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Development of a Model for the Comprehensive Analysis and Evaluation of Service Productivity

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***Abstract*—**Although services play a crucial role in economy, service did not gain as much importance as productivity management in manufacturing. This paper presents key findings from literature and practice. Based on an initial definition of complex services, seven productivity concepts are briefly presented and assessed by relevant, complex service specific criteria. Following the findings a complex service productivity model is proposed. The novel model comprises of all specific dimensions of service provision from both, the provider's as well as costumer's perspective. A clear assignment of identified value drivers and relationships between them is presented. In order to verify the conceptual service productivity model a case study from a project engineering department of a chemical plant development and construction company is presented.

***Keywords*—**assessment model, complex services, service productivity model, value driver.

I. Introduction

SERVICES play a crucial role in economic and social welfare of developed countries. However, service management and especially management of complex, knowledge intensive services is not as well developed as management in traditional manufacturing.

In manufacturing, productivity management is recognized as a key discipline for comparison and optimization. Following Taylors approach of "scientific management" advanced methods and tools have been developed, tested and adopted over decades. In contrast, little attention is paid to productivity in the service sector. Compared to productivity in manufacturing the productivity improvements in the service sector are much lower resulting in a need for further research [24].

The aim of this paper is twofold. First, service productivity models from literature are reviewed and evaluated according to previously defined assessment criteria. Second, based on findings from the literature review and enhanced through research results from an explorative study in the electric and process service engineering field [5], a novel model is proposed. The novel model lays the foundation for a holistic productivity concept for assessment and improvement of complex services. It explains relationships between influencing factors, value drivers and success criteria.

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II. Literature Review

A. Definition of complex services

A literature analysis shows that a plethora of service definitions exists. Some of them are trying to define services by example, others by delimiting them from goods. The most common definition goes back to Donabedian (1980) and his approaches of assessing quality of care [17]. According to his analysis, services can be assessed by specific attributes categorized in a three-dimensional chain [1], [26], [15]:

1. The service structure or service potential dimension
2. The service process dimension
3. The service outcome dimension

Furthermore, he states that there is a causal relationship between these three dimensions in the given order.

Following this, researchers further enhanced the classification by four fundamental characteristics of services [26], [17]. Given the succession stated by Donabedian it is prerequisite that the service provider has the potential and willingness to deliver the service.

This "availability" for service provision is highly space and time dependent and unlike goods, cannot be stored and therefore is *perishable*. In the service process dimension the customer is an integrative part in the service provision. Hence, services are provided and consumed *simultaneously*. Therefore, services are characterized by a high degree of *heterogeneity* because they vary from one provider to another and one customer to another. The service outcome is perceived as an effect of the service provision and consequently it is *immaterial*.

Some researchers argue that some of these fundamental characteristics do not apply anymore [7]. Thus, in order to differentiate between simple, standard services and complex services the following will be adopted:

First, complex services are characterized by a large extent of the mentioned fundamental characteristics of a service. As a consequence, they are – comparable to research and development projects – customer driven and build upon tailored processes where new knowledge is generated.

Second, following systems theory and complexity research in the field of project management, these characteristics should also apply: multiplicity, diversity and variability of the elements composing the service as well as their interrelations (organizational structures, roles, tasks etc.) [25]. Furthermore, a high degree of uncertainty in service provision and service outcome is induced by the customer. Especially the integration of the costumer confers complex services an emergent behavior. Following this, a high degree of variability over time is inherent to complex services.

B. Evaluation criteria

Assessment criteria for evaluating the suitability of existing service productivity models can be structured according to a concept from Stachowiak's modeling theory [13]. Following Stachowiak, a model can be understood as a partial representation of an original, real object or a concept.

Furthermore, a model is built only by a few, model relevant attributes with a specific purpose or for someone's needs. Service productivity models proposed by researchers should therefore include criteria that are mapping the real service provision chain (the service model), important attributes from the field of discourse (point of view) and pragmatic attributes that are mapping the intention of the model (productivity goals) and the user (management of operations and decision support).

For evaluating the service provision chain the following two assessment criteria can be derived from the service definition given above:

a. *Dimensional differentiation*: Complex services have to be assessed through all three service dimensions (potential, process and outcome) along the service provision chain.
b. *Provider and Consumer differentiation*: A service productivity model has to differentiate between service provider's and service consumer's contributions to service performance.

Findings from literature show the necessity to gather and assess quantitative as well as qualitative data for a comprehensive assessment [20], [9], [3], [8].

Assessment of qualitative data is necessary especially due to the fact that quantitative parameters do not exhaustively describe service performance especially when talking about the customer's point of view.

This shows that services comprise hard facts as well as feelings and experience [6]. Therefore, the following two criteria should be met:

c. *Quantitative measures*: A service productivity model should integrate quantitative measures defined as magnitudes of a physical unit.
d. *Qualitative measures*: A service productivity model should integrate qualitative measures that cannot be directly operationalized.

The aim of the productivity model is to asses managerial and system performance and to support management decisions. Findings from literature show that the assessment of task efficiency and effectiveness are the most common management criteria associated with the evaluation of work performance [19], [10].

According to Drucker a manager has to optimize the work being done. This optimization includes two main directions, namely effectiveness as "doing the right things" and efficiency as "doing things right" [21].

Therefore, a service productivity model should integrate the following two objectives of work optimization, representing two more assessment criteria:

e. *Efficiency*: The efficiency of service provision defined as the optimal resource allocation by a given service target has to be considered.
f. *Effectiveness*: The effectiveness of service provision defined as the degree of goal achievement has to be considered.

C. Selected service productivity models

Corsten (1994)

Corsten is one of the first researchers who defined partial service productivities along the fundamental service dimensions although the outcome dimension is not considered in detail [11], [12]. In the potential dimension he defines productivity of the so called "pre-combination" as the ratio of the willingness to perform to the provider's input factors. In the process dimension he defines the productivity of the "end-combination" as the ratio of the service output to the sum of willingness to perform and a combination of further internal and external factors. Corsten's productivity model only includes measures for efficiency rather than effectiveness. It is suitable for quantitative analyses without any details about implementation. The need for qualitative measures is pointed out by the author leaving the implementation open.

Parasuraman (2002)

Parasuraman's conceptual framework builds up on a dual company-customer perspective and describes interrelations between service quality and other factors influencing service productivity [2]. He hypothesizes that there is an influence between service quality and the allocation of company inputs. Furthermore, service quality effects company outputs and therefore service productivity. However the service process dimension is not considered at all. Although efficiency and effectiveness are not mentioned, the conceptual meaning is inherent and partly given (e.g. allocation of company inputs, customer satisfaction). Parasuraman himself notes that the framework offers a broad overview but only few examples of quantitative and qualitative data.

Johnston & Jones (2004)

Following their perception that productivity is judged from different perspectives, Johnston and Jones define two partial productivities: operational and customer productivity [22]. They define productivity as the viewpoint dependent ratio of outputs to inputs over a period of time and also give counterintuitive examples on the relationship between the two partial productivities in which the operational and customer productivities are either positively or negatively related. Johnston and Jones provide a relatively clear service perspective and phase delimitation. Efficiency and effectiveness are defined but not explicitly detailed. Quantitative as well as qualitative data are mentioned only by example.

Grönroos & Ojasalo (2004)

The most comprehensive model on service productivity is provided by Grönroos and Ojasalo [6]. They define service productivity as a function of internal efficiency, external efficiency and capacity efficiency. Internal efficiency focuses on efficient usage of internal resources whilst external efficiency focuses on customer perceived quality. The capacity efficiency describes how well demand matches supply.

There is a clear delimitation between customer and provider from the potential and process perspective but not in the outcome dimension. Efficiency is discussed in a broader way while effectiveness is subsumed as part of the external efficiency. There is no further differentiation between qualitative and quantitative data but the importance of usage of qualitative data is underlined by the authors.

Jones (1988)

Jones describes service operations in the form of a stage model [17]. He defines three stages of service operation where inputs are transformed into outcomes through outputs. Every stage has its own management focus. In the first stage the inputs are transformed into intermediate output. Within this stage the focus lies on internal productivity management. In the second stage the customer engages as consumer and thereby an output is generated. Within this stage the service provider focuses on capacity management. The last stage describes the impact that the output has on the customer, the outcome. In this stage quality management plays an important role. The model doesn't integrate efficiency and effectiveness concepts explicitly; they are partially integrated in the productivity and quality management concept discussed. However, only qualitative measures are discussed in detail.

Parasuraman, Zeithaml and Berry (1985)

Although Parasuraman's et al. approach is not a true productivity model, their findings had a great impact on management of service productivity [3], [4]. They hypothesized, that there is a major gap between perceived and expected service by the customer. In order to explain this gap they identified four more gaps on the provider's side. However, they do not differentiate between the fundamental service dimensions and focus mainly on the discrepancies regarding executive perception on service provision (quality) and the translation through delivery. Based on an explorative study mainly qualitative determinants of service quality were identified.

Vuorinen, Järvinen and Lehtinen (1998)

Vuorinen et al. define productivity as the ratio between quantity and quality of output to input [14]. They, neither differentiate service provider and customer nor between different service dimensions. The authors argue on the importance of efficiency and effectiveness and the difference to productivity but they do not clearly integrate it in their concept. The model focuses also on qualitative and quantitative factors and their interrelations.

D.Evaluation of the productivity models

Based on the literature review and discussion the productivity models are evaluated according to the previously identified criteria. Criteria are fulfilled, if all of the requirements are met, partly fulfilled if some aspects of the criteria are considered in a broad (e.g. discussed in the paper but not integrated in the model illustration) way and not fulfilled if the aspects composing the criteria are not considered at all (see Table I).

TABLE I
EVALUATION OF SELECTED PRODUCTIVITY MODELS

Criterion	Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)
a.	Dimensional differentiation	0	0	+	+	+	-	-
b.	Provider and Consumer differentiation	0	+	+	0	-	+	-
c.	Quantitative measures	+	0	0	+	-	-	+
d.	Qualitative measures	-	0	0	0	+	+	+
e.	Efficiency	+	0	0	+	0	-	0
f.	Effectiveness	-	0	0	0	0	+	0

- criterion not fulfilled
0 criterion partly fulfilled
+ criterion fulfilled

Summarizing following findings can be derived from the review as shown in Table I:

1. The more detailed the model, the more important the dimensional differentiation across the service provision chain.
2. Most of the analyzed service productivity models build up on clear provider consumer delimitation as an inherent characteristic of services.
3. The presented models are on a broad level and are intended to be generally applied to all kinds of services. Hence most concepts do not focus on quantitative and qualitative data.
4. Efficiency is perceived from the technical point of view as an optimal output to input ratio.
5. Effectiveness is discussed especially when considering quality and customer satisfaction.

The findings show the necessity for a broader differentiation in a structured manner along the service provision chain, maintaining the dimensional differentiation proposed by Donabedian. Because of the broad perspective taken, none of the presented approaches fulfill all of the proposed criteria. Furthermore, none of the approaches discuss efficiency and effectiveness in detail at the same time. Most of the models are focusing either on efficiency, in case of the traditional productivity concepts, or on effectiveness, while focusing on quality and customer satisfaction.

Following this, a comprehensive model for service productivity assessment is proposed. The model will differentiate between service provider and consumer from qualitative as well as quantitative point of view in order to evaluate the efficiency and effectiveness of the service provision chain in each service dimension.

III. PRODUCTIVITY OF COMPLEX SERVICES

The foundation of the service productivity model presented in this paper is a detailed description of the factors influencing the productivity of services. It should be noted that the focus of the proposed model is essentially a single service - usually planning and execution of a complex development project - and that it does not, in contrast to the models of Grönroos & Ojasalo (2004), Corsten (1994), and Jones (1988), include a company-wide consideration of the factors and levers of service productivity.

By the restriction on a single service provision, in particular the process of service delivery becomes the center of attention and the success measures are mainly based on process variables.

A. Structure of the proposed model

The basic structure of the model adapts the well-known division of a service provision in the three dimensions: 1) potential dimension, 2) process dimension, and 3) outcome dimension [1]. In contrast to the models presented in the literature review the dual perspective of customer and service provider is maintained through all dimensions of the service provision chain. The potential dimension covers the service provider's as well as the service customer's inputs (potential and willingness) that are provided in order to conduct a proposed service. The process dimension represents the process of service provision and hence the transformation of the inputs into a service outcome. The results of the service provision process are depicted in the model by the outcome dimension.

Based on findings from an explorative study we identified a series of value drivers that were allocated to the defined dimensions [5].

Basically, the model is composed of four different components, which are presented in Fig. 1:

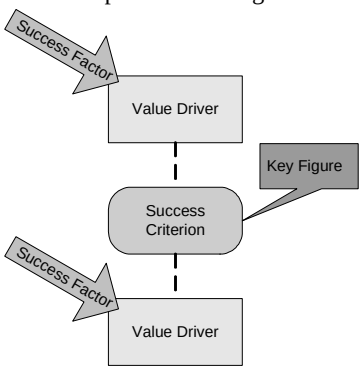

Fig. 1 Components of the proposed service productivity model and their interrelations

- Value driver
- Success factor
- Success criterion
- Key figure

Value drivers are defined as factors that have a direct impact on the productivity of a service, but cannot be influenced directly by the management. They thus represent abstract constructs that are manifested in the definition of *success factors* affecting them. Success factors are leverages directly dependent on management decisions, e.g. resource allocation, resource structure and others. Therefore success factors are, due to their company specific and sometimes even project specific characteristics, not specified in the presented model (see Fig. 2). Value drivers are represented in the model by rectangles.

The ratio of two value drivers is expressed through a *success criterion.* A success criterion hereby represents partial productivities of the observed service.

Success criteria between directly related value drivers represent measures of the efficiency of the underlying service, while success criteria between unconnected value drivers represent the dimension of effectiveness. In the model the success criteria are represented by rectangles with rounded corners.

In order to quantify the partial productivities represented by the success criteria they must be substantiated in *key figures*. Key figures hereby have to be quantifiable, collectable with reasonable effort, relevant, and preferably up to date [23], [16]. In addition, only those indicators are to be considered, which would allow a comparability of different services.

Key figures show – as well as success factors – a company-specific characteristic. Possible key figures of success criteria of the proposed productivity model are shown exemplary in the case study in section IV.

While within the potential dimension, the roles of service provider and service customer are largely separate, a mixture of the roles occurs in the process dimension, taking the integrativity of services into account. In the outcome dimension a partial separation of the two roles takes place to allow for a determined examination from the perspective of the respective actors.

The process and outcome dimensions can be further differentiated. Unlike a production process the service customer is directly involved in the service provision, resulting in an additional, subjective and not directly measurable level of service perception next to the objective, quantitative result. This subjective level is not attributable only to the customer. Also the perception of the service provider matters which is composed by the interaction with the customer and the perception of the provider's own activities and processes. This division between subjective, qualitative and objective, quantitative levels continues throughout the process dimension to the outcome dimension.

B. Model description

The potential dimension represents the potential of the service provider as well as the service customer. Both actors provide a specific willingness to perform, which is derived from the company's potential. The two value drivers representing the respective willingness to perform are linked by the success criterion "effectiveness of the substitution".

From the willingness to perform a performance commitment can be derived as an auxiliary variable, which reflects the transition of the potential dimension to the process dimension and forms the basis for the assessment standards of service provision and service outcome. These assessment standards are manifested in the value drivers of the objective, agreed service and the subjective, expected service.

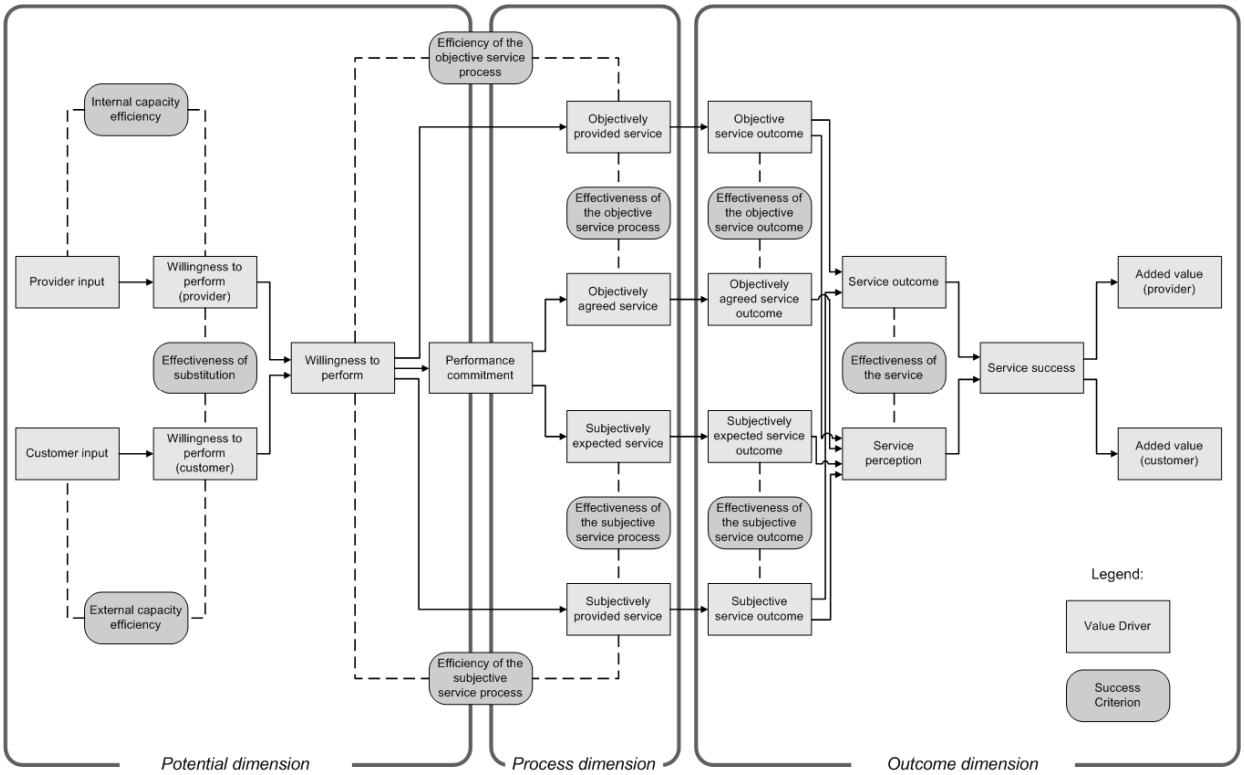

Fig. 2 Proposed model of service productivity

From the willingness to perform of the two actors the subjectively and objectively provided service within the process dimension arises.

In this way the partial results of the service process achieved at the time of observation are assessed on an objective as well as on a subjective level.

The ratios of the provided service and the willingness to perform represent the success criterion of the "efficiency of the service process" that can further be subdivided into objective and subjective efficiencies of the service process.

The ratios of the objectively or subjectively provided service and of the promised or expected partial result of the service are expressed by the two success criteria of the "effectiveness of the service process".

The success criteria of the process dimension are reflected in the outcome dimension. Here the end result of the service provision serves as the basis for the assessment of the success criteria. By combining the objective and subjective level of service provision in the outcome dimension an overall assessment of the efficiency and effectiveness of the service is possible.

This overall result is then transferred to the auxiliary variable of service success in the value drivers of the added value of the provider and the customer.

These value drivers represent not only the monetary value that is generated by the service, but also strategic added value (e.g. customer loyalty) and substantive matters (such as increased competence of the employees).

IV. Case Study

In order to verify the presented conceptual model a case study in a process engineering department from a chemical plant development and construction company was conducted.

TABLE II
EXEMPLARY KEY FIGURES OF THE SUCCESS CRITERIA

Success criteria	Exemplary key figures
Effectiveness of substitution	Provider internal activity quota
Internal capacity efficiency	Capacity utilization
External capacity efficiency	Customer competence level
Efficiency of the objective service process	Project duration to effort ratio
Efficiency of the subjective service process	Interaction quota
Effectiveness of the objective service process	Milestone adherence
Effectiveness of the subjective service process	Conformity with the expectations (e.g. competence, availability)
Effectiveness of the objective service outcome	Delivery duration in relation to planned duration
Effectiveness of the subjective service outcome	Customer satisfaction
Effectiveness of the service	Overall service success

The proposed model was verified by assigning key figures to success criteria as presented in Table II, showing that relevant and important key figures can be assigned to each of the existing success criteria. In the engineering department quantitative figures like "capacity utilization", "project duration to effort ratio", "return on investment" etc. are the traditional approach to analyzing productivity.

Moving the focus on the customer and integrating qualitative key figures enhances the model and unleashes the full potential of the concept.

E.g.: minimizing project duration to effort ratio is not anymore the sole objective. The employee seeks to communicate in a professional way with the customer in order to understand his needs and transform them into valid requirements. This may result in lower change requests from customer and thereby enhances process efficiency and effectiveness.

The company's experts showed great interest in a holistic, model-driven, structured approach to a measurement system for the productivity of their complex engineering services. They especially appreciated the straightforward linkage between value drivers and the possibility to measure how changes in service structure and process affect customer as well as provider outcome. The phase-based approach helped to understand the focus and importance of each phase and to act accordingly following key figures for an unbiased decision. Furthermore, a clear differentiation of efficiency and effectiveness contributed to the logical and structured linkage whereas efficiency follows effectiveness meaning that it's useless to do things right if you are not doing the right things.

V. Conclusion

The paper proposes a novel service productivity model based on a comprehensive literature review and a theoretically underpinned set of value drivers and success criteria. It thereby lays the theoretical foundation for a comprehensive simulation and service assessment software tool. This tool will focuses on a dynamic, process oriented evaluation of service projects for a reliable and realistic forecast of service output as well as outcome. The authors will further develop the concept and will particularly focus on a practicable model.

The model presented in this paper will now be discussed in the company and additional relevant key figures will be added. Based on previous findings, success factors influencing the value drivers will be identified and thus a company-specific image of the service productivity model will be generated. This will lay the foundation for company specific service systems design and improvements. This 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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