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## Article

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## **PRODUCTIVITY OF SERVICES: AN EXPLORATIVE STUDY IN THE ELECTRICAL AND CHEMICAL ENGINEERING SECTOR**

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### **Abstract**

Knowledge intensive, complex services play a crucial role in the economy and welfare of developed countries. However, service productivity management is not as much investigated as productivity in manufacturing. In this paper a literature based and empirically confirmed approach to a comprehensive description of service productivity is provided. Existing service productivity models are evaluated according to a literature based developed evaluation scheme and the results of 32 semi-structured interviews with service experts from two German companies are presented. The results will lay the foundation for the development of a novel comprehensive service productivity model.

**Keywords:** complex services, productivity, explorative study, efficiency, effectiveness

**JEL Classification:** D24

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### **Introduction and motivation**

The service sector, compared to other sectors, gains significant importance due to the high share of gross domestic income and employees in developing and developed countries (in Germany about 70%, Meffert and Bruhn, 2006). However, in terms of productivity gains, it is still lagging behind other industry sectors like manufacturing. According to many scholars, this dilemma results from specific characteristics of services as one of the main drivers for limited productivity in the service sector. Especially for knowledge intensive, complex services well established methods like work standardization and scientific work organization cannot be applied directly. The need for novel methods and tools is crucial for a sustainable service development and provision. But how can something be improved without prior definition and measurement? This paper aims to bridge the gap and to provide a literature based and empirically confirmed approach to a comprehensive description of service productivity. Based on this description managers and service designers will be able

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to systematically identify and measure critical service success factors thus enabling optimization and continuous improvement of service systems.

The outline of this paper is as follows: In the first part an evaluation scheme for service productivity models is developed. Based on the evaluation of existing service productivity concepts, the need for further research is pointed out.

In the second part of this paper the results of an explorative study are presented. Experts from the service sector of two engineering companies were interviewed. The outlook will then comprise the findings from literature and empirical study to a comprehensive service productivity understanding.

### **1. Development of an evaluation scheme for service productivity models**

In order to systematically analyze the relevant literature on service productivity an evaluation scheme is developed based on Stachowiak's modeling theory (Stachowiak, 1983). Stachowiak defines a model as a partial representation of a real object or concept. To develop a model, only the most relevant characteristics of the real system should be considered. For the selection of the right characteristics, Stachowiak defines three essential dimensions to be considered:

- The mapping characteristic: What is the real concept to be modeled?
- The relevant characteristic: What characteristics of the real concept are relevant?
- The contextual characteristic: What is the scope of the model?

Using these dimensions should enable to focus on the important characteristics that have to be considered for a comprehensive service productivity model.

The first question can be answered easily: The real concept that has to be transferred into a model to enable a more extensive observation and measurement is the *concept of service*.

#### **1.1 The mapping characteristics: service definition**

The German statistical federal office defines services by enumerating industry branches such as trade services, financial service, public administration etc. A similar approach is taken by the World Trade Organization which provides a sectoral classification list consisting of 12 sectors and 160 sub-sectors aiming a cross-country comparability and consistency of service policies defined in the "General Agreement on Trade in Services" (GATS, 1995). For a comprehensive service analysis and design on a business or even service operation level the proposed sectoral classification is too broad. When shifting the focus to the business economics perspective, services are described more precisely. One common approach is to delimitate services from goods by defining differences between goods and services. This approach is not practicable since a generally accepted list of differences does not exist (Corsten, 1985).

The most common approach on a definition of services is based on defining constitutive service characteristics following the findings from Hilke (1989) and Donabedian (1980). According to their dimensional differentiation services can be defined along the service

provision chain in three dimensions: the potential dimension, the process dimension and the outcome dimension. Many scholars have adopted and enhanced this concept by enlarging it with relevant service specific characteristics known as the IHIP characteristics: Intangibility, Heterogeneity, Inseparability and Perishability (Fitzsimmons & Fitzsimmons, 2011).

Based on this division a service provider fundamentally has to provide the ability to perform a service by using his company's potentials. This potentials not only consist of a material dimension, such as people and other objects of usage in the service process phase, but also in the precombination of these (Corsten, 1994; Hilke 1989) to an intangible performance commitment (Corsten, 1994; Hilke 1989; Meffert and Bruhn, 2006). This commitment is also highly perishable, as it is time and space dependent.

The process dimension is the central dimension of service provision and it therefore receives the most attention among scholars. From the process perspective a service is defined as an activity chain in order to provide a benefit for someone or on something. Berekoven (1974) states that service provision is impossible without the integration of the customer or the items of the customer. Therefore, the service provision is inseparably tied with the customer's input (Bruhn and Hadwich, 2011).

In the outcome dimension services are regarded as the result or effect of the service provision. This effect is unique as long as it is individually tailored upon customer needs and thereby heterogeneous. Furthermore, due to the fact that services are subjectively perceived by customers the outcome is considered intangible as well (Hilke, 1989).

According to the given approaches on a definition of services and to the specific characteristics of services, the following mapping characteristics can be derived:

- All three constitutive dimensions (the potential, the process and the outcome dimension) should be taken into account when considering service productivity.
- Service provider and service customer are an inseparable part of a service and both have to be considered in a service productivity model.

### **1.2 The relevant characteristics: service performance measures**

The general service concept spans a wide area. The identification of the most relevant characteristics of service productivity is necessary to enable a focused and practicable assessment.

In the manufacturing industry productivity is defined as the ratio between physical quantifiable measures aiming to assess the performance of the production system (Gutenberg, 1980; Corsten, 2007). From this point of view quantitative factors have to be considered in the context of productivity models. In terms of services also qualitative data plays a significant role especially concerning intangibles like employees' motivation or customer relations. There is a consensus among scholars that service productivity cannot be assessed only by quantitative data but qualitative factors should also be considered in detail (Dobni, 2004; Gummesson, 1998).

Furthermore, in order to evaluate the important facets of service productivity the relevant influence factors have to be investigated. These relevant factors are also called the critical

success factors or simply success factors. According to Boynton and Zmud (1984) and Bullen and Rockart (1981), critical success factors are those factors that ensure success or successful competitive performance of an organization (individual or department) and therefore should be given special and continuous attention.

As a result the following relevant characteristics should be considered as service performance measures:

- Quantitative factors
- Qualitative factors
- Success factors

### **1.3 The contextual characteristics: service productivity scope**

The scope of the service productivity model is to assess the performance of the service system in order to support service planners and managers. The assessment of the system can be done in two different ways, *outside in* or *inside out*. Assessing *outside in* is understood as evaluating the system's internal performance, as its internal efficiency. *Inside out* is understood as evaluating the system's performance to the outside, in terms of effectiveness. To ensure a comprehensive view of service productivity, it is necessary to consider both approaches and thus to investigate both, the efficiency and the effectiveness of the service provision.

Furthermore, a comprehensive service productivity model should have the possibility of being operationalized. This is particularly necessary to transfer the service productivity model into practice and to make it applicable. A good way of operationalization represents the definition of key figures allowing the measurement of the efficiency and effectiveness of the service.

Concluding, the contextual characteristics should consider the following:

- Efficiency
- Effectiveness
- Operationalization

## **2. Evaluation of existing service productivity models**

Summarizing the considerations from the previous section, eight criteria have to be fulfilled by a comprehensive and applicable service productivity model. In literature a variety of service productivity models can be found. Their suitability for an exhaustive description of the productivity of services is examined on the basis of the developed evaluation criteria catalog in the following section.

### **2.1 Service Productivity Models**

*Jones (1988)*

Jones (1988) presents a three stage model of service delivery starting from inputs seen as tangible and intangible assets of the company combined to an intermediate output offered to the customer. As the customer engages in the second stage the actual service is provided and consequently an output is generated. Finally the customer perceived quality of the service is materialized in the outcome after the final stage of service provision.

Every single stage has its own management focus starting with productivity management in the first stage defined as the ratio of inputs to intermediate outputs. In the second stage the focus shifts to capacity management defined as matching demand and supply in terms of intermediate output and actual output. In the final stage the focus shifts to service quality as a performance measure of the impact that the service may have on the customer.

*Corsten (1994)*

A similar approach is proposed by Corsten (1994). His concept is based on a two stage model differentiating between a so called phase of service precombination and a phase of service endcombination. In the service precombination the service provider is concerned with preparing the service environment and thus keeping resources available for service provision (Corsten, 1994; Corsten, 2007). The productivity of the precombination is thus defined as the ratio between willingness to perform and the provider's inputs. In the second stage the customer is integrated in the service process by providing external input to enable the transformation from inputs into outputs. The productivity of the endcombination is here defined as the ratio of the outputs to the sum of willingness to perform and further internal and external factors.

*Vuorinen, Järvinen & Lehtinen (1998)*

Vuorinen et al. (1998) are the first researchers to define service productivity from a quantitative as well as a qualitative point of view. According to them, service productivity is "the ability of a service organization to use its inputs for providing services with quality matching the expectations of customers". Any further operationalization of service productivity is not provided in this approach but some requirements for the practical development of productivity measures are pointed out.

*Gummesson (1998)*

Gummesson (1998) addresses service productivity in relation to service quality and their influence on profits. He states that in order to make service operations more efficient, quality, productivity and profitability must be evaluated together. Hereby, productivity is defined in a traditional way as the ratio between input and output. Quality focuses on customer satisfaction and profitability on the combined effect of revenue, cost and capital employed. According to Gummesson (1998), quality improvements lead to productivity improvements and finally to a higher profit margin.

*Parasuraman (2002)*

In his attempt to shift the focus to the service customer, Parasuraman (2002) proposes a conceptual framework that describes the impact of service quality on productivity of the service provider as well as the service customer. Therefore a series of linkages between service provider and customer are hypothesized. Service quality is positively influenced by service providers input but negatively by customers input. Service quality positively influences service provider and customer output. Since productivity is defined as the

linkage between output and input, consequently service quality influences service productivity. The service provider, furthermore, has a great influence on the allocation of resources and thus on service quality and productivity respectively.

*Johnston & Jones (2004)*

Johnston and Jones (2004) adopt a dual perspective to specify service productivity. They define operational productivity as the ratio of operational outputs to inputs over a period of time. Consequently, customer productivity is defined as the ratio of inputs to outputs. Johnston and Jones (2004) also give a series of examples describing the relationship between the two productivity measures, stating that these productivities are time and case sensitive and can be related positively as well as negatively.

*Grönroos & Ojasalo (2004)*

The most comprehensive model is provided by Grönroos and Ojasalo (2004). They define service productivity as a function of internal efficiency, external efficiency and capacity efficiency. The internal efficiency is understood as the efficient usage of service provider's resources to produce a given amount of output. Based on a given amount of input the external efficiency is defined as the magnitude of perceived quality. The output quantity is demand dependent. Capacity efficiency therefore measures how well demand matches supply.

## **2.2 Evaluation results**

Table 1 shows the results of the evaluation of the selected service productivity models, according to the evaluation scheme developed in section 2. In our evaluation criteria of the evaluation scheme can be fulfilled, not fulfilled or partly fulfilled by the respective service productivity models. A criterion is fulfilled if all aspects are considered or present in the concept, partly fulfilled if only some aspects are discussed roughly, and a criterion is not fulfilled if the relevant aspects are not considered at all.

Starting point of the evaluation are the mapping criteria, in terms of the dimensional differentiation and consideration of both, the service customer and the service provider. The majority of the presented productivity concepts consider different viewpoints for specifying services. However, there is still no consensus about the magnitude of customer's influence in all service stages.

When talking about relevant characteristics the focus shifts to specific factors that need to be considered. The starting point of the majority of the presented models is the traditional, manufacturing oriented productivity concept with quantifiable measures and thus quantitative factors. Qualitative factors gain importance as the focus shifts to service customer quality perception and satisfaction. A major lack of the presented concepts is the fact that specific success factors are not discussed.

Furthermore, it becomes obvious that terms like efficiency and effectiveness are often discussed but only partly integrated (mostly not at the same time) in the productivity models.

One of the biggest weaknesses of the evaluated service productivity models is an inadequate consideration of a measurement concept. This aspect is fundamental for an

application of a productivity model in practice, but only few models take a measurement concept into account adequately while it is even completely absent in some models.

**Table no. 1: Evaluation of relevant service productivity concepts**

Evaluation Criteria	Service Productivity Model (see section 2.1)						
	1	2	3	4	5	6	7
- criterion not fulfilled 0 criterion partly fulfilled + criterion fulfilled							
Potential dimension	+	+	+	-	+	+	+
Process dimension	+	+	-	-	-	+	+
Outcome dimension	+	-	+	-	+	+	+
Service provider influence	+	+	0	+	+	+	+
Service customer influence	-	0	0	-	+	+	0
Quantitative factors	-	+	+	+	+	+	+
Qualitative factors	+	-	+	0	0	+	0
Key success factors	-	-	0	+	-	-	-
Efficiency	0	+	0	-	0	0	+
Effectiveness	0	-	0	0	0	0	0
Measurement concept	-	+	+	0	-	-	+

### 2.3 Need for further research

The evaluation of the literature shows that there is a need for further research on a comprehensive service productivity definition especially regarding the following topics:

- The service customer plays a crucial role in all dimensions of service provision and therefore his contribution should be investigated in the service productivity concept in detail.
- There is a need to identify leverage factors as starting point for service system improvement. All of the presented productivity concepts are quite broad and too general for a specific implementation and usage for service systems design and optimization. Therefore the identification and usage of combined quantitative and qualitative factors is a prerequisite.
- In order to assure practicability the service productivity concept should integrate measurements to assess efficiency and effectiveness in a systematical, model driven manner. It should incorporate a measurement approach in order to define and assess relevant key figures.

## 3. Empirical study on service productivity

### 3.1 Study design

Based on the literature analysis, an empirical study was designed, in which service experts participated in semi-structured interviews. The interview guideline contained detailed questions on the basic service structure, on service productivity and on the influencing factors upon the productivity of services. It consists of five sections: 1) general information



of the interviewee, 2) detailed service description, 3) service planning, 4) service productivity and 5) technology and methods supporting the service provision.

In order to conduct the explorative study, project partners from industry provided service experts from different service categories and teams from several headquarters across different regions in Germany. The experts are in charge of plant and infrastructure maintenance, planning of new power transforming plants and access points as well as process development in chemical engineering projects. Overall 32 experts from management and operations participated in the 90 minutes interviews. Ten participants were engineers of different disciplines, the other 22 participants had received training in their field of application, 13 of them with master's certificate.

During the interviews two interviewers took notes, at one of the participating company also audio recordings of the interviews could be made.

### **3.2 Data Analysis**

The gathered data was qualitatively analyzed according to an approach proposed by Mayring (2007). This approach defines steps and rules for the analysis of qualitative data and furthermore provides procedures for interpreting the results.

Based on Mayring's guideline an iterative and spiral approach was chosen (see Fig.1). The theoretical background as well as the research question as stated in the study design were the starting point of the systematical analysis and interpretation of the qualitative data gathered in the 32 interviews.

In the first step a preliminary categorization of the gathered data was carried out. Using responses from the first eight interviewees as well as findings from literature analysis the data were analyzed and categorized. The categorization aimed to reduce the volume of the data by abstraction and generalization. In order to do so, a coding scheme was developed and anchors representing examples for the second round of analysis were defined.

Based on this preliminary categorization a second categorization was made using the entire gathered data. Coding rules and coding anchors were also revised by the project group in charge of the analysis. As a result a final version of the categories and coding rules was specified.

In the last step the results were interpreted by their frequency of occurrence of each category among the interviewee. This step aimed to filter relevant aspects from the gathered data in order of their importance.

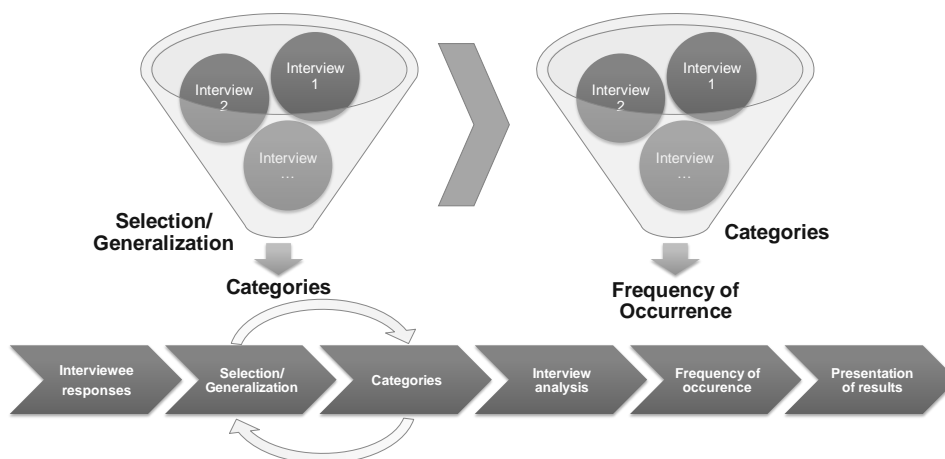


Figure no. 1: Procedure of data analysis and interpretation according to Mayring (2007)

### 3.3 Results

The results of six key questions on the topic of successful service provision and service productivity are presented in the following section. Here a comparison of the most frequently mentioned categories of the two companies is made for each question from the interview.

### 4. Service structure

In the second section of the interview, participants were asked to describe the basic structure of a typical service process. The results of the inductive categorization indicate a service delivery structure, which coincides with the literature findings in chapter 2.1. A clear separation in the three dimensions of potential dimension, process dimension and outcome dimensions can be found in the interview results as well (see Fig. 2). According to the participants, the process dimension can further be subdivided into a service *planning* part and a service *execution* part. The three dimensions can be delimited from each other by milestones. The *inquiry* of a customer represents the entry into the potential dimension in which the *offering* takes place. The customer's *order* is the transition to the process dimension, which is completed by the *acceptance* of the service, representing the starting point of the *closure*, equivalent to the outcome dimension.

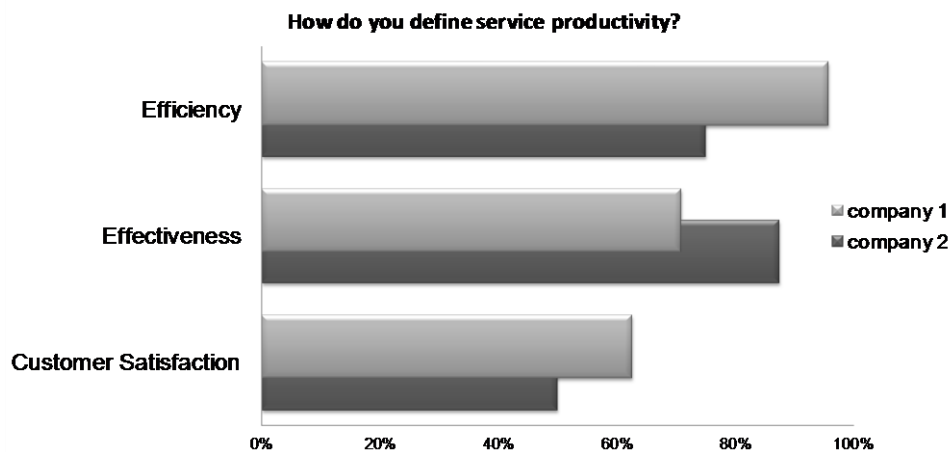


Figure no. 2: Interview results: Basic structure of a service process

*Topic 1: How do you define service productivity?*

The analysis revealed three major aspects determining service productivity. The answers to the question show some similarities in the two participating companies (see Fig. 3). While *efficiency* was mentioned by 96% of the participants in company 1, in company 2, *effectiveness* was the most mentioned category of service productivity (88%). *Effectiveness* reached an occurrence percentage of 71% in the interviews in company 1 and *efficiency* was mentioned by 75% of the interviewees in company 2. The third most mentioned category in both companies is *customer satisfaction*. It occurred in 63% of the responses in company 1 and in 50% of the responses in company 2.

In addition to the *service effectiveness* and *service efficiency*, *customer satisfaction* was chosen as a separate category in the analysis due to the large number of explicit mentions, but can be interpreted as the service effectiveness from a customer-oriented perspective.

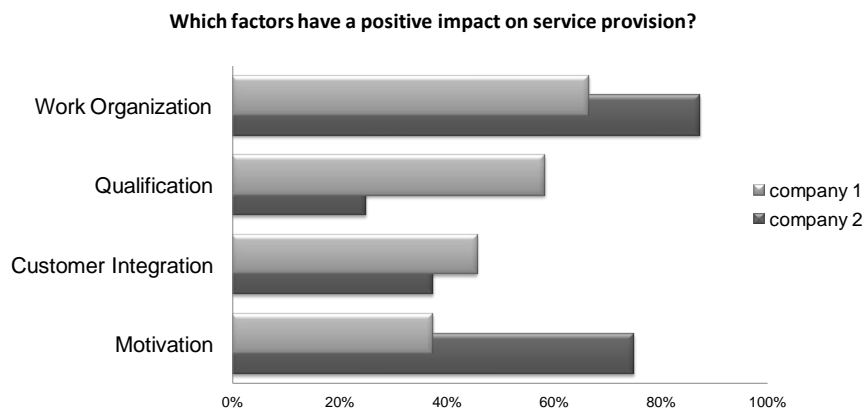


**Figure no. 3: Interview results: Categories of service productivity**

The answers of the participants to this question indicate that a universal model of service productivity has to include efficiency and effectiveness measures from pro-vider and customer perspective in order to map the full range of services productivity aspects adequately. Thereby, the respondents define efficiency either value driven as “profitability” or activity driven as “cost efficient work processes without unnecessary disruptions”. Effectiveness was defined as “reaching the expected results with the previously specified quality” as well as “keeping deadlines and budget restrictions”. Customer satisfaction comprises “meeting or exceeding customer needs and expectations”.

*Topic 2: Which factors have a positive impact on service provision?*

In this topic, differences can be observed between the two participating companies (see Fig. 4). While in company 1 *work organization* and *qualification* are the two major influencing categories (67% and 58%), in company 2, along to *work organization* (88%), *motivation* of the staff is considered as the second most important influence factor (75%). *Customer integration* (the *external factor*) is seen as the third most important factor in both companies.



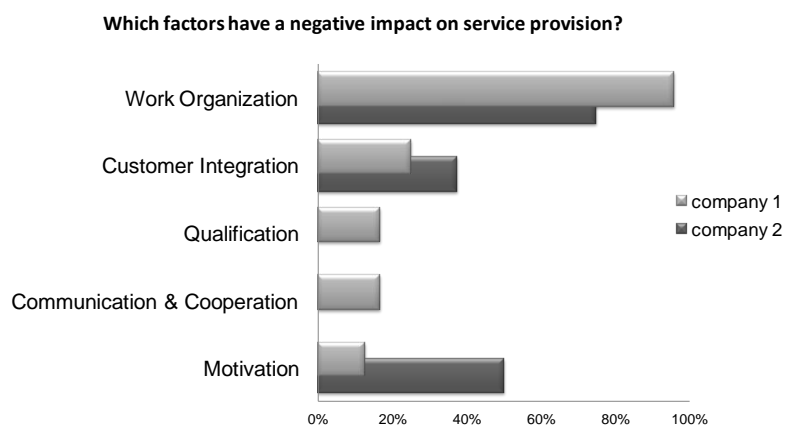
**Figure no. 4: Interview results: Factors positively influencing service provision**

Work organization comprises all facets of work planning as well as workflow design, the organizational structure of the company and the service. In the context of the empirical study, qualification integrates the formal qualification (occupation) as well as social competencies (soft skills) and experience (know-how).

The differences in the results show the necessity to investigate service productivity from a company specific point of view.

*Topic 3: Which factors have a negative impact on service provision?*

The results of this topic show some similarities to the results of the previous topic. The most mentioned negative influence category on service provision in both companies is an inadequate *work organization* (96% and 75%, see Fig. 5). In company 2 the second most mentioned negative influence category is *demotivation* (50%), followed by insufficient *customer integration* (38%). This category represents the second most mentioned negative influence category of company 1 (25%).



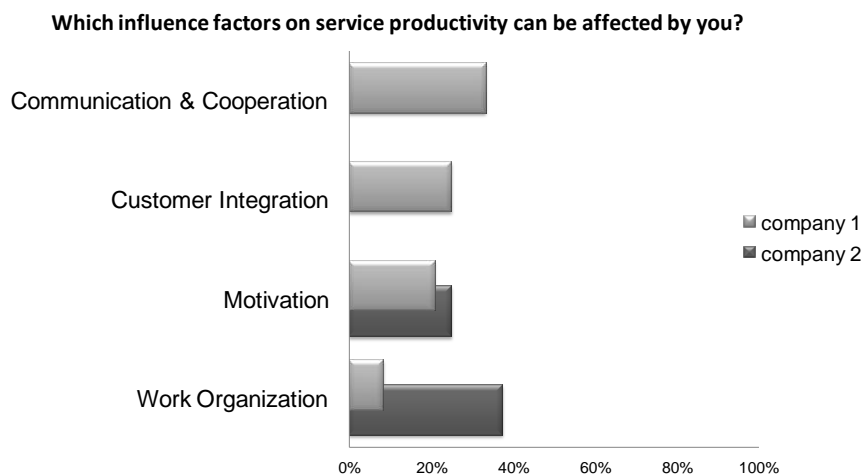
**Figure no. 5: Interview results: Factors negatively influencing service provision**

In company 1 the third most mentioned categories were *qualification* and *communication & cooperation*. 17% of the participants from company 1 named these categories, while they were not mentioned at all in company 2 in this topic.

*Topic 4: Which influence factors on service productivity can be affected by you?*

The answers to the question on productivity factors that can be affected by the interview participants show great differences between the two companies (see Fig. 6). Overall the opportunities to influence service productivity seems to be small, since the most mentioned categories *communication & cooperation* in company 1 and *work organization* in company 2 only reached a percentage of 33% and 38% respectively.

*Work organization* was mentioned in company 1 by only 8% of the participants. The first and second most mentioned categories in company 1 – *communication & cooperation* (33%) and *customer integration* (25%) – were not mentioned at all in company 2. Here *motivation* was the second most mentioned category (25%).



**Figure no. 6: Interview results: Factors that can be affected by the participants**

*Topic 5: Which actions do you perform to increase the productivity of services?*

Although the statements of the participants show that the possibilities to affect the factors influencing service productivity are very limited, many actions are performed in the companies to increase service productivity. In both companies these actions primarily address the *qualification* of the employees (71% in company 1 and 88% in company 2, see Fig. 7) and improvements of the *work organization* (59% and 88%). Further actions are performed to improve the *communication & cooperation* (33% and 50%) and to increase the *motivation* of the staff (8% and 50%).

Which actions do you perform to increase the productivity of services?

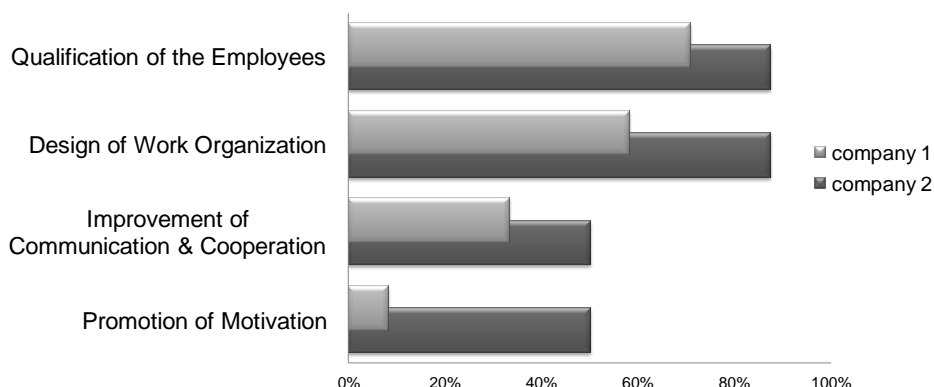


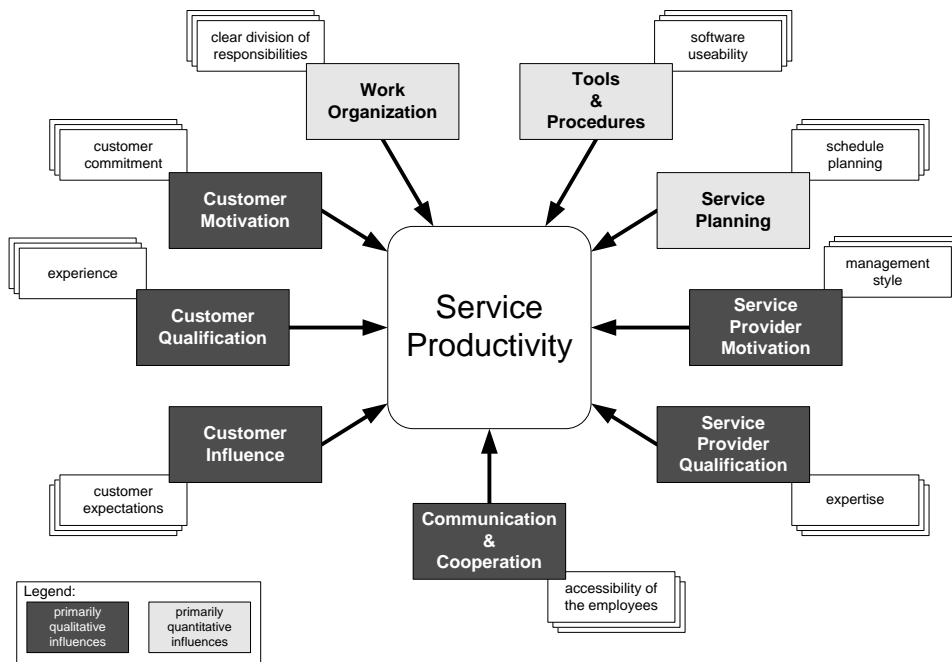
Figure no. 7: Interview results: Actions to increase service productivity

The high response rate of the category *motivation* in company 2 is remarkable in this topic moreover emphasizing the importance of this factor. Herein lays one of the most obvious differences between the two companies, since *motivation* only plays a subordinate role in the answers of the participants from company 1.

4. Concluding remarks

The results of the presented categorization and analysis of the interviews constitute a verification of the evaluation criteria presented in section 2. First, the results show that the differentiation in the three dimensions *potential dimension*, *process dimension* and *outcome dimension* is necessary to cover the whole process of service provision. The categories and especially a deeper analysis of the answers of the participants reveal the need for a distinction into *quantitative factors* and *qualitative factors*. A differentiation and simultaneously consideration of *efficiency* and *effectiveness* are another evaluation criterion, which could be confirmed by the analysis of the conducted interviews.

Furthermore, the results show the diversity of parameters and factors influencing the productivity of services. The analysis of the main sections of the semi-structured interviews revealed that seven key influence factor categories can be differentiated. Two of these categories – motivation and qualification – can further be subdivided in a service provider and a service customer perspective, highlighting the need for a differentiation of the *service provider* and the *service customer* in some aspects. The seven categories of influence factors on service productivity can further be classified according to a mostly qualitative and mostly quantitative characteristic (see Fig. 8).



**Figure no. 8: Interview results: Categories of influence factors on service productivity**

The weighting of these categories can be derived from the frequency of responses within each category and it shows significant differences between the two companies in some aspects, but also great similarities in other aspects.

**5. Impact of the empirical study on the development of a new service productivity model**

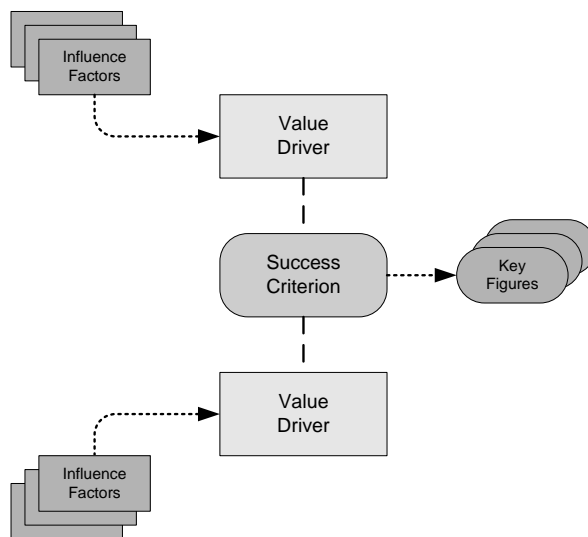
The criteria of the developed evaluation system for service productivity models and the analysis of the literature give in conjunction with the results of the conducted semi-structured interviews suggestions on further developments in the field of descriptive models of service productivity.

Although a great variety of influence factors and company specific factor specifications exists, a general conceptual model for the representation of service productivity is necessary to create a theoretical fundament of components that represent the essential characteristics of service processes.

The currently developed new service productivity model considers these aspects by introducing the two components of *value drivers* and *success criteria*. Value drivers are defined as factors having a direct impact on the productivity of a service, but cannot be influenced directly by the employees or the service management. They thus represent abstract constructs that are manifested in the definition of *influence factors* affecting them. Influence factors are leverages directly dependent on management decisions, e.g. resource allocation, resource structure and others and they represent a company specific and sometimes even project specific characteristic.

The ratio of two value drivers is expressed through a *success criterion*. A success criterion hereby represents a certain part of the productivity of an analyzed service. Success criteria between directly related value drivers represent efficiency aspects of the underlying service, while success criteria between unconnected value drivers represent the dimension of service effectiveness. In order to quantify these partial productivities represented by the success criteria they must be substantiated in key figures. Key figures show – as well as influence factors – a company-specific characteristic.

The fundamental structure of a proposed new service productivity model, covering the aspects mentioned in the evaluation criteria as well as the outcome of the literature analysis and the interview analysis is shown in 0



**Figure no. 9: Components and relations of the new service productivity model**

The identified categories of relevant influence factors (see section 4) enable the structuring of the influence factors and will help performing a targeted company specific operationalization of the service productivity model.

Furthermore, the proposed service productivity model has to cover all evaluation criteria. To meet this, our concept of service productivity is oriented on a value-oriented view of the service value chain (see Fig. 10).

Following the structure in Fig. 10, the model differentiates the fundamental three dimensions of service provision (Donabedian, 1980; Bruhn and Hadwich, 2011), the service potential dimension, the service process dimension and the service outcome dimension.



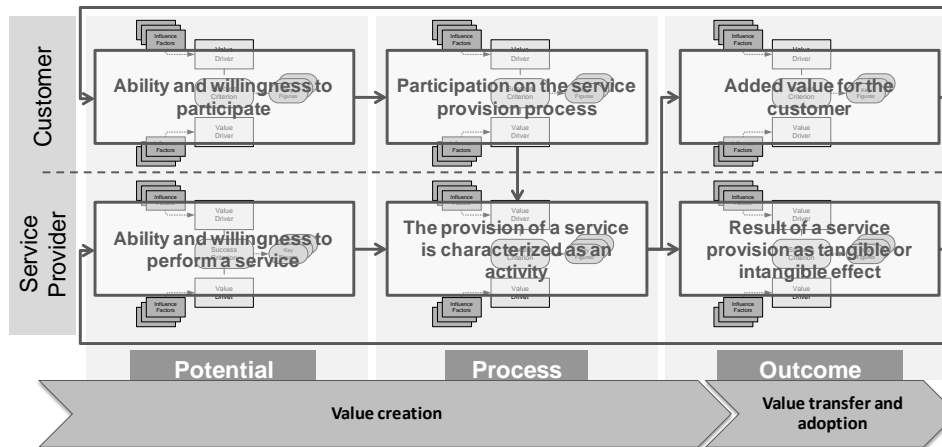


Figure no. 10: Basic structure of the new service productivity model

The potential dimension represents the potential of the service provider as well as the service customer and provides a joint willingness to perform. In the process dimension the performance of tasks to provide the service is conducted by the service provider and the service customer cooperatively. The outcome dimension represents the overall result of the service provision and serves as the basis for the assessment of the service success. By combining quantitative and qualitative levels of service provision in all dimensions an assessment of the efficiency and effectiveness of the service will be possible by defining company specific key figures to measure the partial productivities of the service.

## 6. Further research

To provide further empirical data, a structured online survey is performed to gather representative data on service productivity on all dimensions. The currently developed new service productivity model will be verified and evaluated on the basis of the results of this survey. Furthermore, the model will be evaluated in practice by our industrial project partners, leading to company-specific images of the service productivity model including sets of operationalized influence factors and key figures. This will lay the foundation for company specific service systems design and improvements. Additionally, the findings from the empirical studies lay the foundation for a comprehensive simulation based service process optimization tool.

This tool focuses on the optimization of complex service processes in terms of a company-specific target system (e.g. minimization of service cost and service duration, balancing the employee's workload, etc.). The new productivity model presented in this paper represents the evaluation course of the tool. The possible course of the service provision is generated by a dynamic work process simulation and the resulting valid service processes will be evaluated with regard to their productivity. The productivity will subsequently be maximized by a multi-objective optimization algorithm, affecting the simulation parameterization.

This tool will enable especially service operation managers to optimally plan their complex services, to dynamically manage and control the service provision process and resources allocation and last but not least support them to make the right decision under inherent uncertainty.

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