Methodology for the risk and reward evaluation of industrial subscription models

Methodik zur Bewertung von Chancen und Risiken industrieller Subskriptionsmodelle

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Abstract. A promising type of innovative business models for the machinery and plant engineering industry are subscription models. In an industrial context, subscription models are enabled by novel opportunities due to ongoing digitization and Industrie 4.0. Customers receive a regular delivery of performance in terms of a product-service system in return for a continuous payment of a subscription fee. Prerequisite for an efficient subscription model is the interaction of several industrial players with in-depth knowledge in a network, in which every player derives its benefit from a low-risk long-term business. Before implementing this new business model, companies need to assess the potential risks and rewards of the subscription model for their particular application. This paper presents a methodology for the evaluation of risks, rewards and chances for stakeholders in a subscription ecosystem. Furthermore, it can be used as an appropriate tool for designing efficient, subscription-based partner networks and attractive value propositions for machinery and plant engineering companies.

Keywords: Business model evaluation, Subscription model, Product-Service System, Value Network, Ecosystem

Abstract. Das Subskriptionsmodell stellt ein innovatives Geschäftsmodell für den Maschinen- und Anlagenbau dar. Im industriellen Kontext werden Subskriptionsmodelle durch die fortschreitende Digitalisierung und Industrie 4.0 ermöglicht und bieten dem Kunden eine vertraglich zugesicherte Leistung eines Produkt-Service Systems im Gegenzug zu einer regelmäßigen Zahlung einer Subskriptionsgebühr. Grundvoraussetzung für ein effizientes Subskriptionsmodell ist die Zusammenarbeit von verschiedenen Industrieunternehmen mit jeweils speziellen Kernkompetenzen in einem Unternehmensnetzwerk, in dem jeder Partner Vorteile durch ein langanhaltendes und risikoarmes Geschäft erfährt. Vor der Implementierung dieses neuartigen Geschäftsmodells sollte jeder Partner die

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potenziellen Risiken und Vorteile, die das Subskriptionssystem für den praxisspezifischen Anwendungsfall bietet, analysieren und bewerten. Dazu wurde eine Methode zur Bewertung von Risiken, Chancen und Vorteilen aller Partner des Subskriptionsökosystems erarbeitet. Des Weiteren kann die Methodik als ein geeignetes Werkzeug bei der Planung und Entwicklung effizienter Subskriptionsökosysteme und attraktiver Leistungsversprechen im Maschinen- und Anlagenbau verwendet werden.

Keywords: Geschäftsmodellbewertung, Subskriptionsmodell, Produkt-Service System, Wertnetzwerk, Ökosystem

1 Introduction

Digitization and Industrie 4.0 enable the development of new business models for machinery and plant engineering companies. Besides this technological push, an increase of the market pressure is leading to an ongoing innovation process of the business models (BM) of machinery providers, whereas a shift towards service-based business models is notable [1]. This trend is caused by limited chances for organic growth through classic transactional businesses, growing competition and decreasing technological advantages [2]. Service-based business models offer the possibility to significantly rise the profitability of companies in the machinery and plant engineering industry through recurring service businesses and to exploit the potential offered by Industrie 4.0 at the same time [2] [3]. The subscription-based business model represents a relevant use case for service-related business models. In a subscription-based business model, clients subscribe to a service and are charged a periodic recurring fee [4] [5]. In the machinery and plant engineering industry, a subscription service can be delivered by a product-service system (PPS), which requires the participation of various partners in a network. The subscription network delivers the machine, offers the services, provides auxiliary materials and consumables for the production process as well as enables a continuous guarantee and upscaling of production performance through the process and technology expertise of the network. The partners can increase their performance due to the possibility of fully exploiting their core competencies within these industrial networks [6]. However, there is a lack of an evaluation method in order to examine the effects of this new type of business model.

This paper provides a framework for the methodical evaluation of subscription-based business models in the mechanical and plant engineering industry. Furthermore, the risks and rewards of this type of business models can be analysed with the help of the framework.

2 Relevant Terminology and Related Work

In the following, an overview of concepts and definitions within the topic of subscription-based business models are given.

Business models. Business models in general are defined as "the rationale of how an organization creates, delivers, and captures value" [7]. Osterwalder developed an established framework for the description, visualization and development of business models. This framework is better known as the Business Model Canvas and commonly accepted as well as used in scientific and industrial context. The Business Model Canvas is divided in nine dimensions: key activities, key partners, key resources, value proposition, customer relationship, customer segments, channels, cost structure and revenue streams. The core element of the business model canvas is the value proposition, which describes the delivered value to the customer [7]. The value proposition is crucial for the success of the business model, because it constitutes the main factor in the decision-making process of the customer [7]. Gassmann et al. define four main dimensions to describe a business model: value proposition, customers, value creation and financials [5].

Product-service systems. Bundling products with services is a growing trend in the machinery and plant engineering industry and can lead to a high-competitive value proposition [8]. These bundles of products combined with services are called product-service systems (PSS) and defined as "a marketable set of products and services capable of jointly fulfilling a user's need. The product/service ratio in this set can vary, either in terms of function fulfilment or economic value" [9]. Digitization and Industrie 4.0 are forcing manufacturing companies to adjust their business model and increase the value of services offered simultaneously to the product [10]. Thus, a transformation from product-centric companies to solution-providing companies in the manufacturing industry can be observed [11].

Subscription-based business models. Subscription-based business models are focusing on the provision of a solution instead of a product. This business model is defined by a frequent delivery of its value proposition to the client for a periodically recurring fee [5] [12] [13]. By offering the customer an innovative overall solution, the subscription-based business model provides many advantages, e.g. a better prediction of revenue streams and a flexibility in resource planning. The quality and trust of a subscription service are the main drivers to a successful subscription business model, since customers and firms are connected closely [14]. The focus within subscription-based business models shifts "from the point of sale to the long-term, ongoing customer relationship" [15]. Currently, this type of business model is mainly known from the IT- and software sector, however it has been applied to other industries and continues to be embedded in existing and emerging businesses [15].

3 Methodology to Evaluate Subscription-Based Business Models

To provide an evaluation tool for subscription models in the machinery and plant engineering industry, a subscription evaluation framework has been developed. Therefore, the following research question is addressed within this paper:

"How can risks, chances and rewards of subscription-based business models in the machinery and plant engineering industry be evaluated?"

3.1 Methodological approach

For the elaboration of a framework to evaluate risks, chances and rewards of subscription-based business models the business model evaluation guidance of Schallmo was used [16]. The author points out that, in order to evaluate a business model, an all-encompassing analysis of the stakeholders and the supply chain as well as the characteristics and principles of the business model is indispensable [16].

Taking this into account, in this paper as a first step the business ecosystem including stakeholders and supply chains is analysed (see Fig. 1). The scope of this task is to transparently display all traded entities within the subscription network. After the analysis and modelling of the subscription network, a joint value proposition, the so called network value proposition, can be elaborated as a second step [17]. The network value proposition is a combination of competencies and capabilities of the network's partners [17]. For the analysis of the added value of the subscription concept, literature recommends the application of critical success factors (CSF) [18] [19]. Therefore, the third step of the methodology is defined by performing a critical success factor analysis. The fourth step consists of a qualitative assessment of the impact, fulfilment and complexity of the CSFs and its solutions, provided by the subscription model. Within the fifth step, the risks, rewards and chances are derived from the previous step's results and presented as the evaluation's result.

The presented steps are building the core element of the evaluation tool for analysing risks, rewards and chances of subscription-based business models in the machinery and plant engineering industry. Input factors can be derived from literature, case studies and expert interviews. By following the described methodology (see Fig. 1), a subscription-based business model can be analysed.

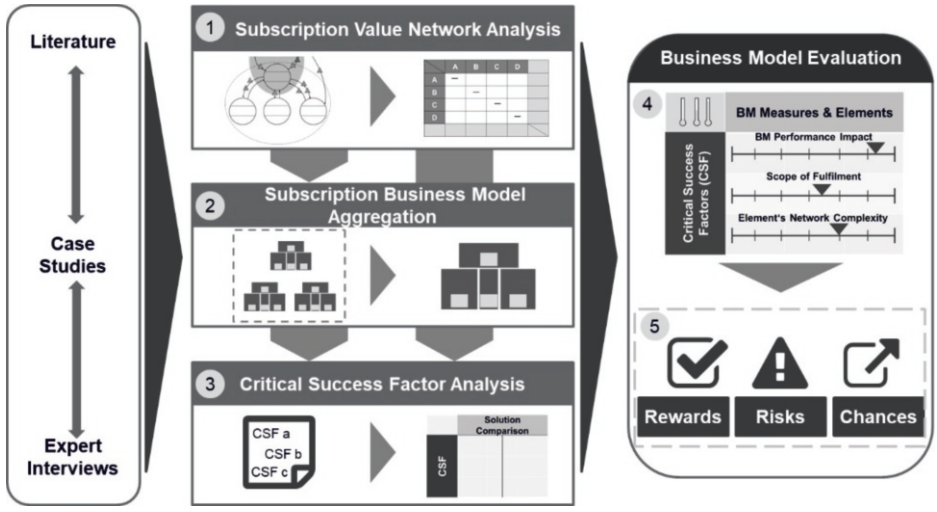
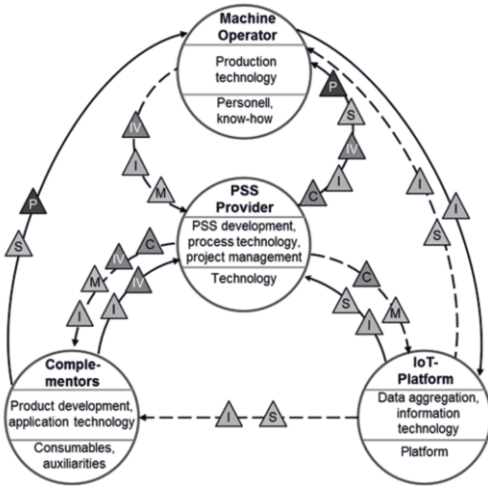


Fig. 1. The subscription-based business model evaluation framework

3.2 Derivation and application of the framework

The methodology for the evaluation of subscription-based business models is divided into five steps. The derivation and function of each step is explained below.

Step 1. At first, a common understanding of the interaction of all participants within the subscription ecosystem is important. To gain this understanding, the Ecosystem Network developed by Vorraber et al. is applied [20] [21] [22]. The network consists of actors, which are linked through revenue or provision links. Every actor is described by its capabilities and assets. All correlations between the participating actors are transparently presented and described by the exchanged entities (products, services, information, brands, coordination, monetary and immaterial values). Fig. 2 illustrates a subscription ecosystem network in the machinery and plant engineering industry in general terms with a description of the actors' inputs and outputs (amount of traded entities) in a matrix. This matrix enables an analysis of roles within the subscription ecosystem. Thus, the orchestrator of the ecosystem can be derived. In the presented subscription ecosystem in Fig. 2, the PSS supplier provides the most entities, which is shown by the active sum. Furthermore, he owns the coordination tasks of the network. Taking this into account, the PSS provider's role as an orchestrator of the network can be declared.



	Machine Operator	PSS Provider	Comple-mentor	IoT-Platform	Active Sum
Machine Operator	—	3	0	1	4
PSS Provider	5	—	4	2	11
Comple-mentor	2	2	—	0	4
IoT-Platform	2	2	2	—	6
Passive Sum	9	7	6	3	

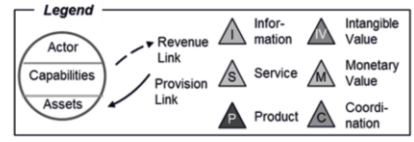


Fig. 2. Industrial subscription ecosystem with inputs and outputs

Step 2. The second step contains the aggregation of the individual business models of all partners participating in the subscription ecosystem. Target of this second step is the formulation of the business model of the subscription ecosystem.

The work of Ebi et al. provides a toolbox as well as guidance for the creation of the aggregated subscription ecosystem business model [23]. The authors developed an extensive description of service-based business models based on the Business Model Canvas with constituting elements of service-based business models. This generic description contains the key features and target state of subscription models, which are representing a subset of service-based business models.

At first, the elaboration of the business model-specific dimensions of each individual partner is conducted. These dimensions are not linked to each other yet. Second, an aggregated business model is developed based on the value network, the independent business models and the constitutive elements of service-related business models. Through the aggregation of the business model of the subscription ecosystem a general understanding of the network's objectives and functionalities can be derived. They are necessary for the further analysis.

Step 3. In the third step critical success factors (CSF) are applied in order to define the target state of the subscription ecosystem business model. The fulfilment of CSF leads to a successful operation of a business, whereas a non-fulfilment can lead to failure [18]. Therefore, by applying and analysing CSF, the success of the examined business model can be made assessable [24].

CSF are derived from existing literature and an ideal solution scenario is defined for each CSF. This solution scenario should enable a total fulfilment of the CSF of the subscription model. In the following the ideal solution is compared to the solution provided by the subscription ecosystem. Herewith, differences between the subscription and ideal solution are derived and a qualitative description of the resulting impacts can be elaborated. The respective steps and tasks are presented in Fig. 3. The avoidance of unpredicted machine downtime is a possible example for a critical success factor. A possible solution for this CSF is predictive maintenance, which is enabled by the collection and analysis of machine data. Due to customer restrictions a collection of data might not be possible, so only regular recurring maintenances can be provided as scheduled. The lack of data for providing predictive maintenance is the main gap in this example and leads to impact of non-predictable machine downtimes.

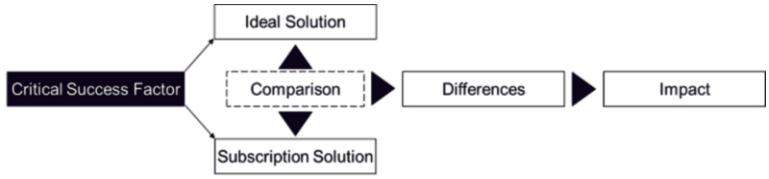


Fig. 3. Steps within an impact analysis of solution differences

Step 4. In the fourth step an assessment of the subscription model's risks, rewards and chances is conducted. Therefore, impact, fulfilment and complexity of the CSF onto the subscription ecosystem business model are derived.

Based on the Innovation Performance Matrix by Trienekens et al. [25], a matrix is created for the evaluation of the indicators. The relevant critical success factors derived in the third step are listed on the ordinate of the matrix. These factors form the requirements for the success of the subscription-based business model. The abscissa contains the existing solution elements of the subscription model, which were elaborated in the second step. These elements are subdivided in groups formed by the four elements of the Business Model Canvas. Each of the groups contains a set of business model elements which are helping to fulfil the CSF. This results in a matrix, which is called Requirements Solution Matrix (see Fig. 4). The resulting combinations within the ma-

trix are evaluated for each cell. The aim is to identify fields in which the CSF is influenced by an element of the business model. If this applies, a qualitative evaluation based on the Failure Mode and Effects Analysis Method (FMEA) and its calculation of Risk Priority Number (RPN) is carried out [26]. The following assessment dimensions are proposed for the evaluation of subscription-based business models in the machinery and plant engineering industry:

Impact (I). Impact of the critical success factor on the performance of the subscription ecosystem (1 = low, 10 = high),

Fulfilment (F). Degree of fulfilment of the critical success factor by the examined solution (1 = high, 10 = low),

Complexity (C). Complexity of the value generation of the examined solution (1 = low, 10 = high).

The procedure is shown in Fig. 4. According to the FMEA, the values of these three elements are multiplied to receive an indication about the impact of the assessed solution for the overall business model. A high number indicates that this solution is carrying a high risk of not fulfilling the requirements for a satisfaction of the customer's demand if not addressed adequately. Therefore, the calculated product is called Subscription Risk Indicator (SRI). Listed solutions which fulfil a high-impact rated success factor with a high degree and moderate complexity are providing the performance elements of the subscription system. Those performance elements are leading to rewards for the entire subscription ecosystem. Hence, risks and rewards of the subscription-business model can be analysed and deducted within this step of the evaluation.

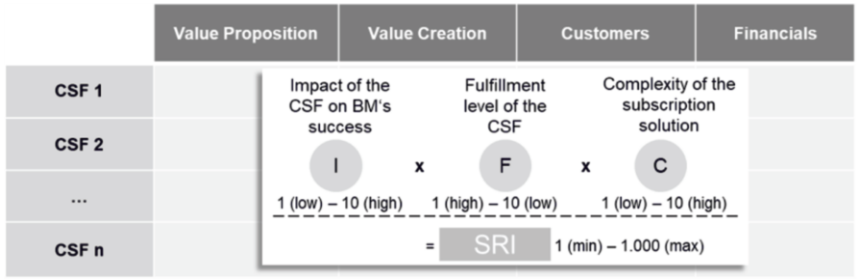


Fig. 4. Requirements Solution Matrix and derivation of the Subscription Risk Indicator

Step 5. The derivation of risks, rewards and chances of the subscription model is compiled in this step. For this purpose, all previous steps have to be considered.

The SRI indicates whether a proposed solution for the CSF fulfilment is given in a strong or weak manner. After this first indication has been analysed, the investigation for the result's sources can be conducted. This investigation analyses steps 1-3 and derives reasons and implications for the SRI score and enables the evaluation of risks, rewards and chances. In the following, a possible scenario of indications for risks, rewards and chances is presented:

- A high SRI score does result in the risk of not fulfilling the connected CSF. By looking into the three multipliers of the SRI, the reason for the high score can be examined. A combination of the reasons for the high score of the indicator with the resulting risk constitutes fundamental information for the risk's reporting.
- A first indication for rewards achieved through the subscription-model can be derived from business model elements, which are linked to a low SRI score. Secondly, its business model element must have a high impact on the overall subscription ecosystem.
- Opportunities or chances are defined by subscription solutions for a critical success factor, which do not yet completely fulfil it. Hence, a potential for improvement can be derived through this outcome.

The presented approach is using the SRI score to identify the risks, rewards and chances. Possible scores range from 1 to 1.000, with 1.000 constituting a high-impact, low-performance solution. The score 1 describes a low-impact, high-performance solution. All scores in between require an observation of the score's composition to enable a detailed evaluation as explained.

4 Summary and Conclusion

This paper introduces a framework to assess the risks, rewards and chances of industrial subscription-based business models. The developed evaluation framework consists of five steps and is based on analysing the subscription-ecosystem, the aggregated value-proposition and critical success factors. With the results of the mentioned analysis, all necessary input factors for the Requirements Solution Matrix (RSM) can be provided. The RSM delivers a consolidated assessment of the subscription-network's complexity, the subscription-solution's impact and the estimated level of proposed-value fulfilment for the customer. With the help of the RSM the Subscription Risk Indicator (SRI) is derived. Combining the SRI's score with the results of step 1-3, a detailed report about the investigated business model element can be provided. Therewith the presented framework enables the specific evaluation of subscription-based business models in the machinery and plant engineering industry. However, research limitations still exist. One limitation is the theoretical approach of the model. Future research should address this limitation by a validation with industrial use cases. By doing so, the industry-relevant case studies can be used to identify business model elements and patterns which are driving the success of subscription-based business models. The understanding about links between the success of subscription models and a specific structure of partner networks and value-propositions is of great scientific relevance.

References

1. Gebauer, H., Fleisch, E., Friedli, T.: Overcoming the Service Paradox in Manufacturing Companies. European Management Journal, Volume 23, Issue 1 (2005).
2. Schuh, G., Friedli, T., Gebauer, H.: Fit for Service: Industrie als Dienstleister. Hanser, München (2004).

3. Bauernhansl, T., Paulus-Rohmer, D., Schatz, A., Weskamp, M., Emmrich, V., Döbele, M.: Geschäftsmodell-Innovation durch Industrie 4.0: Chancen und Risiken für den Maschinen- und Anlagenbau. Dr. Wieselhuber & Partner, Fraunhofer IPA, München (2015).
4. Rappa, M.: The utility business model and the future of computing services. IBM systems journal 43(1), 32-42 (2004).
5. Gassmann, O., Frankenberger, K., Csik, M.: The business model navigator: 55 models that will revolutionize your business. Pearson UK, London (2014).
6. Schuh, G., Riesener, M., Breunig, S., Koch, J., Kuntz, J.: Evaluation of Variety-induced Costs in Product-Service Systems (PSS). Procedia CIRP 2017, vol. 61, 673-678 (2017).
7. Osterwalder, A., Pigneur, Y.: Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. Wiley&Sons, New York (2013).
8. Mont, O.: Clarifying the concept of product–service system. Journal of cleaner production 10(3), 237-245 (2002).
9. Goedkoop, M. J., Van Halen, C. J., Te Riele, H. R., Rommens, P. J.: Product service systems, ecological and economic basics. Report for Dutch Ministries of environment (VROM) and economic affairs (EZ), 36(1), 1-122 (1999).
10. Arnold, C.: The Industrial Internet of Things from a Management Perspective. Journal of Emerging Trends in Marketing and Management 1(1), 8-21 (2017).
11. Schuh, G., Salmen, M., Jussen, P., Riesener, M., Zeller, V., Hensen, T.: Geschäftsmodell-Innovation. In: Reinhart, G. (ed.) Handbuch Industrie 4.0, Hanser, München (2017).
12. McCarthy, Daniel M., Peter S., Bruce G. S.: Valuing subscription-based businesses using publicly disclosed customer data. Journal of Marketing 81(1), 17-35 (2017).
13. Rappa, M. A.: The utility business model and the future of computing services. IBM systems journal 43(1), 32-42 (2004).
14. Lee, S. H. S.: An Exploration of Initial Purchase Price Dispersion and Service-Subscription Duration. Sustainability 11(9), 2481 (2019).
15. Janzer, A.: Subscription Marketing: Strategies for Nurturing Customers in a World of Churn. Cuesta Park Consulting, Mountain View (2017).
16. D. Schallmo: Geschäftsmodelle erfolgreich entwickeln und implementieren. 2nd edn., Springer Gabler, Berlin (2018).
17. Bititci, U., Martinez, V., Albores, P., Parung, J.: Creating and managing value in collaborative networks. International Journal of Physical Distribution & Logistics Management 34(4), 251-268 (2004).
18. Rockart, J. F.: Chief executives define their own data needs. Harvard Business Review 57(2), 81-93 (1979).
19. Weigel, S., Hadwich, K.: Success factors of service networks in the context of servitization – Development and verification of an impact model. Industrial Marketing Management 74, 254-275 (2018).
20. Vorraber, W., Müller, M., Voessner, S., Slany, W.: Analysing and Managing Complex Software Ecosystems: A Framework to Understand Value in Information Systems. IEEE Software 36(3), 55-60 (2019).
21. Vorraber, W., Vössner, S.: Modeling Endogenous Motivation and Exogenous Influences in Value Networks of Information Service Systems. Journal of convergence information technology 6(8), 356-363 (2011).
22. Biem, A., Caswell, N.: A value network model for strategic analysis. Proceedings of the 41st Annual Hawaii International Conference on System Sciences 2008, 361-368. IEEE, New York (2008).

23. Ebi, M., Tittel, J., Doelle, C., Schuh, G.: Generic Description of Service-Related Business Models in the Field of Machinery and Plant Engineering. Congress of the German Academic Association for Production Technology, 763-775. Springer, Cham (2018).
24. Schmalen, C., Kunert, M., Weindlmaier, H.: Erfolgsfaktorenforschung: Theoretische Grundlagen, methodische Vorgehensweise und Anwendungserfahrungen in Projekten für die Ernährungsindustrie. Schriften der Gesellschaft für Wirtschafts-und Sozialwissenschaften des Landbaues eV, vol. 41, 351-362. Landwirtschaftsverlag, Münster (2006).
25. Trienekens, J., van Uffelen, R., Debaire, J., Omta, O.: Assessment of innovation and performance in the fruit chain: The innovation-performance matrix. British Food Journal 110(1), 98-127 (2008).
26. Kmenta, S., Ishii, K.: Scenario-based failure modes and effects analysis using expected cost. Journal of Mechanical Design 126(6), 1027-1035 (2004).