

Flexible Development and Calculation of Contract Logistics Services

T. Spiegel, J. Siegmann, C. F. Durach

Abstract—Challenges resulting from an international and dynamic business environment are increasingly being passed on from manufacturing companies to external service providers. Especially providers of complex, customer-specific industry services have to cope with continuously changing requirements. This is particularly true for contract logistics service providers. They are forced to develop efficient and highly flexible structures and strategies to meet their customer's needs. One core element they have to focus on is the reorganization of their service development and sales process. Based on an action research approach, this study develops and tests a concept to streamline tender management for contract logistics service providers. The concept of modularized service architecture is deployed in order to derive a practice-oriented approach for the modularization of complex service portfolios and the design of customized quotes. These findings are evaluated regarding their applicability in other service sectors and practical recommendations are given.

Keywords—Contract Logistics, Modularization, Service Development, Tender Management.

I. INTRODUCTION

FOR more than two decades, outsourcing of non-core activities has become widely accepted as a business strategy [1]. In the course of this development, the services and the interdependency between manufacturing companies and service providers are becoming increasingly complex [2].

As a result of an increasingly close relationship with service providers, challenges following from a more and more international and dynamic business environment are being passed on to external service companies. This is particularly true for highly integrated providers of more complex, customer-specific industry services.

Prototypes for this kind of service provider are contract logistics companies which have to cope with continuously changing requirements, international competitors, high cost pressure and tight time constraints [3]. In the literature there are a great variety of attempts to define contract logistics (CL) (inter alia [4]-[7]). Even though these definitions have different focuses, all of them emphasize the customer-related individuality and complexity of CL services. We define CL services as client specific, integrated bundles of individually

customized logistics services containing essential logistics functions – like transport, warehousing and cargo handling – which are typically supplemented by value added services (e.g. production processes or product refinements) [8]. These bundles are designed according to customer specifications, so that individual contracts are needed [9]. Distinctive for these contractual frameworks are a minimum contract period of at least one year and a minimum business volume of € 0.5 million per annum [6].

Over the past 20 years, the CL sector has grown in importance [10]. In 2010, it was characterized by a potential market volume of €381 billion, in Europe alone. However, the share of outsourced services equaled just 25% of this estimate. Thus, the CL segment has turned out to be highly attractive especially for growth oriented and sophisticated logistics service providers [11].

To fulfill customer needs in this demanding context, contract logistics service providers (CLSPs) require efficient and highly flexible structures. For CLSPs, every contract has a relevant financial effect. They must be able to respond to individual enquiries quicker and with more convincing concepts than their competitors. Thus, one core element they have to focus on is the reorganization of service development and sales process. A flexible, efficient and customer-oriented tender management can be regarded as a key success factor to exploit the market potential. Due to the high financial risks which are often connected to CL service concepts, an exceptionally high reliability of the tender calculation procedure has to be guaranteed.

Within the scope of a recent survey [12], about 70% of the CLSPs' customers underlined their requirements of high service development competence and proactive innovation behavior. At the same time, almost 50% of the CLSPs admitted that their service development process is not very efficient.

In a preliminary study on 2012 we polled 34 managers and executives from CLSPs [13]. Four relevant drivers for the reported inefficiency of the CLSPs' tender management could be identified:

- Due to highly specific customer needs, conceptualizing and preparing a tender is highly complex and resource-intensive.
- The degree of standardization is very low, especially at small and medium-sized CLSPs, tenders are usually developed from scratch without using standardized elements.
- CLSPs employees have to single out similar matters from previous tenders to collect information necessary for

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calculating a tender. This makes tender quality highly dependent on employees' experience.

- Spreadsheet-tools, such as Microsoft Excel are currently used by almost all CLSPs when it comes to preparing customized tenders. These tools ensure high flexibility on the one hand but impede the implementation of standards on the other hand.

One can conclude that high complexity and a lack of standardization in the fields of tender management and product portfolio management are key leverages for efficiency improvements. For this reason, the central research questions are:

- How should CLSPs streamline their service development and calculation process in a dynamic and customer-specific business environment?
- What does this mean for other service sectors with similar environmental conditions?

The leading theoretical concept behind this research originates in the field of systems theory. In the sense of this theoretical framework, a CLSP's service can be interpreted as a complex and dynamic sub-system within a company [14], whose internal structure again can be divided into heterogeneous sub-systems [15]. This idea of reasonable decomposition is used to understand and reduce the complexity of CLSP's service development process.

In the following, this paper provides a detailed description of the research design and explains of the theoretical background. Then the concept and the results of its validation are demonstrated. Finally, a potential extension to other industry related service sectors is discussed.

II. RESEARCH APPROACH

This research follows the guidelines of application-oriented research. As opposed to fundamental research, applied research mainly involves practical application of science. Because our research question deals with a practical issue, we aim to evaluate the research results in terms of its practical feasibility [16].

Practical feasibility of a research result is supported by an exchange of researcher and practitioner perspectives during the research process [17]. Hence, an action research approach was identified as suitable methodology. The term "action research" was coined by Lewin (1953) [18]. It aims to support practical needs and contributes to expand the knowledge of the scientific community [19]. It is based on three principles [18]:

- Researchers and affected persons are equal partners for changing investigated systems in a desired direction,
- Investigated problems are of practical relevance, and
- Gaining knowledge is based on an iterative exchange of information between the engaged parties which can be characterized as co-learning.

For this research, two representative German CLSPs – a medium-sized and a large one – have been selected and nine managers of these two companies complemented the research team. To ensure validity in this qualitative approach, these managers were chosen because of their expertise in the investigated phenomena. More precisely, preparation and

calculation of tender is part of their day-to-day business and they are responsible for the operational execution. Therefore they could provide valuable insights during the research. Besides the input of the managers, secondary data of the two CLSPs were investigated. In particular, records of tender calculations and management and process documentation of their operational services was analyzed.

The course of action for this investigation is structured as follows. In a first step, the analysis of requirements was conducted in a two-way-approach with desk research and in-depth interviews. In-depth interviews are superior to short interviews regarding the possibility to gain deeper insights into the interviewees' general opinions and ideas on a certain subject and to explore a topic holistically from their perspective ([20], [21]).

Afterwards, a holistic concept for managing the inherent complexity of the tender preparation was developed, validated and adapted. According to action research, these steps were carried out in close cooperation between the researchers and the experts from the above mentioned CLSPs. Finally, the concept was implemented in a software tool and applied and evaluated under practical conditions. Fig. 1 illustrates the research approach.

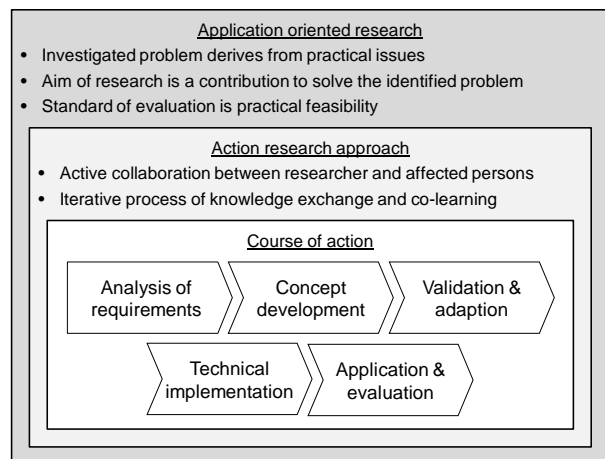


Fig. 1 Research approach

III. PRELIMINARY CONSIDERATIONS

We based the concept development on some fundamental preliminary considerations. These considerations of the nature of the problem as well as its theoretical background are discussed in the following. According to Ulrich, systems theory is, as mentioned before, eligible for investigating complex issues in the context of business administration [22].

Project managers mainly seem to experience problems during tender calculation due to the complexity of the process. The concept of modularization has been proven as a suitable strategy to reduce complexity in logistics systems [23].

Modularization is understood as re-structuring the architecture of a system, product or service into clearly defined, independent and manageable elements [24]. By decomposing a system into those independent elements or

modules, which act in mutual interdependence through clearly defined interfaces, the complexity of the overlaying system is reduced [25]. The autonomy of the modules allows flexible adjustments and customization in a very efficient way without influencing the system as a whole [26]. By combining independent modules over defined interfaces one can create an integrated overarching system with minimal effort. Thus, modularization of logistics systems means to define independent, logistics-oriented subsystems of operational processes and performances [27]. There are several principles and methods for modularization (e.g. [28]-[31]). With regard to the issue of contract logistics services as object of modularization, the principle of modular service architecture, developed by Burr, has been adapted. In accordance with this principle, the overall function of a logistics system can be divided into sub-functions (processes) and offered services can be divided into partial services. The services are modularized by allocating the processes to the partial services and defining standardized interfaces [32]. In order to use the modules for calculating a CL service tender, each module's function, performance and costs have to be defined and standardized. The following Fig. 2 shows the principle of calculating the transformation of goods within a logistics system using standardized modules.

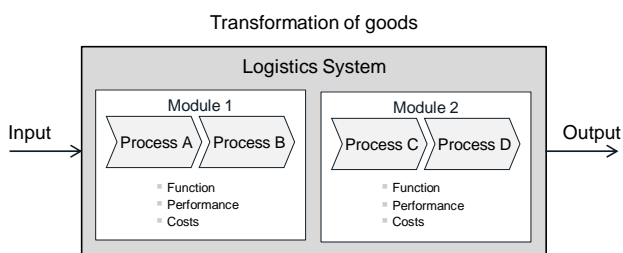


Fig. 2 Modularization of a logistics system

In general, the fundamental function of a logistics system is the transformation of goods, which is expressed by change of time, place, quantity, type or property (flow of goods) as well as change of the logistical determinism (flow of information) [33]. All of these transformations within a logistics system can be defined as processes and mapped in a process model. In this particular case, the process perspective is very useful because processes have clearly defined inputs, outputs and functions. They can be structured in a hierarchical order by taking into account the flow orientation of logistics. We also find that process documentation is a widespread practice at logistics service providers and their clients.

Consequently, a process reference model for creating function-oriented modules of CL service is a central element of the aspired concept. Models are simplified reflections of reality and they represent empirical objects, phenomena, and physical processes in a logical and objective way. Reference process models consist of structures (data, processes) with a generic character and are designed to be used by all individuals of a certain group, e.g. all enterprises of a branch or an industrial sector [34].

In the case of CLSPs, the required performance of a service module is determined by the quantities of logistical entities the specific process has to deal with. These quantities are given by customers' demands which are generally specified in a so called request for proposal. Configuration and arrangement, however, differ from project to project, e.g. in level of detail, accuracy, quality and standards. To deal with this variation of data, a standardized template has to be developed to transfer all given information into a standardized pattern for the breakdown of quantities.

CLSPs' customers demand high transparency regarding costs and performance in all services. To fulfill these demands, activity-based costs accounting has been identified as the most suitable method. The primary focus of activity-based costs is to allocate costs by cause to activities or processes and their quantitative repetition [35]. By determining cost drivers as references regarding the by-cause principle for each activity or process, a high transparency is given in view of cost per unit, cost per activity, and resources used. Therefore, an activity-based-cost-orientation was setup as a precondition for the ongoing investigation.

IV. CONCEPT FOR A MODULARIZED SERVICE LIBRARY

Based on these preliminary considerations, a first concept for the modularization of CL services in order to support the tender management process has been drawn. In the following, this concept is called "Modularized Service Library" (MSL). Basically, the MSL consists of standardized elements for processes, resources and breakdown of quantities. It brings them together in "Service Modules" (SM) for the calculation. Once an SM is calculated, it should be applicable and adaptable for other tenders.

To calculate the price for CL services, the calculation procedure had to be defined and a standardized template had to be developed. As the procedure of the tender calculation is activity-cost-based-orientated, the following steps have to be conducted [36]: Defining processes, defining quantities and cost drivers, allocating and evaluating resource deployment and calculating costs. The calculation of costs is differentiated in accordance to the type of costs: (a) costs which are directly affected by process quantities (quantity driven costs) and (b) costs which are independent of quantities (quantity independent costs). As customers of CLSPs very often demand the allocation of quantity independent costs to processes or units, it was decided to allocate them by using reference figures if deemed necessary. In order to calculate the final price of a tender, the allocated costs within the service modules have to be complemented with the share of quantity independent costs which had not been allocated to the SMs, just as other surcharges like margins, risk surcharges and assurance fees. Fig. 3 illustrates the basic concept of the MSL.

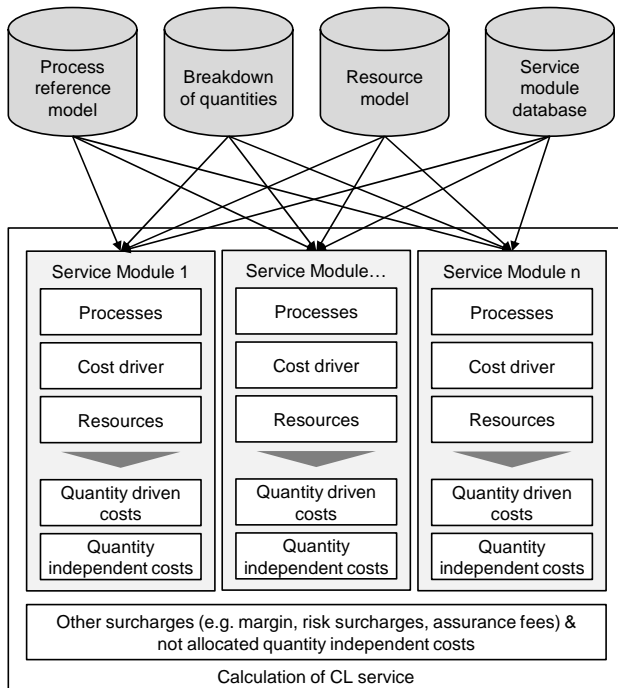


Fig. 3 Concept of the modularized service library

As explained above, the basis for creating logistics-oriented CL service modules is a process reference model for CL services. The first step for developing such a model was an intensive literature review, mainly focused on process reference models, guidelines and standards dealing with logistics processes. In total 13 relevant sources were identified and evaluated in terms of their contribution to a process reference model for CL services. From eight suitable sources (including [37]-[39]) a process model with 344 processes and sub-processes resulted. Since there had been no selection of processes up to this point, the data base contained some duplications and double meanings. According to the principle of modular service architecture, the portfolio CL services have to be divided into partial services. As CL services are mainly warehouse-based [40], the first subdivisions of service module categories are oriented on basic-warehouse functions, namely the receiving, handling, storing, commissioning, packing, and shipping/sending of goods [41]. These basic-functions are supported by administrative activities and goods transport [34]. Hence, those functions have been added as well.

To ensure a consistent procedure during allocating processes to the service module categories, the function of each category had to be defined precisely, e.g. "The receiving of goods contains all activities at the point of entry of a warehouse, including preparation and provision for storage, transport or other utilization." [33]. Processes which could not be allocated to one of the defined categories were collected in a category named "others". Subsequently, the allocation of processes to the service modules was conducted, the data base was cleaned up (elimination of duplications and double meanings) and the category "others" was structured into

distinctive functions. Then, the literature-based process model was challenged and complemented by the process documentation of the two German CLSPs. The result was a process model with 15 service module categories and 284 processes and sub-processes.

The first draft of a standardized resource model was also based on an extensive literature review and the resource databases of the two German CLSPs, and a catalog of 786 resources and types of resources was developed. This catalog is structured in a hierarchical manner with up to seven levels. On the first level the resources are structured into five categories: personnel, area/space, equipment and materials, stocks, and external services.

Following the concept of the MSL, the calculation of certain services takes place within the SMs. The structure of an SM derives from the procedure of calculation and the requirements of Burr's concept of modular service architecture. For that reason, each SM consists of a header and a body, as shown in Fig. 4.

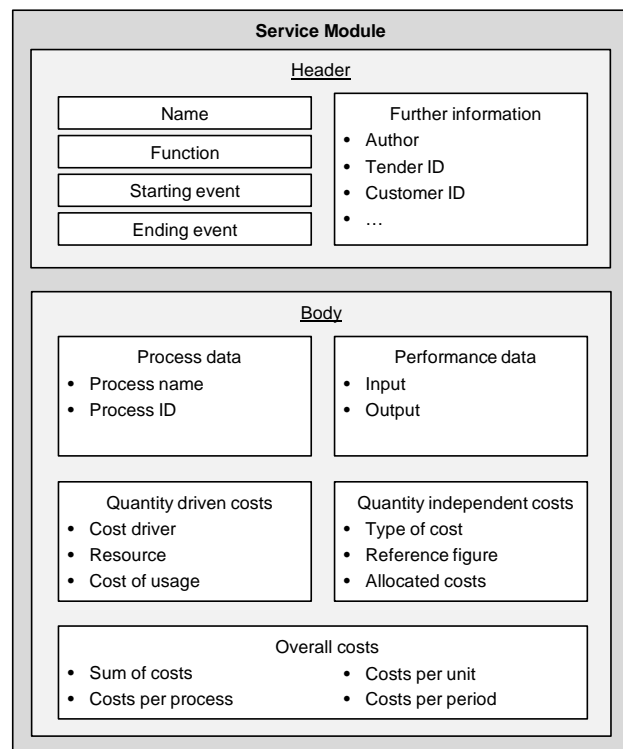


Fig. 4 Service module structure

The header defines the relevant characteristics and properties of an SM, e.g. starting event, function and ending event. The interfaces between SMs are defined by these starting and ending events. The ending event of a module has to be the starting event of the following module, except for modules triggering the entire service to start or end. The SM's body serves for the calculation of the transformation process. For that reason it consists of the following parts:

- Process data: Out of the reference process model,

necessary processes have to be allocated (process name, process ID).

- Performance data: Out of the standardized breakdown of quantities, for each process the quantities of inputs and outputs have to be allocated.
- Quantity driven costs: For each process the cost driver has to be defined. In addition, out of the standardized resource model, for each process the required resources have to be allocated and evaluated regarding usage (time, area, quantity) and costs of usage.
- Quantity independent costs: Costs which are not influenced by process quantities, e.g. general or administrative costs, but nonetheless should be allocated to processes as a customer requirement, could be allocated by using reference figures. For that reason, the type of costs and the reference figure for allocation have to be defined.
- Overall costs: The calculations of quantity driven costs and quantity independent costs are summed up to generate the overall costs per process, cost per unit, per period and for the SM as a whole.

By the combination of several SMs, a bundle of complex services is transformed into a clearly laid out, standardized and comprehensible structure for tender calculation.

V. VALIDATION AND EVALUATION

A. Concept Validation and Adaptation

The basic concept of the MSL, as described above, was eventually validated by conducting coded semi-structured interviews with the project managers. Coded semi-structured interviews allow new ideas to be raised during the interview as a result of what the respondent says. Applying semi-structured interviews provides the interviewer with enough flexibility to track the respondent by asking questions which support the flow of the conversation and help receive required information without constraining possible answer choices [42]. Thus, the researcher is more likely to receive new insights. The interviews were aimed at validating our initial concept of the MSL by asking questions about essential features for a software which is intended to support project managers calculating and managing tenders.

The interviews were recorded, transcribed, coded and eventually reviewed by the interviewees. The analysis and evaluation of the transcripts was conducted in four steps:

1. Identify each essential remark: In total 157 statements could be extracted from the interviews.
2. Conduct a microanalysis of these remarks: The remarks were investigated individually in greater detail in order to filter those which are relevant to our aim (in total 139 relevant remarks could be identified).
3. Cluster relevant remarks: The relevant remarks were investigated regarding relational contents. Three main categories with 17 subcategories could be identified.
4. Elaborate key remarks: For each subcategory one or more key remark was elaborated. In total 44 key remarks could be extracted from these interviews.

Table I provides an overview of the results of the interview analysis.

The interviews led to three major adaptations of our initial concept for the MSL. First, a high level of flexibility is an essential requirement for project managers to support their day-to-day businesses. It seems to be especially important to provide the possibility to adapt the process elements of the library. The process reference model has to be understood as a first step on the way to a customized process model. For that reason, the reference model has to be expandable and flexible without losing its impact as a standardized process model for the calculation. Second, project managers seem to be especially concerned to include standard values, such as standard process times in their MSL in order to standardize tender calculations within their corporation. In addition, selected standard values must be changeable to fit specific conditions. Third, the interviewees require knowledge management support for users of the MSL. In today's tender management process, employees are actual knowledge holders and carriers [43]. This expertise has to be secured and provided to all project managers within a CLSP in an efficient manner. Tenders must be comprehensible for more than just the project manager and assumptions have to be noticeable at the corresponding object.

B. Development of Software Prototype

The final concept of the MSL was initially built into a Microsoft Excel spreadsheet, in order to check whether the concept is applicable and feasible. For evaluation purposes, we requested the interviewees to provide us with two typical calls for tender. The tenders were then calculated with our excel sheets and the results were compared to the originally tenders calculated by the CLSPs. The results and the feasibility of the features indicated a solid concept. We eventually provided the CLSPs with the Excel spreadsheet to request a final validation. After receiving positive feedback, the software concept was built into a web based user interface. To ensure a high feasibility from the technical point of view and to enhance the chance of future usage by CLSPs, the software was developed on open source standard applications, e.g. Java-Script and SQL-database.

TABLE I
RESULTS OF THE INTERVIEW ANALYSIS

| Main-Category | Sub-Category | # Key remarks | |
|----------------------------------|---------------------------------------|----------------------|---|
| MSL structure | Adaptiveness | 1 | |
| | Visualization of material flow | 1 | |
| | Process inputs and outputs | 1 | |
| | Cost calculation | 3 | |
| | Service structure | 3 | |
| | Resource model | 3 | |
| | Standard values for calculation | 2 | |
| | Breakdown of quantities | 1 | |
| | Allocation | 2 | |
| | Services in Multi-user-Warehouses | 1 | |
| | | 18 | |
| | Knowledge Management | Service planning | 8 |
| | | Support an provision | 5 |
| Kind of knowledge | | 6 | |
| | 19 | | |
| Improvement of Tender Management | Increased efficiency | 2 | |
| | Increased quality | 1 | |
| | Reduction of complexity and risk | 2 | |
| | Simplified coordination with customer | 1 | |
| | 6 | | |
| Sum | 17 | 43 | |

Fig. 5 illustrates a screenshot of a service module of a project and corresponding processes.

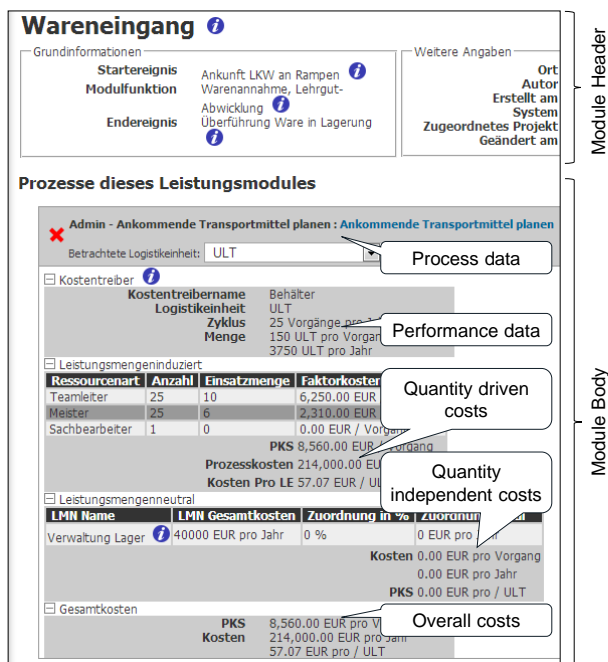


Fig. 5 Service module screenshot

C. Software Application and Evaluation

Active collaboration between researchers and CLSPs during the application and evaluation phase of the software, helped to improve the software tool.

We installed the software at the two CLSPs. Along with the

software we provided a user manual and conducted two training exercises at each CLSP in order to teach the employees to use the new software.

The CLSPs were then asked to evaluate the software by calculating two extensive tenders. Evaluation was conducted in three rounds by the experts. In each round, the CLSPs provided the researchers with feedback and improvement suggestions. We immediately incorporated their feedback in the software and send out an updated version. The three updates included minor adjustments mostly concerning aspects of usability. The pre-evaluated software concept received exclusively positive feedback.

Comparing the process of calculating the two tenders with the traditional calculation procedure in these companies indicates that calculation times can be shortened by applying the software. However, more large scale application is needed in order to show whether time savings are significant.

Nevertheless, feedback provided by the CLSPs shows that the standardized procedures in the software decrease the need to communicate within a company or to single out similar matters from previous tenders to collect information necessary for calculating a tender. Essential information is already provided though the software. This leaves less room for error and makes tender quality less dependent on employees' experience.

VI. CONCEPT EXTENSION FOR OTHER INDUSTRY RELATED SERVICES

The concept described above was developed with a special focus on CLSPs; however, we find that the basic idea can also be transferred to other services. Generalizing the model, i.e. applying the model to other industries, is particularly promising for businesses where contracting parties have to deal with complex service bundles.

Our model thereby supports the whole Smithian process whereby companies specialize in different tasks and then transact with one another to increase the economic potential of an interconnected society [c.f., 44]. In our research, we harmonized and simplified this process by developing the MSL. Previously manual tender calculations will become semiautomatic and standardized.

Modularizing and standardizing a pre-existing service portfolio helps to reduce complexity while building a modularized service library with a corresponding workflow and calculation logic helps to streamline service designs and calculation processes. It is this level of standardization which increases transparency between contracting parties and thereby decreases information asymmetry.

Our concept will help to build a solid foundation for contracting services, as contract details can be worked out in much more detail. This helps to cut monitoring costs, which contributes to reducing overall transaction costs.

The MSL is also a fundamental basis for building trust into a relationship. Trust is fundamental to any business, as it supports economic activities and transactions by protecting rights and enforcing contracts, etc. Usually, transactions will not function well in its absence. Fear of counterparty cheating

and opportunistic behavior may prevent companies from entering into the contracts and mutual gains will go unrealized [45]. Our concept allows both parties to benefit from clear and distinct contract details, which are part of the calculation in the MSL. This helps both parties to reduce risks of loss.

Implementing the MSL in industries with less complex services is basically possible, but is not proposed due to disproportionately high efforts.

VII. CONCLUSION

Standardization of tender management in the service industry has not yet received enough attention. Today, tender management in service industry is often characterized by high complexity, individual customer requirements and a low degree of standardization. This research aimed at streamlining the tender management and calculation process of companies in a dynamic and customer-specific business environment, based on the example of CLSPs' service development. We then sought to transfer the concept to other service industries with similar environmental conditions.

A concept of a Modularized Service Library was developed by following the guidelines of application-oriented research with close cooperation between the researchers and experts from CLSPs. We reduced the complexity of tender calculation applying two leverages, originating in systems theory: (a) According to the concept of modular service architecture, complex logistics services were divided into partial services and calculated separately in service modules. (b) The calculation of service modules was simplified by using standardized elements and its transparency and flexibility was increased by using an activity-based cost approach.

The final concept of the MSL consists of a process reference model, structured according to the main functions of CL services, a resource model and a standardized template for customer specific breakdown of quantities. It was transferred into a software prototype which was implemented at two CLSPs for evaluation. It was found that the concept can be helpful in any other industry sector which offers complex customized services.

The evaluation shows that main improvements are to be expected through increased efficiency (reduced process time for tender calculation and validation), increased quality of tenders through usage of a reliable, standardized database and less room for individual mistakes (including reduced financial risks through higher reliability and transparency of tenders for high-volume contracts).

Although first application of the software prototype suggests decreased tender calculation time and reduced scope for error, more quantitative research is needed to further evaluate possible impacts of the MSL on the tender management procedure. Therefore further research might be fruitful in two areas. First, more research is needed to evaluate the degree of transferability of the findings from the study on the MSL to further industry sectors. Second, further research on mass customization of the software tool is needed in order to ensure feasibility of the concept for other industrial sectors.

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