Significance of service-based business models – A survey in the machine tool building industry

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European machine tool builders are facing competition from emerging countries in a situation coined by the economic crisis. New business models with a stronger service orientation are seen as an instrument to react to the upcoming competition and future challenges. Therefore, the aim of this paper is to analyze specific types of service-based business models in the machine tool building industry. By doing so, three concepts of particular promising new service-based business models were identified. Data was collected in the second half of 2012 by an online survey among the members of the European machine tool association (CECIMO). Results indicate that especially flexibility-oriented services can help to support machine tool building firms in the face of competition.

1. Introduction

Machine tools are used for multiple industrial purposes and serve as input for many industrial production processes. Therefore the machine tool building sector can be described as the heart of industrial production. European machine tool building (MTB) companies are known for developing and producing high quality and high precision machines. However, European manufacturing companies in general – and especially MTBs – still have to deal with the aftermaths of the economic downturn and additionally they are facing new competitors from emerging markets. New business models with a stronger service orientation are seen in this situation as a means to react to the upcoming competition and to react to future challenges (Spring; Araujo, 2006).

These so-called service-based business models can help to cope with the market challenges by offering a different value proposition: Instead of selling a product, a sale of use is offered by integrating product and services to a comprehensive offer (Tukker, 2004). Through this additional service component customer loyalty and customer acquisition can be positively influenced (Kinnunen, 2011).

Advantages of expanding the industrial service business, as well as pitfalls in doing so, have been intensively analyzed for companies belonging to the manufacturing industry (e.g. Gebauer et al., 2012; Storbacka et al., 2013; Brax, 2005). However, the design of service-based business models, their dispersion rate and motives vary widely in the different sub-sectors of manufacturing industries. Although case study research in this field is rich and highlights the specialties of different sub-sectors, like e.g. ICT (Visintin, 2012), automotive (Baines et al., 2009), pulp and paper (Davidsson et al., 2009), there is comparatively less quantitative research testing the application

of these specialties for whole sub-sectors. Therefore, the aim of this paper is to analyze specific types of service-based business models in the machine tool building sector.

Based on the findings in scientific and practice-oriented literature, and supported by qualitative interviews with stakeholders of European machine tool building companies, three concepts of particular promising new service-based business models for the machine tool industry were identified. Afterwards, empirical data on this business models were collected via an online survey among the members of the European machine tool association (CECIMO). Based on these results of the specifically collected data, a state-of-the-art overview of service-based business models for MTBs can be given. Furthermore, an analysis highlights the specificities of the business models and how the contextual factors look like.

Summarizing, the paper is organized as follows: First, the differences between traditional and new business models are described. The subsequent analysis of key characteristics of new business models leads to the examination of three new business models, which are described in detail. In the following section, the design of the survey is reasoned out. In the last section the results are described and conclusions from the analysis of specific business models in the machine tool sector are given.

2. Business Model Characteristics

2.1. Traditional Business Models

Thinking in business models, which became prominent in the field of e-business, found its way into all sectors and ages of firms (e.g. Chesbrough; Rosenbloom, 2002; Osterwalder; Pigneur, 2010). The objective of a business model is to exploit a business opportunity in the way that value for all involved parties is created (Zott; Amit, 2010). Although differing descriptions on constitutive components exist, the proposed components of a business model identified in literature can be grouped into three main dimensions (Doganova; Eyquem-Renault, 2009), which holds true also for a recent business model definition by Osterwalder and Pigneur (2010): First, the value proposition, which describes the value-added that the offer delivers to the customer. Second, the value chain architecture, which describes how the value is created, which actors need to be involved and how the value-added is delivered to the customer. The third and last dimension is the revenue model, that lines out which revenue mechanisms are applied. As constitutive parts of a business model these three dimensions are outlined in brief in the following.

Value Proposition

The value proposition describes the advantages and the value generated by the business model for the provider and customer as well as for other partners of the network, e.g. suppliers or co-operating parties (Osterwalder; Pigneur, 2010). The value proposition is at the end the ensemble of products and services offered by the company. Hence, a business model is not tied to a specific product, but is defined by the value creation for the customer. At the same time the value proposition distinguishes which activities do not create value for the customer and should not be carried out by the company (Stähler, 2002).

Value Chain Architecture

The architecture of the production of goods and services is subdivided into three parts: 1) Product & market offer, 2) internal architecture, and 3) external architecture. The business model establishes a linkage between these three elements in order to fulfill the value proposition given to customers and partners. The product design lays down the exact configuration of what is offered by the company (Knyphausen-Aufseß; Meinhardt, 2002). This can be a product, a service or a combination of both components. The final configuration also constitutes a differentiation feature against offerings of competitors (Spath; Demuß, 2006). In the market design the decision in which market or market segment the company wants to be active with the offer is captured. This decision can be made according to e.g. customer characteristics or geographical considerations (Zollenkop, 2006). The internal architecture comprises the resources applied to realize the value proposition, the sequence of activities performed in every step of the value chain and finally the communication channels and mechanisms for coordination between the value chain steps. Furthermore, it defines what activities have to be performed within the company and, by doing so, segregates what activities need to be performed by external parties such as value chain partners or customers. In the external architecture interfaces to third parties, which either actively or passively take part in the fulfillment of the value chain, are exposed (Stähler, 2002).

Revenue Model

The revenue model states from which sources and in which way revenue is generated in the business model logic. A business model can also comprise different revenue sources. There is no singular revenue mechanism that characterizes the business model, rather a specific mix (Hamel, 2000; Stähler, 2002). Figure 1 shows a graphical presentation of the business model of the given definition.

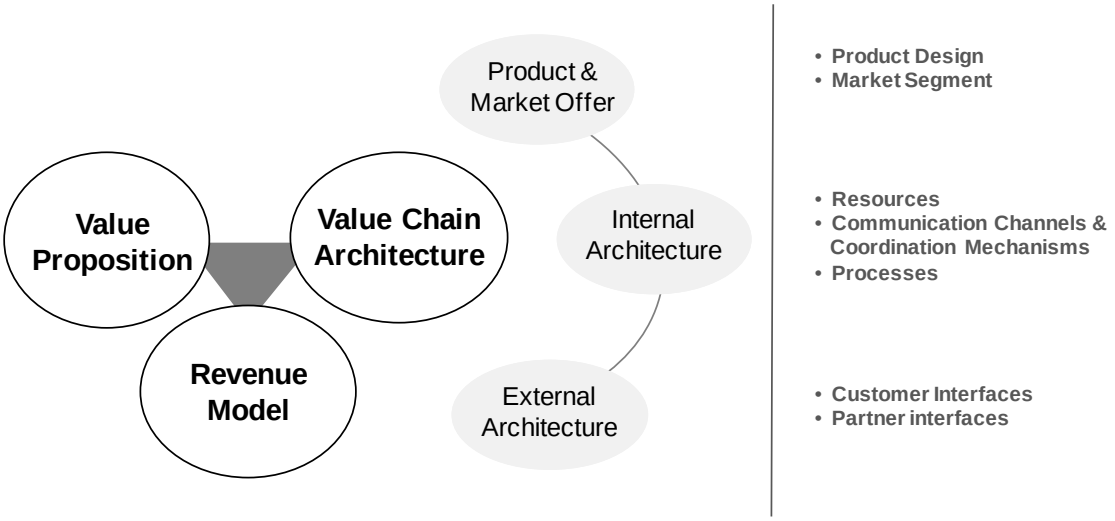

Fig. 1: Business model dimensions according to Stähler (2002) and Timmers (2000)

Accordingly, a business model is meant to show the mutual linkages between the involved internal and external parties. In addition, it allows to identify starting points for innovation and changes in the external business environment (Rentmeister; Klein, 2003, Osterwalder; Pigneuer 2010). Furthermore; a business model refers to an individual field of business activities. Following this principle, a company that is active in several different business fields can have different business models. Vice versa a

business model can be a valid image of the business activities for several independent companies (Hedman; Kalling, 2003). Especially in mature markets where companies often hardly can be distinguished in terms of the value proposition for customers, a group of sector specific business models can be attested (Stähler, 2002; Timmers, 2000). This conceptualization of a business model allows us to speak of a traditional business model in industry sub-sectors and to confront it against new service-dominated offers in the machine tool building sector.

2.2. Business model innovation

An innovation can be described as new compared to the status quo and at the same time improving the economic situation of a company (Stähler, 2002; Schumpeter, 1964). Following the OSLO manual, an innovation is the alteration of technical processes, organizations, products or services judged from the subjective perspective of the individual company (OECD, 2004). The alteration of a business model (Vives; Svejenova, 2011) categorizes the alteration of a business model according to its reason and nature. In front of this categorization is a dynamic understanding of the business model which also runs through a lifecycle (Teece, 2010). However, the innovation of business models is still a research area in its infancy. Most approaches to dissect the nature of innovation focuses on pure technological innovations for products or processes, but more recently the rise of service innovations gets to the center of scientific attention. All elements as well as the structure of the model itself can be a potential epicenter for a business model innovation (Osterwalder;Pigneuer, 2010). Due to the interconnectedness of the elements of the business model, an innovation affects and requires major changes for at least two business model dimensions (Ahlert et al., 2001).

On the one side, the obvious complexity going along with a renewal of the business model sets high demand to the management in handling this transition. But on the other side, competitive advantages are expected from a successful transition of the business model (Hedman; Kalling 2003) which are less easy to imitate and more sustainable. The competitive advantage incorporated by a new business model has to fit into the overall strategy and has to be represented within the business model through interlinkages with the pre-existing organizational structure.

The need for business model thinking in developing new services has already been pointed out by some scholars (e.g. Spring; Araujo, 2009, Neu; Brown, 2005). A business model innovation has a multi-dimensional nature. This is corresponding with the differing nature of producing and selling a product or a service. New service-oriented offers can be attested by changes in the existing business structure such as delivery system, client interface and the relationship of customer and supplier which relates to the shift of risks. Storbacka et al. (2013) highlight four areas of change that are necessary in the business models for offering comprehensive services and point out their interrelatedness. A widely acknowledged categorisation of combined product-service offers is proposed by Tukker (2004), which differentiates:

- Product-oriented services: sale of product including add-on services;
- Use-oriented services: sale of the use or availability of a product;
- Result-oriented services: sale of the result or capability instead of a product.

Figure 2 shows a graphical representation of the different business models, highlighting on an aggregate level the major differences. First insights on the practical implementation of new business models in manufacturing are provided by e. g. Palo and Tähtinen (2011) focusing on the network of actors comprised by a business model. Their focus is on the different actors working together to fulfil the value proposition of the customer. Kujala et al. (2011) analyse the factors that play a role in the decision for business models offering solutions through integrating product and service. Copani (2013) analyzes the process of expanding the service offer in the machine tool industry and highlights the different strategies behind the development paths of service-oriented business models.

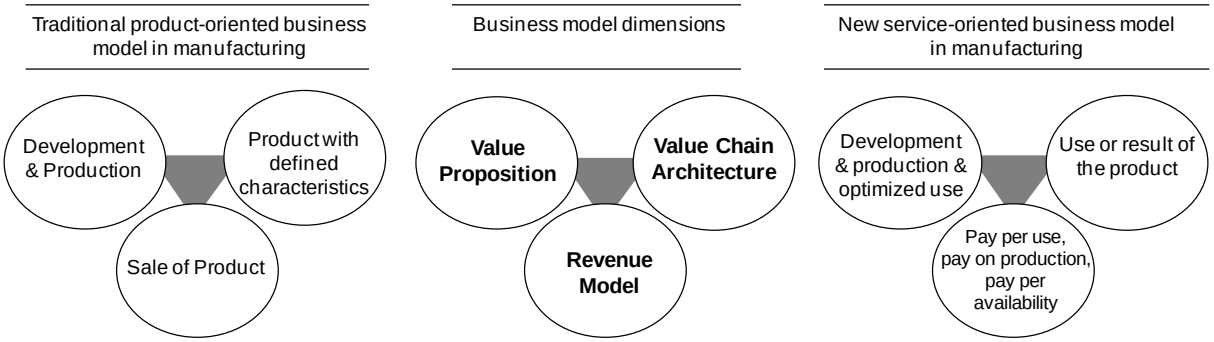

Fig. 2: Product-based versus service-based business models (adopted from Lay et al. 2009)

3. Service-based Business Models

Based on the findings in scientific and practice-oriented literature and the qualitative interviews with stakeholders involved in designing new dematerialised machine systems, three concepts of promising new business models for the machine tool industry were identified. These are:

- Availability Guarantees (Use-oriented concept)
- Operational Services/Contract manufacturing (Result-oriented concept)
- Flexibility Guarantees (Use-oriented or result-oriented concept)

Hereby availability guarantees represent the concept of use-oriented service and operational services the concept of result-oriented services of Tukker (2004). The idea of flexibility-oriented services resulted out of interviews with machine tool building companies (Buschak; Copani, 2013, Copani; Urgo, 2012). The first two concepts were debated in literature yet, while to the best of our knowledge the third one (flexibility guarantee) has not been discussed before, neither by practitioners nor by scientific literature.

The concept of selling the use or result of machine systems instead of selling the physical product is marketed as one means to dematerialize the industry and is held as a promising concept for reducing the environmental impact of production and consumption. The term “functional economy” coined by Stahel (1986) stands for this idea refraining from selling ownership to selling use. Although these both concepts still have some history, the diffusion in the sector is quite limited. But new technological development and promoted image of a service society are affecting a mature and conservative industry re-boosting these concepts. Both concepts (use-oriented and

result-oriented services) have been already analyzed in the manufacturing sector. Biege (2011) shows that according to company size between 18% (50-249 employees) and 32% (>250 employees) offer result-oriented services in the German investment goods industry which includes MTBs. Due to their practical importance the service concepts were chosen to be further analyzed. For all three business concepts the constitutive dimensions – value propositions, value chain architecture and revenue model – will be outlined in the following.

3.1. Availability Guarantees

The concept of availability guarantees promises the customer a pre-defined level of availability for the product (Tukker, 2004). The provider monitors the operating conditions of the product and/or extends this by comprehensive maintenance activities (Kindström, 2010;Lay et al., 2009).

Value Proposition

The value proposed in this business model is that the MTB takes over responsibility for the technical performance of the machine and sells the use of the machine tool. Due to the technical complexity and the already present expertise of the company, the MTB is more likely to be able to achieve the maximum availability of the machine, squeezing out the marginal potential of availability gains compared to the customer. The customer in turn is relieved from responsibility of taking care of production equipment. The company agrees on a level of availability and leaves it up to the MTB to select and perform the right activities. From manufacturing companies in Germany applying availability guarantees about 85% reported a reduction of downtime. With a lower number also cost reduction on spare parts, on planning and organization costs, on scrap costs and reduction of material and energy consumption were reported (Schröter et al., 2010).

Value Chain Architecture

The product is designed according to the customer specifications. To secure the achievement of the guaranteed availability high reliable components are built into the machine or sensors to monitor the performance remotely. Rather less influencing the product design is the possibility to send maintenance personnel to the customer´s facilities on site, permanently securing the function of the machine.

The target groups of these offers are the old customers as well as new customers. The target group might be companies that have trouble to finance the purchase of a machine and use the contract of availability guarantee as a kind of rent by paying monthly fees. Another customer type are companies where the machine is a bottle neck working with a very high capacity. They benefit from the know-how of the provider that allows to squeeze out the few percents more of efficiency.

The responsibility for the availability of the performance of the installed machinery requires some safeguarding mechanisms. This can be done by applying technology or by locating a monitoring person at the customer´s side. In both cases human capital with the necessary skills is a pre-requisite. The front end personnel must be embedded in a network of internal units reacting on the monitoring results, such as the sending and sometimes shipping of spare parts preventive to a fail out.

Characteristic for these offers is that the interfaces to the customer company are expanded in the way that either a more frequent coordination is necessary, as well as a deeper relationship needs to be build up. Additionally to this front end cooperation also backward cooperation with suppliers, such as CNC control suppliers is necessary to solve problems and prevent time outs of the machine.

Revenue Model

Clearly the revenue cannot be tied to the product price and a mark up for services. The basic for any price calculation is the promised level of availability, this can be a certain amount of hours per month were the machine works properly or calculated as a percentage of operating hours. Often the machine is sold to the customer and an additional contract on the availability is closed. However, to find measurable parameters is quite tricky. To account the often not stable efforts such as maintenance visits, spare parts or monitoring costs into a monthly stable fee is even more difficult. In these models it is quite common to agree on a bonus and malus principle, where when the MTB does not meet the guaranteed level, he must pay a pre-agreed malus (Lay et al., 2009). On the other side, when the company exceeds the level, it is paid a pre-agreed bonus. This revenue scheme reduces the uncertainty of the customer, as what exactly the providing company does is a black box, and the revenue scheme is used as an incentive for the providing company to perform efficiently.

Figure 3 depicts a morphological box for the availability business model. For every characteristic on the left side are possible attributes on the right. The attributes are selected considering the context of the machine tool building industry. Business model types such as the availability model cover different possibilities which are highlighted in orange in Figure 3. However, individual business models can only be drawn for a concrete case.

Characteristic features		Options					
Ownership	During use phase	Equipment producer	Leasing Bank	Service Company	Customer		
	After use phase	Equipment producer	Leasing Bank	Service Company	Customer		
Personnel	Manufacturing	Equipment producer	Service company	Customer			
	Maintenance	Equipment producer	Service company	Customer			
Location of service		Equipment producer´s establishment	Permanent on customer´s side	Remote/on-site visits			
Location of equipment		Equipment producer	Third party	"Fence to Fence" to the customer	Customer		
Single/multi customer operation		In parallel operation for multi customer	Operation for a single customer				
Payment modus to Equipment Manufacturer		Pay on Production	Pay per Use (Rent)	Pay for availability	Win-win share	Fixed rate	Pay for equipment

Fig. 3: Characteristics for availability guarantees (adapted from Lay et al., 2009)

3.2. Operational services

Operational services are process oriented services in which the supplier is directly engaged in the production of the results (for example by managing operations) and being also paid on results. Pay on production concepts are stereotypical examples in literature representing result-oriented services (Kleikamp, 2002; Kim et al., 2007). Also, this business model reduces the uncertainty for the customer. Selling the result is an appropriate way to bring very new production technology into the market as the risk is shared by MTB and the customer (Lay et al., 2007).

Value Proposition

The value proposed is that the MTB takes over the responsibility for the technical performance of the machine, as well as for the operating the machine and finally for the quality of the result. The MTB takes over the technical risk and also risk from any mistakes during operating. With the disposition of ownership at the MTB the customer is relieved from operational tasks, operational risks (scrap, downtime) and often also space limitations. From manufacturing companies in Germany applying availability guarantees about 63% reported a reduction of planning and organization costs. With a lower number also cost reduction on spare parts, downtime, scrap costs and reduction of material and energy consumption were reported (Schröter et al., 2010).

Value Chain Architecture

The product design is in case a new machine system is build corresponding to the customer specification. If several customers are targeted with this model, the machine tool building company must reconfigure the machine for every customer according to the special needs. Designing from the beginning, a modular system architecture is in this case of great value (Morelli, 2003). However, the knowledge and technical capability of the employed engineers in reconfiguration is of greater importance.

The target groups of these offers are the old customers as well as new customers. The target group might be companies that have trouble to finance the purchase of a machine, are in need to level temporary capacity peaks or do not reach the critical mass of the production volume. In addition, this model is a valuable offer in times of a general overhaul of the machinery.

The delivery of the parts produced on the own machine in the right time and in the right quality is essential. Compared to a pure machine tool producer planning tools and capabilities for capacity scheduling are needed especially when several short term orders with high time pressure are served or when the machines for the service business are also needed for internal testing. In addition, personnel for the service business is required that needs to be skilled in operating the own machinery. For example, employing temporary workers is not an adequate means to build up a sustainable business model focusing on a higher quality of the parts produced compared to the customer. Trained personnel are required for this task which often needs to be trained over a longer time span. In addition, if this service is offered at the MTB facilities there has to be enough job shop capacity. Often a crucial parameter for the success is the capability to wisely apply complementary assets for this model such as when the production and service personnel are equally experienced and could rotate between production service business units.

Also characteristic for these offers is that the interfaces to the customer company are expanded in the way that either a more frequent coordination is necessary, as well as a deeper relationship is build up. Additionally, sometimes logistics have to be organized by the MTB or in close cooperation with the customer, such as the delivery of raw material or in time forwarding to the next production step.

Revenue Model

The revenue for the MTB is hereby tied to the product that matches the quality requirements. Crucial is the market risk of the customer which becomes implicitly a matter of revenue schemes. When no fixed numbers of parts are pre-agreed, the machine tool provider is highly dependent on the number of parts the customer is able to sell to the end-customer. To prevent the MTB from taking over the market risks of the customer and its success or failure in selling its final product, a minimum amount of parts should be agreed in the contract. According to the level of risk, the provider is taking a risk premium which must be considered and added to the price. For calculating the right price of the parts different calculating tools than for the machine tool production should be applied. Furthermore, it takes some experience in calculating the price. Depending on the motive of the customer (leveling short term capacity peaks or long-term outsourcing and building a systemic partnership) the mark up on the costs can differ. However, the customer´s internal costs of producing the part is a good benchmark. In summary, business model types such as the operational services cover different possibilities which are highlighted in orange in Figure 4.

Characteristic features		Options					
Ownership	During use phase	Equipment producer	Leasing Bank	Service Company	Customer		
	After use phase	Equipment producer	Leasing Bank	Service Company	Customer		
Personnel	Manufacturing	Equipment producer	Service company	Customer			
	Maintenance	Equipment producer	Service company	Customer			
Location of service		Equipment producer´s establishment	Permanent on customer´s side	Remote/on-site visits			
Location of equipment		Equipment producer	Third party	"Fence to Fence" to the customer	Customer		
Single/multi customer operation		In parallel operation for multi customer	Operation for a single customer				
Payment modus to Equipment Manufacturer		Pay on Production	Pay per Use (Rent)	Pay for availability	Win-win share	Fixed rate	Pay for equipment

Fig. 4: Characteristics for operational services/contract manufacturing (adapted from Lay et al., 2009)

3.3. Flexibility Guarantees

The willingness of an actor to modify a given agreement in order to align it with the current environmental conditions is described as flexibility. Flexibility is covering three dimensions: the capability to react to the demand for modification, the willingness to react, and the actual behavior (Ivens, 2005). Whereas flexibility in production has a

long tradition, it is rather a new topic in service-oriented business models. Though flexibility of actors in a business relationship selling industrial services is a phenomenon under study (Ivens, 2005), flexibility as value proposition in the manufacturing industry is a completely new concept. Flexibility-oriented business models are a new concept discussed in the literature (Copani; Urgo, 2012).

Value Proposition

The value proposed is to guard the customer against the dynamic changing environment. Shorter product life-cycles turn up the frequency of change in the production of end products. Production technology has been a cradle of technological evolution as more efficient production technology goes in most cases hand in hand with generating higher profit margins and which sustains a competitive edge in this sector. Thus the ability to modernize capital goods in order to keep pace with the fast changing customer demands and gaining momentum through emerging competitors has become a value adding factor. A specificity of this model is that flexibility is tapped in two ways: First the flexibility to react in a certain time to modify the machinery and second the ongoing flexibility in the business relationship to react to any customer demand such as sending spare parts in time or solve a problem quickly on a hotline.

Value Chain Architecture

The product design is highly affected by this type of business model, because the level of flexibility (capacity of the production system to adjust its performance to meet changing demand requirements without hardware modifications) and reconfigurability (capacity of the production system to modify its hardware in order to meet changing demand) should be carefully selected based on industrial situations. Additionally, these offers require from the provider to be at all time informed about the condition of the machine. Though the agreement on a future reconfiguration does not seem to deviate from the traditional sale of the product logic, the differences come through the back door. The key performance indicator for this model is the performance after the reconfiguration which is directing the monetary success of the model for the MTB. This is also the discriminating factor against providing industrial services such as modernization and retrofit. The proper functioning after a major change to the original design has to be guaranteed. Especially as inherent to any changes of a running system, any interface can be a breaking point. Therefore industrial services are a means to safeguard the functioning of the reconfigured system to the customer.

The problem of production systems flexibility management is so complex that even big companies often use naive approaches which are based on experience more than on structured analysis and design. But whereas big companies have basically the pool of resources needed to sense and adapt to the changing conditions of the environment, reacting is even more difficult for small and medium companies building for example in Germany the majority of MTBs. Therefore, especially SMEs need help for setting up and optimizing processes and production systems.

Flexibility in this model requires that the MTB is able to support customers any time to have available the right production capacity to satisfy market demand, which might change in terms of features to be manufactured and volumes. In terms of resources the most important one is the technical knowledge on how to plan and forecast production system dynamic evolution, and to modify, upgrade and overhaul the production system with the available resources. The internal value chain in this model has to keep up permanently the potential to deliver flexibility. This requires an ongoing en-

gagement in research, an active sensing without concrete customer demands on application possibilities for the current installed base of the customer, the provision of human resources able to perform activities such as forecasting, planning and pricing reconfiguration and maintenance services. The support of the planning of flexibility and the assessment to which extend it is actually feasible with the current machinery software tools and to quickly process all the information are enablers that make this value proposition economically feasible.

Different to the already described models (availability guarantees and operational services) the flexibility guarantee given by the MTB requires a supportive network of partners that have to follow the same business logic (dealing with uncertainty, keeping up to the edge of technology, several lower and discontinuous income flows). In availability guarantees the MTB gives a guarantee and if needed requires help from the supplying network. However, it is in most cases sufficient to cooperate in a business transaction or connect suppliers with customers. In flexibility-oriented models potential external partners must be part of the consortium right from the beginning, bringing in their expertise in technical design and feasibility. So these types of business models require a strong network and thus the capability to coordinate the activities of the network and distribute the effort and money in a way perceived as fair by all parties.

Revenue Model

The basis for calculating the revenue of this model is the additional value provided to customers by optimizing system flexibility design and guaranteeing the availability of manufacturing capacity. This is subject to the scope of the demanded changes to be done. Cost positions are in any case the working hours for reconstruction and material. Business model types such as the flexibility guarantees cover different possibilities. According to the already presented business models, also for the flexibility guarantees a conceptual proposal for a morphological box is presented in Figure 5.

Characteristic features		Options					
Ownership	During use phase	Equipment producer	Leasing Bank	Service Company	Customer		
	After use phase	Equipment producer	Leasing Bank	Service Company	Customer		
Personnel	Manufacturing	Equipment producer	Service company	Customer			
	Maintenance	Equipment producer	Service company	Customer			
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Fig. 5: Characteristics for flexibility guarantees (adapted from Lay et al., 2009)

4. A survey in the machine tool building industry

4.1. Survey Setting

Given the lack of data to industrial services provided by MTBs, the following quantitative analyzes are based on a primary survey collected in the second half of 2012. The questionnaire was pre-tested by researchers from Italy, Spain and France familiar in the field of manufacturing. The aim of the survey was to test the industrial applicability of services and service-based business models in the European machine tool sector. In addition to the question to what extend the new value propositions discussed are dispersed in the industry, the experiences of the MTBs with these new value propositions and the impact of these on the value chain activities were of interest. To the best of our knowledge no data on these issues on industrial services and new service business models on the European machine tool building industry exists at this level of details.

The online survey addressed European companies who mainly or partially produce machine tools in Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Italy, The Netherlands, Portugal, Spain, Sweden, Switzerland, Turkey, and United Kingdom. In these countries MTBs are organized in sector self-organizations and thus companies can be selected and addressed directly. Taking into account the unequal dispersion of machine tool production in Europe the top 5 countries of the European machine tool production namely Germany, Italy, Switzerland, Austria and Spain (VDW, 2011) were tried to address in their mother tongue (German, Italian, French, Spanish). For the residual English as lingua franca was another option to fill out the survey.

Due to the lack of a valid population frame of MTBs in Europe it was decided to rely on the self-organization of the sector for getting access to the firms. In Europe, the European machine tool association (CECIMO) represents the interests of European Machine Tool Industries including in total around 1,500 companies which are organized in 15 member associations. These companies constituted the population for the online survey, which contained five blocks of questions. The first questions in order to identify the target group were posed in order to filter any parties that received the link for the survey but do not belong to the addressed target group. The second block contained questions regarding the offering of industrial services and is connected with the third part dealing with comprehensive service offers and service-based business models. The fourth block was concentrated on the advantages and disadvantages of the individual business models and at last some basic information on the firms was requested.

4.2. Survey Results

In the following the results of the online survey are presented. The data covers a wide range of machine tool building companies from different European countries. At least 213 times the link to the survey was ticked. Out of them 110 respondents filled in the questionnaire; 24 used the English version, 11 the French, 35 the German, 27 the Italian, and 13 the Spanish version. Out of them 19 questionnaires revealed that the firm addressed does not manufacture any machine tools at all. This result shows

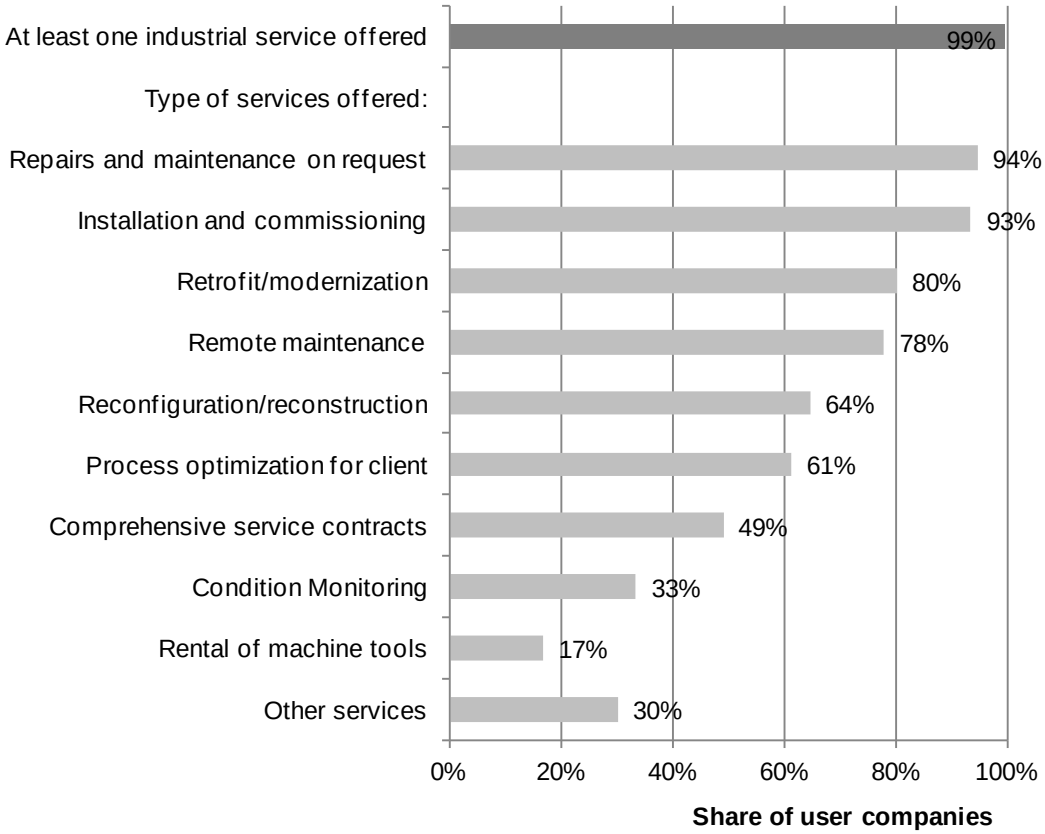
that addressing the population via CECIMO can be assessed as successful referring to the accuracy. Due to the survey frame the data does not provide any statistically representative picture, neither the sampling frame nor the responsitivity of the companies provides a common probability to participate. However, the framework of the survey provides a broad coverage of the population and therefore a basis for statements about the group of the MTBs in Europe. The following analyses are based on the information of 110 companies. The main characteristics of the companies surveyed can be summarized as follows and are also given in Figure 6. Small and medium sized enterprises as well as larger companies delivering products and services to a great variety of customer sectors are included in the sample. None of the firms produces standard machines, but in contrast offers customized or predominantly custom-made machines.

Characteristic		N	%
total number		110	
Company size	up to 49 employees	15	19%
	50 to 99 employees	10	13%
	100 to 249 employees	17	21%
	250 and more employees	38	48%
Sectors delivered to	Automobile industry	65	71%
	Metal working	65	71%
	Machinery and equipment	60	66%
	Space and aviation industry	53	58%
	Railway cars and shipping	45	49%
	Defence technology	28	31%
	Medical technology, precision mechanics and optics	27	30%
	Electrical engineering	19	21%
	Other branches	33	36%
Degree of customization	Predominantly standard machines	0	0%
	Customization based on standard machines	68	75%
	Predominantly custom-made machines	23	25%

Source: DEMAT survey on machine tool industry 2012, n=110.

Fig. 6: Overview of participating firms (multiple choices available for “Sectors delivered to”; due to missing values number of samples partly below 110)

In Figure 7 the offered industrial services are shown. Among the respondents nearly all offer at least one industrial service complementing the machine tools sold. The most often provided services are repairs and maintenance on request (94%), installation and commissioning (93%), retrofit/modernization (80%) and remote maintenance (78%).



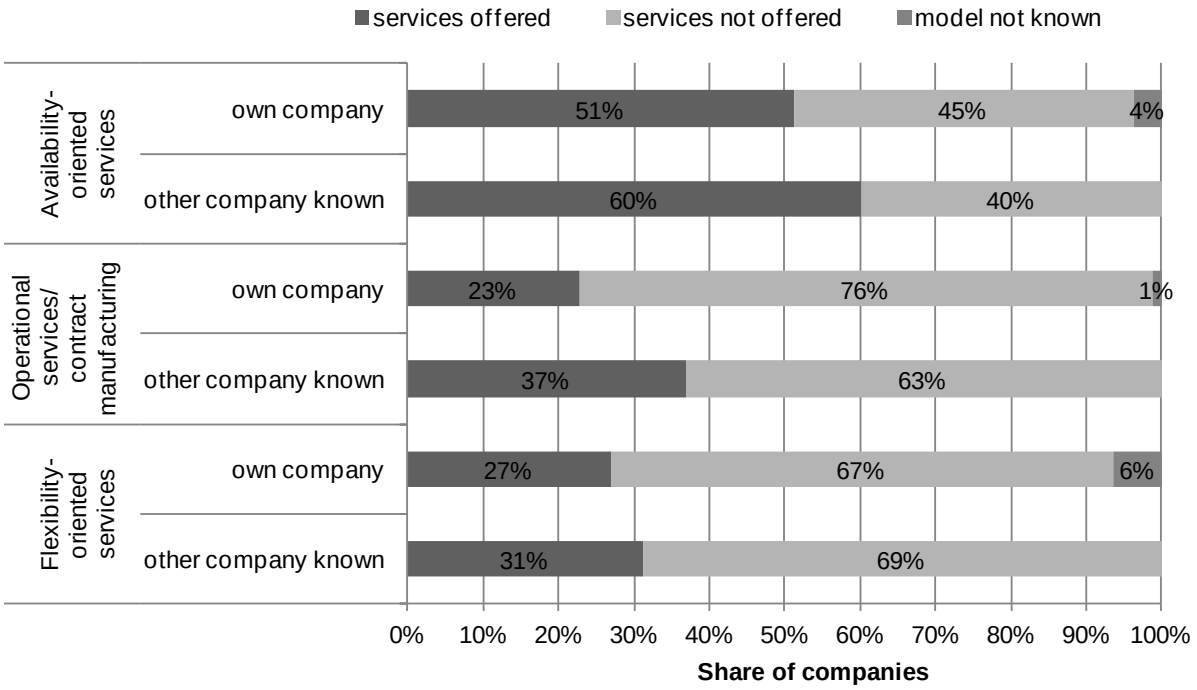
Source: *DEMAT survey on machine tool industry* 2012, n=90.

Fig. 7: Offering of industrial services

In Figure 8 the distributions of the three discussed service-based business models are presented. Two different propositions can be distinguished: The offering of the specific service by the company on their own, as well as the fact to know another company which is successfully offering these kinds of services. It seems outstanding, that nearly two-thirds of the companies know at least one other company offering availability-oriented services and even about the half provide it by their own. In contrast, operational services are only offered by a quarter of the respondents. Flexibility-oriented services are offered approximately by a quarter of the polled firms, which shows that there still is a huge potential for business models build on flexibility guarantees.

It has to be noted that the flexibility business model is indeed an unexploited concept in the scientific literature, as well as in practice, which was approved by desk research and qualitative interviews. However, the results of Figure 8 show a remarkably high rate of dispersion for flexibility oriented services which requires some more explanation. As described before business models are unique for every company. Only on an aggregate basis homogenous parameters allow to identify types of business models that characterize a dominate design of how business is done in a specific industry. Due to the innovativeness of flexibility-oriented services the challenge is to pose a question that allows the participating companies to understand the concept in case the person answering has never heard of before and to put him into place to decide if the company offers this service. On the one side, a strict formulation would not accommodate the variety of actual variants of business models and exclude potential providers. On the other side, a softer formulated question would

also fudge the result by seducing non-providers to positively answer the question. Therefore, we decided to have the following formulated first question on flexibility-based offers: “Do you offer your customers flexibility by guaranteeing the adaption of sold machine tools to future production requirements at already fixed conditions?”, clearly highlighting the differentiating characteristics such as “guarantee” of “sold machine tools”, “future production requirements” at “already fixed conditions”. As second filter we asked for the essential factors for this business model that are necessary to implement the model. These two questions allow us to have a better estimation on the real level of dispersion of the flexibility-oriented model. While flexibility oriented services are widely offered, we assume only a part of the companies to have tied to take over the full responsibility for the result in monetary terms.



Source: *DEMAT survey on machine tool industry* 2012, n=80.

Fig. 8: Offering of service-based business models

However, it can be contemplated that there is an emerging demand for flexibility from the customer side and European MTBs have already reacted upon. To which extend this is done by committing itself into the relationship with the customer or just expanding of services can be more clearly seen taking the implications of the organizational architecture into account. However, the results in this case have to be perceived with care and need to be linked with other questions. For the other two business models, due to their high profile in the industry, these problems did not arise.

In Figure 9 the details on the offered flexibility-oriented services are shown. This flexibility-oriented services include the design, building and selling of a manufacturing system with a focus on flexibility, which means that the provider foresees and guarantees future reconfigurations of the machine and is paid at a fixed price in advance. Even if the figures are based only on responses of the companies having declared to use these business models, a trend becomes visible. First, it seems that neither customer pressure, nor the company`s own initiative is a dominant reason to offer these

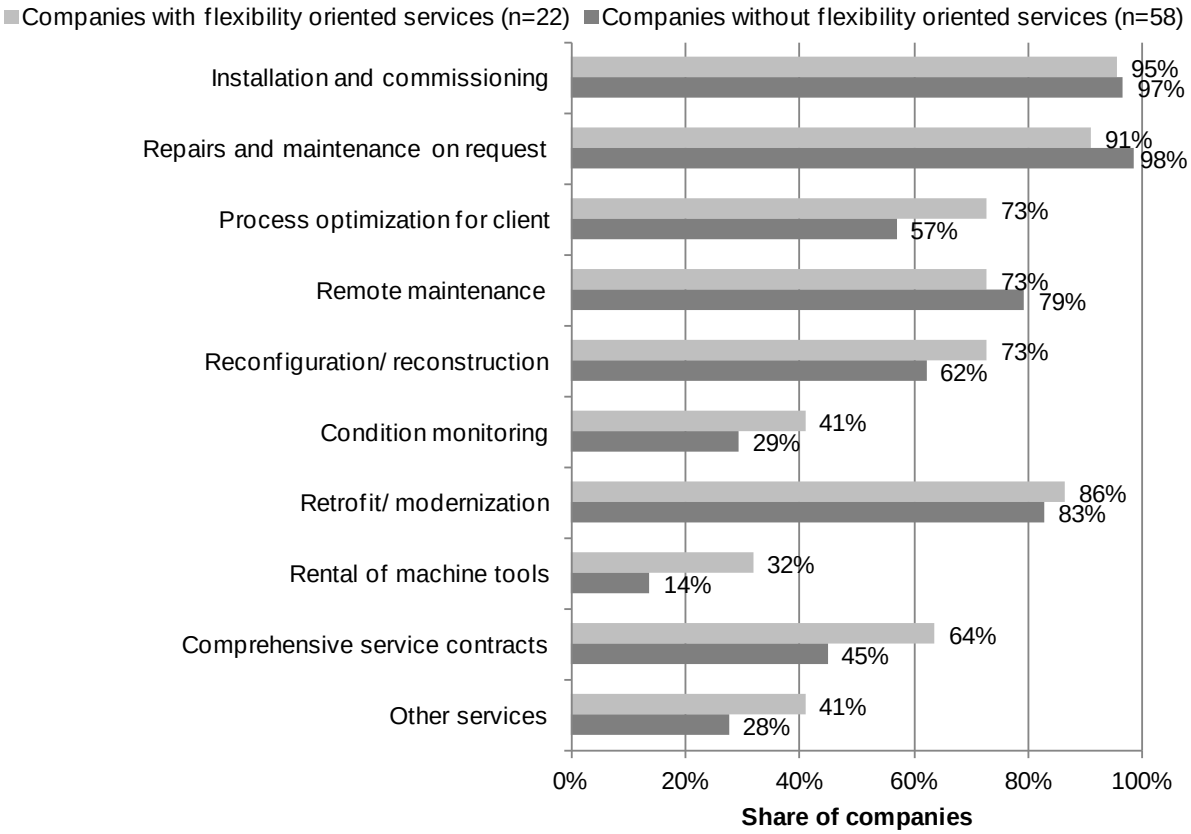
kinds of advanced services. Secondly, over one third of the respondents conducted some restructuring activities to be ready to serve flexibility-oriented services to their customers. The most important restructuring activities are the setting up of independent service units (100%) and the development of new internal competences (88%) as well as a stronger networking of internal teams (63%).

Introduction due to customer pressure		
	rather due to customer pressure	41%
	rather due to own initiative	41%
	Not known	18%
Restructuring activities when introducing		
	Yes	36%
	No	36%
	Not known	28%
Restructuring activities for flexibility-oriented services (multiple answers)		
	Setting up of independent service-unit	100%
	Development of new internal competences	88%
	Stronger networking of internal teams	63%
	Adaption of machine tool design	50%
	Application of new technologies	38%
	Cooperation with external partners	13%

Source: DEMAT survey on machine tool industry 2012, n=22.

Fig. 9: Details on offered flexibility-oriented services

Other new and interesting insights can be won by combining the offered industrial services with the more comprehensive service-based business models. In Figure 10 the different industrial services offered by companies with flexibility-oriented services are shown and compared with the services offered by firms which don't provide flexibility-oriented services. Not surprising is the fact that most of the rather basic services, like installation and commissioning or repair and maintenance on request, are even more offered by companies without flexibility-oriented services. On the contrary, more comprehensive services, like process optimization, reconfigurations and reconstructions, condition monitoring or comprehensive service contracts, are offered to a greater extent by companies with flexibility guarantees. These kind of industrial services seem to play an important role and may act as a precondition for the potential offer of flexibility-oriented services, which can help to support machine tool building firms in the face of new competition.



Source: DEMAT survey on machine tool industry 2012

Figure 10: Services used by firms with flexibility-oriented services

5. Discussion and Prospects for Future Research

In this paper three alternative service-based business models, formed by new value propositions, revenue models and supply chain architectures, were presented and analyzed. These comprehensive service offerings can be divided in 1) Availability Guarantees, 2) Operational Services/Contract manufacturing and 3) Flexibility Guarantees.

While availability guarantees and operational services are already intensive investigated, flexibility-oriented business models are quite innovative for the machine tool building industry. The value proposed in this flexibility-oriented business models is to guard the customer against the dynamic changing environment. Flexibility in this model requires that the MTB is able to support customers any time to have available the right production capacity to satisfy market demand, which might change in terms of features and volumes.

To a greater extend then compared to the models of availability guarantees and operational services, the flexibility guarantee given by the MTB requires a supportive network of partners that have to follow the same business logic, which means dealing with uncertainty, keeping up to the edge of technology, and the acceptance of lower and discontinuous incomes. The basis for calculating the revenue of the flexibility-oriented model is the additional value provided to customers by optimizing system

flexibility design and guaranteeing the availability of manufacturing capacity accordingly.

However, there are some possible barriers preventing the business model implementation. For instance, in order to implement the new business models, changes are necessary to machines and systems design, which are potential technology barriers. Beside these barriers others can be allocated to strategy and marketing barriers, competence barriers, supply chain and networking barriers and organizational barriers. Future research should concentrate on proposals how to overcome these barriers and how to establish win-win-situations for both, the provider and the customer, in innovative service-based business models like flexibility guarantees.

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References

Ahlert, D.; Backhaus, K.; Meffert, H. (2001): Geschäftsmodelle im E-Business – Modethema oder mehr?, in: Absatzwirtschaft, Special Edition for the German Marketing Day 2001, pp. 32-44.

Baines, T; Lightfoot, H.; Benedettini, O.; Kay, J. (2009): The servitization of manufacturing: a review of literature and reflection on future challenges, in: Journal of Manufacturing Technology Management, Vol. 20, No. 5, pp. 547-567.

Brax, S. (2005): A manufacturer becoming service provider - challenges and a paradox, in: Managing Service Quality, Vol. 15, No. 2, pp. 142-155.

Buschak, D.; Copani, G. (2013): Value of service-enhanced offerings: A network perspective, EurOMA Conference 2013, Dublin, Ireland, June, 7th-12th, 2013.

Chesbrough, H.; Rosenbloom, R. S. (2002): The role of the business model in capturing value from innovation: evidence from Xerox Corporation´s technology spin-off companies, in: Industrial and Corporate Change, Vol. 11, No. 3, pp. 529-555.

Copani, C. (2013): New service business models in the machine tool industry: A customer-supplier perspective. Lap Lambert Academic Publishing.

Copani, G.; Urgo, M. (2012): New business models and configuration approaches for focused-flexibility manufacturing systems, Procedia CIRP, Vol. 2, pp. 10-15.

Davidsson, N.; Edvardsson, B.; Gustafsson, A.; Witell, L. (2009): Degree of service-orientation in the pulp and paper industry, in: International Journal of Services Technology and Management, Vol. 11, No. 1, pp. 24-41.

Doganova, L.; Eyquem-Renault, M. (2009): What do business models do? Innovation devices in technology entrepreneurship, in: Research Policy, Vol. 38, No. 10, pp. 1559-1570.

Gebauer, H.; Ren, G.-J.; Valtakoski, A.; Reynoso, J. (2012): Service-driven manufacturing. Provision, evolution and financial impact of services in industrial firms, Journal of Service Management, Vol. 23, No. 1, pp. 120-136.

Hamel, G. (2000): Leading the Revolution, Boston.

Hedman, J.; Kalling, T. (2003): The business model concept: theoretical underpinnings and empirical illustrations, in: European Journal of Information Systems, Vol. 12, pp. 49-59.

Ivens, B.S. (2005): Flexibility in industrial service relationships: The construct, antecedents, and performance outcomes, in: Industrial Marketing Management, Vol. 34, No.6, pp. 566-576.

Kim, S-H.; Cohen, M. A.; Netessine, S. (2007): Performance Contracting in After-Sales Service Supply Chains, in: Management Science, Vol. 53, No. 12, pp. 1843-1858.

Kindström, D. (2010): Towards a service-based business model - Key aspects for future competitive advantage, in: European Management Journal, Vol. 28, No. 6, pp. 479 - 490.

Kinnunen, R.-E. (2011): Servitization of Manufacturing Companies - Framework for Analyzing Servitization Capabilities, Aalto University, School of Economics.

Kleikamp, C. (2002): Performance Contracting auf Industriegütermärkten, Lohmar/Köln.

Knyphausen-Aufseß, D. z.; Meinhardt, Y. (2002): Revisiting Strategy: Ein Ansatz zur Systematisierung von Geschäftsmodellen, in: Bieger, T.; Bickhoff, N.; Caspers, R.; Knyphausen-Aufseß, D. z.; Reding, K. (Eds.): Zukünftige Geschäftsmodelle – Konzept und Anwendung in der Netzökonomie, Berlin et al., pp. 63-89.

Kujala, S.; Kujala, J.; Turkulainen, V.; Artto, K.; Aaltonen, P.; Wikström, K. (2011): Factors influencing the choice of solution-specific business models, in: International Journal of Project Management, Vol. 29, pp. 960-970.

Lay, G.; Schroeter, M.; Biege, S. (2009): Service-based Business Concepts: A Typology for Business-to-Business Markets, in: European Management Journal, Vol. 27, No. 6, pp. 442-455.

Morelli, N. (2003): Product-service-systems, a perspective shift for designers: A case study: The design of a telecentre, in: Design studies, Vol. 24, No. 1, pp. 73-99.

Neu, W. A.; Brown, S. W. (2005): Forming Successful Business-to-Business Services in Goods-Dominant Firms, in: Journal of Service Research, Vol. 8, No. 3, pp. 3-17.

OECD (2005): Oslo Manual - Guidelines for collecting and interpreting innovation data, Oslo.

Osterwalder, A.; Pigneur, Y. (2010): Business Model Generation. A Handbook for Visionaries, Game Changers, and Challengers, Hoboken, NJ: John Wiley & Sons.

Palo, T./Tähtinen, J. (2011): A network perspective on business models for emerging technology-based services, in: Journal of Business & Industrial Management, Vol. 26, No. 5, pp. 377-388.

Rentmeister, J.; Klein, S. (2003): Geschäftsmodelle – ein Modebegriff auf der Waagschale, in: Zeitschrift für Betriebswirtschaftslehre (ZfB), Ergänzungsheft 1, pp. 17-30.

Schröter, M.; Buschak, D.; Biege, S. (2010): Service-based Business Concepts: Diffusion and Effects on Customer Companies in the German Manufacturing Industry; EurOMA Conference, Porto, Portugal, 6.-9.6.2010.

Schumpeter, J. (1964): Theorie der wirtschaftlichen Entwicklung. Eine Untersuchung über Unternehmergewinn, Kapital, Kredit, Zins und den Konjunkturzyklus, Berlin, 1964.

Spath, D.; Demuß, L. (2006): Entwicklung hybrider Produkte – Gestaltung materieller und immaterieller Leistungsbündel, in: Bullinger, H-J.; Scheer, A-W. (Eds.): Service Engineering: Entwicklung und Gestaltung innovativer Dienstleistungen, Berlin et al., pp. 467-506.

Spring, M.; Araujo, L. (2009): Service, services and products: rethinking operations strategy, in: International Journal of Operations & Production Management, Vol. 29, No. 5, pp. 444-467.

Stähler, P. (2002): Geschäftsmodelle in der digitalen Ökonomie: Merkmale, Strategien und Auswirkungen, Lohmar/Köln.

Stahel, W. R. (1986): The Functional Economy: Cultural and Organizational Change, in: The Industrial Green Game. 1997, pp. 91–100, Washington, DC: National Academy Press.

Storbacka, K.; Windahl, C.; Nenonen, S.; Salonen, A. (2013): Solution business models: Transformation along four continua, in: Industrial Marketing Management, available online 2 June 2013.

Teece, D.J. (2010): Business Models, Business Strategy and Innovation, in: Long Range Planning, Vol. 43, No. 2-3, pp. 172-194.

Timmers, P. (2000): Electronic Commerce. Strategies and Models for Business-to-Business Trading, New York et al.

Tukker, A. (2004): Eight Types of Product-Service Systems: Eight Ways to Sustainability? Experiences from SusProNet, in: Business Strategy and the Environment, Vol. 13, No. 4, pp. 246-260.

VDW (2011): VDW - Die deutsche Werkzeugmaschinenindustrie im Jahr 2011, 2012. http://www.vdw.de/bin/load_file_inter.pl?p_bereich=wirtschaft&p_paket_id=11&p_dok_id=10001402&p_typ=doc&p_sprache=d, last access: 17.07.2012.

Visintin, F. (2012): Providing integrated solutions in the professional printing industry: The case of Oce, in: Computers in Industry, Vol. 63, pp. 379-388.

Vives, L.; Svejenova, S. (2011): To, from and beyond the margins: Business models: towards an integrative framework, in: Management Research: The Journal of the Iberoamerican Academy of Management, Vol. 9, No. 3, pp. 230-242.

Zollenkop, M. (2006): Geschäftsmodellinnovation: Initiierung eines systematischen Innovationsmanagements für Geschäftsmodelle auf der Basis lebenszyklusorientierter Frühaufklärung, Gabler, Wiesbaden.

Zott, C.; Amit, R. (2010): Business Model Design: An Activity System Perspective, in: Long Range Planning, Vol. 43, No. 2-3, pp. 216 - 226.

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