKT** A new perspective beyond technology • What drives smart product adoption? • Akzeptanz von Smart Speakern • Veränderungen in der Customer-Experience • Cashierless Stores • Capturing Value • John Deere Case Study **KOMMENTAR** Die Grundfrage bleibt: Warum verhält sich der Mensch, wie er sich verhält? **SPEKTRUM** Face-Recognition

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Marketing im Internet der Dinge



What Drives B-to-B Customers' Adoption of Smart Product-Service Systems?

The Internet of Things is associated with a high revenue potential. However, its implementation and associated smart product-service offerings are still in the early stages. This article identifies the key adoption drivers and barriers on the part of B-to-B customers and highlights the strong influence of external pressure on the adoption of smart product-service systems.

Eva Kropp, Prof. Dr. Dirk Totzek

Increasing digitization and the Internet of Things (IoT) are creating new opportunities for manufacturing firms to combine products and services. In particular, manufacturing firms can offer new data-based services like predictive maintenance (Porter & Heppelmann, 2014). These so-called “smart” product-service systems (PSS) are associated with great opportunities in terms of revenue growth, long-term competitive advantages, and corporate success (Lerch & Gotsch, 2015). However, studies by consulting firms show that smart PSS are not yet in widespread use. A study by Roland Berger (Feldmann, Herweg, Rau, & Synek, 2017), for example, shows that only 40% of the surveyed firms in the German machinery industry offer predictive maintenance, whereas the majority are still in the process of developing offerings or are as yet inactive. A study by McKinsey and Company (2017) about the adoption of IoT technologies across industries concludes that most firms are still in a proof-of-concept phase. One reason is that customers are often reluctant to adopt these new systems. This is particularly due to the fact that the systems’ “smartness” raises new customer adoption barriers such as security and privacy concerns (Paluch & Wunderlich, 2016).

It is thus important to determine how B-to-B suppliers should deal with these and other major customer acceptance barriers. In this context, we address the following two research questions: (1) What are the specific customer acceptance drivers for smart PSS? (2) What are the specific customer acceptance barriers for smart PSS?

These questions were addressed with two studies with industry experts. In the first study, 262 industry experts identified the most relevant customer adoption drivers and barriers for smart PSS. In a second study, we surveyed 160 potential customers of smart PSS in order to determine how the most important factors shape the likelihood of customer adoption in practice. Our results help suppliers to better assess their customers’ concerns regarding smart PSS. Managers can use this information to improve their own offerings and to adapt their sales strategy to increase B-to-B customers’ adoption of smart PSS.

Understanding Smart Product-Service Systems

There is an ongoing transformation of manufacturing firms from product-oriented firms into service providers (Vandermerwe & Rada, 1988). In this respect, manufacturing firms offer more and more bundles of products and services, so-called PSS, to create higher value for their customers (Baines et al., 2007). A traditional example in the industrial context is a machine bundled with a maintenance contract.

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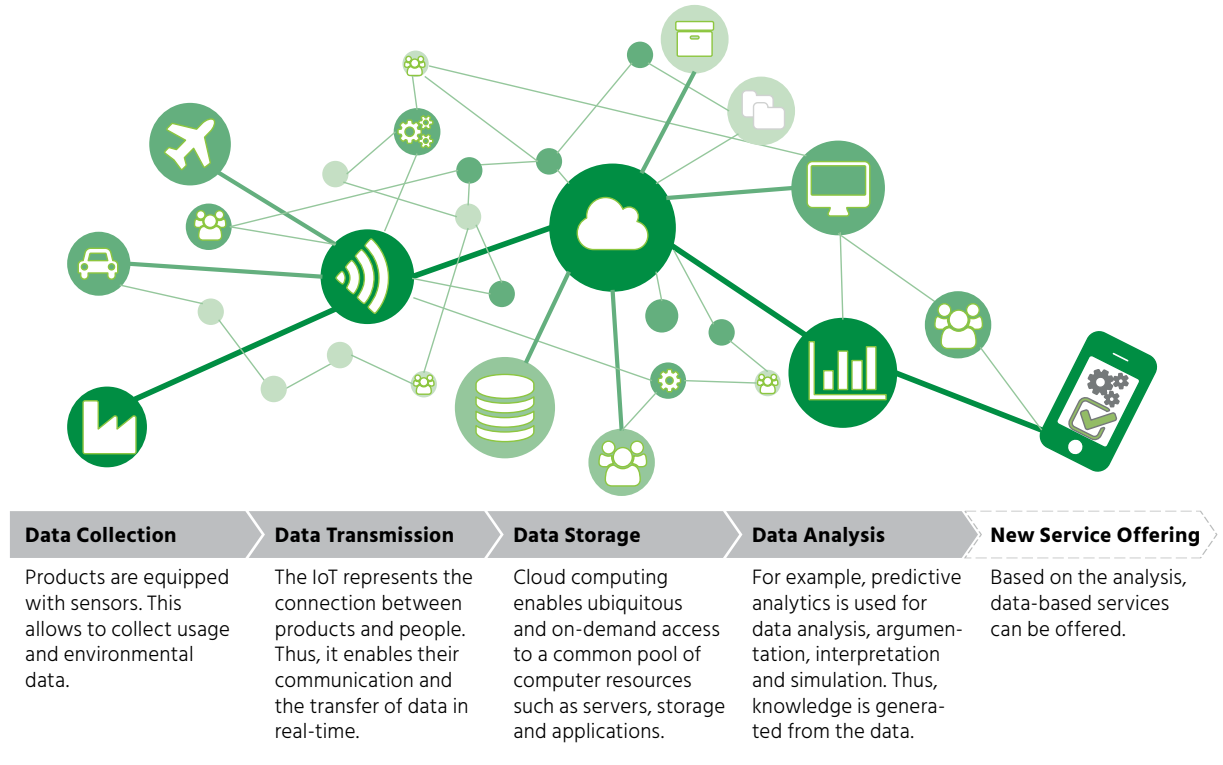
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The IoT is a crucial enabler technology for the ongoing service transformation of manufacturing firms (Ardolino, Saccani, Gaiardelli, & Rapaccini, 2016). The IoT creates new opportunities to offer new and “smart” services based on the collection, transmission, storage, and analysis of data (see figure 1). To collect data, products are equipped with additional components, particularly sensors measuring different parameters, such as temperature, localization, vibration, and noise, during the entire product life cycle (Lerch & Gotsch, 2015). This data can be transmitted in real time and is often stored and analyzed using cloud computing and special algorithms (Ardolino et al., 2017).

Well-known examples of smart PSS in business practice are offerings such as machines (product) along with predictive maintenance (data-based service) or entire fleet management solutions (see figure 2). In the energy sector, for example, General Electric offers and sells the predictive solution “PowerUp” to increase the efficiency of wind turbines and to prevent downtime. “PowerUp” is considered a success for General Electric in terms of revenue increase, as it was expected to yield \$ 1.1 billion in 2014 and \$ 5 billion by 2017. In addition, the smart PSS was beneficial to customers as well since the pilot fleet of 1,400 wind turbines contracted under “PowerUp” yielded an overall increase of 4% in power output at 60% of its turbines (Buvat, Bisht, & Subrahmanyam, 2015). Besides predictive maintenance, other applications for smart PSS such as fleet management solutions are gaining in importance. For example, John Deere, a pioneer in the agriculture sector, offers the telematics solution “JD-

Fig. 1: Data Processing and Data-based Services as Central Characteristics of Smart PSS



Source: Based on Ardolino et al. 2017.

Link” to optimize the fleet management of forestry machines. More precisely, machines are connected to mobile devices allowing operators and users to remotely keep track of their fleet and monitor work processes.

Drivers of Customer Adoption of Smart Product-Service Systems

To identify the key drivers of customer adoption of smart PSS, we conducted two studies. As a starting point, we identified potential adoption factors by a structured literature analysis. We analyzed prior work drawing on different adoption models and theories. The literature discusses adoption at different levels. Some theories consider adoption at the individual level. These adoption factors are mostly product-related and refer to the perceived characteristics or the usability of the innovation (Diffusion of Innovations Theory, Rogers, 2003; Technology Acceptance Model, Davis, 1989). This includes, for example, the benefits and costs of an inno-

vation. An example of such benefits is provided by certain aspects of a product addressing customer needs and pain points. Other theories consider adoption at the organizational level. For example, stakeholders in the business environment may exert external pressure on a firm’s adoption behavior. Firms often adapt to the expectations of their social environment in order to gain legitimacy (Institutional Theory, DiMaggio & Powell, 1983). Finally, an integrated perspective combines product-related and external factors with organizational factors (Technology–Organization–Environment Framework, Tornatzky & Fleischer, 1990). These include, for example, the firm’s innovativeness and resources.

Study 1

In Study 1, 262 German managers from various industries and positions evaluated the relevance of the adoption factors identified in our literature analysis for smart PSS. Most experts came from the transportation and logistics (14%), auto-

motive (13%), machinery (12%), construction (11%), or energy (8%) and chemicals (8%) sectors. The experts held positions in marketing and sales (28%), production and logistics (18%), research and development (15%), or in general management (12%). The majority had more than five years of professional experience (80%).

We conducted an online survey in collaboration with a German online panel provider. In the first part, the experts should directly indicate which factors they consider important for a customer's decision to adopt a smart PSS. The experts could name up to five factors in total that would affect customer adoption positively or negatively.

Results of open-ended questions

We evaluated the responses using a text analysis software. In total, the experts named 829 factors which might influence a customer firm's decision to use smart PSS. We synthesized them and identified 20 adoption barriers and 33 adoption drivers. Figure 3 illustrates these barriers and drivers in two separate word clouds. Both word clouds show a clear picture: the most frequently mentioned factors directly relate to the characteristics of smart PSS.

On the one hand, the experts highlighted security and privacy concerns as central risk factors. More specifically, 58 participants named security concerns, which is thus the most frequently mentioned adoption factor. Closely related to security concerns are privacy risks (23 mentions). Another customer adoption barrier is the customer's uncertainty about the reliability and functionality of smart PSS (20 mentions). Furthermore, 33 participants highlighted their reservations regarding the (real-time) data transmission and 13 participants referred to the connectivity of the product as a major adoption barrier. Our results show that our experts particularly highlighted adoption barriers related to the essential role of data (collection, transmission, storage, and analysis).

On the other hand, the experts also highlighted customer benefits associated with smart PSS. The most important ad-

option driver is the ability of smart PSS to solve problems quickly (52 mentions). This is closely linked to the ability to offer new data-based services in general (20 mentions) and the provision of predictive maintenance (43 mentions), which represents the most prominent application of smart PSS. Further, the experts highlighted cost savings (39 mentions) and ease of use (32 mentions) as key adoption drivers.

In summary, our experts primarily named factors directly related to the smart PSS and its characteristics. Further, the experts focused more on adoption drivers and benefits of smart PSS (33 benefits vs. 20 barriers). However, while there are clear benefits of smart PSS driving customer adoption, there are also important adoption risks and barriers.

Results of a card sorting task

In the second part of the expert survey, we employed a card sorting task. In addition to characteristics of smart PSS (e.g., usability), we also included potential organizational adoption factors (e.g., organizational readiness) and external adoption factors (e.g., competitive pressure). In total, we had derived 24 adoption factors based on our literature analysis. In the card sorting task, we sequentially showed all these factors to our experts. The experts had to classify each factor as important or unimportant for the adoption of smart PSS.

We analyzed how often our experts classified each one of these factors as important. Figure 4 shows the top five adoption drivers and top five adoption barriers of smart PSS. For our experts, ease of use was the most important adoption driver. We used ease of use as a reference point and scaled it to 100% in terms of frequency. The experts rated the compatibility of smart PSS with the needs of potential adopters and their relative advantage almost as important as ease of use. In addition, the readiness of the customer firm in terms of resources and capabilities was considered crucial. In line with the results to our open-ended questions, the experts generally assessed adoption barriers as somewhat less important. However, the experts clearly highlighted privacy and

Fig. 2: Predictive and Fleet Management Solutions as Examples for Smart PSS

Predictive Solutions		Fleet Management Solutions	
Offering	PowerUp: Turbines equipped with sensors to capture performance data (product); based on analyzed data General Electric improves machine efficiency and prevents downtime (data-based service).	Offering	JDLink Fleet management: Forestry machines (product) and operators are connected via telematics solution; this enables the remote access to machine's location, utilization and diagnostic data to enable the optimal use of the machine (data-based service).
Customer	E.ON	Customer	Operators and users of forestry machines

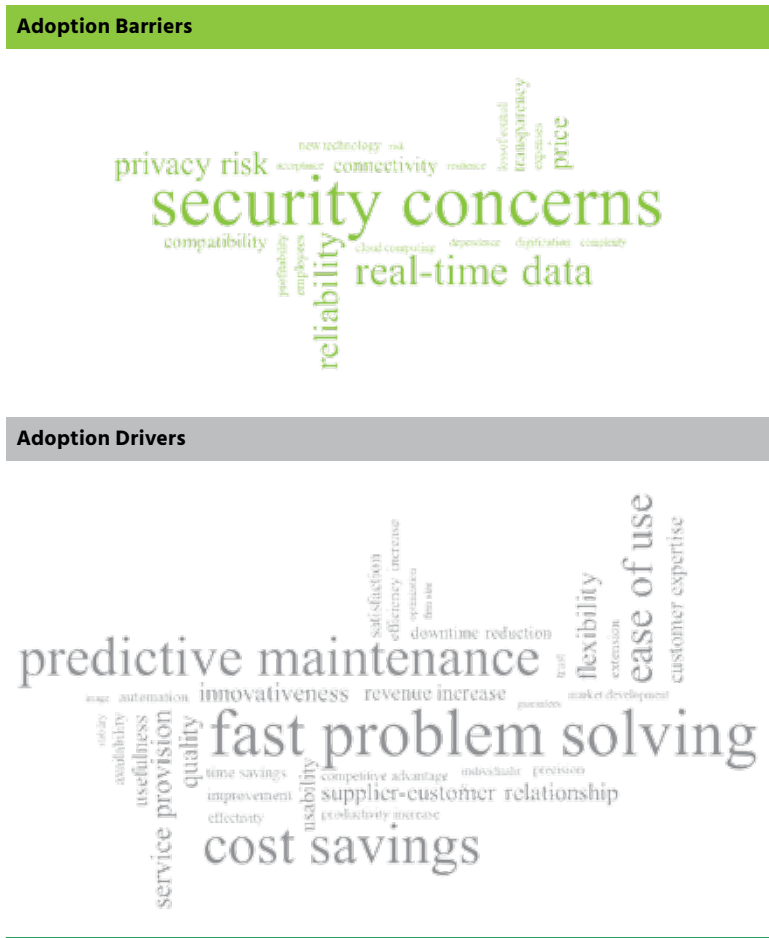
Source: Authors' own illustration.

Management Summary

To sell smart product-service systems successfully, it is crucial for B-to-B suppliers to gain acceptance of these systems among their customers. This article shows that benefits of smart product-service systems such as fast problem solving and cost savings are key adoption drivers, whereas security and privacy concerns are key adoption barriers. Moreover, the article indicates that external pressures by competitors, suppliers, or customers also have a strong influence on the adoption of smart product-service systems.

Fig. 3: Results of an Expert Survey: Risks and Benefits as Prevailing Adoption Topics

The size of the words reflects the number of mentions.



Source: Authors' own illustration.

security concerns. Additionally, they addressed financial and functional risks of the smart PSS.

In summary, the results show that product-related factors are particularly important for customer adoption, followed by firm-level factors. In contrast, external factors such as the external pressure exerted by stakeholders appear to be relatively unimportant based on the expert judgments.

Study 2

We conducted a customer study to examine which adoption factors actually influence the likelihood of adoption. For this purpose, we aggregated the most important adoption drivers and barriers based on the results of Study 1. With regard to product-related factors, we included the relative advantage of smart PSS compared to traditional systems. This factor subsumes ease of use and compatibility. As most important product-related barrier, we included privacy risk, which encompasses the perceived danger of disclosing confidential and sensitive data and fears of industrial espionage. In terms of firm-level factors, we included the customer firm's (i.e., organizational) innovativeness, which represents the openness to new ideas as an aspect of a firm's culture.

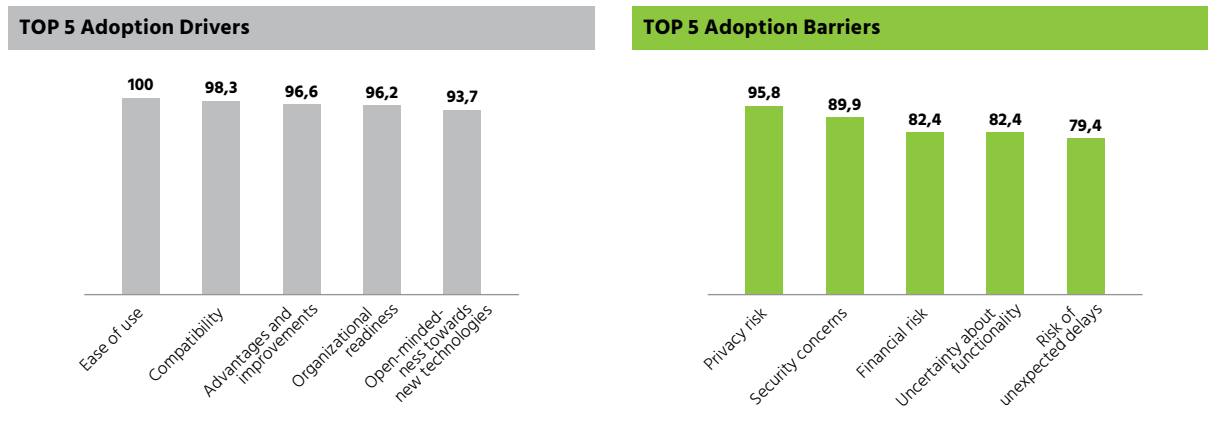
We targeted German firms for which smart PSS might be generally relevant solutions and surveyed B-to-B firms that are currently thinking about the adoption of smart PSS. We asked the customer firm representatives about a specific smart PSS in their industry that their firm is planning to adopt. In total, 160 managers participated in the online survey. Most of them were from the energy (37.5%) and agricultural sectors (35%), other sectors were automotive (11.3%) and machinery (5%).

Regression analysis was used to test what adoption factors influence customers' likelihood of adopting smart PSS. Overall, our results confirm that relative advantage and privacy risks are key adoption factors. Relative advantage ($\beta = .19, p < .05$) has a significant positive effect and privacy risk ($\beta = -.16, p < .05$) has a significant negative effect on the customer's likelihood of adopting this specific smart PSS. Additionally, there is a positive effect of organizational innovativeness ($\beta = .26, p < .01$) on customer adoption.

Quite surprisingly, however, this model explains customers' adoption likelihood to a limited extent only ($R^2 = .17$). Therefore, other adoption factors, which are not as obvious, may explain more of the customers' likelihood of adopting smart PSS. In particular, we did not take into account the influence of external factors that might also shape customer adoption. The experts in Study 1 classified these factors as less important. However, this may be due to the fact that they

Fig. 4: Results of an Expert Survey: The Top Five Adoption Drivers and Top Five Adoption Barriers

The most frequently mentioned adoption factor ease of use is scaled to 100%.



Source: Authors' own illustration.

are more implicit and not part of the experts' mental models on customer adoption.

In a second regression model, we thus included external pressures on customer adoption, which may be exerted by stakeholders in the business environment (e.g., competitive pressure, political pressure, or collective expectations of stakeholders). The results indicate that relative advantage ($\beta = .17, p < .05$), privacy risk ($\beta = -.16, p < .05$) and organizational innovativeness ($\beta = .17, p < .05$) still have a high impact on the customer's likelihood of adoption. However, external pressures actually had the strongest impact ($\beta = .32, p < .01$) and the explanatory power of the model increased significantly ($R^2 = .27$).

In summary, the results of our customer survey show that the adoption factors our experts explicitly mentioned had a weaker influence on the customers' likelihood of adoption than the factors they considered less important or even unimportant. In particular, external pressures by competitors, suppliers, or customers are important implicit drivers of customer adoption of smart PSS.

Summary and Implications

The ability of smart PSS to collect, transmit, store, and analyze data creates new opportunities and challenges in many B-to-B industries. One of the biggest challenges for B-to-B suppliers is to offer and sell smart PSS successfully. Therefore, it is crucial for them to foster acceptance of these sys-

tems among their customers. Current business developments and relatively low adoption rates show that this is more difficult than expected. For B-to-B suppliers, it is thus important to understand the determinants of customer acceptance to improve their offerings and to adapt their sales strategy.

We show that practitioners perceive product-related factors as most important adoption drivers. Obviously, managers should emphasize the benefits of smart PSS in their communication and sales efforts. Especially new data-based services, increased profits, and reduced costs make these systems attractive for customers. Managers should not only focus on selling benefits, however, but also consider adopti-

Main Propositions

1. The Internet of Things is on everyone's lips, but its acceptance by B-to-B customers is still in the early stages.
2. Product-service systems are getting smart and offer new opportunities and challenges at the same time.
3. B-to-B customer acceptance is determined by the benefits and risks of using smart product-service systems.
4. External pressure as an implicit driver has a great influence on the adoption of smart product-service systems.


on barriers arising from the processing of data. Data security is a particularly sensitive issue for customers. Thus, it is important to address these customer concerns appropriately.

Apart from benefits and risks, organizational factors are important for increasing the customers' likelihood of adoption. Not every customer firm has sufficient resources and capabilities to implement smart PSS. In this respect, innovative firms are more likely to adopt smart PSS. Therefore, suppliers should adapt their marketing activities accordingly and target firms that are open and ready for innovations.

From a research perspective, our studies generally show how digitization changes existing product-service offerings. In this respect, we have enriched the existing adoption litera-

ture by identifying the most important drivers and barriers for smart PSS adoption. In particular, we highlight that external pressures are crucial but often overlooked adoption factors.

More specifically, we show that external adoption factors have so far been widely underestimated by many practitioners. In our first study, almost no expert regarded them as important customer adoption factors. However, B-to-B suppliers must be aware that organizational adoption decisions are not only based on an evaluation of risks and benefits. External pressure can affect customer firms in such a way that they are more willing to adopt smart PSS. For example, the expectations of suppliers and customers can exert this kind of pressure as soon as smart PSS are widespread. Therefore, B-to-B firms may use pull strategies by approaching the customer's customers to engender support for the adoption of smart PSS.

It is still unclear, however, whether external pressure always has the same effect on customer adoption or whether the outcome depends on certain context factors. Our results are an important starting point for future research when it comes to identifying the conditions under which suppliers can effectively use external pressure to influence customer adoption of smart PSS. Another interesting question is how adoption drivers and barriers vary across different industries. Since our two studies are derived from different industries, they cannot be used for a detailed comparison. Moreover, we used data from Germany only, which limits the generalizability of the results across countries. Future research might assess country- and market-specific drivers of the customer adoption of smart PSS. 

Lessons Learned

1. Adapt your communication and sales efforts: B-to-B suppliers should emphasize the benefits of smart product-service systems, but also address customer concerns which arise from the processing of data.
2. Target the right firms: B-to-B suppliers should target firms that are open and ready for innovations. To boost adoption they should use pull strategies by approaching their customer's customers.
3. Keep external pressure in mind: Managers should be aware that external pressures strongly influence their own decision-making process, in particular with regard to highly innovative offers.

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