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A simplified approach towards customer and provider value in PSS for small and medium-sized enterprises

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Abstract

While the provision of PSS is becoming more and more common, the transition toward a servitized business model is still critical. This is particularly true for small and medium-sized enterprises (SMEs) due to their limited internal resources and ability to define a servitization strategy. A crucial aspect during this transition is the identification of the right solutions to be implemented into the business, which must render high value capture for providers and create value for customers. While a literature review showed that a large number of evaluation methods are available, these are often complex and require substantial amounts of resources in order to be carried out. This paper aims at supporting companies in taking decisions during early design phases by proposing a method that combines two existing approaches: The EVA method and the ProVa method. The combined method simplifies the existing ones while aiming at an easy implementation and application in SMEs. It is composed of two steps, the first pursuing the identification of valuable concepts from both the customer and the provider perspective; the second pursuing an individual analysis of the components available for use in the concept selected. The application of the simplified method in a student-executed case of a startup company seeking to enter the distributed mobility market highlights the ease of use of the method in rendering valuable PSS concepts and in evaluating its specific components.

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Keywords: Provider value; Value assessment; Value evaluation; SME; Design method

1. Introduction

Following the trend of servitization, a large number of manufacturing companies is integrating its product offer with intangible services.

Although the provision of composite offers (Product-Service Systems, PSS) [1] and the associated business model are well known for the benefits they could bring to the provider (see [2]), "A critical aspect that the companies involved in the PSS strategy have to face is the need for a new range of capabilities to develop advanced services aligned to the market offer" [3]. In particular, the lack of structured design processes and the organizational differentiation required [4–6] can be highlighted. However, as many types of businesses increasingly move towards becoming PSS providers [7], handling the complexity of a lifecycle-focused design process incorporating products and services becomes a challenge [8].

While transitioning to PSS is challenging for industrial companies of large size [5,9], particularly small and medium sized enterprises (SMEs) are experiencing difficulties as they move towards becoming a servitized business. These originate, for example, in the very limited internal resources and SMEs' limited ability to define a servitization strategy [10,11].

One key task that academics, as well as practitioners, have to face in the shift towards PSS is identifying and balancing value for both customers and providers of PSS [12–14]. Particularly, since early stage design is a key step, assessing and weighing different solutions at that moment is important, as later changes become increasingly costly [15].

In order to systematically support companies in designing solutions rendering a high value capture for providers and value

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creation for customers, few methods have been introduced [16,17]. However, the complexity of these methods is considered unfitting for the needs of SMEs in particular for streamlined and simple methods (cf. [19]). Thus, this paper aims to meet the need for a systematic support during the early stage design of new PSS in SMEs enabling the assessment of the expected provider and customer value.

To this end, two existing methods are combined towards a comprehensive and simplified approach aimed at easy implementation and use. The methods used are the EVA (Engineering Value Assessment) method (first introduced in [16]) and the ProVa method (Provider Value Evaluation, first introduced in [17]). By way of this combined approach, SMEs have the opportunity to carry out rough assessments for different PSS concepts as they venture into offering integrated solutions of products and services. Ensuring ease of use and a low consumption of time, the approach introduces SME-based users to the value concept and lifecycle thinking, without requiring excessive investments of time or funds.

2. Background and research approach

In order to provide an overview of the state of the art with respect to the assessment of PSS concepts, a brief summary of literature on this topic is given. Thereafter, the research approach for this paper is laid out.

2.1. Brief discussion of literature on PSS concept assessment

While a plethora of companies is moving toward the innovative PSS business model, the academic research into the topic is also increasing. Methods, models and tools to guide manufacturing companies throughout the whole PSS design process are under development. However, there is still a relevant need to consider the individual lifecycle phases of the solution [19].

A major concern in literature is the lack of established methods and metrics to systematically assess and evaluate PSS concepts [15,20]. This plays a crucial role in the future success of a company's servitization path since it can either lead to successful PSS solution or to "either miss interesting business opportunities or bet on the wrong PSS in the wrong markets" [14]. Methods proposed to cope with this phase are few and the existing ones often fail to meet the industrial requirements that consider the ease of use of utmost relevance [18].

While some existing research is focused on the concept assessment phase, a specific method to carry out such a phase is not defined. [21,22] approach the problem from the standpoint of criteria to be adopted for the evaluation. They listed criteria for the evaluation of sustainable performance, but no method is suggested to exploit the potential of the proposed criteria.

Further, some structured methods were proposed in prior research. These works often share a strong emphasis on customer satisfaction while they tend to "pay little attention to producer and cost perspectives, which are also crucial in the process of PSS evaluation and operation" [23]. [24] developed a method to evaluate customer acceptability with respect to PSS solutions. In the same direction, [25] also worked on the assessment of engineering characteristics of a PSS from the viewpoint of customers. [26] studied the value of each solution with respect to the customer value and to the impact on his budget.

A further category of evaluation methods worth mentioning is the set of papers proposing methods for the detailed assessment as summarized in [27]. However, they are hardly applicable in an early design stage, because they are too data intensive to be applied in situations where information with regards to costs, markets, prices and processes is unstable. They refer, for example, to lifecycle assessment and lifecycle cost analysis [23,28].

Furthermore, [29] proposed a method based on lifecycle thinking that allows evaluating life cycle performance, life cycle cost, and life cycle environmental impact of a PSS for value assessment.

Overall, while a large number of approaches and methods are available to practitioners when moving into design and provision of PSS, they often are complex, requiring large amounts of knowledge, and investments of time and resources. Additionally, they often appear to not be tailored to industrial application and lack of both clarity and simplicity as described in [18].

To take a first step towards filling this gap, the following subsection describes a simple, easy to use and implement approach that integrates two methods to support SMEs moving towards PSS.

2.2. Research approach

To provide a comprehensive but sufficiently simple approach for SMEs to design PSS with a focus on both the value capture for the provider side as well as the value creation for customers, the following two methods are used as a basis:

The EVA method [16] offers a holistic approach for concept selection from the provider and customer point of view. A first and complete exemplification of the EVA method is reported in [16] and it shows all the steps required to perform a complete concepts evaluation. The ProVa method [17] allows the user to evaluate different tangible and intangible components (products and services) for high expected value capture for providers.

In integrating both methods in a reduced fashion, the goal is to provide a fast and simple approach to assess ideas and concepts very early on in the design process, as well as to estimate the expected value capture of the components intended to realize the concept selected. While the overall concepts assessment takes both customer and provider value into account, the preliminary evaluation of product- and service components is focused on provider value. The reason for this is that the concept assessment already point out valuable concepts from customer perspective and an understanding for the implications of becoming a PSS provider for the value capture often is much harder to achieve [30].

Figure 1 shows the research approach used in analyzing the two methods and in combining them in a simplified version. The new form aims to benefit PSS providers who lack resources to perform large scale analyses of PSS concepts and components.

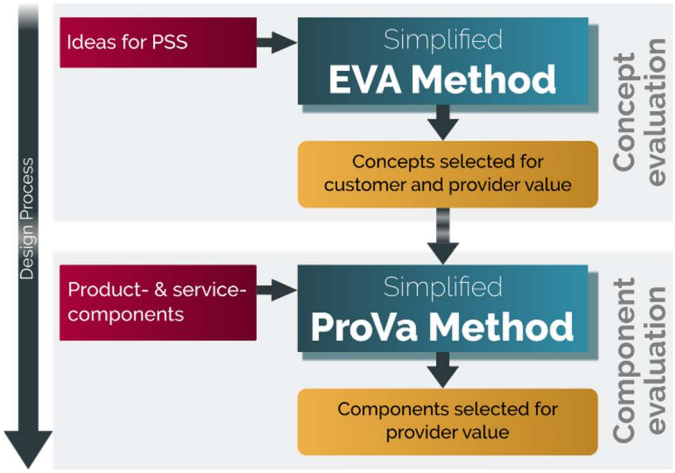

Fig. 1. Research approach and combination of EVA and ProVa methods.

3. Provider and customer value for SMEs in the conceptual design phase

3.1. Key characteristics of both methods

In order to arrive at a meaningful integration and simplification of the two methods, a brief analysis of key characteristics of both methods is performed. The result of this is shown in Table 1 in aggregated form.

The key aspects of the EVA method [16] are related to its capability of managing and merging the perspectives of the customer and the provider. It lays its foundation on the value co-creation process considering that a better engagement of customers and all stakeholders in the value creation and engineering process shall be pursued [31]. Furthermore, it proposes the adoption of the Importance-Performance Analysis (IPA) Matrix [32] to combine the two perspectives and to visualize the value associated with each solution by both the actors. This immediately shows if the identified PSS would represent a “win-win” solution or if either the customer or the provider do not gather suitable value for its “business”. An additional characteristic of the EVA method is the wide set of value criteria, identified through an extensive literature analysis [13], that are aimed at guiding the PSS evaluation. Finally, it is worth mentioning the qualitative trait of the EVA method. Although the PSS concepts are given a score, the approach is mainly qualitative and do not bring specific information about the investment costs or the possible revenue associated with each solution.

The ProVa method is focused on the assessment of product and service components to be used to realize a certain PSS concept. This assessment centers on the value to be captured by the provider through the lifecycle. The focus of this assessment is to broaden the view from a sole focus on production cost towards a lifecycle view of the benefits for PSS providers [17]. In addition, particularly with respect to smaller or new market actors, provisions have been taken to allow a basic assessment of the expected monetary value of the offering. Further, to take account of the uncertainty present when entering a new field of business such as PSS [33], an assessment-step for the data used and its quality is included in the initial version of ProVa.

Table 1. Comparison of key characteristics of the EVA and ProVa methods

EVA	ProVa
Considers both provider value and customer value	Considers analysis of specific components inside a PSS
Suggest a trade-off between CV and PV	Provide a quantitative analysis of profit
Wide set of value criteria for the evaluation	Analysis of data uncertainty
Mainly focused on qualitative analysis and on the service component of a PSS	Capable of assessing PSS "hard" component and infrastructure

3.2. Identifying synergies

As shown in Table 1, the two methods analyzed present some complementary features. The weaknesses of each method, either EVA or ProVa may be partially overcome through the feature of the other.

To this end, the EVA method could be used for a first screening of the available PSS concepts. If the number of available solutions is high, it could be costly and complex to collect specific data and info regarding all of the identified solutions. The qualitative approach of EVA could be used as a preliminary analysis to identify the solutions that could be worth further developments. Moreover, it brings insights about both customer and provider value ensuring that the solutions selected are appreciated by both of them. The concepts (e.g. a low number of two) selected through the EVA would be further analyzed in detail through ProVa. The latter would guide the assessment of value for the provider on a per-component basis as well as include a rough assessment of the attainable monetary value through the collection of more detailed data. The ProVa analysis of uncertainty would also support this phase making it more robust and giving a clearer view of the value of the assessment. Thus, ProVa can fulfill the role of the analysis of specific components and functionalities of the identified PSS.

3.3. The combined method

The combined method exploits the EVA and ProVa synergies.

The EVA method is firstly used to perform a first screening of the complete set of PSS solutions and to select few of them for further analysis. To this end, only the first step of the EVA method is included in the combined method.

The PSSs concepts to be evaluated and the two sets of criteria, as included in the EVA, are the input of the first step. Then, the Pugh approach (see [34]) is adopted for the comparison of new concepts with respect to an existing valuable concept, called baseline, defined by the provider. According to the Pugh method, the baseline scores “0” in all chosen evaluation criteria. All the other identified concepts are assigned a (+), (-) or (0) if they are, respectively, better, worse or equal to the baseline with respect to a single evaluation criterion. Each criterion is weighted by the engineering team, to stress (or not) its relevance. Once the matrix is completed,

concepts are given a total score by summing up all "+", "-" or "0" obtained. The Pugh assessment is repeated twice, firstly with a focus on the customer criteria, then on the provider ones.

Fig. 2. IPA matrix used to visualize assessment result (based on [32]).

Once the concepts obtain a score through the Pugh matrix, they are shown within the IPA matrix, as represented Figure 2. According to the positioning of the concepts into the matrix, it is then possible to identify what are the most valuable solutions that are worth further studies through the ProVa method.

After this first assessment is completed, the most important aspects of the ProVa method are carried out in simplified form. First, the components available for use in the concepts selected are evaluated individually against the provider value categories. A large number of categories with different foci have been presented in prior research [13] though a basic set as shown in [17] may be a sufficient starting point for the purposes of this evaluation and was used in the case study introduced below. A weighted score of 1-10 is used, while 0 is equivalent to "does not apply". Thereafter, a basic assessment of the uncertainty at the basis of the decisions made in the step before is performed. For this, three levels are available to be selected:

- (+) Well-Informed assessment. Previous experience with component, actual data exists that supports the assessment.
- (0) Informed assessment. Some prior knowledge.
- (–) Guesstimate. New component which the practitioner assessing is not acquainted with.

Lastly, an approximation of the expected monetary value from a certain component is performed, based on experience curve (services) and economies of scale (products) -effects, as described in detail in [17].

Eventually, this process renders a database of components based on the concepts selected, which have been evaluated for their value-capture for the provider and their monetary value, while making the user aware of the uncertainty involved.

Figure 3 gives the reader a direct overview of all steps of the combined method.

3.4. Case Study

In order to verify the approach, the method was applied through a student-executed case of a prospective startup company seeking to enter the distributed mobility market.

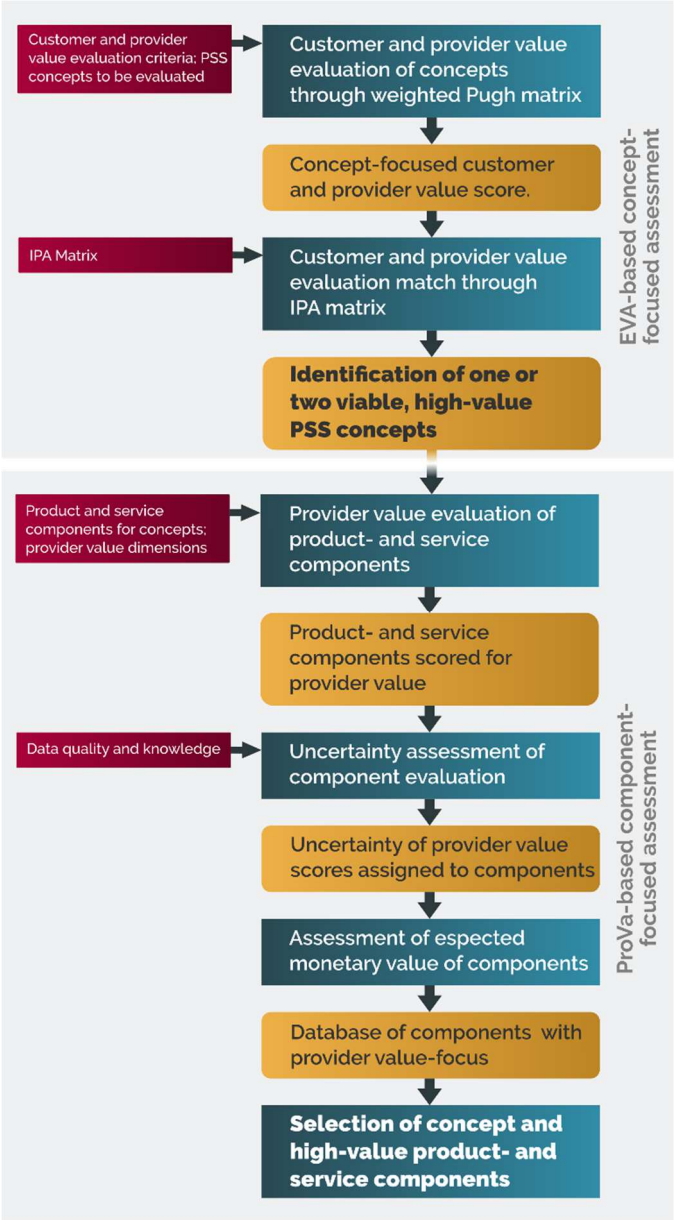

Fig. 3. The combined value-assessment method for SMEs.

This case was inspired by the StreetScooter, a successful electric commercial vehicle developed not by established car manufacturers, but a startup originating in academia. In the case, four concepts were considered with the aim of accelerating the changes in urban mobility:

1. E-Bike: Development of a highly efficient electric bicycle.
2. Bettery: Development of a standardized swappable battery for electric vehicles as well as a station network.
3. Car sharing platform: Development of a car sharing platform for private electric vehicles.
4. E-Car with platform: Similar to 3, but with an own, tailor made vehicle to facilitate efficient use.

The different concepts were evaluated for provider and customer value as described in Section 3.3 above. Figure 4 shows the outcome of the assessment of the four concepts.

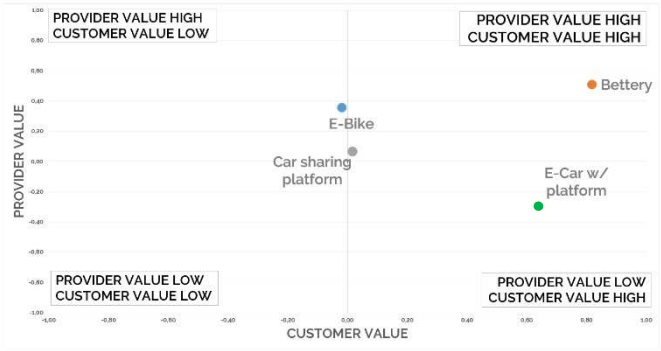

Fig. 4. Result of IPA matrix for selection of PSS concepts for value.

Immediately, it became clear that neither the car sharing platform nor the e-bike provides a meaningful departure from the status quo and other offers already on the market. Further, the tailor-made e-car with a sharing platform promised high customer value but would prove a substantial challenge to implement, rendering low provider value. Particularly the impact of the expected environmental performance led to the case team moving forward with *Bettery*, a novel battery swapping concept. This concept is centered on a standardized battery which can be used in any electric vehicle and can be swapped and charged in a broad network of stations.

Now, the team moved forward towards solidifying the concept and developing actual components. In this process of sharpening the concept and moving for full-fledged development, the case team turned to the simplified ProVa-approach as shown in Section 3.3. In this case, since the case was focused on a start-up situation, the focus was less on deciding which components to include on comparison to functionally equivalent ones, as shown in [17], but rather on prioritization of the design tasks and making decisions on how to move forward. To this end, the team conceptualized a virtual prototype to identify key components. As the customer value aspects were sufficiently clarified in the first phase of the assessment, the provider-oriented aspects were seen as key in this phase. The provider value assessment was carried out using the same evaluation categories as shown in [17]. Part of the results of this evaluation is shown in Table 2. Here, it became clear, that development should first focus on the core physical elements of the offering as well as building up and training staff in service, before the more infrastructural aspects of the offering are taken into closer consideration. Being able to arrive at this conclusion quickly and with little effort was considered valuable in this scenario, because assigning resources of time and money effectively in an early phase was a key challenge.

While an entirely new concept was to be developed, the participants of the case commanded over extensive prior knowledge in the mobility sector, so that the uncertainty of the assessment remained on an overall low level. An assessment of monetary value was performed but is not shown due to limitations of space. Regardless, when estimating monetary value, uncertainty was too high at this early stage to render meaningful results. For that reason, it was decided that the monetary evaluation would have been much more relevant at a later stage. Thus, as a result of this application, it became clear that the value evaluation method must not necessarily be carried out in a linear fashion but rather that different steps can be carried out when they are most relevant. Nonetheless the overall structure was helpful to retain a good overview of the necessary steps to develop towards the engineering of PSS with high customer and provider value.

Overall, the case showed both the usefulness and relevance of the simplified approach towards value assessment in PSS, while substantially reducing workload and data required to perform the combined value assessments compared to the extensive base methods EVA and ProVa [16,17].

Table 2. Provider Value assessment for components of *Bettery* (cf. [17]).

	Cust.omer Relations	Knowledge and info.	Infra-strcuture	Time-to-Market	Long-term thinking	Σ	Uncert.
Weight	0,15	0,25	0,15	0,25	0,2	1	
Ind. charger I (home)	4	1	9	6	1	3,9	o
Ind. charger II (car)	5	1	6	2	4	3,2	-
4G/5G Modem	8	10	9	9	4	8,1	+
Battery	1	2	9	9	6	5,45	+
Sensors	7	10	3	8	7	7,4	+
Comm. interface	7	3	2	9	1	4,55	+
Pred.-maint infrastruc.	8	1	1	4	7	4	o
Analytic data app.	6	6	3	9	4	5,9	o
Phone/Chat support	10	8	1	7	2	5,8	+
Service stations	8	7	6	7	3	6,2	+
Equipment installers	5	2	3	8	1	3,9	o
Maint (chg. equipment)	7	1	1	9	7	5,1	o
Usg. plan. software	4	4	2	4	8	4,5	o
Billing	5	2	5	7	1	3,95	+
Error-response	10	7	2	6	2	5,45	+

4. Concluding discussion

Throughout the transition toward PSS, the identification of valuable solutions for both the customer and the provider is of utmost relevance. This is particularly true for SMEs that need streamlined and simple methods. In order to systematically support companies in designing solutions rendering a high value for providers and for customers, this paper proposes a method that combines the synergies of two existing methods (EVA method and the ProVa method) to assess the value of PSS concepts at early stage of design. The combined method includes a simplified version of the two former methods. It

consists of a first application of a simplified EVA method to perform a first screening among the identified solutions and the sequent application of a streamlined ProVa to analyze and evaluate the value of the components of the selected concepts.

The combined method was applied in a student case in the market of electric commercial vehicles. Among the four identified concepts during the brainstorming phase, the first step of the method (through EVA) enabled the selection of one of them that provides relevant value for both provider and customer. In a second phase, ProVa was used to evaluate the PSS components in an effort to prioritize and guide the design process. The approach was found to be useful. Moreover, it emerged that the method elements should be applied throughout the conceptual design of PSS when required rather than completing it in a linear fashion.

The application of the combined method presented in this paper highlights the ease of use of the method and the limited time required for its application. These features are of high relevance for SMEs that embark the servitization journey and have limited available resources.

A number of trajectories for future research remain: First, an industrial case study in an SME environment must be conducted to gather additional lessons learned and optimize the method with practitioners in mind. Further, an easy to understand handbook should be written, as is currently being done for the full ProVa method itself. This is key to achieve notable industrial dissemination and use.

To conclude, the work represents a first step towards a value-oriented approach to assess PSS concepts and their realization of customer and provider value that is tailored towards small businesses. Supporting these companies, which constitute the backbone of most western economies, in an effective transition to highly resource-efficient PSS may be key to ensure the success of such offerings on the road to a sustainable, circular future.

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