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Service Portfolio Measurement:
Evaluating Financial Performance of Service-Oriented Business Processes

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ABSTRACT

Service-oriented architectures offer promising means to flexibly organize business processes. At the same time, new challenges for management arise in order to realize these potentials. Given the technological opportunities, these challenges essentially lie in choosing the right mix of services on the basis of an appropriate infrastructure supporting value adding activities. In order to support this management perspective, a focus on service-oriented business processes is suggested in this article. Hence, a shift from technical aspects of designing service-oriented information systems to economic aspects of using them according to business needs is drawn. For this purpose, findings on the evaluation of financial performance of service-oriented business processes are presented in this paper. The objective is to develop a measurement system for decision support on the configuration of a company's service portfolio reflecting specific economic conditions relevant in a certain situation. Following a design science approach, general principles of a measurement system are worked out and structured in a comprehensive framework. Then, the application of a corresponding system is presented with a practical study. Finally, perspectives on the specification and implementation of the system are sketched.

Keywords: *evaluation of services engineering; outtasking performance measurement; service-oriented business process management; total costs of ownership; return on investment*

TOWARDS A MANAGEMENT OF SERVICE-ORIENTED BUSINESS PROCESSES

Service-oriented architectures (SOA) facilitate the design of information systems by flexibly combining highly-specialized services that are obtained via the web on demand (Loh & Venkatraman, 1992). Examples for technologies that have been developed for this purpose are COM+, CORBA, und RMI (Weikum & Vossen, 2002). With the initiative of Enterprise Application Integration (EAI), Web services turn out in practice to enable a widely-spread realization of SOA (Hung, Li et al., 2004; Yang, 2003).

From an economical perspective, SOA offers great potentials for flexibly adopting business processes to the ongoing changes inside and outside the company (Dickson, Cheung et al., 2004; Tiwana & Ramesh, 2001; Vonk &

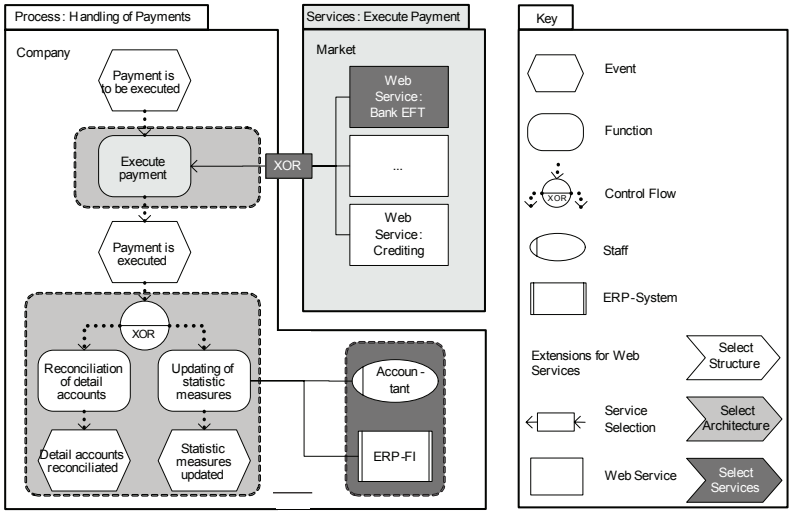
Grefen, 2003). On the basis of SOA, processes of an information system can be extracted and 'out-tasked' to service providers. According to Keen and McDonald "Out-tasking […] breaks a company into a portfolio of process-centred operations rather than interlocking departments or functions"(Keen & McDonald, 2000). The economical relevance of SOA is reflected by the concept of service-oriented business processes in this article. Figure 1 illustrates this concept on the basis of a business processes modelled in the notation of Event-driven Process Chains (EPC) (Scheer, 1994).

In service-oriented business processes, parts of the entire process can be out-tasked to alternative service providers (Grefen et al., 2002). That way, the business process integrates a certain set of services that have to be both combined with internal functions and configured according to the companies needs (Limthanmaphon & Zhang, 2003; Orriëns et al., 2003). The basis for service-oriented business processes are set by service-oriented information systems. Hence, SOA puts companies in a position to concentrate on their core competence by sourcing out parts of a process to service providers and thereby flexibly adopt changes.

According to Forrester, companies with a service-oriented architecture can reduce costs for the integration of projects and maintenance by at least 30 percent (Vollmer & Gilpin, 2004). Major providers of ERP-Systems incorporate service-oriented architectures in their solutions: 'Sonic ESB' by Sonic Software (Craggs, 2003), 'mySAP Business Suite' by SAP (SAP, 2004), 'e-Business on demand' by IBM (IBM, 2004), and the 'Application Server' by Oracle (Oracle, 2004). As a future trend, Gartner predicts that by 2007 most company frameworks will have changed to service-oriented architectures (Farber, 2004).

As information systems offer means to out-source services, the question arises which collection of services should be selected according the specific business needs of a company. Following a business perspective, this also comprises considering services that are not exclusively automatically carried out by parts of an information system. Along with the business processes, also those services that may be partly or fully carried out by staff have to be taken into account. In order to make appropriate decisions on the selection of the service portfolio, an appropriate Service Portfolio

Figure 1. Concept of service-oriented business processes using Web services



Management (SPM) is required. On the whole, this means that a management process has to be established on the appropriate composition of a corporate service portfolio. Apart from technical issues of service selection (Padovitz et al., 2003), methods for evaluating the performance of a company's service portfolio from a business perspective are required (Kaplan & Norton, 1992). In this article, these methods are referred to as service portfolio measurement. Considering that measurement should be made out of various perspectives (Neely, 2004), the predominant task seems to be finding out what drives the efficiency of service-oriented business processes from a financial perspective. This task is focussed on in this article.

Referring to the concept of service-oriented business processes introduced in this article, related studies in the fields of managing activities, infrastructure, and services have to be considered.

- **Activities:** There is a respective amount of studies carried out in the field of process management, taking into account the organization of business activities within business processes. Most of these contributions in IS focus on matters of designing processes with respect to both organisational structure (Becker, Rosemann et al., 2006) and operation by workflow management engines (Jablonski & Bussler, 1996). At present, the development of standardised exchange formats of processes is one of the major concerns (Aalst & Kumar, 2003). Research on the assessment of processes is predominantly covered by management literature and focuses on qualitative aspects (Davenport, 1993; Hammer & Champy, 1993; Smith, 1996). Some approaches in accounting science take a more quantitative look on processes, like activity based costing (Cooper & Kaplan, 1991). However, these approaches abstract to a large extend from process models.
- **Infrastructure:** Designing information system infrastructures is an essential task in IS. Studies focussing on the assessment of alternative solutions can be found with either a qualitative (Farbey et al., 1995) or quantitative orientation. Profound research on quantitative assessment is particularly carried out in the field of total cost of ownership-analysis (TCO) aiming at calculating all relevant costs chargeable to an information system throughout its life cycle (Ferrin & Plank, 2002; Gartner, 2002). Apart from methodological contributions (Daniels, 1993; Tam, 1992), special analysis has been carried out evaluating specific aspects in systems design (Faye Borthick & Roth, 1994; Smith David, Schuff et al., 2002).
- **Services:** In recent years, special research on services engineering is increasingly arising (Shostack, 1982; Stiglitz, 2000). Within the ITsector, studies in the field of standards, like ITIL, serves as an example for service engineering (OGC, 2001). Special studies on the assessment of services are carried out with respect to sourcing strategies. Most assessments are based on argumentations, partly structured by means of pros and cons lists (Knolmayer, 1997), checklists (Buck-Lew, 1992; Kador, 1990; Kascus & Hale, 1995), analytical hierarchy process models (Putrus, 1992), and flowcharts (Knolmayer, 1997). Quantitative approaches focus on cost analyses, such as special task comparisons (Espinosa & Carmel, 2004), multi-task cost comparisons and holistic cost-risk comparisons (Aubert et al., 2002; Bahli & Rivard, 2003; Jurison, 2002).

These studies offer valuable insight in the management of service-oriented business processes. One essential shortcoming, however, is to be seen in the fact that single aspects of service-oriented business processes are focussed on in each field. Thus, an integrated picture is lacking, which would, all the same, be necessary for configuring the company's service portfolio. Contributions towards such integration of activi-

ties, infrastructure, and services can be found in the field of orchestration and choreography of Web services (Aoyama et al., 2002; Cardoso et al., 2004; Wang et al., 2004). However, this work focuses on technical aspects of coordinating services running service-oriented processes, so far. For SPM, on the contrary, insight into designing these processes right is needed, considering long-term economic consequences coming along with decisions on the configuration of the services portfolio.

A first approach to apply capital budgeting in service-oriented computing has recently been presented (vom Brocke & Lindner, 2004). In this work, the monetary consequences of a service-oriented architecture are evaluated and opposed to those of conventional architectures. This work sets a basis for the development of a methodological framework for the assessment of the financial performance of service-oriented information systems (vom Brocke, 2006b). From a business perspective, however, these works are still limited to the assessment of services and infrastructure. With the concept of service-oriented business processes, such assessments are consecutively put in relation to the company's business activities aiming at an integrated frame for evaluating activities, infrastructures, and services. Such an integrated view is presented in this article.

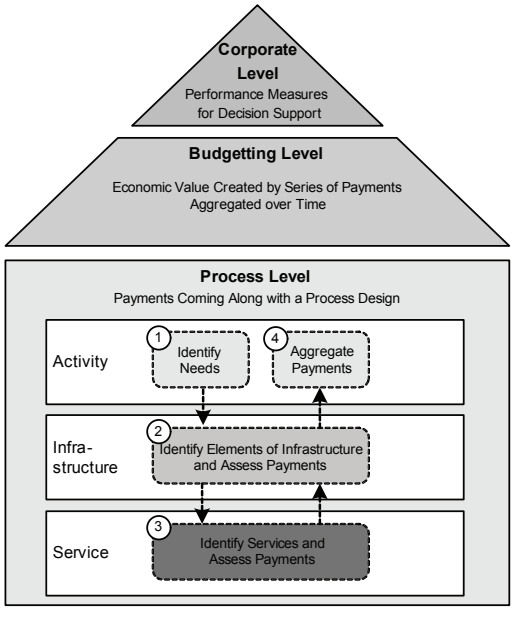
INTRODUCING A MEASUREMENT SYSTEM FOR THE MANAGEMENT OF SERVICE-ORIENTED BUSINESS PROCESSES

Framework

The measurement system is mainly structured on three levels, each addressing specific aspects of calculation: process-level, budget-level, and corporate-level. The framework of the system is displayed in Figure 2 and will be illustrated in more detail in the following.

Special emphasis is to be put on the process-level as relevant payments chargeable to a service-portfolio of a business process are to

Figure. 2. Framework of a measurement system for service portfolio measurement

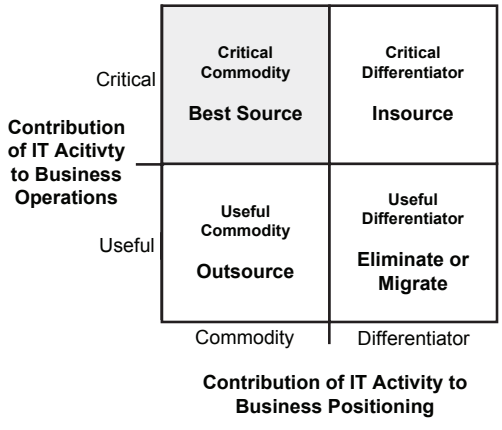


be calculated. Consecutively, these payments are aggregated on budget and corporate-level, applying and adapting methods of capital budgeting.

- **Process Level:** On the process level, payments (out-payments) and receivables (in-payments) brought about by the business process design are analysed. For that purpose, special calculations have to be carried out with respect to activities, infrastructures and services as essential parameters of a processes service-portfolio. Starting with the business needs on an activity level, both alternative infrastructures and services have to be assessed regarding e.g., pricing as well as operational availability. Following a business perspective, these payments are then aggregated according to the specific business processes of a company and summed up to one representative series of payments.
- **Budget Level:** On the budget level, additional parameters are taken into account relevant for judging the economic value created by series of payments. Relevant parameters are e.g., derived from specific conditions of funding and taxes that a company faces in its economic situation. These series of payments are then consolidated over time by applying methods from capital budgeting. That way, a survey of financial consequences is created.
- **Corporate Level:** Finally, on the corporate level, the profitability of the process design applying a certain service-portfolio has to be compared to alternative investments available for the company. Measures like the Total Cost of Ownership (TCO) and the Return on Investment (ROI) help consider relevant parameters for this purpose.

In the following sections, this framework will be applied with a special focus on evaluation of the monetary consequences by applying SOA in the design of business processes. Principally, one leading question is how far investments in migrating to SOA may be economically justified by benefits due to a greater degree of flexibility in choosing services for the implementation of business processes. For that purpose, a general introduction into relevant types of payments and methods of calculating is given. This may serve as a guideline for individual evaluations. The approach is then demonstrated by means of an example of a specific case.

Figure 3. Positioning out-tasking as a sourcing strategy



Measurement on the Process-Level

Identifying Business Needs Related to Activities

A deeper understanding of service-oriented business processes can be gained by differentiating the underlying concept of out-tasking from various sourcing strategies. For that purpose, a framework provided by Lacity et al., can be applied (Lacity et al., 1996).

The framework aims at structuring business processes according to characteristics that are relevant for sourcing decisions. In particular, two dimensions are applied: The importance of activities for the operation of business processes and its contribution to strategic business positioning. Against the background of the approach, the following service categories can be differentiated:

- **Critical Differentiators:** Tasks of high strategic and operative relevance are suggested to be fully in-sourced. An outsourcing of these tasks would result in a loss of know-how and innovation potential, and would threaten core competence.
- **Useful Commodities:** Tasks that are neither strategically nor operatively outstanding are candidates to be fully out-sourced. In these situations, potentials of reducing costs by aid of outsourcing can likely be realised.
- **Useful Differentiators:** Tasks that are considered to be highly relevant for strategic differentiation but show little relevance in operational business neither in- nor out-sourcing are recommended. They should be eliminated sooner or later.
- **Critical Commodities:** Tasks those are customary in trade but show little strategic relevance should be controlled inside but operated outside the company. That way, positive effects of specialisation can be realized (Quinn, 1999).

As to the model, service-oriented business processes especially offer potentials for the case of critical commodities. In this respect, out-tasking can be considered as a realisation of a best sourcing strategy which is rendered possible by aid of service-oriented architectures.

Starting from a certain sourcing strategy, the requirements of services being candidates for implementing activities have to be specified. Essential requirements can be derived from process models, as they document the result of an activity that is considered to be necessary from customer perspective. In addition, further requirements can be identified and specify the mode in which the result is delivered. Typical examples for these kinds of characteristics are service-levels and failure- or breakdown-rates. These qualitative requirements set the frame for reselecting appropriate service candidates. Applying them, a set of services that may either be integrated conventionally or on the basis of a service-oriented architecture is identified. These selected alternatives should then be evaluated regarding relevant payments coming along with them, in order to identify the most profitable service portfolio for a company.

In order to assess relevant payments, the entire life cycle of business processes has to be considered. To give an orientation, essentially the phases of development, operation, adaptation, and disintegration should be analysed. With the purpose of identifying payments in the phases, basically two approaches can be distinguished: total or partial calculation. According to a total calculation, all payments chargeable to business process applying a certain service portfolio have to be accumulated. The total calculation tends to be rather complex, but offers a great flexibility of calculation as various alternatives can be compared with each other. Following a partial calculation, on the contrary, only additional payments that are relevant in comparison to two alternative solutions are calculated. Partial calculation reduces the scale of the computation. However, the assessment is limited to the pair of alternatives selected.

The decision on a partial or total approach has to be taken under consideration of the specific company's situation. This will be

further analysed with respect to the selection of infrastructures and services in the following chapters.

Assessing Payments Related to the Infrastructure

With respect to the infrastructure, two typical context situations have to be distinguished: Projects for new- and redesigning of information systems. In case of newly designing a system, a total calculation may be undertaken in order to compare a wide range of alternatives. In case of a redesign, on the contrary, payments for setting up the existing infrastructure are not relevant for decision making. They have to be considered as so-called sunk costs. Thus, a partial assessment appears to be adequate. As most companies in fact run certain infrastructure already, they are actually concerned with decisions on migrating towards service-oriented architectures. Thus, a partial calculation will be conducted in the following.

Phase of Development

Analysing the series of payments brought about by a migration towards a service-oriented architecture, payments related to purchasing hard- and software, implementing the infrastructure, for building up know-how, for administration and for support have to be considered in stage. In-payments will hardly be occurring in this phase. They can result from saving of labour by not implementing services that are out-sourced.

Considering the situation of a system's redesign, special aspects have to be considered. As the tasks that are likely to be out-sourced have been implemented already, the payments driven by them are no more relevant for the out-tasking decision. They are classified as so-called 'sunk costs.' In addition, further out-payments brought about by the work for redesigning have to be considered. As far as the functionality of the information system is not extended, these payments are totally to be charged to the out-tasking decision.

Phase of Operation

In total cost of ownership analysis, costs for the maintenance work on information systems and user support are usually considered during operations (Faye Borthick & Roth, 1994). Against this background, it can be argued that by out-tasking services, total payments for maintenance work are reduced by the equivalent for the work on these services. In contrast, additional payments have to be considered for the maintenance of the interfaces. Examples for this kind of maintenance work are adaptations to new versions of exchange formats on both data and services. Correspondingly, the payments related to support are derived. In addition, the implementation of a service-oriented architecture offers the potential of modernising information systems. If legacy systems can be replaced by the purchase of a SOA, running costs would consequently be cut. Savings would be rendered possible which would be calculated as in-payments of an operational phase.

Another important effect, however, is neglected in most of the analyses: The efficiency of business processes that are enabled by the information system. In order to calculate these effects properly, Grob and vom Brocke suggest a method in which process models are used in order to identify relevant in- and out-payments brought about by a certain process design (Grob & vom Brocke, 2006). According to this concept, out-tasking creates the opportunity to reduce the resources that are needed for running the information system. In order to calculate the amount of savings that are chargeable to a service, the values of all relevant resources as well as the rate in which they are used have to be considered.

Further in-payments can be gained during operation phase by sharing parts of the infrastructure with partners. These partners can be found either inside or outside the company. Due to increasing costs and risks, the cooperation is increasingly attractive for companies in order to reach economies of scale. Therefore, service-oriented architectures offer promising

means for 'selective service sharing.' Therefore, further in-payments may be achieved, as a wide range of partners can be involved in sharing information system services.

Moreover, specific payments to the service provider have to be considered during the phase of operation. Both, the amount of these payments as well as their distribution throughout the life cycle clearly vary according to the model of pricing that has been agreed upon earlier. Also payments for general licensing agreements have to be taken into account coming along with company's information system.

Phase of Adaptation

During the runtime of an information-system, adaptations will have to be made to the system. These adaptations can be necessary in order to both implement new services as well as to modify existing ones. Examples for drivers of such adaptations are technological innovations and changing demands.

Depending on the particular infrastructure, different financial consequences of these adaptations have to be taken into account. In case parts of the system that are run inside the company are affected, out-payments for the implementation of changes to the system have to be charged. Relevant indicators are both the amount of man-months needed as well as the appropriate average cost rate to be calculated. In case out-tasked services are affected, these payments might be saved. However, it should be taken into account that the prices for the services provided might rise. Moreover, it is likely that changes might have to be made, that are not covered by service providers, so that services might have to be in-tasked by the company again.

As the need for changes is highly uncertain, methods of probability calculation should be applied here. One approach might be to estimate out-payments for adaptations in each period during the planning horizon, for example by using the scenario technique. In order to simplify these estimations, different types of adaptations can be defined depending on their duration and the average amount of payment. These types of adaptations can be planned by estimating the probability and the point in time they occur in.

Phase of Disintegration

Finally, it has to be analyzed, in how far specific financial consequences of a migration to a service-oriented architecture can be foreseen in the phase of disintegration. A positive effect can result from the reduction of the resources that are needed in order to run the information system. Due to this effect, idle time costs can be saved by disintegrating services. However, potential bounds by the contracts with service providers have to be taken into account. These bounds might both limit the flexibility of changing partners as well as bring about ongoing payments.

All relevant parameters have to be aggregated in a series of payments. A summary of the consequences discussed above is given in Figure 4.

In addition to the listing of relevant payments, their derivation is characterised by marking the main emphasis of each payment over the planning horizon. These payments reflect the monetary consequences coming along with the decision about a service-oriented architecture on a process-level. Further examinations have to be undertaken regarding the selection of services that are combined in a company's service portfolio.

Assessing Payments Related to Services

Apart from evaluating monetary consequences of a service-oriented architecture, the decision about the sourcing structure of a service portfolio has to be taken on process-level. Doing so, concrete services of a specific quality have to be selected which are offered by providers under certain conditions. As to the quality, various service levels need to be considered.

In contrast to the evaluation of the infrastructure, the seizing of the services should be carried out according to a total calculation. A greater flexibility that is offered by the total calculation sets the basis for optimising the service

Figure 4. Service portfolio measurement on the process-level assessing SOA

Elements of the Series of Payments with SOA			
Point in Time	0	…	n
Phase of Development			
Out-Payments			
- for building up know-how			
- for implementing SOA as a new architecture			
- due to reorganization work (redesign only)			
In-Payments			
+ due to not implementing services in-house (new design only)			
Phase of Operation			
Out-Payments			
- for additional maintenance work on the interfaces			
- for support (1st / 2nd level)			
- for conducting operation			
- for licenses with providers			
In-Payments			
+ for shared service			
+ by savings concerning lowering resources needed			
+ by saving for maintenance work on the services			
Phase of Adaptation			
Out-Payments			
- for adaptation work on interfaces			
In-Payments			
+ by savings due to adaptation work on services			
Phase of Disintegration			
Out-Payment			
- for replacement like ongoing contracts			
In-Payment			
+ by saving according to idle time costs of the resources			
+ by liquidation of technology			
Series of Payments According to Partial Calculation			

portfolio. By evaluating each service entirely regarding its relevant out- and in-payments, various alternative compositions of a service portfolio can be calculated. Payments for the evaluation of services can also be distinguished between the phases of development, operation, adaptation, and disintegration.

Quality of Services

Choosing appropriate services for the company's service portfolio, differences in quality of the services have to be considered (Kester, 1984; Niessen & Oldenburg, 1997). As a consequence of the total calculation, it has to be considered that differences in service quality are not to be quantified by savings. Savings can only be calculated by comparing two alternatives, which is done on the corporate-level.

Service quality is considered best on a two-fold level in the measurement system. Firstly, a service needs to be appropriate on a factual level in order to conduct a sub-process according to operational demands. The system only records those services that meet the demands according to the factual specification. Secondly, various security levels can be defined with which the service will be provided according to the factual specification. In this case, the level of security represents the equivalent value of the breakdown ratio quantified in percentage.

For a more detailed assessment, the monetary consequences of a total breakdown and failures of different extend can be distinguished. In order to record monetary consequences of different security levels, average costs for service breakdown have to be calculated. The amount of costs can be quantified either on the basis of a process calculation (Grob & vom Brocke, 2006), or by means of estimation (OGC, 2001). The out-payments for risk of breakdown of the service can be derived by calculating the product of the failure probability and the amount of personal losses due to breakdowns. In the same way, additional characteristics of the service quality can be incorporated in the measurement system.

Out-Payments

Apart from mere production costs, transaction costs have to be considered. According to transaction cost theory these costs are specifically high when incorporating market-like coordination mechanisms more than hierarchical ones (Coase, 1937; Williamson, 1985). In the measurement system particularly coordination costs are relevant. Coordination costs are special transaction costs that refer to internally arising costs for the planning, the steering, and the control over the work of the external service provider that is the costs which exceed the actual production of one product (Nam et al., 1995). Parts of these costs can for example be explained by the principal agency theory (Bamberg & Spremann, 1989). Hence, coordination costs essentially comprise cost for control and so-called 'Bonding Costs'. Bonding Costs result from the need of documenting the service relation. Costs for control also refer to those costs caused by the management of the service-portfolio. They have to be reduced by an appropriate system management. For this purpose, also costs of lacking profits due to miscalculation have to be listed. Allocating payments for coordination estimations has to be carried out that can partly be grounded on internal transfer prices of the company's cost accounting system.

In-Payments

Services that come into consideration for out-sourcing can hardly be calculated for specifying in-payments. However, in case an internal cost accounting is carried out in a company, internal transfer price rates may be accounted for. Originally, transfer prices are charged for ITservices within a company for coordination purpose. Yet, these rates may as well be allocated as an equivalent for the in-payment of a service.

If appropriate methods for calculating transfer prices are not available, it might also seem reasonable to consider the costs brought about by the service. However, this assumes

that appropriate cost information is available concerning single services. Methods of activity based costing offer promising means to provide this information (Grob & vom Brocke, 2006).
Series of Payments

The most relevant parameters of the monetary consequences discussed above, are summarized in Figure 5.

Looking at a company's business processes, the payments identified above, refer to special aspects of these processes. Thus, these payments have to be aggregated according to the individual process structure of a company.

Aggregating Payments Regarding Process Structure

For the purpose of aggregation, payments driven by processes and those not driven by processes have to be differentiated. Payments that are driven by the process vary according to quantities of these processes. Principally, payments in the operational phase turn out to be dependent on the processes quantity, whereas those payments relevant in the phases of development, adaptation and disintegration tend to be independent from the quantities. An overview on calculation of aggregation on the

Figure 5. Service portfolio measurement on the process-level assessing services

Elements of the Series of Payments of a Service			
Point in Time	0	…	n
Phase of Development			
Out-Payments			
- for building up relations to services provider			
- for implementing the interface for integrating the service			
Phase of Operation			
Out-Payments			
- for production or provision of a service			
- for co-ordination of service integration			
- for risk of service breakdown			
- for risk of service failure			
In-Payments			
+ from internal calculation of transfer prices			
Phase of Adaptation			
Out-Payments			
- for adaptation work on interfaces			
Phase of Disintegration			
Out-Payment			
- for replacement like ongoing contract			
In-Payment			
+ for replacement like credit			
Series of Payments According to Total Calculation			

basis of the payments identified above is given in Figure 6.

On the basis of the series of payments calculated above, additional financial parameters have to be taken into account in order to assess the economic value of the service portfolio based on a service-oriented architecture. These aspects are considered on the budget level of the measurement system, which is described in the following.

Measurement on the Budget-Level

On the budget level of the measurement system, the financial consequences that arise from providing the payments needed during the life cycle are measured. For their analysis, the method of 'visualisation of financial implications' (VOFI) is applied (Grob, 1993). Using VOFI, the financial consequences of long-term decisions are structured and calculated by means of spreadsheets that serve as a database for further analysis. Compared to formulas applied by conventional methods of capital budgeting (e.g., present value or annuity of an investment project), calculating the investment on the basis of a spreadsheet offers greater transparency and adaptivity (vom Brocke & Lindner, 2004).

Customising VOFI specific parameters that are relevant in a certain capital situation (e.g., funding conditions) can be considered. Typical parameters that may serve as a reference are summed up in the VOFI given in Figure 7.

In order to consolidate the various influences on the effectiveness of the decision over time, a periodic update of the capital stock has to be calculated. Starting in period zero, each period has to be calculated in a way that there is a balance between in- and out-payments. The following example may illustrate the essential procedure. In the first period, usually an out-payment has to be financed. If the internal funds available are insufficient, a loan has to be taken out. As usual, various conditions for loaning can be agreed upon, and also a combination of various loans can be calculated in the VOFI. Correspondingly, multiple forms of funding can be included.

By calculating the adequate amount of loaning or funding, also tax payments have to be taken into account. In order to calculate tax payments, an auxiliary calculation has to be carried out. Depending on tax law, relevant parameters are for example individual depreciations that are chargeable to the investment as well as tax rates. In each period, these periodical in- and out-payments have to be balanced. As a check-up, the net funding value, which is defined as the accounting balance of all out- and in-payments, should be zero.

On the basis of these flow figures mentioned previously, the capital stock can be updated periodically. For this purpose, the balances of all loans and funds have to be recorded. The accounting balance of both of them finally results in the net balance of the total investment. By this algorithm the value of an investment in a service-oriented architecture can be monitored during the whole life cycle of the information system simply by observing the net balance in each relevant period. For special interest investigations, additional efficiency measures can be calculated on the basis of VOFI. These measures are calculated on the corporate level of the measurement system, which is illustrated in the following.

Measurement on the Corporate-Level

In order to facilitate the design of a company's service portfolio properly, the various evaluation results have to be aggregated for decision purpose. On the basis of the calculations on the budget and process level described above, a wide range of efficiency measures can be applied from accounting science. For service portfolio measurement, particularly the Total Cost of Ownership (TCO) and the Return on Investment (ROI) are significant (vom Brocke & Lindner, 2004). They are well-spread in practice and serve as a means to illustrate the relevant parameters for decision making at the same time.

Whereas the TCO is limited to cost analysis, calculating the ROI reveals the profitability of investments in service-oriented business processes. By applying this measure, a ratio that

Figure 6. Aggregation of payments according to business processes

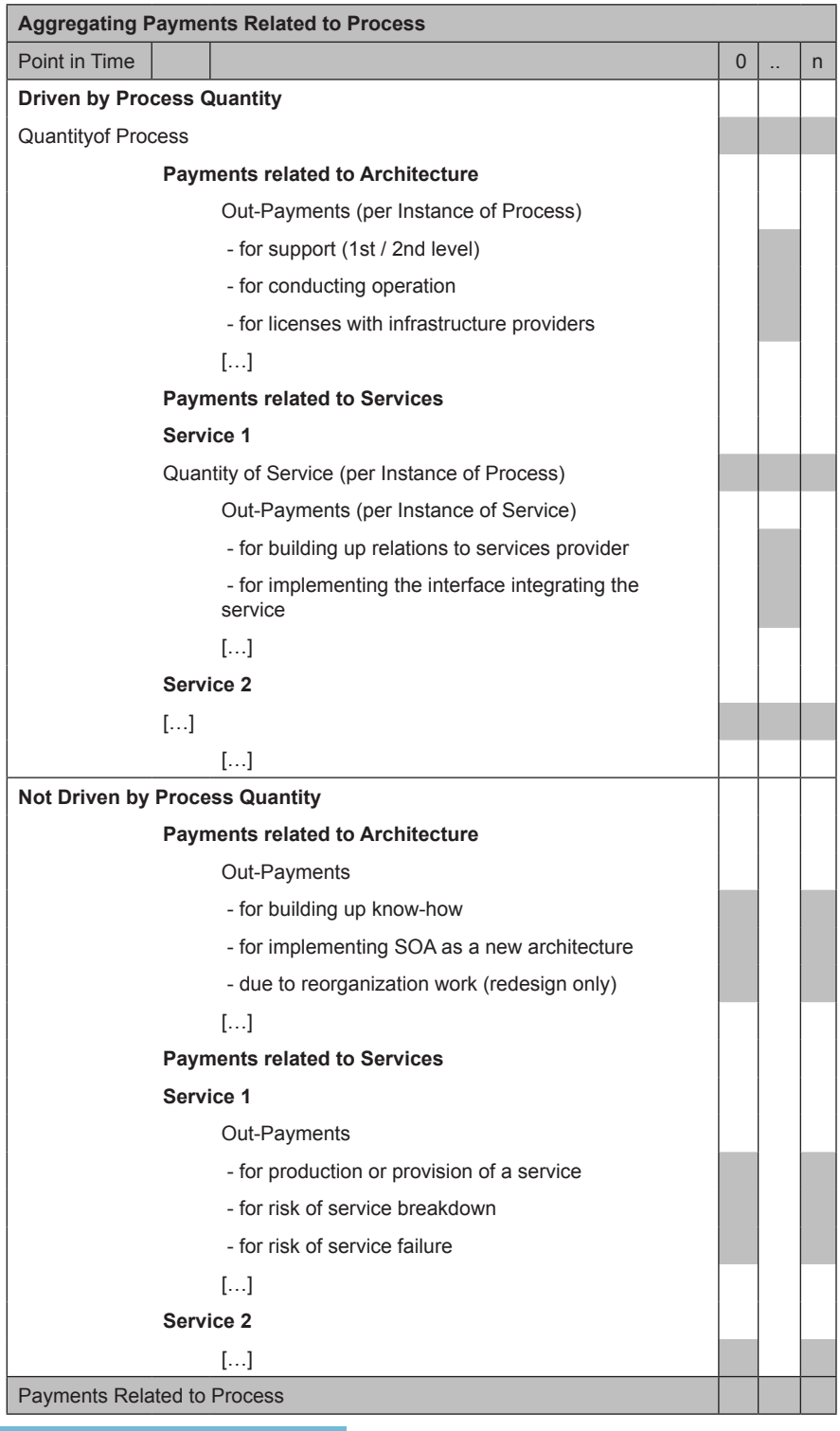


Figure 7. Service portfolio measurement on the budget-level using VOFI

VOFI for Localisation Projects				
Point in Time	0	1	…n…	h
Series of Payments				
Internal Funds				
– Withdrawals				
+ Deposits				
Installment Loan				
+ Credit Inatake				
– Redemption				
– Debitor Interest				
Annuity Loan				
+ Credit Inatake				
– Redemption				
– Debitor Interest				
– Creditor Interest				
Loan in Current Account				
+ Credit Inatake				
– Redemption				
– Debitor Interest				
Financial Investment				
– Reinvestment				
+ Disinvestment				
– Creditor Interest				
Tax Payments				
– Out-Payment				
+ In-Payment				
Net Funding	0	0	0	0
Balances				
on installment loan				
on annuity loan				
on current account				
on financial investment				
Net Balance				

sets the total profit in relation to the stock of capital provided for the investment is calculated (Friedlob & Plewa, 1996). Consequently, the ROI indicates the interest payment made by an investment. While the ROI seems to be suitable for comparing investments of different kinds, it is a static measure, therefore, inappropriate to support long-term decisions. This point can be considered by calculating the ROI on the basis of VOFI. In doing so, the ROI is not only a dynamic measure, but it also considers various conditions of loaning and funding as

well as taxes. For evaluating the efficiency of an investment, the ROI has to be compared to the average capital cost within planning periods. Figure 8. shows the definition of this ROI as well as the criteria for decision support.

In particular, the ROI can be used for decision support on the configuration of service portfolios. The relevant data for the calculation can be taken directly from the VOFI database. In case distributions of funds are planned, these payments have to be considered in the fraction's numerator. That way, the ROI is appropriate for evaluating whether payments necessary for the migration to a service-oriented architecture will be justified by future savings due to the performance of the company's service portfolio.

Up to this stage, the measurement system has been described from a methodological perspective. In the next chapter, the system is applied to a concrete situation of a company.

APPLYING THE MEASUREMENT SYSTEM FOR THE MANAGEMENT OF SERVICE-ORIENTED BUSINESS PROCESSES

In this passage, the measurement system for the management of service-oriented business processes will be illustrated by means of an application. The case of the travel agency DECIS may serve as an example. DECIS is a

Figure 8. Service portfolio measurement on the corporate-level using ROI

Target: ROI

$$ROI = \sqrt[n]{\frac{NBI_n + EF_0 + CI \cdot (1 - pt)}{IF + EF_0}} - 1 \quad \text{and} \quad NBI_n + EF_0 + CI \geq 0$$

Benchmark: c

$$c = \sqrt[n]{\frac{NB_n + OI + CI \cdot (1 - pt)}{IF + EF_0}} - 1$$

Decision Support

Investment is financially profitable, if ROI > c

Symbols

ROI	ROI, on a dynamic basis
NBI_n	Net Balance of the Total Investment in t=n
IF	Internal Funds Used
EF_0	External Funds Used in t=0
n	Planning Horizon
pt	Tax Rate on Profit
CI	Total Creditor Interest
OI	Total Interest of the Opportunity
c	Average Capital Cost

demonstration company for analysing the economic impact of SOA (DECIS = Demonstrating the Economic Impact of Service Orientation). The case, along with additional resources, is presented at www.decis.org.

Introduction

The DECIS is a travel management service provider that predominantly offers holiday travels for private and business customers. Round trips only form a small part of its product portfolio. The core competence of the business is the individual configuration of holidays according to the specific needs and wishes of its customers. Therefore, the company's tourism market is limited to the high-end segment. DECIS uses both digital chain of distribution and classic travel agency sales. The excellent customer service is the trademark of the company which differentiates itself clearly from other businesses and competitors.

However, especially in recent years, DECIS has been exposed to increased pressure by more and more competitors who have been pushing both reduced costs and amelioration of the service. Until now, IT tasks have only been accomplished by the IT department of the company itself. The company's IT development has achieved excellent tasks, yet, the costs for individual IT services have been partly too high compared to the market value.

The business processes of DECIS are substantially based on information systems for e-commerce as well as travel agency sales. The goal management perspective of the business is now to use, despite of the high cohesion, service-oriented architectures. That way, parts of the information system environment could be given away to external service providers. Focus of the evaluation is whether the supply of a service-oriented architecture would be worthwhile. Furthermore, the most adequate service-portfolio has to be determined.

In order to cover the payments, internal funds of 10.000 €, an instalment loan, and a loan in current account are available. By means of the instalment loan, funds of further 10.000 € are provided for the duration of two years, a creditor interest rate of 6% and a disagio of 5%. The loan in current account comes along with a creditor interest rate of 8% and a debtor interest rate of 6%. In addition, tax rates relevant for DECIS vary during the planning horizon: in t=1 of 55.0%, in t=2 of 52.5%, in t=3 of 50.0%, in t=4 of 47.5% and in t=5 of 45.0% with t serving as a time index.

The management of DECIS has grasped the long-term character of the decision which needs to be taken. It determines the planning horizon of five periods. Thus, the measurement system described in this article was applied.

Measuring on the Process-Level

Identifying Business Needs Related to Activities

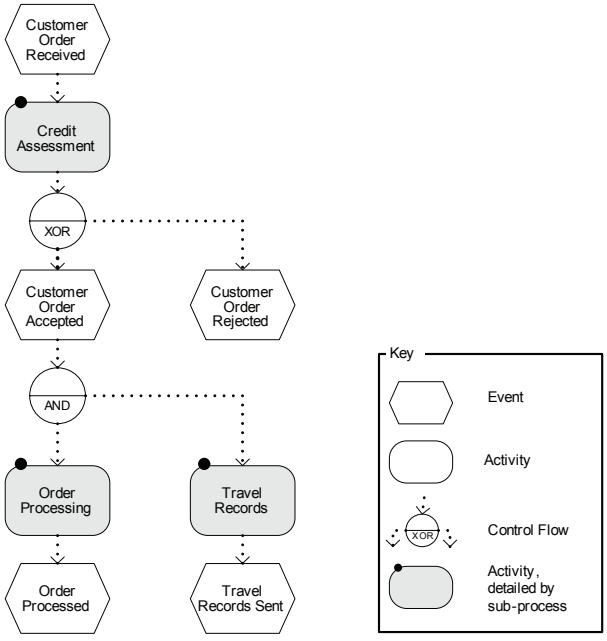
For decision support, the main activities within the business of DECIS were structured by means of process models. An excerpt of these models, relevant for this study, is given in Figure 9.

After receiving a customer order, a credit assessment is carried out. In case the order is accepted, individual payment conditions are calculated on the basis of the assessment and handed over to the order processing process. Right after the order is accepted, travel records are being collected for the customer. With these records, extensive information material regarding the journey and the destination are handed out to the customer in the most convenient way (e.g., brochures or mail).

On the basis of the process models, the main activities were analysed according to characteristics relevant for sourcing decisions:

- **Credit Assessment:** The assessment of customer solvency is considered to be of high operative importance. In particular with respect to online-bookings, the assessment safeguards the company's liquidity. As the assessment also serves to calculate individual payment condition, it also contributes to the differentiation of DECIS for some customers.

Figure 9. Mapping relevant activities at DECIS



- **Travel Records:** The compilation of travel records is considered to be of high strategic importance in the competition. DECIS is running particular data-warehouse-software for this purpose that offers specific way of compiling the records. This core competence is constantly being extended and ameliorated by means of software solutions in the internal IT department.
- **Order Processing:** The processing of orders has turned out to be rather standardized. In the current state, it is conducted by a workflow management system. However, it connects numerous application systems in order to support individual steps in processing. In addition, feedback loops need to be coordinated according to a staging system for approval.

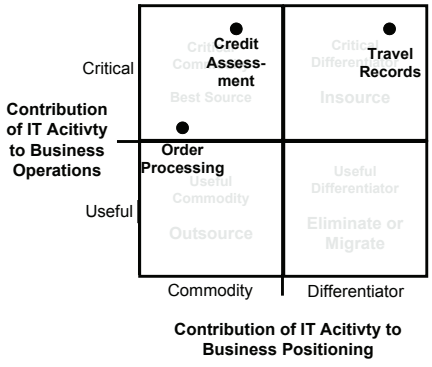
According to the characterization, sourcing strategies were worked out for each activity. Figure 10 gives the classification of the services in the model from Lacity.

The 'travel records'-activity as one result of the analysis should be carried out internally also in the future. The 'credit assessment' turns out as an activity that can be supported by 'best-practices' of external service providers, leading to a cost reduction for the company. Also for the 'order processing,' an appropriate out-tasking alternative should be provided.

In order to choose appropriate services for the activities, the management defined a detailed set of requirements to be fulfilled for each activity. An excerpt of these requirements to be considered in this study is given in the following:

- For 'credit assessment' and 'order processing,' a medium availability of 99.5% according to the ITIL-standard is required. The error ratio should not exceed 0.01%

Figure 10. Deriving sourcing strategies at DECIS



- For the service 'travel records,' a high quality and highly available functionality are required. The requirements concerning availability is around 99.9%, the maximum error ratio is around 0.001%.

In order to ground the decision on the service portfolios, a calculation of the monetary consequences was carried out according to the measurement system introduced in this article. Thus, an assessment of the payments on process level was conducted first.

Payments Related to the Infrastructure

The payments coming along with the introduction of a SOA at DECIS were analysed in detail according to the types of payments described above. In Figure 11, a summary of these payments is given. Explanations to some of the positions will be given in the following.

The initial payment for implementing SOA consists of 14,000€ for the provision of hardware and 4,000€ for software (which is an enterprise service bus application). On a time schedule of five years, 16,000€ on the whole have to be written off of the capital costs. This has an impact on the tax payments, to be considered on the budget level. Payments for building up the know-how of 10,000€ mainly arise for trainings of administrators.

The payments for maintenance work—starting with 1,000€ in the first period—increase periodically by 10%. Further payments are driven by the amount of bookings to be realised in each period: 0.27€ for first and second level support, 1.88€ for conducting operation and 0.40€ for licensing with infrastructure providers, the latter decreasing by 10% each period due to economies of learning curves. In-payments of 6,000€ are expected for the parallel use of the infrastructure with a partner enterprise. Starting with the fourth period, an intensification which increases in-payments to 9,000€ is planned.

Adaptations of the infrastructure were estimated by 10% of the capital costs of the purchase per period. The in-payments in the phase of disintegration are due to further utilisation of hardware (liquidation proceeds of 1,5000€) as well as the decrease of idle time of resources due to an early cut of capacities (1,000€). Additional payments for ending contracts are not being calculated.

The financial efficiency of the investment in SOA is essentially driven by the performance of the service portfolio that can be run on the infrastructure. Consequently, the payments related to the services available for DECIS were assessed in the following part.

Payments Related to the Services

By means of a market analysis, service offers have been collected that fit to the requirements analysed on the activity-level. Each service was assessed regarding the types of

Figure 11. Estimated payments with SOA at DECIS according to partial calculation

Estimated Series of Payments with SOA for DECIS						
Point in Time	0	1	2	3	4	5
Phase of Development						
Out-Payments						
- for building up know-how	10,000					
- for implementing SOA as a new architecture	18,000					
In-Payments						
+ due to not implementing services in-house						
Phase of Operation						
Out-Payments (per instance of process)						
- for support (1st / 2nd level)		0.27	0.27	0.27	0.27	0.27
- for conducting operation		1.88	1.88	1.88	1.88	1.88
- for licenses with providers		0.40	0.36	0.33	0.30	0.27
Out-Payments						
- for additional maintenance work on the interfaces		1,000	1,100	1,210	1,331	1,464
In-Payments						
+ for shared service		6,000	6,000	6,000	9,000	9,000
+ by savings concerning lowering resources needed		1,000	1,000	1,000	1,000	1,000
Phase of Adaptation						
Out-Payments						
- for adaptation work on interfaces		1,800	1,800	1,800	1,800	1,800
Phase of Disintegration						
In-Payments						
+ by saving according to idle time costs of the resources						1,000
+ by liquidation of technology						1,500

payments described above. In Figure 12, the results of selected services are summed up. In the following, a short explanation on the conditions is given.

For the Process 'credit assessment', three service offers were identified at an announcement for external service providers. Two of which have been implemented on a Web service basis (B1 and B2) and one has been implemented on the basis of an alternative infrastructure (B3). According to the process 'travel records', the IT department made a suggestion to migrate towards SOA and to provide the service internally (A1). Apart from that, the service may well be carried out according to the current state of the art (A2). For the 'order processing', there are two offers available from the same external service providers (C1, C2), of which C2 offers 99.7% of availability as opposed to 99.5% availability offered by C2. Neither C1 nor C2 applies SOA.

In addition, internal examinations have been carried out, in order to quantify costs. Process analysis has discovered that, in case the service for credit assessment is temporarily not available, average costs of 50€ should be calculated. Failures in service sometimes cause additional interaction with the customer or the

Figure 12. Conditions of services for SOA and non-SOA at DECIS

Service Conditions	A1	…	B1	B2	B3	…	C2
Phase of Development							
Out-payments							
- for building up relations to services provider	500 €	…	1,500 €	2,000 €	3,500 €	…	500 €
- for implementing the interface …	5,000€	…	1,000 €	1,600 €	3,000 €	…	0 €
- for providing the software components	4,000	…	0 €	0 €	4,000 €	…	2,000 €
Phase of Operation							
Out-payments							
- for production of a service (per transaction)	0.75€	…	0.70 €	0.65 €	0.85 €	…	0,90 €
- for co-ordination of service integration	6,000€	…	3,000 €	4,000 €	8,000 €	…	1500 €
Average percentage							
- of service availability	99.8%	…	99.9%	99.4%	99.5%	…	99.5%
- of service failure	0.002%	…	0.001%	0.001%	0.01%	…	0,002%
Phase of Adaptation							
Proportional work on adaptation per period	6.0%	…	4.0%	4.5%	4.0%	…	6,5%
Phase of Disintegration							
Out-Payment							
- for replacement	3,000€	…	1,000 €	500 €	8,000 €	…	2500€

drop out of payments, so an average of 1,000€ for the handling of a failure case is estimated. On the basis of this information, the payments coming along with each service within the planning horizon have been calculated following the approach described above. In Figure 13 this calculation is presented in detail for Service B1.

On the basis of the separate assessments of payments related to alternative infrastructures and services, an aggregation of payments was carried out.

Aggregation of Payments Related to the Process

From a business perspective, the various payments identified have to be aggregated according to specific business processes of TravelSmart. In particular, this means to put payments in relation to structure and quantity of processes. Thus, estimation was carried out on how often the process analysed above is to be carried in each period. According to estimation, 7,500 customer orders have to be handled within

Figure 13. Estimated payments related to service B1 on the process-level at DECIS

Series of Payments related to Service B1						
Point in Time	0	1	2	3	4	5
Phase of Development						
Out-Payments						
- for building up relations to services provider	1,500					
- for implementing the interfaces	1,000					
Phase of Operation						
Out-Payments (per instance of process)						
- for production of a service		0.70	0.70	0.70	0.70	0.70
- for risk of service breakdown		0.05	0.05	0.05	0.05	0.05
- for risk of service failure		0.01	0.01	0.01	0.01	0.01
Out-Payment for co-ordination						
- for co-ordination of service integration		3,000	3,000	3,000	3,000	3,000
In-Payments (per instance of process)						
+ from internal calculation of transfer prices		4.00	4.00	4.00	4.00	4.00
Phase of Adaptation						
Out-Payments						
- for adaptation work on interfaces		100	100	100	100	100
Phase of Disintegration						
Out-Payment						
- for replacement						1,000

Figure 14. Aggregating payments regarding business processes at DECIS

Aggregating Payments Related to Process									
Point in Time				0	1	2	3	4	5
Driven by Process Quantity									
Quantityof Process					7,500	8,250	9,075	9,983	10,981
	Payments related to Architecture (SOA)								
		Out-Payments (per Quantity of Process)							
		- for support (1st / 2nd level)			2,000	2,200	2,420	2,662	2,928
		- for conducting operation			4,000	4,400	4,840	5,324	5,856
		- for licenses with infrastructure providers			3,000	3,000	3,000	3,000	3,000
		Total Driven by Process applying SOA			-9,000	-9,600	-10,260	-10,986	-11,784
	Payments related to Services								
		Service B1							
		Quantity of Service (per instance of Process)			1	1	1	1	1
			Out-Payments (per instance of Service)						
			- for production or provision of a service		5,250	5,775	6,353	6,988	7,687
			- for risk of service breakdown		375	413	454	499	549
			- for risk of service failure		75	83	91	100	110
			In-Payments (per instance of process)						
			+ from internal calculation of transfer prices		30,000	33,000	36,300	39,930	43,923
		Total Driven by Process applying B1			24,300	26,729	29,402	32,343	35,577
		Service A1							
		[..]			0.90	0.90	0.90	0.90	0.90
		Total Driven by Process applying A1			40,256	43,957	48,139	52,728	55,767
		Service C2							
		[..]			0.90	0.90	0.90	0.90	0.90
		Total Driven by Process applying C2			17,263	19,169	21,211	23,507	18,477
Not Driven by Process Quantity									
	Payments related to Architecture								
		Out-Payments of Development							
		- for building up know-how		10,000					

Figure 14. continued

		- for implementing SOA as a new architecture	18,000					
		Out-Payments of Operation						
		- for additional maintenance work on the interfaces		1,000	1,100	1,210	1,331	1,464
		In-Payments of Operation						
		+ for shared service		6,000	6,000	6,000	9,000	9,000
		+ by savings concerning lowering resources needed		1,000	1,000	1,000	1,000	1,000
		Out-Payments of Adaptation						
		- for adaptation work on interfaces		1,800	1,800	1,800	1,800	1,800
		In-Payments of Disintegration						
		+ by savings according to idle time costs of the resources						1,000
		+ by liquidation of technology						1,500
		Total Not Driven by Process applying SOA	-28,000	4,200	4,100	3,990	6,869	9,236
	Payments related to Services							
		Service B1						
		Out-Payments for Development						
		- for building up relations to services provider	1,500					
		- for implementing the interfaces	1,000					
		Out-Payments for Operation						
		- for co-ordination of service integration		3,000	3,000	3,000	3,000	3,000
		Out-Payments for Adaptation						
		- for adaptation work on interfaces		100	100	100	100	100
		Out-Payments for Disintegration						
		- for replacement						1,000
		Total Not Driven by Process applying B1	-2,500	-3,100	-3,100	-3,100	-3,100	-4,100
		Service A1						
		[..]						
		Total Driven by Process applying A1	-3,000	-4,500	-4,500	-4,600	-4,700	-4,800
		Service C2						
		[..]						
		Total Driven by Process applying C2	-13,000	-5,000	-5,050	-5,050	-5,100	-5,100
Payments Related to Process			-46,500	64,419	71,705	79,732	91,561	93,273

the first period, from which approximately 90% go through the booking process. Due to a shortly initiated campaign, an increase of customer orders by 10% per period is expected.

Following the method described above, the aggregation of payments was calculated for each configuration of service portfolio possible. In the following the calculation is demonstrated by the combination that turned out to be most efficient: A1, B1 and C2. For illustration purposes, the monetary consequences for SOA and B1 are presented in detail. Further alternatives A1 and C2 are considered in sum. The computation is presented in Figure 14 and will be explained in the following.

Aggregating the payments driven by the process, the frequency of each service per period has to be taken into account. The entire process is triggered approximately 7,500 times in the first period. The same frequency occurs with the services implementing the credit assessment activity. Contrarily, to that, the activities "travel records" and "order processing" only take place in 90% of the cases, according to the process model (see Figure 9). Thus, payments to be calculated per instance of service, like payments for production or risk of failure, have to be accumulated on a basis of 6,750 instances (= 7,500 x 90%) in fact.

On that data basis, payments both driven and not driven by the processes regarding infrastructure and each service have to be summed up. As a result, one series of payments that is representative for the monetary consequences of the service portfolio applied for implementing the process is calculated. These results set the basis for the further analysis of the payments on the budget-level. This part of the system's application is presented in the next passage.

Measurement on the Budget-Level

For each potential combination of the services, the financial consequences have been calculated on the budget level. Comparing the net present value at the planning horizon in t=n, the most efficient combination was identified. This is the combination of A1, B1 and C2. As an example, the computation for this combination is displayed in Figure 15. It comprises the aggregation of the series of payments, the VOFI, and auxiliary calculations for computing the tax payments.

During the computation, further VOFI calculations have been carried out for each combination of services regarding their specific requirements on the infrastructure. As an example, the calculation for a service portfolio without SOA is given in Figure 16.

As part of the various calculations of alternatives, in particular the situation without any changes to the sourcing strategy has to be included according to the measurement system. This very calculation represents the so-called opportunity, which essentially assesses the yield of the internal funds as if they would have been allocated in a financial investment. Its calculations are carried out in the same way as described above.

An instant comparison of the alternatives can be carried out checking the net balance value in t=n=5, which should reach a maximum level. As to the opportunity a net balance of 11,593€ was calculated. For a more detailed analysis, performance measures can be calculated on the database.

Measurement on the Corporate-Level

On the basis of the detailed assessment on both budget and process level, performance measures have been calculated in order to support the management of DECIS. Figure 17. gives an excerpt from the entire report that was generated.

In the DECIS case, the investment in SOA turned out to be profitable. The investment in the migration towards the new technology can be compensated by savings in later phases of the information system's life cycle. In particular, the benefits result from the opportunity of outtasking services to specialised service providers according to common standards. In addition, out of the various service offers available, the most profitable sourcing strategy for DECIS could be calculated. By aid of the measurement system

Figure 15. Financial consequences of the investment in the service portfolio with SOA on the budget-level at DECIS

VOFI for the Service Portfolio [SOA, A1, B1, C2]						
Point in Time	0	1	2	3	4	5
Series of Payments	-46,500	64,409	71,706	79,732	91,561	93,274
Internal Funds	10,000					
Installment Loan						
+ Credit Intake	10,000					
– Redemption			10,000			
– Creditor Interest	500	600	600			
Loan in Current Account						
+ Credit Intake	27,000					
– Redemption		27,000				
– Creditor Interest		2,160				
Financial Investment						
– Reinvestment		2,502	25,526	42,307	51,805	56,771
+ Debtor Interest			150	1,682	4,220	7,328
Tax Payments						
– Out-Payments		32,147	35,729	39,107	43,976	43,831
Accounting Balance	0	0	0	0	0	0
Balance on						
Installment Loan	10,000	10,000				
Loan in Current Account	27,000					
Financial Investment		2,502	28,028	70,335	122,141	178,912
Net Balance	**-37,000**	**-7,498**	**28028**	**70,335**	**122,141**	**178,912**

Calculation of Tax Payments					
Point in Time	1	2	3	4	5
Tax Rates	55.0%	52.5%	50.0%	47.5%	45.0%
Surplus of In- and Out-Payments	64,409	71,706	79,732	91,561	93274
– Creditor Interest	2,760	600			
+ Debtor Interest		150	1,682	4,220	7,328
– Depreciation	3,200	3,200	3,200	3,200	3,200
Assessment Base for Taxes	58,449	68,056	78,214	92,582	97,402
In-Payments					
Out-Payments	32,147	35,729	39,107	43,976	43,831

Figure 15. continued

Calculation of Depreciation					
Point in Time	1	2	3	4	5
Book Value, Beginning of the Year	16,000	12,800	9,600	6,400	3,200
– Depreciation Linear Rate	**3,200**	**3,200**	**3,200**	**3,200**	**3,200**
Book Value, End of the Year	12800	9,600	6,400	3,200	

a combination of the service offers A1, B2, and C2 is suggested. That way, a ROI of 36.43% of the entire investment in SOA is calculated.

Apart from the initial decision on the information systems infrastructure, an ongoing assessment of the financial efficiency of the information system can be conducted. For that purpose, it might prove positive that the measurement system provides common performance measures of corporate management. That way, the investment in the company's information systems design can easily be compared to other potential investments within the scope of management.

SPECIFICATION AND IMPLEMENTATION

The measurement system described in this article is formally specified by means of reference meta models (vom Brocke, 2006a). These models serve as a formalisation of essential elements for the system needed in order to conduct the calculations on the profitability of service-oriented business processes. At the same time, such models are designed in a way that they offer a critical flexibility to customize the measurement system according to individual needs.

In order to give an example, the specification of business processes may briefly be illustrated. As part of the framework, essential elements of business processes are formalised within a reference meta model on the activity level. This model comprises elements needed for assessing activities along with the relevant quantities. Hence, the modelling language to be used for mapping processes is not limited.

In the field of service-oriented architectures, process models are particularly represented by means of XML-Schemes (Van der Aalst, 2003). Standards like BPML (BPML, 2002), WSCI (Arkin et al., 2002) and WS-BPEL (Alves et al., 2006) are particularly common at present. In addition, XML-Schemes are developed for the most part of graphical languages for process mapping. Examples are the Event-driven Process Chain Modeling Language (EPML) (Mendling & Nüttgens, 2004), the Petri Net Modeling Language (PNML) (Billington et al., 2003), and the XML Modelling Interface (XMI) for the UML Meta Object Facility (OMG, 2005).

In order to implement the measurement system in alignment with these standards, a special XML-Scheme for the measurement system has been developed according to the reference meta model. Thus, model transformations can be carried out by means of XSLT-Scripts (Clark, 1999). That way, the framework remains independent of the rather quickly developing standards in process modelling.

The reference meta models set the basis for implementing the measurement system as a software tool for decision support. Currently, a project is being carried out aiming at a prototype version of the system to be implemented

Figure 16. Financial consequences of the investment in the service portfolio without SOA on the budget-level at DECIS

VOFI for the Service Portfolio [without SOA, A2, B3, C1]						
Point in Time	0	1	2	3	4	5
Series of Payments	-40,500	50,769	57,686	65,294	73,664	59,370
Internal Funds	10,000					
Installment Loan						
+ Credit Intake	10,000					
– Redemption			10,000			
– Creditor Interest	500	600	600			
Loan in Current Account						
+ Credit Intake	21,000					
– Redemption		21,000				
– Creditor Interest		1,680				
Financial Investment						
– Reinvestment		820	17,139	33,186	40,284	35,671
+ Debtor Interest			49	1,078	3,069	5,486
Tax Payments						
– Out-Payments		26,669	29,996	33,186	36,448	29,185
Accounting Balance	0	0	0	0	0	0
Balance on						
Installment Loan	10,000	10,000				
Loan in Current Account	21,000					
Financial Investment		820	17,959	51,145	91,429	127,100
Net Balance	**-31,000**	**-9,180**	**17,959**	**51,145**	**91,429**	**127,100**
Calculation of Tax Payments						
Point in Time		1	2	3	4	5
Tax Rates		55.0%	52.5%	50.0%	47.5%	45.0%
Surplus of In- and Out-Payments		50,769	57,686	65,294	73,664	59,370
– Creditor Interest		2,280	600			
+ Debtor Interest			49	1,078	3,069	5,486
– Depreciation		0	0	0	0	0
Assessment Base for Taxes		48,489	57,135	66,372	76,732	64,856
Out-Payments		**26,669**	**29,996**	**33,186**	**36,448**	**29,185**

Figure 17. Measuring the performance of service portfolios on corporate-level at DECIS

Service Portfolio Performance on the Corporate-Level		
Infrastructure	**With SOA**	Without SOA
Services	**A1, B1, C2**	A2, B3, C1
Final Value, NBI_n *(Opp.= 11,593)*	**178,912**	127,100
Pay-Off-Period	**2**	2
Return on Investment, ROI *(Opp.= 3.0%)*	**36.43%**	31.87%

as part of a J2EE-based collaborative suite for business engineering. With this implementation, the measurement system can be applied in authentic situations and might thus serve as a means for coordination on the evolving market of Web services. A sample version of the tool set is available at www.decis.org.

CONCLUSION AND OUTLOOK

Given the technological achievements for the design of service-oriented information systems, the challenge of managing service-oriented business processes arises. This is significant for both management and information systems research. In particular, there is a distinct need for evidence on selecting the proper services according to a company's needs. In order to incorporate these needs properly, a focus on the assessment of service-oriented business processes rather than on information systems artefacts was suggested with this article.

Aiming at a measurement system for decision support, findings on the evaluation of service-oriented business processes were presented in this article. Due to the long-term economic consequences of setting up an appropriate environment to run service-oriented business processes, the financial perspective was focused on. In particular, methods of capital budgeting have to be applied in order to assess economic consequences properly. That way, common business measures that indicate the financial performance of the decisions in comparison to alternative investments can be calculated. From a methodological perspective the findings were summarised in a general framework and then applied by means of an example. The specification and implementation of the framework facilitates the practical use of the measurement system.

The measurement system describes focuses on the profitability of an investment in the company's service portfolio from a financial perspective. In addition, also non-monetary consequences of the process design may be analysed. Thus, future work will concentrate on the enlargement of the system by various perspectives that may be relevant. Perspectives of interest may for example address customer relations or security aspects. The system presented in this article may provide a basis for further research on this particular field of service engineering.

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REFERENCES

Aalst, W. M. P. & Kumar, A. (2003). Xml-based schema definition for support of interorga-

nizational workflow. *Information Systems Research*, *14*(1), 23-46.

Alves, A., Arkin, A., Askary, S., Bloch, B., Curbera, F., Goland, Y., et al. (2006). *Web services business process execution language version 2.0. Committee draft*: OASIS.

Aoyama, M., Weerawarana, S. & Maruyama, H. (2002) Web services engineering: Promises and challenges. In *Proceedings of Conference on Software Engineering*. (pp. 647-648).

Arkin, A., Askary, S., Fordin, S., Jekeli, W., Kawaguchi, K., Orchard, D., et al. (2002). *Web service choreography interface (wsci) 1.0*.

Aubert, B., Patry, S. & Rivard, S. (2002). Managing it outsourcing risk: Lessons learned. In *Information systems outsourcing in the new economy*. New York: Heidelberg, Berlin,

Bahli, B. & Rivard, S. (2003). The information technology outsourcing risk: A transaction cost and agency theory-based perspective. *Journal of Information Management*, 211-221.

Bamberg, G. and Spremann, K. (1989). *Agency theory, information and incentives*. Berlin

Becker, J., Rosemann, M. & Kugeler, M. (2006). *Process management, a guide for the design of business processes*. Berlin: Springer-Verlag.

Billington, J., Christensen, S., Kindler, E., Van Hee, K., Kummer, O., Petrucci, L., et al. (2003). *The petri net markup language. Concepts, technology and tools, Proceedings of 24th International Conference, ICATPN 2003, Applications and Theory of Petri Nets 2003*, (pp. 483 - 505).Eindhoven, The Netherlands.

BPML (2002). Bpml 1.0 analysis, retrieved June, 2002 from http://www.ebpml.org/bpml_1_0_june_02.htm [30.09.06].

Buck-Lew, M. (1992). To outsource or not? *International Journal of Information Management*, *12*(1), 3-20.

Cardoso, J., Sheth, A. P., Miller, J. A., Arnold, J. & Kochut, K. (2004). Quality of service for workflows and web service processes. *Journal of Web Semantics*, *3*(1), 281-308.

Clark, J. (1999). *Xsl transformations (xslt) version 1.0*. http://www.w3.org/TR/xslt [01.06.06].

Coase, R. H. (1937). The nature of the firm. *Economica*, *4* (11), 386- 405.

Cooper, R. and Kaplan, R. S. (1991). Activity-based costing: Ressourcenmanagement at its best. *Harvard Manager*, 87-94.

Craggs, S. (2003). *Best-of-breed esbs - identifying best-of-breed characteristics*. http://www.sonicsoftware.com/products/whitepapers/docs/best_of_breed_esbs.pdf.

Daniels, H. C. (1993). *Information technology: The management challenge*. New York: Addison-Wesley Longman Publishing Co., Inc,.

Davenport, T. H. (1993). *Process innovation, reengineering work through information technology*. Boston.

Dickson, K. W. C., Cheung, S. C., Till, S., Karlapalem, K., Qing, L. & Kafeza, E. (2004). Workflow view driven cross-organizational interoperability in a web service environment. *Inf. Tech. and Management*, *5*(3-4), 221-250.

Espinosa, J. A. & Carmel, E. (2004) The effect of time separation on coordination costs in global software teams: A dyad model, In *Proceedings of 37th Hawaii International Conference on System Sciences*, Hawaii.

Farber, D. (2004). *All roads lead to soa*.

Farbey, B., Land, F. & Targett, D. (1995). A taxonomy of information systems applications: The benefits' evaluation ladder. *European Journal of Information Systems* (4), 41-50.

Faye Borthick, A. & Roth, H. P. (1994). Understanding client/server computing. *Management Accounting, August*, 36-41.

Ferrin, B. G. & Plank, R. E. (2002). Total cost of ownership models: An exploratory study. *The Journal of Supply Chain Manage-*

ment, *38*(3), 18-29.

Friedlob, G. T. & Plewa, F. J. (1996). *Understanding return on investment*. John Wiley & Sons

Gartner. (2002). *Tco manager*. Web: http://gartner11.gartnerweb.com/bp/static/tcomanhome.html [10.09.05].

Grefen, P., Ludwig, H. & Angelov, S. (2002). *A framework for e-services: A three-level approach towards process and data management*.

Grob, H. L. (1993). *Capital budgeting with financial plans, an introduction*, Wiesbaden.

Grob, H. L. & vom Brocke, J. (2006). Profitability of business processes. In J. Becker, M. Rosemann & M. Kugeler (Eds.), *Process management, a guide for the design of business processes,* (2ed). Berlin: Springer Verlag.

Hammer, M. & Champy, J. (1993). *Reengineering the cooperation: A manifesto for business revolution*. New York: Harper.

Hung, P. C. K., Li, H. & Jeng, J.-J. (2004) Ws-negotiation: An overview of research issues, In *Proceedings of the 37th Annual Hawaii International Conference on System Sciences (HICSS'04)* - Track 1 - Volume 1 10033.10032.

IBM. (2004). *E-business on demand*. http://www-5.ibm.com/services/de/ondemand/solutions_bizproc.html.

Jablonski, S. & Bussler, C. (1996). *Workflow management: Modeling concepts, architecture, and implementation.* London:International Thomson Computer Press.

Jurison, J. (2002). Applying traditional risk-return analysis to strategic it outsourcing decisions. In R. Hirschheim, A. Heinzl & J. Dibbern (Eds.), *Information systems outsourcing - enduring themes, emergent patterns and future direction* (pp. 177-186). Berlin.

Kador, J. (1990). The dollars and sense of outsourcing. *Candle Computer Report*, *12*(8), 1-5.

Kaplan, R. S. & Norton, D. P. (1992). The balanced scorecard. Measures that drive performance. *Harvard Business Review*, *70*(1), 71-79.

Kascus, M. A. & Hale, D. (1995). *Outsourcing cataloging, authority work, and physical processing. A checklist of considerations*, Chicago.

Keen, P. & McDonald, M. (2000). *The eprocess edge: Creating customer value and business wealth in the internet era*. Berkeley.

Kester, W. C. (1984). Today's options for tomorrow's growth. *Harvard Business Review, March-April*, 153-161.

Knolmayer, G. A. (1997). Hierarchical planning procedure supporting the selection of service providers in outtasking decisions. In H. Krallmann (Ed.), *Wirtschaftsinformatik, 97*. (pp.99 - 119)Heidelberg.

Lacity, M. C., Willcocks, L. P. and Feeny, D. F. (1996). The value of selective it sourcing. *Sloan Management Review*, *37*(3), 13-25.

Limthanmaphon, B. & Zhang, Y. (2003) Web service composition with case-based reasoning. In *Proceedings of the 14th Australasian database conference on Database technologies 2003: Volume 17*, (pp.201-208)Adelaide, Australia.

Loh, L. & Venkatraman, N. (1992). Determinants of information technology outsourcing: A cross-sectional analysis. *Journal of Management Information Systems*, *9*(1), 7-24.

Mendling, J. & Nüttgens, M. (2004) Exchanging epc business process models with epml. In *Proceedings of 1st GI Workshop on XML Interchange Formats for Business Process Management (XML4BPM), Modellierung 2004*, (pp. 61-79).Marburg.

Nam, K., Rajagopalan, S., Rao, H. R. & Chaudhury, A. (1995). Dimensions of outsourcing: A transactionscosts framework. In M. Khosrowpour (Ed.), *Managing information technology investments with outsourcing* (pp. 104-128). Harrisburg, PA: Idea Group Publishing.

Neely, A. (2004). The challenges of performance measurement. *Management Decision*,

42(8), 1017-1023.

Niessen, J. & Oldenburg, P. (1997). Service level management - customer focused. In *It infrastructure library*. Norwich.

OGC (2001). *Service delivery (it infrastructure library)*. The Stationery Office, Norwich.

OMG. (2005). *Meta object facility xmi mapping specification version 2.1*.

Oracle. (2004). *Oracle application server*. http://otn.oracle.com/products/integration/pdf/integration_tech_wp.pdf.

Orriëns, B., Yang, J. & Papazoglou, M. P. (2003). A framework for business rule driven web service composition. In *Conceptual modeling for novel application, lecture notes in computer science, volume 2814* (pp. 52-64). Berlin: Springer-Verlag.

Padovitz, P., Krishnaswamy, S. & Loke, S. W. (2003) Towards efficient selection of web services. In *Proceedings of Web Services and Agent-based Engineering (WSABE 2003)*, Melbourne, Australia http://www.agentus.com/WSABE2003/program/shonali.pdf [2031.2010.2005].

Putrus, R. S. (1992). Outsourcing analysis and justification using ahp. *Information Strategy*, *9*(1), 31-36.

Quinn, J. B. (1999). Strategic outsourcing: Leveraging knowledge capabilites. *Sloan Management Review*, *40*(4), 9-21.

SAP. (2004). *Sap-solutions*. http://www.sap.com/solutions/business-suite/index.aspx.

Scheer, A.-W. (1994). *Business process engineering: Reference models for industrial enterprises*. New York:Springer-Verlag, Inc.

Shostack, G. L. (1982). How to design a service. *European Journal of Marketing*, *16*(1), 49-63.

Smith David, J., Schuff, D. & St. Louis, R. (2002). Managing your total cost of ownership. *Communications of the ACM*, *45*(1), 101-106.

Smith, G. F. (1996). Identifying quality problems: Prospects for improvement. *Total Quality Management*, *7*(5), 535-552.

Stiglitz, J. E. (2000). The contribution of the economic fo information to 20th century economics. *Quarterly Journal of Economics*, *115*(4), 1441-1478.

Tam, K. Y. (1992). Capital budgeting in information systems development. *Information & Management*, *23*(6), 345-357.

Tiwana, A. & Ramesh, B. (2001) E-services: Problems, opportunities, and digital platforms. In *Proceedings of the 34th Annual Hawaii International Conference on System Sciences (HICSS-34)-Volume 3 - Volume 3* 3018.

van der Aalst, W. M. P. (2003). Don't go with the flow: Web services composition stanards exposed. *IEEE Intelligent Systems*(Jan/Feb, Web Services - Been there done that? Trends & Controversies).

Vollmer, K. & Gilpin, M. (2004). *Integration in a service-oriented world*.

vom Brocke, J. (2006a). Design principles for reference modelling. Reusing information models by means of aggregation, specialisation, instantiation, and analogy. In P. Fettke & P. Loos (Eds.), *Reference modelling for business systems analysis* (pp. in press). Hershey, PA: Idea Group Publishing.

vom Brocke, J. (2006b). Service portfolio measurement (spm), assessing financial performance of service-oriented information systems. In R. Qiu (Ed.), *Enterprise service computing: From concept to deployment* (pp. in print). Hershey, PA: Idea Group Publishing.

vom Brocke, J. & Lindner, M. A. (2004) Service portfolio measurement, a framework for evaluating the financial consequences of out-tasking decisions, In *Proceedings of ICSOC04 2nd International Conference on Service Oriented Computing*. New York.

Vonk, J. & Grefen, P. (2003). Cross-organizational transaction support for e-services in virtual enterprises. *Distributed Parallel Databases*, *14*(2), 137-172.

Wang, G., Chen, A., Wang, C., Fung, C. & Uczekaj, S. (2004) Integrated quality of service

(qos) management in service-oriented enterprise architectures, In *Proceedings of Enterprise Distributed Object Computing Conference, Eighth IEEE International (EDOC'04)* (pp. 21-32).

Weikum, G. & Vossen, G. (2002). *Transactional information systems: Theory, algorithms and the practice of concurrency control and recovery*. San Francisco, CA.

Williamson, O. E. (1985). *The economic institutions of capitalism*. New York: Tree Press.

Yang, J. (2003). Web service componentization. *Communications of the ACM*, *46*(10), 35-40.

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