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## Valuating Business Process Flexibility achieved through an alternative Execution Path

by

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# VALUATING BUSINESS PROCESS FLEXIBILITY ACHIEVED THROUGH AN ALTERNATIVE EXECUTION PATH

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## Abstract

*In this paper we contribute to the research on the valuation of business process flexibility. This flexibility provides the ability for companies to select the most appropriate execution path for each process instance at runtime from alternative execution paths. Therefore, we introduce a model to calculate the value of flexibility, which a company gains by embedding an external service provider that can execute arriving process instances. It is the flexibility to choose whether it is more lucrative to execute a process instance internally or externally depending on the current work load in the process. We determine the value of this flexibility and present the results of a simulation by an example taken from the claim handling process of a German Insurance company. Besides practical implications, our results contribute to research on business process flexibility as they show a way to monetarily value flexibility.*

*Keywords: Business Process Management, Process Valuation, Process Flexibility, Simulation.*

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# 1 INTRODUCTION

“The only constant thing is change.” The Greek philosopher Heraklit coined that saying hundreds of years ago, and today change is still one of the major issues that companies have to deal with. Rapid environmental changes, changing regulations, technological progress, and changing customer requirements (to name only a few) are typical changes that affect the business of companies. In order to successfully cope with those changing circumstances companies must be able to quickly and correctly adjust their business model or business strategy to their environmental situation. This ability is called flexibility (Golden and Powell 2000). Especially in times of economic crises flexibility draws a lot of attention, since correctly reacting to exceptional circumstances is a major—sometimes even infeasible—challenge for most of the companies. It turned out that companies that proof to have a good level of flexibility rather succeed in those challenging situations (Grewal and Tansuhaj 2001). But it is important to keep in mind that flexibility is not just “some good” that a company has unlimited access to; flexibility rather needs to be actively established through setting up suitable resources as well as capable organizational structures, business processes, and information systems (Gebauer and Schober 2006). Since any given business model is realized by defining and executing its related business processes, companies need to design flexible business processes in order to run a flexible business.

According to the World Insurance Report 2009, especially insurance companies face the major common challenge of inflexible business processes (Capgemini 2009, p. 42). Therefore, IBM particularly addresses the need for process flexibility in the Insurance Process Acceleration Framework, which states that in order to achieve process flexibility, companies have to “streamline their core processes across organizational boundaries” (IBM 2009, p. 7). With this in mind it is no surprise that about 4 billion US Dollars were spent for business process outsourcing in the US insurance industry in 2008 and almost two thirds of US insurance companies were already involved in business process outsourcing activities. Knowing this, one has to ask the following question: Should companies actively invest into the creation of flexibility? In order to be able to answer this question and thus to decide about an investment that provides flexibility, companies need to find ways to determine the value they can obtain from flexibility. But as of today, companies have no means to do so (Gebauer and Schober 2006, p. 124).

Due to this dilemma we introduce an approach that determines the value of flexibility. We thereby focus on business process flexibility that a company can gain by creating an alternative execution path (e.g. by embedding an external service provider through a web-interface). The company then has the flexibility to choose through which path a process instance is executed—whatever is more efficient for the company. Finally, we are able to show that an initial investment in the creation of flexibility is likely to pay off in case that the arrival of process instances is highly volatile.

The paper is structured as follows: In chapter 2 we provide an overview on related work regarding process flexibility. Furthermore, requirements for the valuation of business process flexibility will be derived. In chapter 3 we develop an approach, which is based on our requirements and that provides a way to determine the economic value of flexibility that a company can obtain through creating an alternative execution path. We thereby apply a formal-deductive method and take a value-based management into consideration. To exemplify the adaptability of this approach in practice, chapter 4 demonstrates its application with a cutout of the process for handling claims at a German insurance company. Chapter 5 concludes the paper with a summary of the main results as well as a critical reflection on our approach.

## 2 LITERATURE SURVEY AND RESEARCH QUESTION

The concept of flexibility has been thoroughly analyzed for several decades—especially in the field of manufacturing (e.g. Sethi and Sethi 1990, Gupta 1993, Vokurka and O’Leary-Kelly 2000). Thereby, even the process of determining a consistent definition of the term “flexibility” was compared to the search of the Holy Grail (Golden and Powell 2000).

In the field of business process management, flexibility has also been a widely discussed topic. Especially research papers that deal with work flow management systems discuss the necessity of flexibility (Agostini and De Michelis 2000, Heintz et al. 1999, van der Aalst and Basten 2002). Since there is a huge variety of approaches that try to integrate flexibility in workflow management systems, Schonenberg et al. (2008) provide a comprehensive classification of these approaches and thereby focus on the type of flexibility considered in these papers. The authors finally derive four types of flexibility, i.e. flexibility by change, flexibility by deviation, flexibility by underspecification, and flexibility by design. In this paper we will focus on the latter one, since it exactly matches the type of flexibility that we are considering in this paper. Flexibility by design is defined as “ability to incorporate alternative execution paths within a process definition at design time such that selection of the most appropriate execution path can be made at runtime for each process instance” (Schonenberg et al. 2008, p. 4). It further requires the process definition to take place at design time.

So in other words if a company wants to implement this type of flexibility to face a lack of planning reliability arising from uncertain and highly volatile future business process loads in existing business processes, it has to create alternative execution paths. This could be done by realigning internal structures so that the employees can flexibly adjust to different workloads, which leads to investments into reorganisation. Another way could be the connection of an external service provider through a web-interface, who is able to execute some of those process instances. But before this additional execution path can be utilized, investments into the creation of an interface between the company and the external service provider must be made. So in order to correctly decide about a process design that involves alternative execution paths, companies must determine the value they obtain from flexible business processes and ask themselves: What is flexibility worth? Answering this question in turn requires companies to have the right methods to determine the value they obtain from that flexibility. The next chapter therefore provides an overview on approaches that value flexibility.

### 2.1 Status Quo of Flexibility Valuation

Although business process flexibility is widely considered a precious property, as of today, there is only little research on its valuation. In contrast, the valuation of manufacturing flexibility has been a very popular researched topic. This is why we will also take a closer look at these approaches.

De Toni and Tonchia (1998) e.g. focus on the measurement of manufacturing flexibility. They categorize three types of measurement: direct, indirect, and synthetic. Direct measurements refer on the one hand to the valuation of flexibility as options and therefore measurement in terms of probabilities (Stockton and Bateman 1995). Indirect measurements may be economic measures, i.e. valuation approaches based on cash flows, as described by Gupta (1993). Synthetic measurements aggregate elementary measures regarding different types of flexibility of machines and are promoted by e.g. Tonchia (1995) as well as Brill and Mandelbaum (1989).

However, only recently the attention of researchers has been drawn to flexibility in business processes. Hence, the first, very few approaches that specifically address the valuation of business process flexibility, e.g. Schober and Gebauer (2008), are arising. The authors use a combination of decision tree analysis and real options theory to determine by means of a Lorenz curve how much a company should spend on the flexibility of its Information System. The authors take non-specific cost factors of processes, their supporting Information Systems, and their flexibility into account. However, they only provide a high level perspective. In addition to that, the model does only include deterministic

scenarios. However, for a practical measurement of the value of flexibility non-deterministic scenarios should also be considered. Other approaches at least evaluate business processes on a monetary basis, like e.g. Braunwarth et al. (2010). The authors determine the optimal level of automation for a business process based on a cash flow analysis. Balasubramanian and Gupta (2005) introduce a metric to evaluate process designs in terms of process performance in their approach. Kueng and Kawalek (1997) and Nissen (1994) also focus on process performance only.

In conclusion we have to retain that the valuation of flexibility is relatively well researched in the area of manufacturing. The discussion about the valuation of business process flexibility however is still at the beginning. Therefore, our paper will make a contribution to a nearly unexplored field of research and answer the question, how business process flexibility can be valued in order to provide a basis for a company's decision about actively investing into the creation of flexibility.

But before we develop our approach, we will first derive requirements that such a valuation approach must meet in order to provide a correct valuation.

## **2.2 Requirements for the Valuation of Business Process Flexibility**

As we mentioned earlier, we need to make a decision about an investment that extends a business process by flexibility. This requires an ex-ante valuation of the resulting business process flexibility in order to provide a basis for the investment decision. The value of the investment into flexibility must therefore be expressed in monetary terms (Gupta 1993), so we obtain a valid basis for the investment decision. Since the monetary impacts of flexibility (i.e. outsourcing of process instances) occur at an arbitrary time in the future, we also have to consider an adequate time horizon. This leads to the first requirement:

*(R1) The valuation must be based on future cash flows.*

The consideration of future cash flows requires us to focus on the cash inflows as well as on the cash outflows of business processes. Cash outflows usually stem from the manual execution of process instances (e. g. salaries or costs for external service providers). So we can note that execution costs are one major factor that affects the considered cash flows.

Another source for cash outflows as well as cash inflows are potential follow-up costs that are linked to the process instance. This could be for example cash outflows for the settlement of a claim or cash inflows from the sale of products to a customer (Braunwarth et al. 2010). These cash flows solely depend on the characteristics of the process instance (e.g. payments of a claim that is settled) and thus are caused by the work on of the process instance itself. We will refer to those cash flows as direct process-outcomes throughout this paper.

Furthermore, the quality of the process influences the quality of the output and thus the satisfaction of the customers (Adenso-Diaz et al. 2002). Customers that are dissatisfied are likely to purchase at a lower rate, whereas satisfied customers are likely to purchase at a higher rate. Furthermore, customer satisfaction is one of the most important contributors to customer lifetime value (Ho et al. 2006). In other words: the quality of the execution of a business process can have long-term consequences on the customer behavior, which can be expressed as a cash flow that affects a company's value. Therefore, these cash flows (indirect process-outcomes) must also be included in the valuation of business processes. This leads to our second requirement, which is similar to requirement (R5) in Braunwarth et al. (2010):

*(R2) The valuation of business processes must factor execution costs, direct process-outcomes, and indirect process-outcomes.*

Furthermore, the process instances (e. g. customer requests) are unlikely to be identical and thus homogenous. Therefore, we postulate the following requirement:

*(R3) Heterogeneous process instances must be considered within one business process.*

It is important to note that heterogeneity is assumed in regard to specific characteristics of the process instances, but they are still instances of the same process. That means for example in an insurance context that process instances can be distinguished by a different loss amount, although the expected time to execute a specific process activity is the same for each instance. If the process instances were completely different, they could not be executed within the same business process.

If the considered business process has interfaces to customers, its execution is usually triggered by a customer request. The amount of requests as well as the arrival time of each request is therefore unknown and random. This randomness heavily affects the execution of the business process, because the more volatile the amount and/or arrival time of requests is, the more complex becomes the planning of the required resources. Insurance companies for example have a peak of customer requests for adjustments of claims after stormy weather or heavy snow. This uncertainty creates the need for flexible process execution in terms of flexibility by design as described above.

(R4) *The valuation approach accounts for volatile arriving rates of the process instances.*

After deriving these four requirements from the literature, we will now develop an approach that values business process flexibility based on these requirements. We thereby focus on the connection of an external service provider through a web-interface as a mean to provide an alternative execution path. This alternative bears the least risk for the company as it only has to conduct very few internal changes.

### 3 VALUATION OF BUSINESS PROCESS FLEXIBILITY

In this chapter we introduce an inflexible business process and discuss how it can be evaluated considering the requirements derived in the previous chapter. After that, we extend this business process by embedding flexibility through the connection of an external service provider that creates an alternative execution path. Finally, we derive a method to determine the value of that additional flexibility.

#### 3.1 Initial Situation

The basis for the following consideration is a semi-formal model of a business process in a company. This business process is an end-to-end process, which means that the first and the last action of this process possess interfaces with customers, so the arrival of process instances is triggered by customer requests. For simplicity reasons the business process considered in this model only consists of one action. In order to develop our approach we need a basis of assumptions. Thereby, we assure that these assumptions match the requirements derived above.

*R1 & R2: Valuation based on cash flows & Integration of execution costs, direct and indirect process-outcomes*

The company faces cash outflows ( $E_f \in ]-\infty; 0]$ ) for the execution of each process instance  $f$ . These mainly include salaries and wages for the employees involved in the execution. Overhead costs or costs for material are included in the wage rate. Thus we assume:

(A1) The business process consists of one action ( $a$ ) only. For each process instance ( $f$ ) the action is executed by exactly one employee  $r \in R$ . The expected execution time for  $f$  is denoted by  $e_f$  and is compensated with wage rate  $z$ , which also includes proportionate overhead costs.

According to (A1) the cash outflow for executing the process instance ( $E_f$ ) can be determined by:

$$(1) \quad E_f = -e_f \cdot z$$

As stated earlier in (R2), process instances also cause direct process-outcomes, which in turn result in cash in- or outflows for the company linked to the execution of the process instance. These direct process-outcomes are defined as:

$$(2) \quad D_f \in ]-\infty; \infty[$$

On the contrary, indirect process outcomes represent the long-term effects of the execution of a process instance on the company. The customer perceives a certain quality and this influences her satisfaction (Ho et al. 2006). In combination with other factors, e.g. competitor actions and customer behavior, this in turn affects customer loyalty. Only loyal customers generate returns for the company e.g. through repetitive buying (Hallowell 1996). A higher degree of customer satisfaction consequently leads to higher repurchase intentions and longer relationships (Reinartz and Kumar 2003). Together with a higher buying frequency this leads to higher expected customer cash flows and finally increases the customer lifetime value (Reinartz and Kumar 2003). According to (R2) these expected changes are integrated in a thorough valuation of the process as the customer lifetime value can influence the enterprise value. Customer satisfaction can moreover change the reference potential, i.e. the number of potential customers that a customer can reach during her lifetime (Krafft et al. 2005). Customer satisfaction is regularly evaluated in most companies e.g. through customer surveys. For these effects we assume:

(A2) Indirect process-outcomes will be considered as changes of the customer lifetime value. These changes are expressed through cash flows, which themselves depend on the difference between the processing time  $T_{p,f}$  and the accepted waiting time of the customers.

$$(3) \quad I_f(T_{p,f}) \in ]-\infty; \infty[$$

Considering the cash flows (1), (2), and (3) we assure that we fulfill the requirements (R1) and (R2). The overall cash flow  $CF_f$  resulting from the execution of process instance  $f$  can be obtained as follows:

$$(4) \quad CF_f = E_f + D_f + I_f$$

### *R3: Volatile arrival rate of process instances*

In order to correctly value the execution of the business process (according to (R3)) we need to take the stochastic arrival rate as well as arrival time into consideration. Therefore, the business process will be modeled as a queuing system. More precisely, the business process can be considered as an M/D/1-system according to the notation developed by Kendall and extended by Taha (1992, p. 554). The first “M” means that the time between the arrivals of two process instances is exponentially distributed, whereas the “D” signifies the service time being deterministic. “1” defines the number of similar parallel operating units. Using this queuing system we can consider the volatility of the arrival rates and arrival times of the process instances. We further assume:

(A3a) The process instances are homogenous in terms of expected execution time as well as professional skills needed by the processors.

(A3b) The expected amount of process instances  $F_i$  as well as the execution time for a process instance  $e_i$  is known in any time interval  $i \in I$  with length  $L_i$ .

The arrival rate equals  $\lambda_i = \frac{F_i}{L_i}$  for time interval  $i$ , the execution time  $\mu_i = \frac{1}{e_i}$ .

(A3c) The amount of employees  $R$  is fixed. Every employee  $r \in R$  executes maximal one process instance at the same time.

(A3d) In any time interval  $i$  there is an infinite waiting queue  $Q_i$ , where the process instances wait that cannot be executed. No process instance is blocked. Waiting process instances are executed according to the first in - first out principle.

Through modeling the business process as a queuing system we assure that the volatility of the arrival rates and of the execution time are considered within the valuation of flexibility. Figure 1 shows the business process as M/D/1-system:

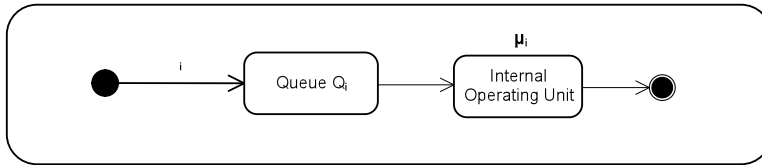


Figure 1: Business process as M/D/1-system

#### R4: Heterogeneous process instances

Due to the fact that we use a queuing system (and therefore according to (A3a)) process instances must possess certain homogenous characteristics that affect the arrival rate as well as the execution time. But characteristics that influence the process outcomes may be different without affecting the applicability of the queuing system.

Since process instances are triggered by customer requests it would be far from realistic to assume similar direct process outcomes for each process instance, especially considering examples like transaction requests or withdrawals in a bank or claim settling in an insurance company. However, the execution time for those kinds of requests can still be similar. Therefore we assume:

(A4) Each process instance  $f$  generates individual direct process outcomes  $D_f$ .

After these assumptions we finally provided the basis for a cash flow-based valuation of a business process. Next, we will extend this process by integrating an external service provider and we will analyze how the value of the nascent flexibility can be determined.

### 3.2 Creating an Alternative Execution Path

In order to be able to flexibly react to peaks in the workload, which are caused by the volatile arriving rate as well as the volatile execution time, the company can embed an external service provider that also executes process instances. The main objective is lowering the processing time of the process instances by reducing their waiting time. This in turn lowers the response time to customers and thus will have a positive effect on the indirect process-outcomes. The company therefore has to create a web-interface to that service provider. This interface defines the attributes that need to be delivered as well as determines how process instances are exchanged between the company and the service provider. The creation of the interface requires the company to identify a capable service provider and conduct a project to establish the needed functional and technical infrastructure. Given a successful project we can further assume:

(A5) Each process instance can be executed internally ( $f^m$ ) or externally ( $f^x$ ) if an interface to an external service provider is established. This interface implies upfront cash outflows  $K$  at the time of implementation.  $K$  includes all the costs arising from the identification of the external service provider as well as from the functional and technical implementation of the interface.

Through embedding the external service provider the queuing system described above will be changed as follows: Instead of having one operating unit the company now can choose to use the second (alternative) operating unit. Consequently, the process can now be modeled as an M/D/2-system:



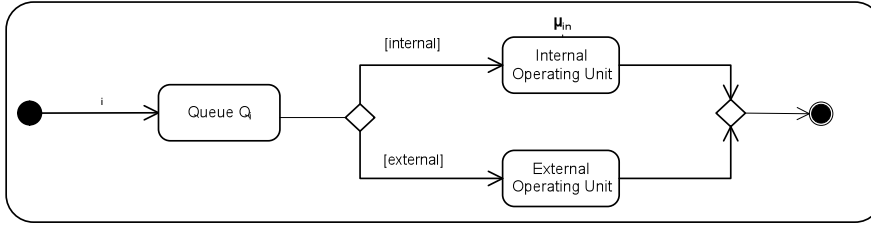


Figure 2: Business process as M/D/2-system

The company further has to conclude service level agreements with the external service provider in order to provide a frictionless collaboration and to protect itself against potential failures. Since these agreements include payments and penalties we assume:

(A6) Each process instance  $f^{ex}$  has an execution time  $t^{ex}$ , whose adherence is secured by service level agreements. The company has to pay  $z^{ex}$  for the execution of  $f^{ex}$  to the service provider:

$$(5) \quad E_f^{ex} = -z_f^{ex}$$

If the external service provider does not execute the process instance in time and therefore fails to fulfill the service level agreements, the processing time and thus the response time to the customer would be lengthened, which results in a cash outflow due to the indirect process-outcomes introduced above. In this case the service provider is charged with a penalty fee due to the service level agreements. For simplicity reasons we assume:

(A7) The penalty fee equalizes the cash outflow that the company suffers due to the indirect process-outcomes.

Each process instance induces the same direct process-outcomes regardless of the integration of an external service provider. The indirect process-outcomes are still strictly dependent on the processing time that is, however, likely to be shorter because of the integration of the external service provider. Therefore we obtain the following overall cash flow for the external execution of the process instance:

$$(6) \quad CF_f^{ex} = E_f^{ex} + D_f + I_f$$

### 3.3 Valuation Approach

The decision on the outsourcing of a process instance  $f$  is made immediately after its arrival. At this time, the amount of process instances that are in the queuing system is known and therefore the expected waiting time of any arriving process instance is also known. Since the company decides on a monetary basis it will source a process instance  $f$  out, if—and only if—the overall cash flow of the execution of a process instance will be increased:

$$(7) \quad CF_f^{ex} > CF_f$$

If we want to determine the value of the flexibility of a business process within a certain time period, we have to sum up the cash flows resulting from all process instances  $f \in F$  for both—the inflexible and the flexible business process. Furthermore, the initial costs  $K$  of implementing the interface to the external service provider also need to be considered. Thus we obtain the following equation that determines the value of business process flexibility:

$$(8) \quad X_{total} = \sum_{f=1}^F CF_f^{ex} - \sum_{f=1}^F CF_f - K$$

It is important to sum up the cash flows for all process instances separately for each alternative scenario first, before the costs for implementation of the interface  $K$  are subtracted. Otherwise one

would ignore the effects the outsourcing of a process instance has on the subsequent process instances. Therefore, it is important to compare one whole scenario to the other. Due to the queuing system the value of the flexibility (equation (8)) is not analytically determinable. Therefore we describe the practical application of this approach in the next chapter and provide a solution of equation (8) through a simulation.

## 4 APPLICATION OF THE VALUATION APPROACH

This chapter shows the practical implementation of our approach with the help of a real world example taken from a German insurance company. The example is structured analogously to chapter 3: first, an existing business process of the insurance company is monetarily valued. Then, a newly designed business process, which is extended by flexibility through the connection to an external service provider, is presented. Finally, the value of this flexibility is derived.

In the following we consider a cut-out of a business process for handling own-damage claims at a German car insurance company. The process instances of this strictly sequential process are triggered by the arrival of customer claims. After a breakage-of-glass claim arrived it is scanned and classified at first. Then, the extraction of the relevant data takes place in a second step followed by the check of the invoice (third process step). If it is justified, the payment of the damage is made before the claim is settled and closed.

It has always been a major (or even infeasible) challenge for the company to assign the right number of employees to the execution of the business process, because the number of arriving claims has been very volatile. Thus, the company initially decided to staff the check of invoice based on the average number of claims of previous years. Since the check of invoice is the most staff-intensive task of this process, we want to take a closer look on this action and depicture the staffing situation of this process step. Historical data showed that on average about 1,300 claims arrived per month and each took one employee on average 33 minutes to execute it. So he or she could process about 16 claims per day given an 8 hour shift. Assuming 20 workdays per month, the company finally decided to assign 4 full-time employees with the in-depth inquiry task.

Due to the volatile arrival rates and the resulting volatile utilization of the staff (i.e. either idle times or peaks in the workload) the insurance company soon realized that the current business process leaves ample space for optimization—more flexibility was needed. Peaks in the workload caused an increase of execution time and therefore of response time, which of course lowered the perceived satisfaction of customers and resulted in complaints. Therefore, the company considered the opportunity of integrating an external provider that could also execute the check of invoice in case of peaks in the workload. It was believed that the customers could be served faster through this alternative path of execution and thus the perceived service quality could be improved, which in turn would lead to a higher retention rate. Therefore the newly designed business process includes an alternative action for the third process step, as depicted in figure 3:

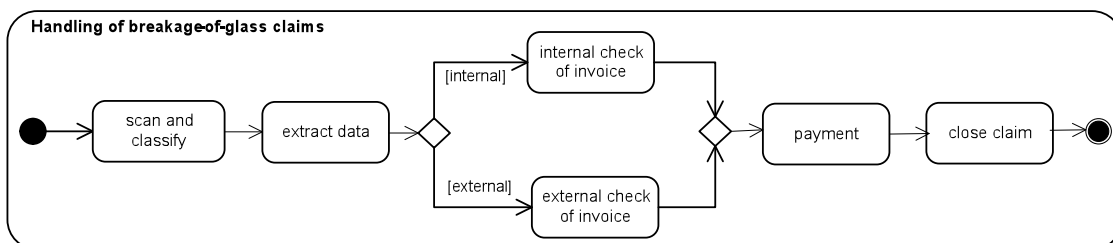


Figure 3: Cut-out of the newly designed Claim Management Process

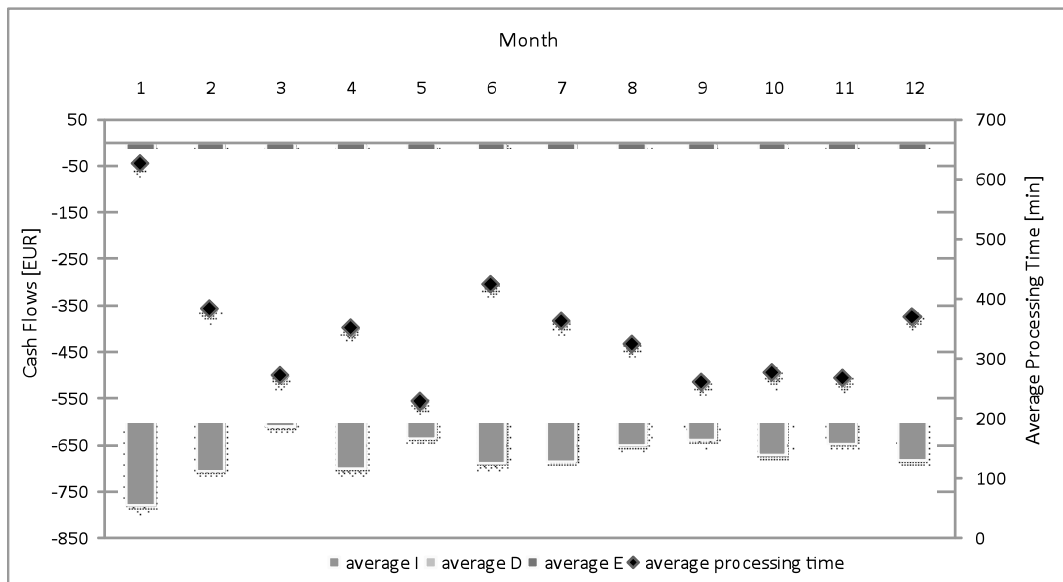
The initial costs of selecting and integrating the external service provider were seen as the major obstacle of this process redesign. These costs included the selection process of a capable service

provider, where longevity and trust played a crucial role. Furthermore, the functional and technical interface itself needed to be defined. A web based interface was determined to be the best solution and therefore mutual attributes (e.g. types of damage, car model codes, customer IDs etc) needed to be determined in order to provide a frictionless exchange of the claims. The insurance company estimated the overall costs to amount to 145,000 EUR. Given these costs, the company of course needed to determine the value they obtain through embedding this flexibility.

Therefore, we want to show how – according to our approach – the value of this type of flexibility can be obtained. Due to the volatile arrival rates of the customer claims this check of invoice can also be seen as a queuing system, which has one operating unit (internal) today and two operating units (internal and external) after the redesign. We first simulate the daily arrival rate of customer claims for one year (240 work days) based on the historical data mentioned above. After that, we determine the overall cash flow for the internal execution of the check of invoice. Finally, we take into account the external service provider and again determine the overall cash flows based on the same arrival rates.

The insurance company determined cash flows for internal execution of a claim to amount to -38.50 EUR. Through customer satisfaction studies the company found out, that customers accept waiting times for the processing of their claims up to five work days. By breaking down this number to the single process steps, the company determined the critical waiting time to be two workdays (i.e. circa 1,000 working minutes) for the check of invoice. If the waiting time goes beyond this time, customers become dissatisfied, which in turn decreases the indirect process-outcomes. If the claims on the other hand were processed faster, indirect process-outcomes would be increased.<sup>1</sup>

The first simulation, where only an internal check of invoice was possible, revealed that several claims ended up waiting up to five working-days before they were processed. This resulted in highly negative indirect process-outcomes, which made up to 50 percent of the overall cash flows. These waiting times occurred although the insurance company had enough staff to handle the average number of claims per month. According to that simulation the overall execution costs for one year amounted to -10.76 million EUR. Figure 4 gives a monthly overview of these results we obtained:

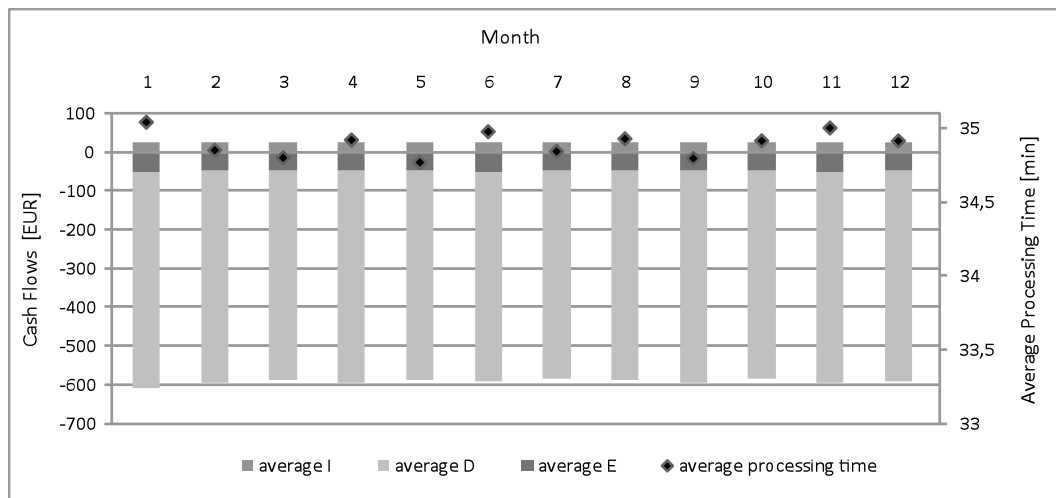


<sup>1</sup> In order to determine the relation between the waiting time and the indirect process-outcomes the following equation is assumed:  $I = ((\mu - 1000 \text{ min})^{1/7} - 0.84(\mu - 1000 \text{ min}) + 2) * 10$ . This equation was chosen due to the fact that it provides a realistic interval of direct process-outcomes for realistic waiting times. However, the determination of this function is not scope of this paper. We therefore reference to the research on customer satisfaction and customer lifetime value.

month	1	2	3	4	5	6	7	8	9	10	11	12
number of claims	1291	1307	1414	1301	1222	1391	1377	1397	1308	1255	1377	1359
average E [EUR]	-38,41	-38,48	-38,49	-38,49	-38,49	-38,49	-38,49	-38,49	-38,49	-38,49	-38,49	-38,50
average D [EUR]	-556,95	-548,85	-533,89	-547,53	-540,69	-542,24	-534,14	-537,88	-546,37	-535,23	-545,83	-543,45
average I [EUR]	-182,28	-115,72	-36,22	-113,37	-55,13	-106,63	-110,06	-73,05	-52,35	-96,20	-60,78	-99,89
average process-cash flow [EUR]	-777,64	-703,05	-608,60	-699,39	-634,31	-687,36	-682,69	-649,43	-637,21	-669,92	-645,10	-681,84
average processing time [min]	627,16	383,20	272,31	350,56	228,48	424,69	362,45	323,98	261,39	276,03	266,76	369,27

Figure 4: Process-outcomes and processing time today

In a next step the simulation data was taken and applied to the extended business process. It was assumed that the company had to pay 80 EUR for each claim that was sent to the service provider, who needed 40 minutes for the check of invoice. Thereby we found out that by embedding the external service provider more than 25% (i.e. 4,329 of 15,999) of all invoices were outsourced. Thus, waiting times were eliminated, which resulted in a shift of indirect process-outcomes from negative to positive cash flows, since the perceived service quality by the customers was increased. As a result, the overall cash flow of the execution of the business process could be reduced to -9.06 million EUR due to this flexibility. Detailed information about process-outcomes and processing time is given in figure 5:



month	1	2	3	4	5	6	7	8	9	10	11	12
number of claims (internal processing)	915	909	1046	1002	914	998	1016	1012	974	913	983	988
number of claims (external processing)	376	326	361	378	308	392	362	384	335	343	393	371
average E [EUR]	-50,59	-49,45	-49,15	-49,87	-48,96	-50,20	-49,40	-49,92	-49,12	-49,83	-50,35	-49,83
average D [EUR]	-556,95	-546,36	-537,63	-545,95	-540,69	-542,24	-534,14	-537,92	-546,33	-535,63	-545,48	-543,45
average I [EUR]	26,38	26,38	26,38	26,38	26,38	26,38	26,38	26,38	26,38	26,38	26,38	26,38
average process-cash flow [EUR]	-581,16	-569,44	-560,40	-569,43	-563,27	-566,07	-557,16	-561,46	-569,07	-559,08	-569,45	-566,90
average processing time [min]	35,04	34,85	34,80	34,92	34,76	34,97	34,84	34,93	34,79	34,91	35,00	34,91

Figure 5: Process-outcomes and processing time after the redesign

In a last step, the value of flexibility could be obtained according to equation (8) as follows:

$$X_{total} = -9.06m \text{ EUR} - (-10.76m \text{ EUR}) - 0.145m \text{ EUR} = 1.56m \text{ EUR}$$

In this case the ex ante valuation of business process flexibility revealed that the integration of an external service provider can create value for the company. Thus, the initial investment into the interface turns out to be lucrative for the company according to our simulation.

## 5 CONCLUSION

The contribution of this paper is a basic model, which values business process flexibility that stems from the creation of an alternative execution path through embedding an external service provider into the process. We thereby address today's shortcoming on literature regarding the valuation of flexibility.

Certainly, the interpretation of the results of this model is restricted due to some limitations in this paper: In this basic model we assume that the considered business process consists of one action only. Thus, we derive the value of business process flexibility based on an alternative execution path for one process action, which of course is not sufficient. We rather need to consider more actions within the business process and simultaneously create alternative paths for each action in order to derive a more realistic result. But this extension also implies the consideration of interdependencies among the actions. The volatility of the arriving process instances paired with different execution times for the different actions make those calculations difficult and subject to our future research. Thus we only use a strongly simplified real world example to show how the model works.

The presented approach currently focuses on service processes without direct customer contact where the performance of existing contractual duties is central. To apply the approach, a process that fulfills these limitations and the assumptions of the model is required. Furthermore, the required data needs to be available or appreciable. We aim to render services with a minimum of required payments. It is of peculiar interest to analyze the behavior of the model in value generating processes e.g. in sales where direct and indirect process-outcomes lead to revenues and thus there are changed prerequisites. Now we focus on insurances – a further starting point is the adaption to specific requirements of service processes of other industries.

## REFERENCES

- Adenso-Diaz, B., Gonzales-Torre, P., and Garcia, V. (2002). A Capacity Management Model in Service Industries. *International Journal of Service Industry Management*, 13 (3), 286-302.
- Agostini, A. and De Michelis, G. (2000). A light Workflow Management System using simple Process Definitions, *Computer Supported Cooperative Work*, 9 (3), 335-363.
- Balasubramanian, S., Gupta, M. (2005). Structural metrics for goal based business process design and evaluation. *Business Process Management Journal*, 11(6), 680-694.
- Braunwarth, K., Kaiser, M., and Müller, A.-L. (2010). Economic Evaluation and Optimization of the Degree of Automation in Insurance Processes. *Business & Information Systems Engineering*, 2 (1).
- Brill, P. H. and Mandelbaum, M. (1989). On Measures of Flexibility in Manufacturing Systems. *International Journal of Production Research*, 27(5), 747-756.
- Capgemini (2009). World Insurance Report, [http://www.de.capgemini.com/m/de/tl/World\\_Insurance\\_Report\\_2009.pdf](http://www.de.capgemini.com/m/de/tl/World_Insurance_Report_2009.pdf); accessed 09/14/2009.
- De Toni, A. and Toncha, S. (1998). Manufacturing Flexibility: A Literature Review. *International Journal on Production Research*, 36 (6), 1587-1617.
- Gebauer, J. and Schober, F. (2006). Information System Flexibility and the Cost Efficiency of Business Processes. *Journal of the Association for Information Systems*, 7 (3), 122-147.
- Golden, W. and Powell, P. (2000). Towards a Definition of Flexibility: in Search of the Holy Grail?, *Omega* 28 (4), 373-384.
- Grewal, R. and Tansuhaj, P. (2001). Building Organizational Capabilities for Managing Economic Crisis: The Role of Market Orientation and Strategic Flexibility. *Journal of Marketing*, 65 (2), 67-80.
- Gupta, D. (1993). On Measurement and Valuation of Manufacturing Flexibility. *International Journal of Production Research*, 31 (12), 2947-2958.
- Hallowell, R. (1996). The Relationships of Customer Satisfaction, Customer Loyalty, and Profitability: An Empirical Study. *International Journal of Service Industry Management*, 7(4), 27-42.
- Heinl, P., Horn, S., Jablonski, S., Neeb, J., Stein K., and Teschke, M. (1999). A comprehensive Approach to Flexibility in Workflow Management Systems. *Proceedings of the international joint conference on Work activities coordination and collaboration (ACM)*, 79-88.
- Ho, T.-H., Park, Y.-H., Zhou, Y.-P. (2006). Incorporating Satisfaction into Customer Value Analysis: Optimal Investment in Lifetime Value. *Marketing Science*, 25(3), 260-277.

- IBM (2009). Accelerating Process Transformation in the Insurance Industry with the IBM Insurance Process Acceleration Framework, available at: <ftp://ftp.software.ibm.com/software/industries/frameworks/pdf/RAB14014-USEN-00.pdf>, accessed 09/04/2009.
- Krafft, M., Rudolf, M., Rudolf-Sipötz, E. (2005). Valuation of Customers in Growth Companies – A Scenario Based Model. *Schmalenbach Business Review*, 57 (2), 103-125.
- Kueng, P. and Kawalek, P. (1997). Goal-based business process models: creation and Evaluation. *Business Process Management Journal*, 3 (1), 17-38.
- Nissen, M.E. (1994). Valuing IT through virtual Process Measurement. International Conference on Information Systems'94, available at: [http://www.usc.edu/dept/ATRIUM/Papers/Process\\_Measurement.ps](http://www.usc.edu/dept/ATRIUM/Papers/Process_Measurement.ps); accessed 09/07/2009.
- Reinartz, W.J. and Kumar, V. (2003). The Impact of Customer Relationship Characteristics on Profitable Lifetime Duration. *Journal of Marketing*, 67 (1), 77-99.
- Schober, F. and Gebauer, J. (2008). How much to spend on Flexibility? Determining the Value of Information System Flexibility. available at: [http://www.business.uiuc.edu/Working\\_Papers/papers/08-0105.pdf](http://www.business.uiuc.edu/Working_Papers/papers/08-0105.pdf), accessed 09/08/2009.
- Schonenberg, H., Mans, R., Russell, N., Mulyar, N., and v. d. Aalst, W. (2008). Towards a Taxonomy of Process Flexibility. Proceedings of the CAiSE'08 Forum, Montpellier, France, 2008, 81–84.
- Sethi, A. and Sethi, S. (1990). Flexibility in Manufacturing: A Survey. *International Journal of Flexible Manufacturing Systems*, 24 (2), 289-328.
- Stockton, D. and Bateman, N. (1995). Measuring the Production Range Flexibility of a FMS. *Integrated Manufacturing Systems*, 6 (2), 27-34.
- Taha, H.A. (1992). *An Introduction to Operations Research*, 5<sup>th</sup> Edition. Prentice Hall, New Jersey.
- Tonchia, S. (1995). Production Performance Measurement Systems – Theory and empirical Evidence on Structure, Characteristics and Indicators. PhD Thesis, University of Padua.
- Van der Aalst, W.M.P. and Basten, T. (2002). Inheritance of Workflows: An Approach to tackling Problems related to Change. *Theoretical Computer Science*, 270 (1-2), 125-203.
- Vokurka, R.J. and O'Leary-Kelly, S. (2000). A Review of Empirical Research on Manufacturing Flexibility. *Journal of Operations Management*, 18 (4), 16-24.