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Development Of A Systematization Of Service-Oriented Business Models For The Mechanical Engineering Industry

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Abstract

Manufacturing companies, such as plant manufacturers and factory equipment suppliers, have been able to expand their traditional business model with services in recent decades, particularly around their core product. Thus, the transactional business model evolved into today's project business, where for example engineering services and after-sales services were additionally provided. Through the advancing integration of producers, customers and machines into cyber-physical systems, known as Industrie 4.0, it is now also possible to offer the core product as a service. This development is described with the help of various concepts such as service transformation, product-service system and servitization. Many of these concepts are interdependent and ambiguous. A clear scientific treatment of the concepts and especially a comparison of the concepts is therefore currently not possible.

Therefore, the purpose of this paper is to develop a systematization in the form of a morphology that describes the various concepts that constitute servitization of the core service product in the engineering industry. In doing so, the systematization is based on the four dimensions: customer, value proposition, revenue mechanics and value chain.

Keywords

Industrie 4.0, business model, mechanical engineering industry; servitization

1. Introduction

Manufacturing companies are confronted with increasingly shrinking margins and stagnating revenues. Due to globalization, this effect will continue to increase as a result of growing competition. For this reason, companies in the industrial goods sectors, such as mechanical and plant engineering, have long since refrained from competing with new rivals on price. Previous means of differentiation were a consistently high level of technological innovation, which led to ever-shorter product life cycles and a high level of investment. However, since even in the field of technological leadership, innovation cannot provide lasting protection against technologically equal competition that draws one back into price competition, companies are looking for sustainable solutions. One such solution is the development of service-oriented business models with a radical customer focus with the aim of achieving a competitive position that cannot be attacked through lasting customer loyalty [1]. For instance, understanding the customer cannot be imitated. Services have therefore been used for many years to create an increasingly individualized offer to the customer [2]. Both complementary services and the core product itself are offered as services. Companies under various names, which are partly similar but also differ in detail, provide a multitude of such offers. Research has not yet been able to provide a uniform model that systematizes these service-oriented business models. In this paper, we, therefore, want to examine the characteristics of service orientation using the example of mechanical and plant engineering in a first step. The aim of the paper is to develop a morphology of service-oriented business models. This morphology should serve to develop an understanding of the manifold characteristics of service-oriented business models.

2. Business model and service transformation in mechanical and plant engineering

Machinery and plant engineering is an important economic sector for many industrialized economies. In terms of turnover, machinery and plant engineering is the second most important industry in Germany and by far the largest industry in terms of the number of employees [3]. For many decades now, machinery and plant manufacturers have not only been pure suppliers or producers of physical products. Although products still form the core of the range of offerings, they are supplemented by services. Examples of such services are engineering, implementation and ramp-up of the machine or plant as an upstream service as well as maintenance, service and upgrades as a downstream service. This addition to the actual service increased the depth of added value and customer loyalty. This development also changed the earnings mechanics of many machine and plant manufacturers. Today, they earn less from the sale of machines, profit is rather generated over the lifetime of the machines [4]. This opens up new opportunities for machine and plant manufacturers to generate revenue beyond product sales and to further differentiate themselves. In addition, falling product margins and stagnating sales in the core business can be countered in this way.

The consistent continuation of this development with a simultaneous conceptual revolution in the sense of a business model has been finding its way into machine and plant construction for a few years now. The core product is no longer supplemented by services, but the product itself is sold as a service. In this way, the production of services or the creation of value is separated from the physical goods and only the former is sold to customers. Therefore, there is no transfer of ownership (transaction) of the machine or plant, but the service provided by the machine is paid for. An example is the company Schneider Electric, where production facilities that actually represent a high initial capital outlay are monetized with a pay-per-use model based on actual consumption. Other examples include the plant manufacturer SMS Group, which offers both entire plants and the associated equipment as an as-a-service business model. This has been accelerated by the emergence of cyber-physical systems and the networking of production facilities, known as Industrie 4.0. It is only through this digitalization and networking that automatic measurement and billing of the service provided is possible and allows these business models to emerge on a broad scale.

Machine and plant manufacturers are currently offering this new service as a complement to their classic product range. A sale of the original product as pure service is not yet taking place. The change from a producer to a service provider is also called service transformation. The service transformation is primarily about the development of new service-oriented business models that are unique and difficult to imitate and thus generate a competitive advantage [5]. This transformation process is proving increasingly difficult and time-consuming for machinery and plant manufacturers. One reason for this is that the service transformation requires high initial investments. Secondly, there is no immediate return on investment and a break-even point cannot be foreseen. Consequently, a successful service transformation is not on the horizon. The situation in which companies find themselves in this transformation process is called the service paradox.

A common cause why providers are confronted with the service paradox is that currently companies do not actively pursue systematic development of business models to achieve a self-defined goal; instead, business model development often takes place on the initiative of the customer [6]. This guarantees a corresponding demand on the market, but questions about profitability are only asked during the development of the business model or after the market launch.

The reason why there is no systematic business model development is that there is no uniform understanding of service-oriented business models. For example, the naming of the service offering varies greatly from provider to provider. Services are advertised using ambiguous and interdependent terms. On the other hand, the services offered differ when the concrete business model is analyzed in more detail. Thus, under the offered service, as described, supplementary services, as well as the core product itself, are offered as a service. These in turn differ in the details of what is offered and how a service contract is structured.

These challenges make it difficult for companies to gain an overview and thus develop an approach that ensures efficient and effective use of investments so that they can successfully go through the service transformation process.

3. Theoretical Background

The development of Industrie 4.0 as an increasingly digitalized and interconnected manufacturing industry has also increased the importance of business models. The innovation of business models describes a holistic change within the company, where various previously separate business areas work together on a business model. For example, the range of services, the way in which services are provided or the way in which payments are processed change. All these changes also require a coordinated transformation so that formerly separate business areas must network and work together. Despite the increasing importance of business models, there is no universally valid definition in the literature. Nevertheless, the common definitions all point in one direction. For example, a business model describes the way a company creates value for its customers and earns money in the process. Similar definitions can be found in Osterwalder [7], Gassmann [8] or Nagl [9].

A business model is usually described with the help of a methodology. Common methodologies are similar and differ mainly in the level of detail. For example, Osterwalder uses nine levels in the so-called Business Model Canvas to describe a business model, while Gassmann's Business Model Navigator reduces these to four elements. These elements include the value proposition (1). This describes all the benefits of a company (products and services) that are of use to customers (2) and satisfy their needs. The customer describes all customer segments to which the business model is addressed. The value chain (3) describes all processes and activities carried out by companies to realize the value proposition. This includes all resources and capabilities used along the value chain. The revenue mechanics (4) describes how the company generates revenue by fulfilling the value proposition and the costs that are incurred. The focus here is on how the company generates value.

A characteristic of digital business models that arise in the context of Industrie 4.0 is that they have a high degree of service orientation. Service transformation refers to the development of a company from a pure product manufacturer to a service provider [5]. The partial term transformation expresses that the process of change or transition is the focus of consideration [10]. Especially, in English literature, service transformation is also referred to as servitization [1], service infusion [11] or service transition [12].

The most important current research topic is the description and development of a procedure for the transformation of a manufacturing company. The number of publications on this topic has risen steadily in recent years [13].

4. Methodological approach

To obtain a comprehensive knowledge base before the actual systematization, the current state of science on business models, business model innovation and service transformation is analyzed. In addition, the status of the German mechanical and plant engineering sector will be examined in more detail. The focus is on the technologies that are being used and current challenges that must be overcome by the companies. The conceptual definition of further steps for the development of a systematization of service-oriented business models in mechanical and plant engineering is shown in Figure 1.

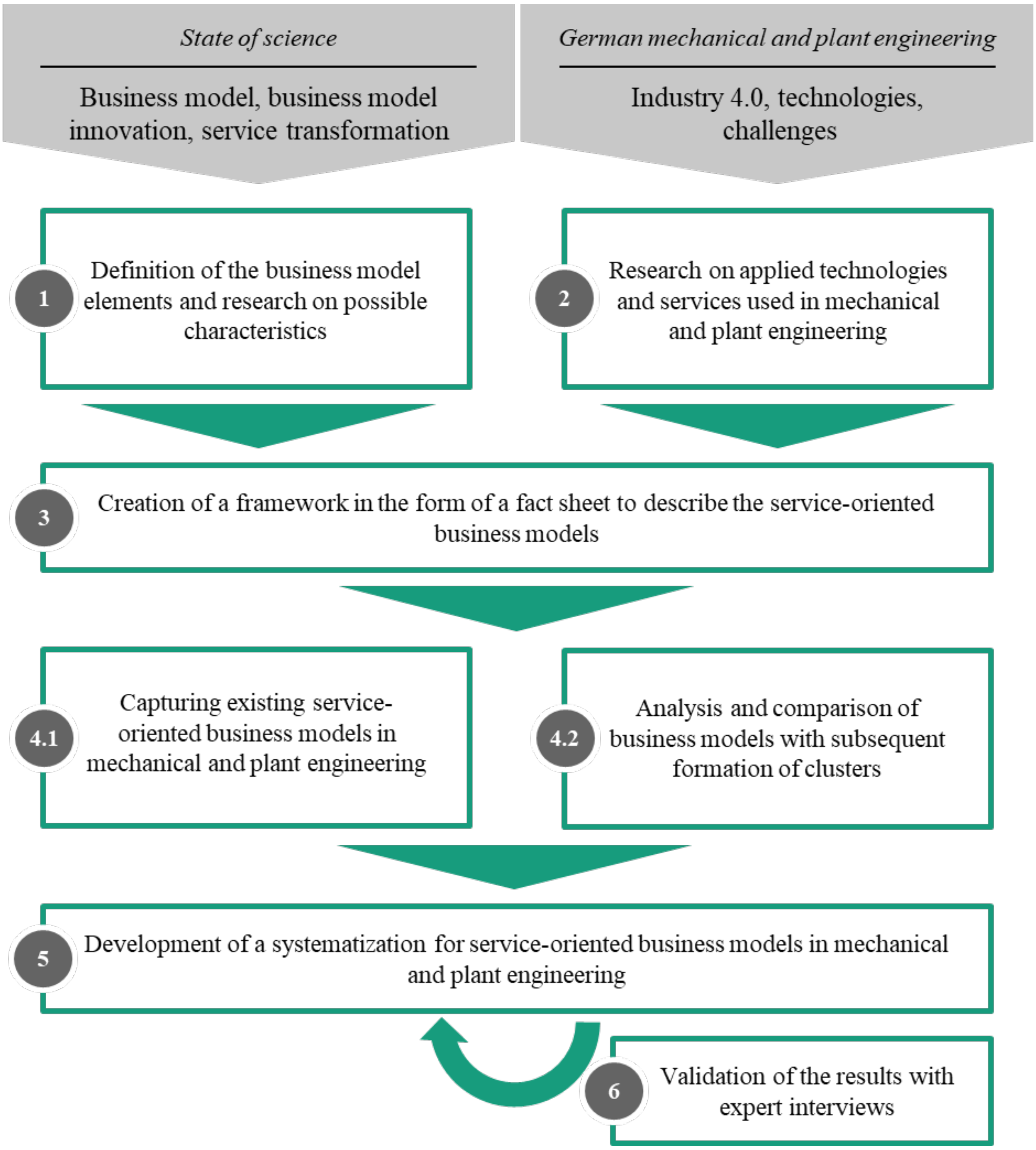

Figure 1 Conceptual approach to systematization

Research on business model elements and characteristics

In the first step, based on the findings from the literature, the business model elements are defined, which are relevant for the elaboration of this work. In addition, it is defined which conditions the business model must fulfill to be called a business model innovation. Subsequently, the literature will be researched to determine which different characteristics exist for the individual elements of the business model.

Research on technologies and services in mechanical and plant engineering

The basis for business model innovations in mechanical and plant engineering is, among other things, new technologies in connection with Industrie 4.0. In this work step, we will examine which technologies are currently offered in the mechanical and plant engineering industry and what potentials they offer for new business models. In addition, which types of services are generally offered in the mechanical and plant engineering sector, as these are core components of service-oriented business models.

Creation of a framework

With the help of the results from the first two work steps, a framework for describing service-oriented business models will be created. Descriptive characteristics that are easy to understand and measure are selected for the framework. The description characteristics are used with the determined forms of expression as a profile for the collection of practical examples. The uniform format makes it easier to evaluate and compare the recorded business models.

Capturing existing business models

Existing business models are mainly examined via an Internet search and missing information is gathered, where possible, via telephone conversations with experts. The focus of the investigation is on companies operating in the German mechanical and plant engineering market. This also includes international companies that have their headquarters outside Germany. If characteristics of the descriptive features can be found that are not yet presented in the framework, they are added.

Analysis and comparison of the business models

The recorded business models are then analyzed. An assessment is made as to whether they are business model innovations. New manifestations of the descriptive characteristics are collected and added to the previous collection. Afterward, the business models are clustered based on similarity characteristics.

Development of the systematization

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Validation of the results

In the final step, the systematization is validated with the help of expert interviews. During the validation, the model is presented to experts from the mechanical and plant engineering sector and the applicability and completeness of the model are checked.

5. Development of the Morphology

Through the many publications in research, the term business model has evolved over the years and many different definitions and models have emerged. Gassmann and Frankenberger's magic triangle describes the business model with four dimensions, customer value proposition, value chain and revenue mechanics. In summary, a business model is defined by who the customers are, what is sold, how it is made, and how revenue is realized [8]. The triangle shows that the cornerstones are interrelated and interdependent. According to Gassmann and Frankenberger, only when at least two of the four elements are changed, business models are innovations. For the further elaboration of the work, the magic triangle with the four elements was taken as a basis. In the next steps, the different forms of the four business model elements will be collected and compiled by researching literature and collecting practical examples. A strong focus is placed on innovative technologies that are currently being used in mechanical and plant engineering. This is because trends and technologies related to Industrie 4.0 are drivers for the development of service-oriented business model innovations. In addition, the different types of industrial services in mechanical and plant engineering are compiled and integrated into the systematization because in service-oriented business models in the manufacturing industry, classic services are usually the basis of the service offered. To capture service-oriented business models from practice and to describe their characteristics, a framework is developed in the form of a profile. The profile consists of descriptive characteristics and their forms compiled so far. The practical examples from literature and internet sources contain basic information about the business models. However, they are not comprehensive enough to serve all description features. Information about the exact revenue mechanics or profound cooperation frameworks is kept confidential by the companies and usually not available from public sources. The core of the profile consists of five selected descriptive characteristics with their respective forms of expression. The characteristics industrial services, benefit potentials, Industrie 4.0 technology, key partners and revenue sources were selected to check whether the collected expressions are comprehensive or whether further points from the practical examples need to be added. In addition, the assumption is made that the business model can be described comprehensibly and extensively with the characteristics mentioned. Based on the characteristics, the business models are later compared with each other and similarities are identified. After the creation of the profile, the next step is to collect practical examples of service-oriented business models in mechanical and plant engineering. The survey method used was against the written-postal survey, because in this classic quantitative survey the questionnaire is sent to the target group and the respondents can answer the questions in writing. With this type of data collection, one often gets a low response rate, which affects the validity of the results. Instead, practical examples were included that are described in detail in the literature, such as studies by research institutes and the website of companies from the mechanical and plant engineering sector was analyzed. Based on the available data, the fact sheet is filled in for each example. With this method, a large amount of data is obtained which can be compared through the uniform profile. Since one person collects the data, the descriptive characteristics, including forms of expression, are uniformly understood and there is little room for misunderstanding. The study focuses on machinery and plant manufacturers operating in Germany but not necessarily having their headquarters in Germany. With the assumption that companies with high sales have more financial means and resources to further develop their business models or to develop new ones, only companies with annual sales of at least 100 million euros are included in the study. In selecting the companies whose business models will be examined in more detail, one of the sources used is the European company database "Amadeus". Amadeus is a free database from Bureau van Dijk Electronic Publishing, Europe's leading provider of electronic company information. Information such as country of origin, turnover and number of employees are taken from the database if available. Otherwise, this data is taken from the company homepage. A total of 50 service-oriented business models from 45 different companies are recorded. After the service-oriented business models have been recorded using the profile, they are compared with each other based on the descriptive features and characteristics. The focus is on the identification of further characteristics of the features and commonalities of the business models. The frequency of the characteristics is counted for the practical examples, whereby multiple answers are possible. Based on the similarity characteristics, the business models are then clustered. The clusters correspond to use cases for service-oriented business models in mechanical and plant engineering., After the analysis of the recorded practical examples, the insights gained are added to the results from previous work steps. The description features used for service-oriented business models in mechanical and plant engineering with all forms of expression can be seen in full as a systematization in Figure 2.

Customer

Customer segments	Mass market	Niche market	Market segments	Diversified customer segments	Multi-sided market

Benefit

Industrial service	Assembly	Commissio-ning	Repair	Spare parts service	Maintenance	Productivity increase	
	Morder-nization	Simulation	Engineering	Software	Analyses	Procurement Service	
	Dismantling/ Disposal/ Recycling	Project-management	Planning	Consulting	Financial Service	Leasing/ Renting	
	Concessions business	General contracting	Transpor-tation services	Trainings	Teleservice	Docu-mentation	
Hybrid service bundles	Bundeling	Systems Selling	Full Service	Service Package	Product Service	Installed Base Service	Solutions
	Integrated Solutions	Eco-Efficient Producer Services	Product-Service System	Functional Sales	Functional Product	Integrated Product and Service Offering	
Degree of digitization	Product-dependent services	IT-based services	Digital services	Digitized product service systems			
Potential benefits	Increase performance	Cost reduction	Transparency of personal data	Data availability			
	Financial transparency	Increase flexibility	Risk minimization	Ressource efficiency			
Qualification of the value porposition	Function-oriented	Availability-oriented	Results-oriented				

Yield mechanics

Cost type	Fix costs	Variable costs						
Cost advantages	Economies of scale	Compound effects						
Source of income	Sales	Benefits fees	Subscrip-tion fees	Rental/ Leasing	License fees	Brokerage fees	Advertising fees	
Price mechanism	List price	Equip-ment depen-dent	Customer segment depen-dent	Quantity depen-dent	Nego-tiation	Earnings manage-ment	Real-time market	Auction

Value chain									
Key activities	Production	Problem solving	Platform/ Network						
Key resources	Financial resources	Physical resources	IT-based resources	Inventory resources	Personal resources	Structural resources	Cultural resources		
Key technology	Cyber-physical systems (CPS)	Cloud Computing	Internet of things (IoT)	Big Data	Arificial Intelligence (AI)				
	Virtual Reality/ Augmented Reality	Smart Factory	3D printing	Digital twin	Blockchain				
Key partner	Competitor	Customer	Suppliers	Banks/ Credit institions	Consulting	Research institutes	Industrial service providers		
Cooperation direction	Horizontal	Vertical	Diagonal						
Motivation for partnerships	Time advan-tages	Know-How advan-tages	Market success	System compe-tency	Cost advan-tages	Risk minimi-zation	Allocation of resources	Acquisitio nof resources	
Cooperation areas	Logis-tics	Pro-duction	Marke-ting	Sales	Service	Compa-ny infra-structure	Human resource s	R&D	Procure-ment
Cooperation intensity	Temporary	Unlimited in time							
Cooperation basic types	Joint Ventures	Strategic alliances	Company network						

Figure 2 Systematization of service-oriented business models in mechanical and plant engineering

6. Summary and Outlook

In this paper, we have developed a morphology of service-oriented business models based on previous research. To this end, we first examined the subject of study, mechanical and plant engineering, as one of the most important and strongest job-creating sectors. The service paradox was identified as the biggest problem here. Companies caught in the transformation process from a provider of physical products to a provider of services are often unable to utilize the full potential of service-oriented business models. Based on current research in the area of service-oriented business models and transformation, a current state of science and research in the area of service-oriented business models was presented. This showed that despite intensive research in the area of the transformation process, a large number of terms has been established to describe the topic. However, there was no uniform systematization and delimitation of the terms in theory. Therefore, we designed an approach in chapter 4 to develop a morphology with the help of the examination of selected practical examples. This development was then carried out in detail in chapter 5.

The benefit of this paper is, on the one hand, an initial compilation of the characteristics of service-oriented business models. In this way, companies can quickly gain an overview of the possibilities offered by service-oriented business models. For the further scientific treatment of service-oriented business models, the results of this paper offer a basis for a holistic and systematized approach to the topic.

Further research needs arise from practice. The compilation developed here is only a first step in a later process of economic assessment and selection or development of a service-oriented business model. Also, further research in similar industries like process or automotive industry makes sense, since industry specific research on business models is relatively scarce by now.

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Biography

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