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Life Cycle Cost-Orientated Service Models for Tool and Die Companies

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Abstract
As the success of a company's service provision is founded in its business model, the latter needs to be re-designed to align strategic and operational objectives. Therefore at RWTH Aachen University a new approach to service models for the European tooling industry links products and services by means of a direct calculation of life cycle costs. Tool and die makers are enabled to offer product-service-systems, which allow expanding the range of service provision by directly addressing the cost-effectiveness of the whole product-service-system. Hence the minimisation of life cycle costs of tools and dies can be used as a new sales pitch for services in this unique industry.
Keywords:
Business Models; Product-Service-Systems; Tool and die making; Life Cycle Costing

1 INTRODUCTION

Tool and die companies play an important role within the production industries of Germany, Japan, the United States and a few other countries as studies show [1, 2, 3]. Their key position is a result of the responsibility for industrial value chains in terms of time, costs and quality (figure 1).

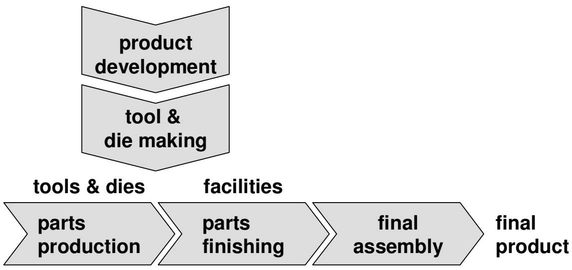

Figure 1: Tool and die making within the industrial value chain.

Purchasing departments of original equipment manufacturers (OEM) use electronic platforms more and more frequently. Ford Motor Co. expects between 70 to 80% of purchasing transactions to take place on the World Wide Web within the next years [4]. Online submissions of quotas, mainly known as e-bidding, leave the product price as the only selection-criterion. Therefore the range to differentiate oneself from the competitor is decreasing rapidly.

Exclusive differentiations in price have not worked out for German tool and die makers over the last years. Furthermore, the basic criteria for such a differentiation are not given in Germany. Therefore a promising approach for differentiation between competitors is to combine the existing range of physical products with customer-specific services. The latter is an integrated product and service offering that delivers value in use (product-service-system) [5].

In order to do this, the information asymmetry between tool and die makers and their customers at the point of sale has to be resolved; otherwise there will be no chance to enforce the price of the product-service-system [6]. To solve this problem, business science offers the theory of signaling [7]. Since investments within the production industries are mainly cost-driven, life cycle costs of product-service-systems prove to be a viable signal.

As the success of a company's service provision is founded in its business model, the latter needs to be re-designed to align strategic and operational objectives. The design of a product-service-system needs to be integrated in the strategic planning and positioning of the company. To consider these challenging demands for tool and die makers, a definition of an integrated service model is developed. The design of this model is made possible by detailed knowledge about the life cycle costs of the product-service-system as a whole.

2 COHERENCE BETWEEN BUSINESS MODEL AND SERVICE MODEL

In general, products are primary reason for customer loyalty; however differentiation within markets can only be achieved through customer-specific solutions. These solutions are no longer sold as a physical product, but rather as a service bundle.

The extension of existing business models provides a chance for German tool and die companies to sustainably improve their competitive position. Value-added can be achieved on the basis of Porter's three generic competitive strategies: overall cost leadership, (product) differentiation and focus [8]. Criteria for differentiation in toolmaking can be: time in terms of adherence to schedule, productivity and life span of the tool – whereof each will allow a price premium, if the information asymmetry can be resolved.

Many approaches to business models lead to various aspects which a business model can consist of. Table 1 summarizes different elements of models according to Mueller-Stewens and Fontin [9], Bieger, Rueegg-Stuerm and von Rohr [10], Knyphausen-Aufsess and Meinhardt [11] as well as Hamel [12].

Mueller-Stewens/ Fontin	Bieger/ Rueegg-Sturm/ von Rohr	Knyphausen-Aufsess/ Meinhardt	Hamel
value proposition	incentive system	product/ market combinations, customer value	core strategy
marketing	communication concept, growth concept	product/ market combinations	interface to the customer
production of goods and services	organization, cooperation mechanism, coordination mechanism, configuration of competencies	configuration and execution of the value added	strategic resources, value added network
benefit	benefit concept	profit mechanism	interface to the customer

Table 1: Synthesis of approaches to business models.

In this context, the main aspect in the definition of a business model should be the capitalization and the benefit mechanisms of a company. This also applies to designing business models for tool and die makers that offer product-service-systems.

As stated above, the integration of service offerings into a company's business model is a crucial factor of success. The latter can be achieved by the implementation of a sub-model into a company's business model. This service model impacts every element of the specific company's business model. Based on the approach of Müller-Stewens and Lechner, the structure of a service model can therefore be divided into four elements (figure 2):

- Value proposition: which value is offered to the customer?
- Marketing: how can appropriate customers be attracted?
- Benefit: how is the profit mechanism to be designed?
- Production of services: how shall the output be generated? [13]

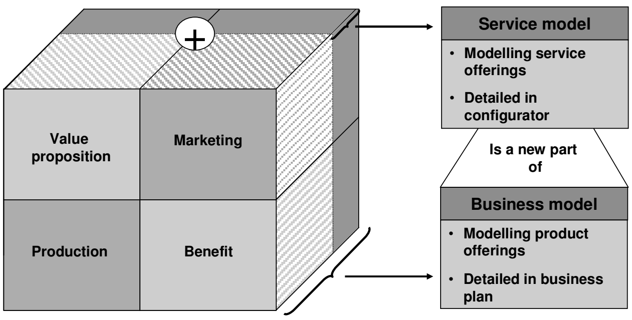

Figure 2: Coherence between service model and business model.

Once the service model has been designed completely, incentive systems tie in with market and performance decisions while offering extensive and efficient problem solutions to the customers. Incentive systems set three objectives:

1. Structuring the product.
2. Make the customer aware of versatile services.
3. Differentiate oneself from competitors.

The more distant service provision is from the initial product, the more customer-specific it has to be designed. Individual partial performances are bundled together into customer-specific packages, thus being advantageous for both the customer and the supplier. Furthermore, the integration into the company's strategic planning and design of value-added processes is guaranteed. Therefore service models are of great importance for companies.

3 ELEMENTS OF SERVICE MODELS

All four elements of a service model are linked and dependent on each other. The detailing of the four elements is highly based on an initial configuration of the product-service-system. The competitive position is to be defined along two dimensions: range of offered tools and range of offered services. Broad formations allow the integration into the customer's processes. Focused formations offer the possibility to use economies of scale and to extend profound know-how. This leads to four possible configurations of toolmakers offering product-service-systems.

- Specialists are focused not only on the offered tool range, but also on the range of offered services. They are experts in special demands in a niche.
- Standard-Suppliers are capable of delivering every possible tool. Usually they only offer repair services. This position demands a wide range of machining capacity.
- All-rounders are distinguished by their high flexibility and competence in providing solutions. They are neither focused on specific tooling technologies nor on special service offerings. This position requires profound know-how and a small range of key customers.
- Customer-integrators are highly customer-focused. They focus on a special tooling technology and support their tools throughout their entire life-cycle. All offered services are geared to specific customer problems and demands.

As described above, a service model consists of four elements. One can speak of a *Strategic Fit*, if all elements of the service model are harmonized with each other [13, 14, 15]. Beyond this, the individual elements are designed such that they support one another. This fit is of particular importance for the tool and die making industry: the cardinal positions of innovative and standardized services lead to varying needs and development potentialities. A concentration on standardized services makes uniquely defined interfaces to adjoining sectors and speediness essential. Innovative services on the other hand demand a steady learning process as well as a significant involvement in their customers' processes.

3.1 Value Proposition

The value proposition defines all services that supply the certain needs of a customer. Thereby services which consist of modular bundles [14] gain in importance: Based on competitive strategies, a service model has to configure reasonable service- and market-combinations. These allow a precise drawing of conclusions on how to achieve competitive advantage.

On this basis, the value proposition defines which services are offered to which customers and how differentiation from competitors can be achieved. The latter notably results from the combination of a premium core-product and a unique service portfolio. As services are even harder to copy than physical products, the existing service landscape is extended by customer-specific product-services in an incentive system, such as guaranteed availability, preventive maintenance or process analysis (figure 3). Results from the research and development project "SMART STAMP^ING" show, that further integration of tool and die makers into the set-up of the parts production process is explicitly desired by their customers. "SMART STAMP^ING" is a German research and development project and its basic idea consists of two objectives:

- Sensor technology is directly applied to press and die in order to collect process-data and data on the actual condition.
- A data interface between stamping plant, press manufacturer and die maker is defined to enable condition-oriented services.

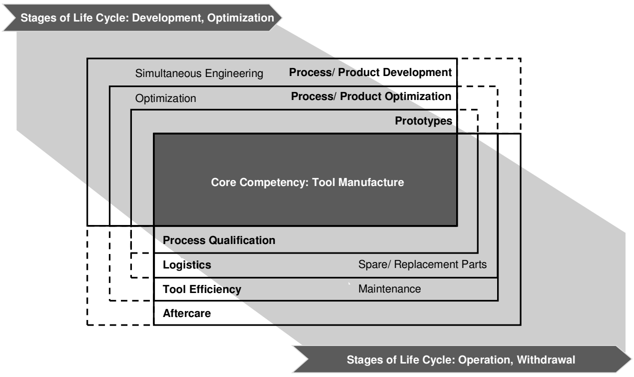

Figure 3: Extension of the service portfolio along the entire life cycle of tools and dies.

3.2 Marketing

A ‘strategic triangle’ is formed by the customers, suppliers and competitors of tool and die making companies. It describes a market in which service offerings are exchanged. The dependencies among the three vertices of the strategic triangle are to be defined in this element. Overall, it has to be considered that marketing defines not only the attitude towards the company’s customers, but also towards their competitors and suppliers.

Marketing is closely related to the definition of services to be rendered. It sets off activities to identify and address the needs of economically attractive customers. This process should be supported by adequate communication tools and the corporate claim. Especially a distribution channel in shape of a key account management allows a direct communication by personal contact with a distribution staff member or (in case of a small toolmaker) the company owner. Thus the individual needs of a customer can be addressed and holistic customer-specific solutions can be achieved. Furthermore, marketing tools, such as internet or exhibition presence and publications in scientific journals, are used to advertise the company itself and its innovative solutions.

3.3 Benefit

What matters in planning benefit is the question concerning the company’s profit mechanism:

- Units, usage and output are determined and a benefits basis built up.
- Achievable benefits from transactions are estimated and benefit levers are selected.

A trade-off between the two contradictory strategies, of maximized availability and utilization of the entire production machinery, needs to be assessed. It has to be specified what is sold and which service deliveries are put down to the customer’s account. An important aspect is the price policy along with the pricing itself, which results from the concrete design of the profit mechanism. Thereby the different stages of benefit for the company are determined. The establishment of a two-stage tariff/ payment rate leads to an extension of the cash flow and provides a basis for a long-term increase in profit.

Calculations reveal that further profit can be realized in the utilization phase of the tool’s life cycle. Afterwards the total price is composed of a basic price and usage-dependent charges, whereby the toolmaker is paid the service price at a certain point of time during the tool’s development phase. Thus the risk of dependence on a specific market can be reduced for the customer through this usage-dependent financing model. In doing so, the operational risk for the tool is carried by the toolmaker – which is a deliberate result from offering a guaranteed availability of the tool.

3.4 Production of services

In a holistic approach to service models it is therefore essential to examine the creation of value throughout the enterprise as a whole. The manner of the value proposition is defined by the production of services. Based on the configuration of the value added the discrete processes are described. Resources and skills are allocated; make-or-buy-decisions are made. Moreover, partner contributions are determined and coordination mechanisms as well as communication channels are installed among the partners and among the defined processes.

Regarding larger tool and die companies with corresponding resources, the separation of process chains into different chains for the classic tool making process itself on the one and a process chain “service” on the other hand is a promising possibility. The process chain “service” usually proceeds without the steps of construction, planning and scheduling. A faster, more flexible reaction to customers’ demands can thus be realized.

4 LIFE CYCLE COSTS: ENABLER FOR SERVICE MODELS

4.1 Classification and aim of life cycle costing

Life cycle costing integrates a new point of view into the companies’ accounting procedures. In addition to the activity-dependency (fixed and variable costs) and the cost-unit-dependency, the life-cycle-dependency is introduced as a third cost-application-criterion. Figure 4 shows, how different accounting standards can be classified along the two dimensions object and time.

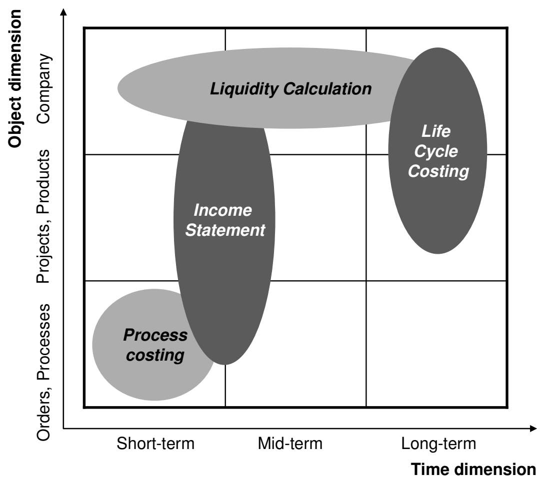

Figure 4: Classification of life cycle costing. [15]

- Process costing is a process simultaneous ratio calculation. Its object-orientation lies on single parameters of the running production processes. It is used to control costs of operational processes and is short-term oriented.
- Income statements serve as a permanent control of the production of goods and services. Objects of focus can be orders, projects or whole companies. Because of its periodicity it is short- and middle-term oriented.

- Liquidity calculation is used for a permanent controlling of the cash holdings of a company. It can be short-, middle- or long-term oriented and is not periodical.
- Life cycle costing is usually long-term oriented. This results from the long time span of the life cycle of examined objects.

As mentioned above, the calculation can be focused on products and potential factors as well as whole projects. The main characteristic of the life cycle costing method is its period-spanning vision.

The main goal of life cycle costing is an extensive evaluation of all costs which occur during the life cycle of an examined object [16, 17]. Thus it may support decisions on alternative products and/ or services and their combination. The costs of tool usage are mostly determined by the tool's quality and the general organisational conditions. These conditions can be improved, if toolmakers and their know-how are integrated into parts production processes. A life cycle costing oriented acquisition policy would help avoiding ruining price competition in the tool and die making sector.

4.2 Life Cycle of tools and dies

In scientific literature the life cycle of production equipment is split into three sections: the acquisition-phase, the utilisation-phase and the disposal-/ rejection-phase. [18]

This approach can also be applied to tools and dies. A characteristic in toolmaking is the cost intensive optimization of tools after the machining process. Additionally, the customer has a vast influence on the optimization process of the toolmaker by determining the rules of acceptance. Based on empirical analysis in the research and development project "SMART STAMP^{ING}", the design of the interface between toolmaker and customer in this section of the life cycle is of high relevance. Conflicts may occur if tool purchasers limit their decision model on acquisition prices and special quality requirements at the same time. To further analyse this interface, the life cycle of tools and dies is modelled in four sections (figure 5).

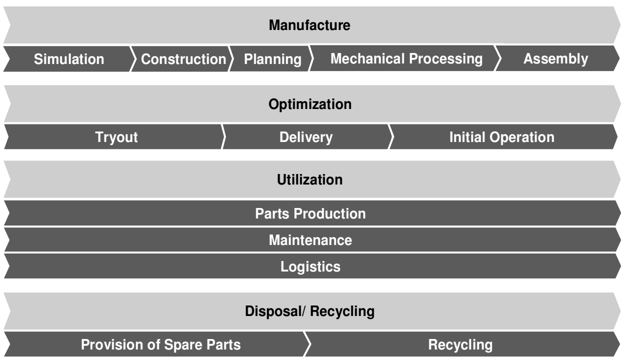

Figure 5: Detailed life cycle of tools and dies.

The section "Manufacture" begins with simulation, construction and planning processes to initiate the machine processing and ends with the assembly of all parts. Following this, the aim of optimization is setting up a ready-to-operate condition of the tool. This section is highly intensive in means of resources and time because of inaccuracies in simulation, machining and in the forecast of forces in forming processes. Based on this condition, the tool enables parts producers to create value added in manufacturing. Thereby the functionality of the tool has to be obtained by maintenance work. At the end of parts production, the tool is placed into stock, disposed of and/ or recycled.

An important factor throughout the life cycle of a tool is the change of responsibility from the toolmaker to the parts producer after optimization. This allocation of responsibility may be affected by realisation of new service offerings in service models, e.g. by the implementation of usage-dependent charges in financing. Throughout manufacture, all risks are carried by the toolmaker himself. From the date of a ready-to-operate condition of the tool and its acceptance, the responsibility for the tool normally devolves to the parts producer.

4.3 Life cycle costing of product-service-systems

In analogy to accounting standards, a product-service-system is regarded as a cost unit to conduct a calculation of its life cycle costs. From the tool's manufacture to its disposal it binds and consumes resources before it enables parts producers to create value added. As described above, the life cycle of tools and dies can be interpreted as an aggregation of processes. Within these processes, which are phases of the life cycle, resources are consumed by production, use and disposal of the tool as well as by the development and provision of services. This consumption of resources causes different types of costs throughout the entire life cycle. For example, cost types can be materials needed for machine processing which are entered on specified accounts and have to be estimated as a whole. In the end, life cycle costs are calculated by means of an activity-based costing.

Within the modelling of life cycle costs, cost elements are defined to enable the conduction of the activity-based costing [19]. A cost element determines what costs are caused by the consumption of resources in a specific part of a process throughout the life cycle (figure 6). The total amount of process costs is determined by the interaction of defined cost drivers. These factors have to be collected and evaluated for each process within the life cycle of the product-service-system.

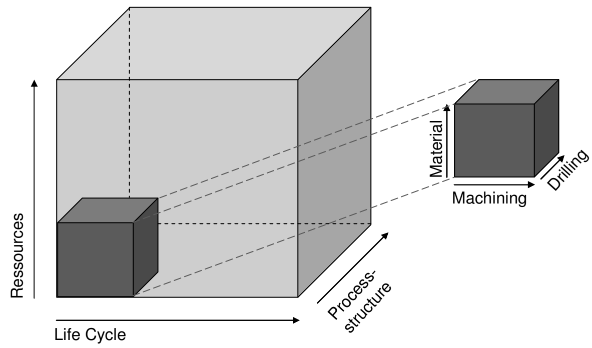

Figure 6: Subdivision of the whole life cycle costs into cost elements.

The developed life cycle costing model contains several ratios to draw overall conclusions from and to compare product-service-systems of toolmakers with one another. These ratios are calculated as net present value of all costs that occurred in processes throughout the entire life cycle. By combining different cost types, e.g. maintenance costs related to manufacturing costs, the quality of specific processes in each section of the life cycle can be evaluated.

5 APPROACHES TO PROVE THE ADDED VALUE OF SERVICE MODELS

A main barrier for the successful implementation of product-service-systems into the market as well as into the toolmaker's value proposition is the lack of availability of life cycle data, which is neither adequately gathered nor communicated. Firstly, the gathering of life cycle data allows tool and die makers to improve their own production and service processes and to reach an ideal learning curve. Secondly, the life cycle data also delivers information about the point in time at which certain costs incurred. Besides a guarantee of availability for their tools, the allocated data and information put both toolmaker and parts manufacturer in the position to get to know the performances of the tool in operation better. In this manner, areas can be revealed in which service models are useful and would be generally accepted.

The developed life cycle costing model shall help to close the existing gap of information between tool and die companies and part manufacturers. Based on an empirical analysis of life cycle data gathered from several tools in operation general statements can be made, that influence the implementation of service models in tool and die companies.

The gathered data enables toolmakers to prove the value-added of their service offerings to their customers. The main restriction for the implementation of service models can be described by regarding the relation between the acquisition price and the life cycle costs of a product-service-system. The life cycle benefit describes the difference in total life cycle costs in comparison between different offerings (figure 7).

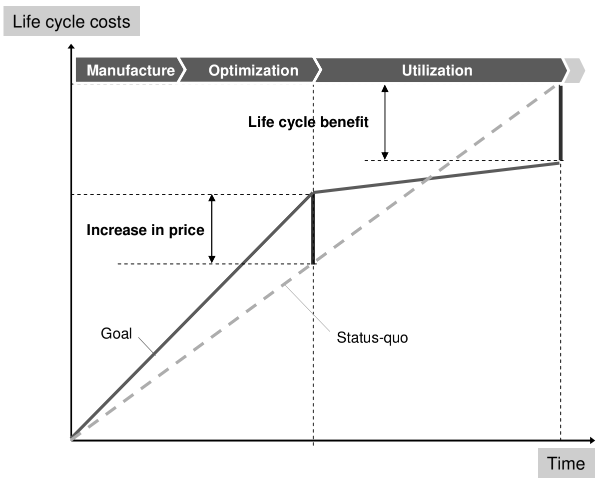

Figure 7: Life cycle benefit of service models.

6 CONCLUSION

As best practices in tool and die making reveal, a promising approach for differentiation over competitors is to enhance the existing range of products by offering customer-specific services. To directly address the customer value in service provision, the creation of services should be based on a detailed life cycle cost-analysis of tools and dies. Therefore customers will be integrated into the process of service design by means of an intense dialogue with the tool and die makers.

A new approach to service models for the tooling industry links products and services by means of a direct calculation of life cycle costs. Tool and die makers are enabled to offer product-service-systems, which allow expanding the range of service provision by directly addressing the cost-effectiveness of the whole product-service-system. Hence the minimisation of life cycle costs of tools and dies can be used as a new sales pitch for services in this unique industry.

A crucial factor of success is to cope with the interdependencies between the organizational business model and its implementation. In the research and development project "SMART STAMP^{ING}" these factors are considered by two main results. Firstly, the developed life cycle costing model allows calculating not only products but product-service-systems as a whole. Secondly, the strategic aspect of developing product-service-systems is considered by the development of service models and their integration into former business model theory. Combining these methodical results, tool and die companies are able to close the information gap between them and their customers. Differentiation on other levels than price is thus enabled.

Further work should concentrate not only on developing product-service-systems, costing models and business models but on developing a reference framework for cooperation between tool and die companies and their customers and suppliers. This cooperation is the main enabler for the life cycle-orientated optimization of products-service-systems in the tooling industry.

7 ACKNOWLEDGMENTS

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