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Pricing For Smart-Product-Service-Systems In Subscription Business Models For Production Industries

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Abstract

In the production industry, subscription business models have the potential to create long-term relationships where a supplier provides a continuous value-oriented service to a customer based on digitalisation. Monetising this increase in value through pricing represents a central challenge for suppliers in subscription business. Unlike the current dominant transactional business, the focus of pricing is on the value-in-use of the customer (e.g. on the increase in output for the customer). In this regard, there is so far no pricing approach for practice that allows the linking of the performance data of the customer with the periodically charged price. However, in subscription businesses, such an approach is required to create win-win situations for the customer and supplier through continuous performance improvement. Therefore, this paper develops a novel process model for pricing of smart-product-service-systems in subscription business for production industries. This process can serve as basis for suppliers of subscriptions in the production industry to align pricing with the created value-in-use. In the long term, this allows companies to systematically develop their pricing to monetise the potential of digitalisation.

Keywords

Digitalisation; Subscription business; Value-based pricing, Value-in-use; Data-based pricing; Smart-product-service-systems

1. Motivation and challenge

In the production industry, smart services are increasingly being offered alongside physical products and services. These digital offerings provide the potential to raise flexibility, efficiency, productivity, and quality within producing companies to a new level. However, despite great expectations and investments, digitalisation has not led to a significant increase in sales for machine and plant engineering (suppliers) and value creation for manufacturing companies (customers) in the last decade [1]. One of the reasons for this is that investment services and goods in the production industry are provided by suppliers mainly in transactional business until now [2]. In transactional business, suppliers focus on offering products and services in single transactions and leave the responsibility for the operation during the usage phase to the customer. However, digital solutions are designed to provide a continuous solution during the usage phase. The customer benefits particularly when the supplier integrates into their processes and continuously provides resources during the operation in the usage phase [3]. To achieve commercial success with the digitalisation of the production industry, tailored business models must be implemented. For this purpose, first industrial companies transformed their previous transaction-based business models into subscription business models in recent years. Prognoses indicate average annual growth rates of 23 percent for suppliers in this sector [4]. In these subscription business models, the supplier and the customer establish long-term relationships through a subscription contract. The focus of the supplier is no longer on selling isolated

products or services transactionally, but on permanently satisfying customer needs through cooperation and collaborative improvement towards a solution tailored precisely to customer requirements [5]. For this purpose, a smart-product-service-system (solution) is offered in the form of a customer solution that integrates a connected product, services and smart services into a single offering for the customer, which is continuously adapted to the customer and improved over the duration of the usage phase [1]. The overall objective is to create a win-win situation in which a customer realises substantially higher added value through the smart-product-service-system and the supplier generates substantially higher revenues and profits from the customer over the usage phase by continuous subscription pricing [4].

The central task of pricing is thereby to implement functions and mechanisms that allow a supplier to participate in the provided added value for the customer during the usage phase [6]. Herby, the suppliers are faced with the challenge of pricing individual, continuously adapted solutions accurately as part of novel subscription business models that focus on the usage phase of the customer. If the pricing is not configured in the favour of all parties or is not linked to the value provided to the customer, the customers will not accept it and the suppliers have no incentive to continuously improve the provided value. As a result, suppliers do not invest resources in improving performance. Consequently, potential for increasing customer value is not exploited and suppliers do not participate in customer value, which is frequently many times higher than the effort required to improve performance [6,7,5,8]. Digitalisation acts as a key enabler for individual value recording due to access to usage data. A scalable implementation of value-based pricing can be facilitated by innovative pricing models where the price is calculated based on the usage data from the customer [9]. To create these mechanisms systematically and efficiently, suppliers need a structured approach as well as defined tools and a decision-making basis. The cost-plus or competition-based pricing approaches which are established in industry for transactional product sales are not applicable for subscription business, as they do not consider the value of the customer in the usage phase [4,9]. Furthermore, existing subscription pricing approaches from other sectors cannot be adopted to the manufacturing industry due to the complexity and high degree of interaction and individualisation within the decision-making processes, smart-product-service-systems and business relationships [10]. Accordingly, the aim of this paper is to develop such an approach for pricing of smart-product-service-systems for subscription business in the production industry. To ensure the scalability of this approach in practice, it is designed as an operation-oriented process model that integrates data and information from the usage phase of the customer.

2. Research ambition

From a research perspective, implementing such a model for pricing of smart-product-service-systems in the production industry leads to a novel value-based pricing approach, which has been not possible in the transaction-based business so far. In existing value-based pricing for transactional business, all activities take place during the sales phase and the pricing is focused on a specific point in time before the actual use of the solution [11,12,9]. The determination of the value for the pricing is done a priori regarding the usage phase. Consequently, the pricing is based on an anticipated value for the customer (s. figure 1). This means, that the generated value-in-use has no direct impact on the price paid, so that there are no direct monetary consequences for the supplier from the usage phase. Accordingly, no direct incentives are created for the supplier to invest resources in the continuous improvement of the solution for the customer and thus in increasing the customers value. In contrast, the subscription business model is focused on continuously recurring payments during the usage phase [5]. The pricing is applied in the usage phase for a continuously provided solution, based on a contractual framework defined in the sales phase. As result, the pricing takes place partially in the usage phase. This means that subscription pricing between a supplier and a customer in production industries can be divided into two central phases with different terms and conditions. First phase is the sales phase in which a subscription contract is worked out between the supplier and the customer. This contract must specify the underlying pricing model, the pricing components, and the pricing metrics

[13]. After conclusion of the contract, the second phase is the usage phase of the customer. Within this phase, the solution provided in a previously defined cycle and the resulting value-in-use are priced on a recurring basis. Therefore, the prices are calculated based on the recorded data of the customer according to the conditions specified in the contract. Through this mechanism, it is possible to realise an a posteriori pricing based on the value-in-use at the customer. On the one hand, pricing must create incentives for continuous improvement for the supplier and on the other hand, the dynamically changing value-in-use of the continuously adapted solution must be recorded based on customer data. Therefore, pricing in subscription models within the usage phase is a flexible and iterative process [4,5].

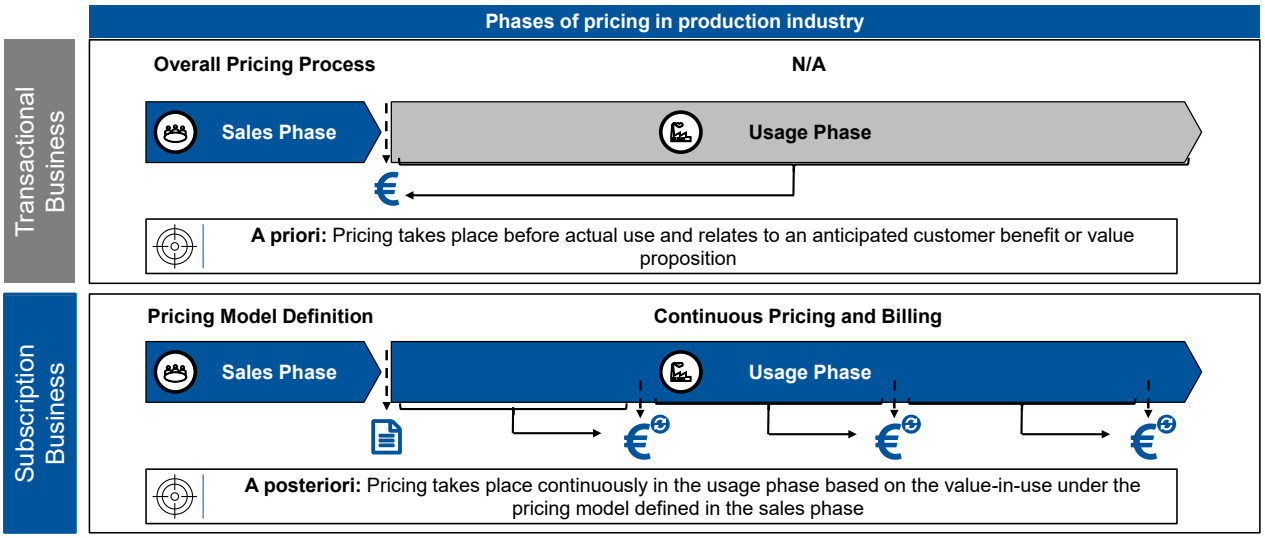

Figure 1: Phases of pricing in production industry (own figure)

Smart-product-service-systems in subscription business represent a complex integrated customer solution consisting of product, service, and smart services, which are individually tailored to a customer [1]. A novel aspect of subscription business compared to existing value-based pricing from the production industries [11,12], is that these represent individual solutions from the perspective of the customer. This involves taking on the technical and economic risks from the customer. In this context, the customer is offered the availability, the usage, the result, or the success with the offered solution [10]. In order to perform pricing, it is necessary to determine how the provided solutions are individually perceived by the customer [14]. A central feature in this regard is the measurement of the value-in-use. This value, which is mainly referred to conceptual approaches for the evaluation of value propositions of services, is not used in operational approaches for pricing [15,16]. In practice, companies have difficulty in identifying and quantifying the key value drivers for individual customers. Moreover, value-in-use is inherently phenomenological, meaning that at one customer, different stakeholders evaluate the value of the same solution differently [15]. This implies that the value assessment for pricing must be based on defined and measurable data [16]. Additionally, for subscription business, the selection of the pricing model and the pricing metric is significantly more complex than in the transactional business. The conventional price metric in transactional business reflects the logic of exchanging a product for a fixed one-time price [9]. To capture customer and supplier requirements, the price metrics in the subscription business are usually multi-dimensional and a price is composed of fixed elements as well as variable elements [13]. In particular, the variable component could be linked to the operational data of the customer. A supplier has a high degree of freedom in determining the price dimension and price metrics, by means the design represents a complex decision-making situation [9,8]. For this purpose, the way of data recording and including in the pricing must be specifically defined. Until now, existing approaches do not link price metrics with specific data from industrial operations of a customer. In summary, to achieve the objective of this paper, the comprehensive extension of current value-based pricing approaches is necessary. Therefore, the process model to be developed goes beyond the existing research by addressing both the sales and the usage phase for

subscription business models. In this context, novel functions and activities for pricing of smart-product-service-systems in subscription business for production industries must be defined.

3. Research method and framework

For the development of the new process model, the research method of modelling is used. The method follows the approach of systems engineering and the principles of orderly model design [17]. For this purpose, the method is based on five key principles. 1. Principle of accuracy: The model must have semantic and syntactic correctness. 2. Principle of relevance: Only the essential aspects that provide a benefit for the task should be included in the model. 3. Principle of clarity: The model must be understandable and intuitive for a user from the practice. 4. Principle of comparability: The recommendations of the process model for pricing must also be usable independently of the application of the model. 5. Principle of systematic structure: The model should have defined interfaces to corresponding models.

For designing a process model for the operative execution of business processes in compliance with these key principles, frameworks are used in research practice. Frameworks define connections among individual elements of the methodology on a high level of abstraction and arranges them in a hierarchy or sequence [17]. To develop such a framework, relevant elements from processes of existing pricing approaches provide the basis. A structured literature research was carried out to identify relevant existing process models. As result, approaches for pricing of subscription were identified. Most of these approaches [18,13,19,6] are primarily designed for pricing in subscription business in the software industry. Therefore, approaches for value-based pricing from the transaction business of the production industry are included as well [20–22,11]. The analysis of existing approaches revealed a consistent pattern regarding the content and process of pricing (s. figure 2). Although the approaches differ to some extent in their scope and design, the elements of all models can be clearly assigned to a higher-level process framework. This process framework contains of the four superordinate elements reference basis, value assessment, price dimension and price metric.

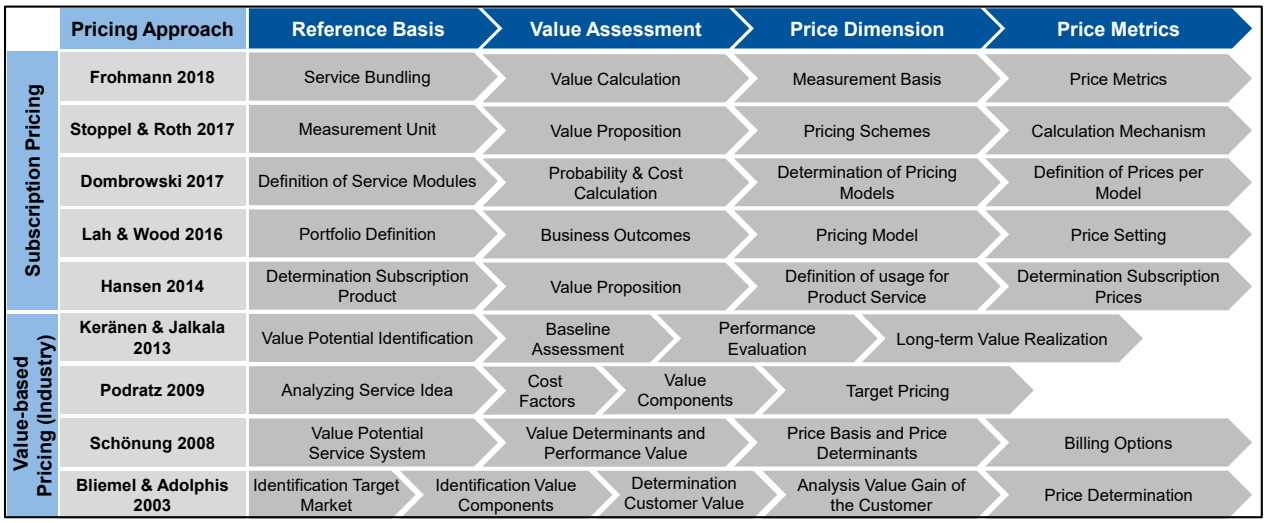

Figure 2: Definition of the framework for the process model to be developed (own figure)

The first element is the **reference basis** in which the offered solution is recorded, defined, and described. This element is particularly important for complex solution offerings in the production industry [11]. In **value assessment**, a recording of the value of the solution from the perspective of the customer and the supplier is conducted. For the customer, this is defined by the value-in-use [9,23] and for the supplier by the customer lifetime value [24].The **price dimension** describes a qualitative logic between the value of a solution and the charged price for the customer [13,10]. The definition of price elements is conducted, that relate a monetary equivalent to an offered solution component that is accepted by both parties [9]. The **price**

metric establishes a quantitative relationship between the charged price and the data-based performance parameters from the customer [13]. Through a specific calculation mechanism, the charged price for the solution is quantified with the data.

4. Development of a pricing approach for smart-product-service-systems

In this chapter, the process model for pricing in subscription business for production industries is derived. To this end, chapter 4.1 develops the eight process steps of the process model based on the subscription and pricing characteristics. Subsequently, chapter 4.2 characterises the individual process steps with features and properties.

4.1 Process model for pricing in subscription business for production industry

The process model to be developed is formed by the previously developed framework for pricing with the four elements reference basis, value assessment, price dimension, and price metric as well as the two phases of pricing for subscription business, the sales phase and the usage phase. The two phases are divided by the signing of the subscription contract. The steps of the usage phase are repeated over and over when the subscription is renewed. As the subscription model in many cases is constantly modified, the steps of the usage phase are continuously processed and flexible [4,5]. During both phases, each element of the pricing framework is relevant and addressed by requirements and tasks. The process model contains an objective-based business process with a detailed workflow logic consisting of eight process steps a supplier in practice performs to determine the specific price for a smart-product-service-system (s. figure 3).

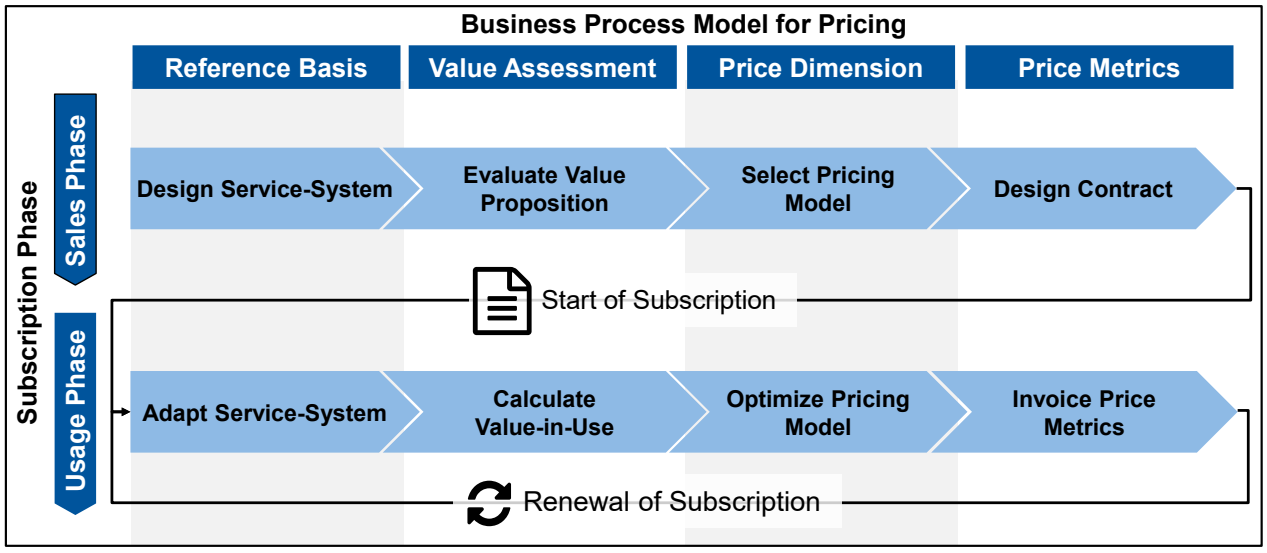

Figure 3: Process model for pricing in subscription business (own figure)

The objectives within each phase result from the elements of the pricing framework, the information and data available at the phase, and the characteristic features of subscription business models [2]. The characteristic feature of reference basis is the continuous increase in value through performance enhancement. The offered solution is oriented to the value-in-use for the customer. The supplier is focused on integrating the solutions into the value creation processes of the customer. A solution is provided individually for a customer and is based on the individual requirements of a customer. The sales phase begins with the **design** of individual **service-systems** as a solution that is tailored to the customers' needs. During the usage phase, the solution is continuously optimised on a higher customer value by the continuous **adaption** of the **service-systems**. In value assessment the characteristic feature is the knowledge of

individual customer value and needs. To address individual value propositions, an **evaluation of the value proposition** is conducted in the sales phase. A digital access to the customer in the usage phase enables recording of individual usage data. This provides the supplier an in-depth knowledge of the of the customer for the **calculation of the value-in-use** of the customer. Characteristic feature of the price dimension is an integrated, continuous, and participatory value creation. A long-term, participative co-creation is established between the customer and the supplier. The basis for this is established by **selecting the right pricing model** in the sales phase. In order that the customer profits by improving the performance processes and the supplier profits through an increase in revenue of the customer, an **optimisation of the pricing model** needs to be conducted within the usage phase for the exploitation of bilateral benefits. Characteristic features for the price metrics are periodic payments based on generated value. Within the sales phase a **contract is designed** that specifies the price components and the reference basis for the chosen pricing model. The continuous transfer of the solution from the supplier to the customer takes place in the usage phase. In return, the customer pays periodic fees to the supplier that are linked to the provided value. For **invoicing the price metrics,** the data of the defined price reference basis are recorded, and the price is calculated and charged for each payment period.

4.2 Properties of the process model for pricing in subscription business

Based on the defined process model, properties for each step are derived and defined in the following. These properties structure the tasks within each phase. An overview of the properties within each step is shown in the following figure (s. figure 4).

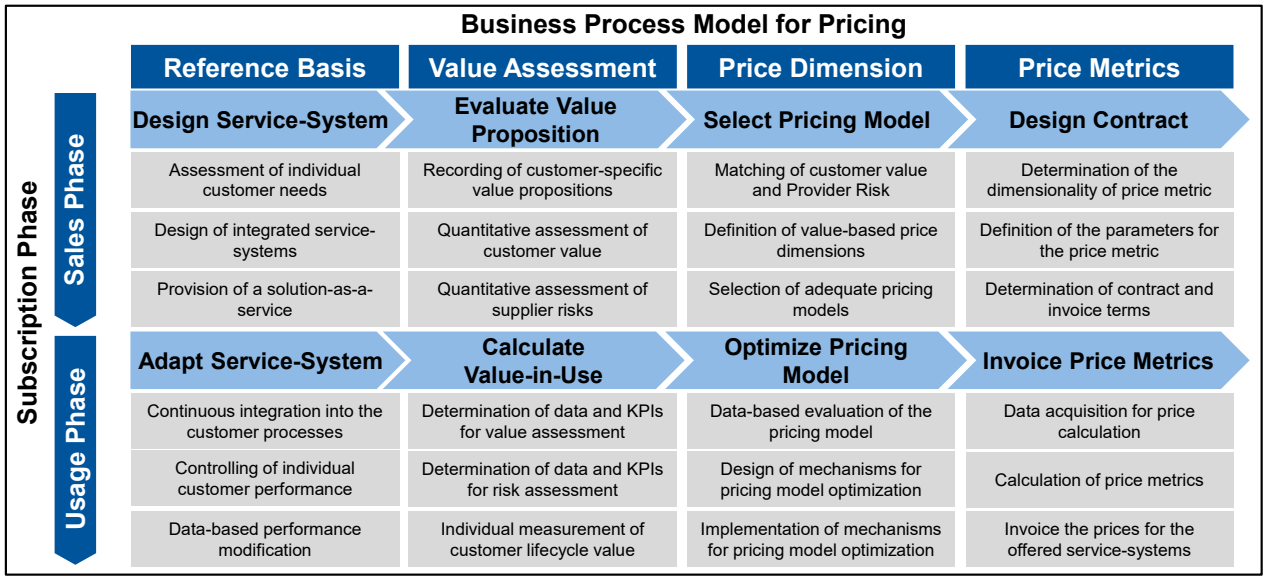

Figure 4: Properties of the process model for pricing in subscription business (own figure)

1. Design Service-Systems: The process of pricing starts with the customer and their needs. The supplier must perform an assessment of the individual customer needs. For this purpose, a supplier must analyse and understand the objectives, processes, resources, and activities of the customer [25]. The second sub-step is to transform the individual customer needs into a concrete solution specification [25]. Based on the specifications, products, services, and smart services must be generated for the design of integrated service-systems for the customer. For the successful design of product-service-systems, Belz defines six design principles. These are the integration principle, the principle of accounting, the participation and explanation principle, the evolution principle, the long-term principle, and the relevance principle [14,12]. Products, services, and smart services are subsumed under a superordinate customer solution, which is integrated into the customers value chain in relational processes [25]. The service-system is provided to the customer as a

solution-as-a-service that meets his requirements. Products act as a distribution channel for the provided solution [15].

2. Evaluate Value Proposition: According to the service-dominant logic, a supplier alone cannot offer values to a customer, but only value propositions. Value for the customer arises from the co-creation of value in which both the customer and the supplier are involved [15]. To record the customer-specific value propositions, it is necessary to identify which preferences and objectives the customer has in the dimensions of efficiency, cost, and quality [3]. In the next sub-step, relevant customer data for the quantitative assessment of this value propositions must be identified and recorded. This data is used to determine a reference point before the subscription solution is provided to the customer [21]. Based on usage data from other customers of a comparison group, a quantitative assessment of the expected customer value income must be carried out [3]. Smart-product-service-systems in the production industry that include investment products involve associated risks for the supplier in the form of counterparty default, market price, and operational risks. Analogously to customer value, a quantitative assessment of the supplier risk must be carried out based on available data [1].

3. Select Pricing Model: The choice of the pricing model has a major impact on customer and supplier value realisation. To select the price dimension, an evaluation must be carried out, where a matching of the customer's value and the supplier's risk is made [23]. On the one hand, taking on promises of higher value leads to more customer value and on the other hand, taking on more risks of the customer can lead to high costs, if the supplier cannot influence them [10]. For the offering in subscription models, a distinction can be made between four different solution types. These successive types define the offer of availability, usage, result, or economic success for the customer. The definition of the value-based price dimension is conducted by selecting the offered solution type. The selection of adequate pricing models is then carried out in accordance to this. For the availability type, the price is taken for the available time of the solution (e.g. flat rate). In the usage type, a price is linked to used time units (e.g. pay-per-use). In the result type, a price is based on the produced unit (e.g. pay-per-output) and in the success type, a price is based on the increase in performance (e.g. profit sharing) [10].

4. Design Contract: For the continuous payments in subscription models, there are different options for the supplier in terms of pricing components. For the determination of the dimensionality of the price metric, a differentiation can be made between one-dimensional metrics with a variable or fixed component, two-dimensional metrics with a variable and a fixed component, and three-dimensional metrics with an additional component at the beginning of the subscription [13]. The selected price models need to be designed using price metrics based on customer-specific data [9]. Criteria for the definition of the parameters for pricing metrics are goal orientation, stakeholder-driven, and simple measurability [9]. The sales phase completes with the determination of contract and invoice terms. For the invoice terms, a distinction can be made between ex-ante billing and synchronized ex-post billing. Synchronized billing is particularly suitable for pricing based on the usage data from a customer [13,11].

5. Adapt Service-Systems: The supplier integrates the solution forward into the value creation process of the customer to link the processes of the two stakeholders [10]. A continuous analysis of individual customer needs is required. The supplier aligns the services, resources, and processes to these needs. Additional solutions are configured under continuous supplier integration into the customer processes. Both the supplier and the customer provide data, resources, and activities as co-producers [15]. Criteria of successful supplier integration are the focus on benefit processes, benefit development at the point of use, the integration paradigm, the interaction paradigm, and the combined push-pull principle [15]. The aim is to offer optimised solutions to the customer in close cycles of performance optimisation. To achieve this, conclusions are drawn about the actual usage behaviour of the customer within an iterative, data-driven learning process. Based on that customer insights, a data-based performance modification is carried within continuous releases [3].

6. Calculate Value-in-Use: Using KPIs, strategic success factors of a company can be quantified. KPIs serve for operationalisation, specification, stimulation, management, and control functions. For pricing, these indicators are primarily used to operationalise and specify the value-in-use [6]. To do this, KPIs and data must be determined for the quantitative value assessment of the customer. The data for this mostly comes from the systems and processes of the customers and from parameters that are defined specifically for the calculation of the KPIs. As a further factor, the profitability of a business must also be ensured by taking risks into account [9]. Here, suitable data and KPIs must be determined for risk assessment as well. In this context, data for cost recording from the internal systems of the supplier play a key role [9]. The factors for the value and risk assessments merge into the Customer Lifecycle Value. This sums up all incoming and outgoing payments within a customer lifecycle and reflects the potential of a customer for a supplier. The individual measurement of the customer lifecycle value represents the central strategic parameter for the decisions of pricing in the usage phase [24].

7. Optimize Pricing Model: The price metric provides the operational link between measurable KPIs and the price [9]. For this, an assessment basis as a logic of linking the individual KPIs with the price model plays a central role. An assessment basis for the data-based evaluation of the pricing model consists of systematised data types [13]. The pricing for availability and usage-based pricing models requires data from the machine, output-based price models require data from the performance process of the customer, and success-based price models require business data from the customer [23]. Following this, the design of mechanisms for pricing model optimisation must take place by identifying potential win-win situations by adjusting the price model. To determine improved price points for price elements, the expected additional value-in-use of the customer must be determined in monetary terms [21]. For this purpose, the financial effect of an improvement of an operational key figure of the customer must be determined and transferred to a single price unit of the price metric [3]. The pricing point is to be set that a supplier only gains a price premium from its customer when the KPIs increase [3]. For the implementation of mechanism for pricing model optimisation, the measurable added value for the customer and thus the theoretical willingness to pay cannot be fully skimmed in practice but only a part of the added value should be monetised [13].

8. Invoice Price Metrics: To record variable value-based price parameters, the active integration of customer-specific data is required to determine the level of the price. This requires the linkage of pricing processes from the supplier with the cyber-physical systems of the customer [9]. By using these systems, the supplier records data such as machine hours, output quantity or energy consumption in the use phase of the customer. To ensure a structured data acquisition for price calculation structures and processes must be created to transfer the data from the customer for the pricing processes of the supplier. The formula and the method for the calculation of the price is property of the price metric [6]. In the contract is the way how the customer pays for the solution and the frequency for the periodic payment defined. With periodic invoicing of the price for the offered service-system, the data-based charging of fixed and variable parameters is possible [13].

5. Conclusion

Manufacturing companies in the production industry increasingly provide their products, services, and smart services as integrated solutions within subscription business models. This enables suppliers to establish a close, long-term partnership within the usage phase of the machine. The objective is to facilitate a win-win situation for both the customer and the supplier, in which a customer receives an increase in value through continuous data-based optimisation of the offered solution, and the supplier receives continuous revenue from a customer that depends on the value of the customer. To achieve this, the charged price by the supplier must be related to the added value for the customer. The digital available data of the customer enable to form such a pricing based on value-in-use. However, most approaches for value-based pricing for the production

industry focus on transaction-based business. This approach allows only an a priori assessment of the anticipated value. The actual value-in-use for the customer and therefore an incentive to the supplier to continuously improve the solution is not created. Accordingly, suppliers in practice do not use a structured process for pricing. As a result, suppliers lack knowledge regarding the way they should offer their solutions or fail to fully exploit the potential for optimising the value they provide when offering their solutions.

Therefore, this paper proposed a novel process model for pricing smart-product-service-systems based on the value-in-use of the customer for subscription business in production industry. Using the structured modelling approach, a model framework for subscription pricing is developed and subsequently equipped with concrete process steps and tasks within these process steps. The framework for this is an abstracted business process of pricing with the four elements reference basis, value assessment, price dimension, and price metric as well as two consecutive phases of the subscription business, the sales phase and the usage phase. To provide a practical method to an operator, a process model with eight consecutive process steps is derived within this framework based on the characteristics of subscription business models. Each of these process steps is assigned with concrete tasks and characteristics for the process specification. This allows suppliers to use the presented process model as a blueprint for developing new or adapting existing pricing processes for subscription business. The approach enables suppliers to establish a standardisable and successful long-term pricing for the subscription business. This offers opportunities for both suppliers and customers in the production industry to strengthen the competitiveness through close and profitable business relationships and to develop new growth potentials. From a scientific point of view, the approach offers a novel, operationally oriented process model for pricing, which enables value-in-use to be considered based on an a posteriori pricing.

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Biography

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