

A Systematic Literature Review on Product-Service Systems Classifications and Types

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Abstract: This paper primarily deals with a systematic literature review on Product-Service Systems (PSS) classifications. The initial question was, how can information and profound knowledge regarding the classification of PSS be acquired? A very extensive scientific and systematic literature research containing 125 works was carried out for this purpose. In doing so, we concentrated on the central question of how PSS can be classified. Here we have found out which PSS classifications are widely used in literature and how they differentiate. As a result, the five identified PSS classifications are described and compared. Derived from this, we have analysed the various PSS types from the PSS classification and made a comparison of these types for the first time in the literature. As a result, similarities and differences between the authors are presented and examined. This research will enable us to go one step ahead and develop a framework that can be applied to classify companies or certain business models in regard to PSS. Thus, a scientific contribution could be made to the field of PSS classification.

1 INTRODUCTION TO PSS

Today's business environment is increasingly characterized by unpredictability - manufacturing companies like AEG, Grundig, Kodak and Nokia are disappearing from the market or are no longer dominant although these companies have distinguished themselves for many years through excellent product and process innovativeness (Mahler et al. 2013; Gassmann et al. 2017).

On the one hand, manufacturing companies operate in global markets and therefore compete directly in terms of quality, technology and costs. This results in strong international pricing pressure, stagnating sales and profit margins, as well as the shrinking possibility of differentiation in technology and quality due to the increasing equivalence of competing products from other global players (Meier und Uhlmann 2012, 2017; Kölmel et al. 2017). These challenges are addressed at the level of product and process innovations. On the other hand, established companies are challenged by business model innovations. Driven and empowered by digitalization, new disruptive business models emerge that replace existing value chains in large parts or even completely. These business model innovations generally affect established providers in an unprepared manner and may lead to complete market displacement,

as in the case of the above-mentioned company examples. For this reason, the development of innovative business models is a basic prerequisite for long-term competitiveness in the business context (Vogel-Heuser und Lindemann 2014; Meier und Uhlmann 2012).

A possible and at the same time promising approach to this challenge are the so-called product-service systems (PSS). These are understood to be an offered solution that contains at least one service element in addition to a product (Wong 2004). These can be seen as a holistic innovation strategy that serves the product, process and business model innovation levels simultaneously. Companies are undergoing a change: they are no longer limiting themselves to the development and sale of products, instead they are supplementing their portfolio with the provision of a system of products and services tailored to specific customer requirements (Manzini und Vezzoli 2003; Kowalkowski et al. 2017; Baines et al. 2007; Richter et al. 2018; Wise und Baumgartner 1999).

This paradigm shift counteracts the changed demand behaviour through flexibly adaptable product and service components on the customer side. The focus is on customer benefit, a sustained customer relationship is established, resulting in a long-term competitive advantage (Vogel-Heuser und Lindemann 2014; Meier und Uhlmann 2012). The strategy aimed

at supplementing products with associated services is called servitisation. This can lead to a constant rise in sales (Beuren et al. 2013; Aurich et al. 2006).

Today, there are many different forms of PSS in practice across different branches. These are multi-layered, not easily understandable and especially not categorisable. The aim of this paper is consequently to identify and compare the different classifications and types of PSS in order to provide the reader with an overview of the existing literature.

The present paper is structured as follows: After the necessity of the topic is pointed out in the current section, systematic literature research with focus on PSS classifications is carried out in the second section. The third section outlines the five identified PSS classifications. The results of the research and the different classifications are the subject of the fourth section. The fifth section provides a conclusion of the work and concludes with an outlook on future research.

2 METHODOLOGY OF THE LITERATURE RESEARCH

The current state of research on PSS is presented by a literature review as a result of the structured literature research according to Brocke et al. (Brocke et al. 2009). The literature research consists of the five phases: Definition of review scope, Conceptualisation of Topic, Literature Search, Literature Analysis and Synthesis and Research Agenda. The following subsections describe the phases in more detail. phases in more detail.

2.1 Definition of Review Scope

The scope of the investigation was determined at the start of the literature research. The taxonomy of Cooper (Cooper 1988) was applied. as provided in the methodology of Brocke et al. (Brocke et al. 2009). The focal points of the individual categories (1) Focus, (2) Goal, (3) Organisation, (4) Perspective, (5) Audience and (6) Coverage are marked in grey in Table 1. The focus was on the identification of existing PSS theories as

well as on the identification of research approaches to PSS classification. The second characteristic dealt with the goal of research, which focuses on the critical examination of existing PSS classification patterns. The next characteristic describes the organisation of the research, which was carried out conceptually. The literature was examined and presented for different concepts. The literature research was performed from a neutral perspective, which was not evaluated beforehand. The fifth characteristic describes the audience, which has, on the one hand, the scientific character and, on the other hand, a benefit for practice. Moreover, a selective literature search was carried out, based on a complete literature search, but only selected works are dealt with in depth.

2.2 Conceptualisation of the Topic

In a first step, existing knowledge such as keywords, approaches and concepts were generated and documented in line with the topic using the creativity methods of brainstorming. The result is a quantitative and disorganized collection of topic specific terms. In the next step, a concept mapping was carried out, whereby the contents from the brainstorming were brought into a logical context.

2.3 Literature Search

The third phase of literature research deals with the identification and evaluation of relevant literature.

Initially, the search was focused on journal and conference papers. Professional books were also an elementary part of the search. The Academic Journal Guide (AJG) Ranking 2015 was used to identify high-quality journals (Association of Business Schools 2015). The wide-ranging PSS topic was addressed with a cross-divisional search of economic, technical and strategic aspects. Journals of category 4 or 4* of the AJG2015 evaluation, which are among the most renowned journals of the respective research departments, were considered. The AJG was used to identify 16 relevant journals, which were then systematically searched according to the following pattern:

Table 1: Applied taxonomy of Cooper (Cooper 1988).

Characteristics	Categories			
(1) Focus	Research outcomes	Research methods	Theories	Applications
(2) Goal	Integration	Criticism		Central Issues
(3) Organisation	Historical	Conceptual		Methodological
(4) Perspective	Neutral representation		Espousal of position	
(5) Audience	Specialised scholars	General scholars	Practitioners	General public
(6) Coverage	Exhaustive	Exhaustive and selective	Representative	Central/pivotal

The following search parameters and the search process were standardised and applied to all literature search operations for the purpose of comparability. The study period ran from January 1995 to January 2018. The publications were searched by using the English search string *Product-Service System* or *PSS* respectively in combination with *classification* or *type* in the title, keywords and abstract. The search results were sorted by relevance and the first 100 results were analysed. The search results were evaluated by a subsequent review of the abstracts in regard to the PSS topic focusing on PSS classification. Once a publication meets these criteria it has been considered for literature analysis. The literature search of the 16 identified AJG journals generated 114 results, of which 13 articles were relevant and taken into account for the literature search.

The previous research work in the field of renowned journals led to the identification of four suitable online databases in which a keyword search was performed. These include Springer, ScienceDirect, Emerald Insight and Web of Science. The search parameters and the search process were adopted from the standardised journal search, expanded by the concepts from the previous subsection and searched in English and German form in the various databases: First PSS as a fixed term, then in conjunction with the search terms *Classification*, *Synonym*, *Concept*, *Relevance* and *Definition*. Due to the overlaps from the previous search in the area of journals as well as within the four databases, only new literature was considered. The database search enabled the identification of 80 further publications consisting of journal and conference papers as well as textbooks.

In addition, the literature search was extended by a forward and backward search. The search was carried out using ResearchGate, a kind of social network for scientists, and Google Scholar, a specially designed search engine for scientific documents. This made it possible to increase the literature search by another 32 to a total of 125 relevant publications.

2.4 Literature Analysis and Synthesis

This section has two key points: First, the 125 identified works from the literature search are examined in detail, then the identified concepts from the second subsection are compared with the identified works from the previous section of the literature search.

The literature search carried out resulted in 125 literature works in the field of PSS. The majority of the works (97) were published in English, 28 in German. Most works were found in the ScienceDirect da-

tabase (36), followed by Springer (27), Emerald Insight (21), Google Scholar (18), ResearchGate (14) and Web of Science (9). From the year 1999 to the year 2017, at least one work was consistently considered. With 25 included publications from the year 2017, the relevance of the topic is also highlighted. In quantitative terms, the works of the author Baines are most frequently represented with five publications. The authors Lightfoot, Nüttgens and Thomas are each represented with four publications. In the category of media types, 79 of the 125 works are papers in journals, 14 in conference papers, 25 in textbooks (monographs), four in individual sections in textbooks (anthologies) and three in doctoral theses. The publications were examined in detail by publishing company as well as by journal. Eleven monographs and anthologies were published by Springer Gabler Verlag, eight others by Springer Verlag and five publications by Springer Vieweg Verlag. The remaining five works were published by other publishers. In the area of journals, 19 papers were published by the well-known Journal of Cleaner Production and 13 papers by the International Journal of Operations & Production Management. The remaining publications are distributed among other journals.

Afterwards the method of the Concept-Matrix, as proposed by Brocke et al. (Brocke et al. 2009), was used. With this in mind, the contents of the researched literature were analysed in detail and assigned to the various PSS concepts in the concept matrix. This extremely comprehensive overview was of fundamental importance for the further procedure, as important works could be identified in this way and different aspects of the concepts could be made visible.

2.5 Research Agenda

The literature search concludes with the formulation of the research agenda. No literature could be identified that provided comprehensive coverage of the manifold PSS concepts in adequate depth. Rather, the concepts are only discussed individually or very superficially. In addition, different concepts of several authors have been identified in the field of classification. In comparison to other concepts such as synonyms or relevance, this topic is still underrepresented. This reveals a research gap which will be investigated in this paper. According to the findings mentioned above, the literature search leads to further potential research directions, which will be dealt with in depth in the following research questions:

- RQ1: Which PSS classifications exist in the literature?

- RQ2: What do the PSS classifications have in common and what are their differences?
- RQ3: Derived from RQ2 what PSS types exist and how are they described?
- RQ4: Is it possible to summarize and compare the PSS types on the basis of criteria?

3 PSS-CLASSIFICATIONS

In the following, the five identified PSS classifications of the respective authors are presented in chronological order. Each classification contains at least one PSS type, these types are also described in detail in this section.

3.1 Classification According to Mont

Mont is one of the pioneers of the PSS research area. Her work *Clarifying the concept of product-service system* (Mont 2002), published in 2002, is the foundation for further scientific work in the field of PSS. One of the main components of her above mentioned work is the classification of PSS. As can be seen in Figure 1, the classification comprises five elements from which the first PSS types are derived.

A PSS consists of products, services or a variable combination of both elements. Services at the time of sale include, for example, personal consultation in the salesroom, financing offers for the customer, as well as the product's explanation to the customer. There are two concepts for the use of the products: On the one hand, there is the (a) user oriented concept, in which the customer derives the product benefit from the product. On the other hand, there is the (b) result oriented concept, in which the product benefit is made possible for the customer by the product through the provider. Maintenance services ensure that the product is maintained and that its functions are properly

retained. In addition, it is possible to enhance the product through function upgrades and thus extend the product life cycle. The fifth element contains services that are based on the concept of sustainability and close the product-material lifecycle. These include the take-back of products, the re-use of functional parts or recycling if re-use is not possible (Mont 2002).

With a focus on the classification of PSS types, the third element of Monts classification is particularly interesting. For the very first time, the two types of use oriented and result oriented PSS are mentioned there. In the context of her research, Mont does not give any more detailed definitions of the two types mentioned. However, it sets the basis for the PSS types, which will be developed in the following years.

The classification of Tukker from the year 2004 presented in the following already draws on the preparatory work of Mont from the year 2002.

3.2 Classification According to Tukker

In 2004, the Dutch researcher Tukker published the paper *Eight Types Of Product-Service System: Eight Ways To Sustainability? Experiences From Sus-ProNet* (Tukker 2004) based on Mont's research. The contained typology (see Figure 2) is a special form of classification, which represents at the same time the most common classification in the context of PSS research (van Ostaeyen et al. 2013; Dimache und Roche 2013). Tukker sets PSS between pure product and pure service. In between, Tukker defines three PSS types. In addition to the use and result oriented PSS already mentioned by Mont, Tukker introduces the product oriented PSS type for the first time. In addition, Tukker divides the three PSS types into a total of eight different sub-types, which he describes as eight archetypal models. The use oriented PSS type is divided into the three archetypal models product

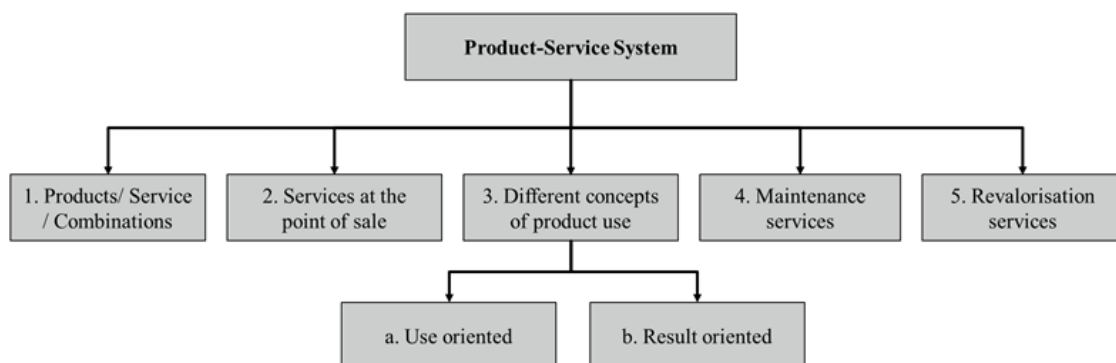


Figure 1: PSS classification according to Mont (Mont, 2002).

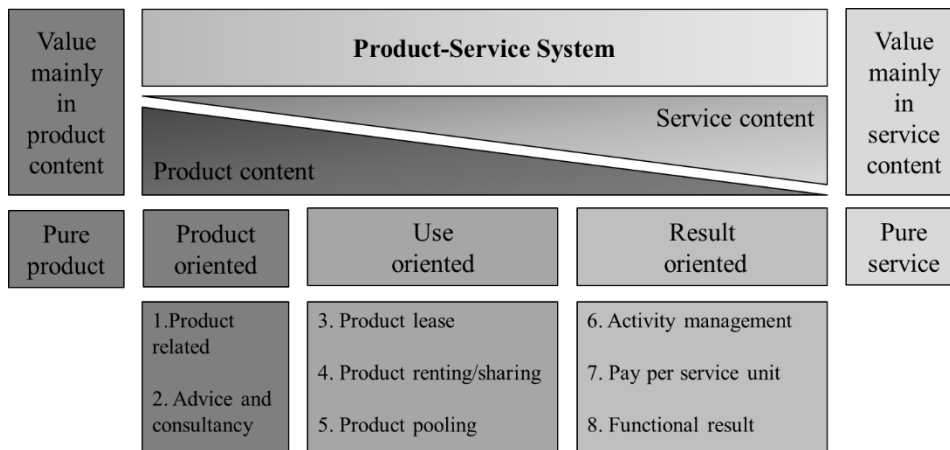


Figure 2: PSS classification according to Tukker (Tukker 2004).

lease, product renting/sharing and product pooling, per service unit and functional result. Here it has to be mentioned that the product share from the product oriented to the use oriented up to the result oriented PSS types successively decreases and the service share increases in return (Tukker 2004). In the following, the three PSS types and the eight archetypal models are described.

The product-oriented PSS concentrates on the sale of products, which are additionally extended by individual services. Two archetypal models can be identified (Tukker 2004):

Product related services: In addition to the sale of a product, the customer is offered additional services that are tailored to the product and serve to ensure usage. These services range from maintenance contracts to the delivery of consumables to the return of the product at the end of its life cycle (Tukker 2004).

Advice and consultancy services: In addition to the sale of the product, the supplier offers consulting services to enable the customer the most efficient use of the product. Examples of consulting services in this regard are activities to improve the organisational structure or to optimise logistical processes (Tukker 2004).

According to Tukker, the product still plays an important role in the benefit-oriented PSS, but the business model is no longer focused exclusively on selling the product, but on the use that can be generated from the product. The supplier retains the ownership rights and provides the product to different customer segments in different offering forms. Altogether three archetypes can be identified (Tukker 2004):

Product lease: During use, the product remains in the ownership of the provider, who is also in charge of maintenance, servicing, repair and inspection. The customer is charged a fee for using the product on a regular basis. In return, the customer receives an unlimited and

individual product usage opportunity (Tukker 2004).

Product renting/sharing: Similar to the lease offer, the product remains in the ownership of the provider during use, who is also accountable for maintenance, servicing, repair and inspection. In the same manner, the customer pays a fee to use the product. The main difference to leasing is the scope of use. In this case the use is limited in terms of time and not restricted to a single individual. In other words, different users may use the same product at different times (Tukker 2004).

Product pooling: This fifth archetype has identical characteristics to the rental and sharing offer. The only difference is the time of use. The product can be used equally and at the same time by different numbers of users (Tukker 2004).

With result-oriented PSS, the customer is not offered a product for sale, but is offered a certain result as a service, which the provider must fulfil. The provider is responsible for the manner in which the service is fulfilled. Three archetypes can be determined (Tukker 2004):

Activity management/outsourcing: In this context, parts of activities are outsourced to third parties. In order to ensure a certain quality, performance indicators are defined, which in many cases are contractual components. This type can be found, for example, in the cleaning or catering industry (Tukker 2004).

Pay per service unit: The product is the base that the customer does not have to buy. Together with the customer, a predefined performance is described, which must be paid for according to the extent of use. The provider is responsible for all activities required to provide the performance. Charging is based on the service unit being used (Tukker 2004).

Functional results: The provider commits to delivering a predefined result to the customer. The focus is exclusively on achieving the result. How the provider

achieves the result plays a minor role (Tukker 2004).

As mentioned at the beginning, the classification according to Tukker is widely acknowledged in the literature and thus represents the reference point for further classifications in the field of PSS research (Dimache und Roche 2013).

3.3 Classification According to Meier et al.

Almost simultaneously with Tukker, the German researchers Meier et al. develop a similar understanding of PSS. Their work *Hybride Leistungsbündel* (Meier et al. 2005) appeared in 2005. Meier et al. describe a further classification approach. This is aimed exclusively at the B2B market and captures the perspective of a manufacturing company. Meier et al. define a total of three PSS types that can be grouped between a pure product and a pure service (Meier et al. 2005). These characteristics can be found in Figure 3.

In the following, the three PSS types according to Meier et al. are presented. In addition to use oriented and result oriented PSS, which have already been mentioned by Mont and described by Tukker, Meier et al. coin the term function oriented PSS (Meier et al. 2005; Mont 2002; Tukker 2004):

Function oriented PSS: In addition to the sale of a product, services are also provided in order to guarantee the functionality of the product over a certain period of time. A meaningful example is a maintenance contract for a production machine (Meier et al. 2005).

Use/Availability oriented PSS: This type guarantees the customer a certain availability of the product. The provider is involved in the customer's business processes for the first time and thus partially bears the production risk. This includes all processes, such as maintenance or repair, in order to guarantee availability. In a further publication, Meier et al. rename this PSS type as availability oriented PSS (Meier et al. 2005; Meier und Uhlmann 2012).

Results oriented PSS: The supplier commits to the customer to assume production responsibility for a

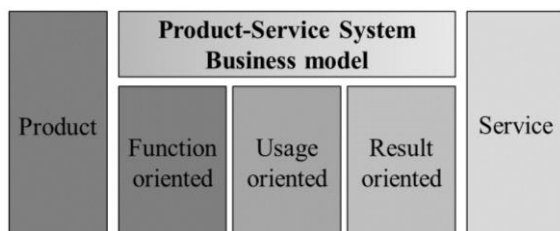


Figure 3: PSS classification according to Meier et al., (2005).

certain result. Ultimately, only fault-free parts are invoiced between the supplier and the customer (Meier et al. 2005).

The classification approach of Meier et al. has parallels to Tukker's concept. A major difference, however, is the focus on the B2B market.

3.4 Classification According to Neely

Three years after Meier et al. Neely, a renowned researcher from Cambridge University, published the work *Exploring the financial consequences of the servitization of manufacturing* (Neely 2008). This primarily focuses on the empirical investigation of the practical implementation of the servitisation concept of manufacturing companies by means of practice-oriented company data. In this context, Neely provides a classification of PSS. The three already known PSS types product, use and result oriented PSS are discussed and two new PSS types are added Neely thus elicits five different PSS types. in a comprehensive way, which are illustrated in Figure 4 (Neely 2008).

The five PSS types are located between pure product and pure service and are presented one after the other as shown in the diagram.

Product-oriented PSS: The customer is the owner of the product by purchasing the product. In addition, services are offered that are specifically tailored to the product. This includes, for example, design and development services, installation and maintenance services as well as material procurement services. Compared to integration oriented PSS, product oriented PSS means the product is supplemented by all services that contribute to the use of the product (Neely 2008).

Service oriented PSS: As in the previous case, the customer owns the product by purchasing it. A characteristic feature of this PSS type is the inherent service component contained in each product. This means that value-adding additional services are included as an integral part of the performance offer. Neely cites the two examples of health monitoring systems and intelligent vehicle health management. Compared to product oriented PSS, the service oriented PSS type includes the integrated combination of product and service for the first time (Neely 2008).

Integration oriented PSS: Product acquisition grants the customer ownership of the product. In addition to the product, services with vertical integration are offered. Consequently, the services offered are not directly related to the product, which makes it possible to distinguish them from product oriented PSS. Examples are sales and distribution strategies,

financial or consulting services and logistics services (Neely 2008).

Use oriented PSS: This PSS type has already been described by Tukker. The focus is increasingly on the use generated by the product. As a result, the provider usually retains ownership of the product and only sells the use of the product to the customer through various forms of offering such as rental, pooling or lease offers (Neely 2008).

Results oriented PSS: The product is increasingly being replaced by a service. In this context, no product is sold to the customer, but a certain result is offered as a service, which the provider must fulfil. When the result is achieved, the customer pays a fixed monetary amount in advance (Neely 2008).

Neely's research builds on Tukker's classification and supplements it with two further PSS types that enable a more specific differentiation from product-related PSS (in the sense of close to pure products).

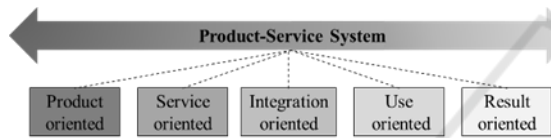


Figure 4: PSS classification according to Neely (2008).

3.5 Classification According to Gassmann et al.

As already argued in the introduction, PSS can ultimately be seen as a special form of a business model. For this reason, identified literature in the area of business model innovation that has interfaces with PSS should be considered. One name that was found during the research in this context is Gassmann. As Professor of Innovation Management at the renowned University of St. Gallen and Chairman of the Institute of Technology Management, Gassmann is mainly focused on empirical research of business models. In 2013, together with his colleagues Frankenberger and Csik, he first published the work *The Business Model Navigator: 55 Models That Will Revolutionise Your Business* (Gassmann et al. 2013). Meanwhile published in its second edition, Gassmann et al. contains 55 existing business model models that classify about 90 percent of all new business models, including PSS business models. This paper intends to describe these business models and assign these to existing PSS classifications. In contrast to Osterwalder and Pigneur (Osterwalder und Pigneur 2010), Gassmann et al. describe a business model in four instead of nine dimensions. These are visualised in the following Figure 5 (Gassmann et al. 2017).

The four dimensions of Gassmann et al. essentially contain the same contents as those of Osterwalder and Pigneur and are only briefly explained:

Who are our target customers? The customer is the focus of every business model, therefore the offering company has to identify the relevant customer segments (Gassmann et al. 2017).

What do we offer the customer? This dimension describes the promise of benefits and values that is offered to the customer to meet his needs (Gassmann et al. 2017).

How do we create value proposition? This includes all processes and activities that a company must carry out in order to fulfil its promise of benefits and values (Gassmann et al. 2017).

How is the revenue created? The fourth dimension deals with financial aspects such as the cost structure or turnover (Gassmann et al. 2017).

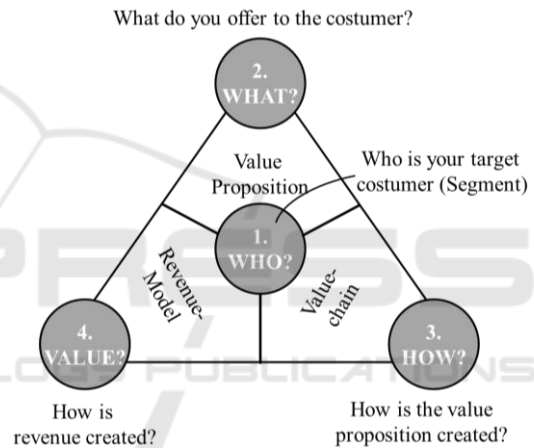


Figure 5: Business model classification according to Gassmann et al., (2013).

The 55 identified business model patterns of the St. Gallen Business Model Navigator are based on the concretisation of the above questions. Each business model pattern has specific characteristics with respect to the four questions. Several types can be identified in the field of PSS business models:

Business model pattern 20 – Guaranteed Availability: The customer does not obtain any property rights through the purchase of the product, instead receives a guaranteed availability and thus the use of the product. This minimizes downtime costs, as these are covered by the supplier through replacement equipment, as well as repair and maintenance services. By paying a fixed fee to the provider, the customer receives all services necessary for the availability of the product. This pattern has parallels to Tukker's archetype product lease (Gassmann et al. 2017).

Business model pattern 35 – Pay per use: This pattern is defined in analogy to Tukker's archetype Pay per service unit. According to this, the customer is only charged for the effective use of a product, i.e. the actually consumed service units. This principle ensures a high level of cost transparency for both the customer and the provider. (Gassmann et al. 2017).

Business model pattern 38 – Performance-based contracting: This pattern is a result-oriented pattern. The customer does not pay for ownership of the product, but on the basis of a service measured by a specific result. The supplier receives a fixed monetary amount and in return the supplier bears all cost items such as operating, maintenance and repair costs of the product. In contrast to pattern 35 above, the number of product uses for the manufacture of a service unit is not crucial. Achieving the pre-agreed result is the ultimate objective. A characteristic of this pattern are so-called operator models, in which the product and the operator personnel are to be assigned to the supplier. Similarly, this pattern can be assigned to Tukker's archetype functional results (Gassmann et al. 2017).

Business model pattern 40 – Rent instead of buy: Instead of purchasing products, the focus here is on product benefits through rental concepts. Due to a more short-term rental price, the customer can gain access to products for which acquisition costs could not be covered. Compared to product acquisition, the provider can access greater sales potential. In terms of ownership rights, this model is comparable to model 35, as only temporary ownership is assured. If the parallel to Tukker is drawn, this design corresponds to the archetype product renting/ sharing offer. (Gassmann et al. 2017).

Business model pattern 47 – Solution provider: The supplier provides a customer-specific total solution consisting of product and service. Services include, for example, consulting services or the provision of consumables and spare parts. Tukker's archetype outsourcing comes close to this pattern (Gassmann et al. 2017).

4 RESULTS

This section presents the results of literature research on PSS classifications. The findings are presented in two subsections. First, a condensed presentation and classification of the individual classification approaches and their characteristics is given. This is followed by the main part of the results, which represents the consolidation of the PSS types. These are derived from the respective classifications and are placed in a logical context.

4.1 Comparison of the Classification Models

The Swedish researcher Mont was the first person who published a scientific paper on PSS classification in 2002. She focused on a broad approach, representing PSS concepts rather than PSS types to be considered separately. Moreover, she first mentions the two PSS types use oriented and result oriented, but does not specify them. Two years later the Dutch researcher Tukker wrote a paper which classifies PSS between pure product and pure service for the first time. At the same time he describes three PSS types, the two known types of Mont are extended by the product oriented type. In addition, he subdivides his three PSS types by eight so-called archetypes, which allow a more detailed description. After a short time the German researchers of Meier et al. publish a paper which deals with a further PSS classification. The special characteristic, the PSS classification is specifically designed for the B2B market. In this context, they also introduced the function oriented type. In a later publication in 2012, he renamed the type use oriented to availability oriented and redefines it. In 2008, the British researcher Neely published an empirical study focusing on the implementation of servitisation in manufacturing companies. He also presents a PSS classification based on numerous practical examples from industry. In addition to the three known PSS types, he introduces the service-oriented and integration-oriented PSS types. Since PSS can also be seen as a special form of a business model, the publication of Gassmann et al. in 2013 is to be brought into connection. Five of the 55 business model patterns by Gassmann et al. show strong parallels to five archetypes by Tukker. In summary, the PSS classification has continuously been developed from theory and aligned with practice. Several points of view (holistic, B2B market) have been taken into account and various PSS types have been derived. These are the subject of the following section.

4.2 Consolidation of the PSS Types

This subsection contains a consolidation of the PSS types used in the literature, which have also been extended to include the business model patterns from section 3.5. The previous PSS classification approaches are consolidated in Figure 6 and provide an overview of the PSS classification types in literature. This clearly illustrates the relationship between the PSS types and Gassmann's business model patterns. Between pure product and pure service, these business model patterns tend to be characterized by a high share of service.

In addition to the consolidation of PSS a further classification between pure product and pure service is carried out. This tabular representation contains a generally valid definition, a meaningful example, as well as the corresponding source of the individual PSS types. The elements listed above are displayed in Table 2. This table summarizes for the first time all PSS types commonly used in the literature and provides the reader with a general overview.

The differentiation and separation of the individual PSS types appears complex, for this reason a further tabular illustration should help. This section is completed by a comparison of the introduced PSS types listed and analysed below, taking various PSS

characteristics into account. The comparison is based on the following characteristics: Responsibility for application, affiliation of application employees, ownership, initiation of services, affiliation of service employees and revenue model (Leimeister 2015). The following

Table 3 is to be used for this purpose. The PSS type (4) use oriented has the following characteristics. The customer is responsible for the application and provides the corresponding application personnel. The provider has the rights of ownership, initiates services and provides the corresponding service personnel. Costs are charged for the period used.

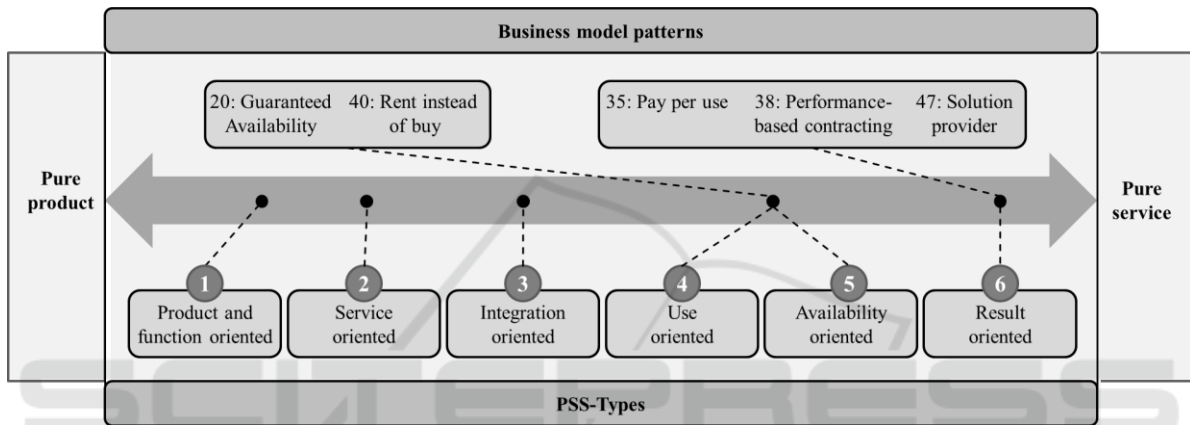


Figure 6: Consolidation of the identified PSS types from the literature.

Table 2: Comparison of the identified PSS types from the literature.

PSS-Type	(1) Product and function oriented	(2) Service oriented	(3) Integration oriented	(4) Use oriented	(5) Availability oriented	(6) Result oriented
Definition	In addition to the sale of products, services are offered which guarantee and extend the functionality of the product.	The sold product contains an inherent service component	In addition to the sale of the product, services are offered that enable vertical integration and do not represent a direct reference to the product.	Instead of selling the product, the use of the product is sold over a specific time period	The use of the product is also in the foreground, additionally an agreed availability of the product is guaranteed.	Instead of product acquisition, a specific result is offered as a service performance
Example	Maintenance contract for a machine, supply of consumables	Intelligent vehicle health management system	Consulting or logistics services that extend beyond product usage	Leasing or rental offer of a motor vehicle	Guaranteed availability of a machine	Provision of printing equipment, charging based on printed pages
Source	(Tukker 2004) (Meier et al. 2005) (Neely 2008)	(Neely 2008)	(Neely 2008)	(Mont 2002) (Tukker 2004) (Neely 2008)	(Meier und Uhlmann 2012) (Meier et al. 2005)	(Mont 2002) (Tukker 2004) (Meier et al. 2005) (Neely 2008)

Table 3: Characteristics of the identified PSS types.

PSS-Type	(1) Product and function oriented	(2) Service oriented	(3) Integration oriented	(4) Use oriented	(5) Availability oriented	(6) Result oriented
Responsibility for application	Customer	Customer	Customer	Customer	Customer	Provider
Affiliation of application employees	Customer	Customer	Customer	Customer	Customer	Provider
Ownership	Customer	Customer	Customer	Provider	Provider	Provider
Initiation of services	Customer	Customer	Provider	Provider	Provider	Provider
Affiliation of service employees	Customer	Customer/ Provider	Customer/ Provider	Provider	Provider	Provider
Revenue model	By order	By order	By order	By time period	By availability	By result

5 CONCLUSION AND OUTLOOK

In summary, we can state that we can answer the initial question (RQ1) comprehensively. Out of the extensive literature research 125 publications were identified and examined for classification, five different approaches could be identified. This article offers a clearly structured presentation of the individual PSS classifications (RQ2). The majority of authors classify PSS between pure product and pure service. One author primarily describes PSS concepts from theory, others base their work on empirical studies with practical relevance, while others refer the PSS classification exclusively to the B2B market. A generally accepted classification does not exist in this context, but Tukker's work is widely acknowledged (Haase et al. 2017; Dimache und Roche 2013). In other respects, parallels between PSS and business models have been demonstrated. Each of the listed classifications contains different PSS types (RQ3). In total, this research enabled us to determine six different forms of PSS types - described in the individual sections. In order to complement this, specific forms of business model patterns were examined for PSS content-related issues. We also found five business model patterns similar to PSS types. In a next step we succeeded in consolidating the identified PSS types (RQ4). In doing so, the five business model patterns mentioned were assigned to the PSS types. An overview table compares the six PSS types. The consolidated types are

described and illustrated by a practical example. The types are specified in a further table. There, the characteristics of the PSS types are described in detail using six variables. This table shows the similarities as well as the differences of the six mentioned PSS types. Overall, the four research questions presented at the entrance to this paper are answered.

This research, however, is subject to limitations. Another PSS classification was found based on a different approach. The PSS classification action by van Ostaeyen et al. (van Ostaeyen et al. 2013) uses a different procedure which does not allow a comparison with the approaches explained in this paper. Therefore, and for reasons of complexity, this approach is not the subject of this research. A further limitation is given by the lack of document access, as well as by the selection of the database and the search scope. Furthermore, the practicability of identified classifications can neither be confirmed nor criticized.

As already mentioned at the beginning, digitalisation will continue to progress. Therefore, further research activities in the field of digital business models or business models with PSS character is essential. The present work with the literature research on the subject of PSS is a precious foundation. The identified and described PSS types are very helpful to develop a general understanding of the multi-layered PSS topic. Changing the perspective from theory to practice, we then plan to develop a PSS classification framework that will enable us to analyse successful

companies on the basis of defined characteristics. In this way, success factors can be deduced. Moreover, the PSS classification identified in RQ1 but not investigated shall be examined (having RQ2 in mind).

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