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Would i use my personal blog for commercial exchange?

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SOURCING AND AUTOMATION DECISIONS IN FINANCIAL VALUE CHAINS

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Abstract

As information-based processes are usually independent of the location or even the processor, they can be oftentimes either automated or relocated to foreign sites to profit from differences in wages. Both strategies bear enormous micro-economic potential in terms of cost savings. However, with the main focus on cost reduction, risk due to the uncertain development of effective labor costs or future transaction volumes are oftentimes either inadequately considered or neglected. This systematically leads to false decisions, in particular since the two strategies – relocation and automation – result in different risk profiles. In this paper, we analyze the conditions for automating or relocating parts of business processes and propose a decision model that suggests a risk/return efficient allocation to the alternatives. In particular, we consider how uncertainties of effective labor costs and transaction volumes influence the decision. As shifting tasks to other locations has effects on the workload at the original location, we also take into account costs for social effects. The practicability of our approach is demonstrated with an example that is based on real data of a major financial services provider.

Keywords: *business process sourcing, relocation, automation, social effects, risk, decision model*

1 INTRODUCTION

Today, globally acting companies that are integrated into world-wide value chains are constantly in demand to make sourcing decisions. This includes relocating business processes entirely or in parts to foreign countries to profit from effects such as increased cost efficiency due to wage differences and opening up new labor pools. Such relocation is accomplished either by outsourcing the business processes to external services providers that are located abroad or by shifting the processes internally from one site to another. Relocating business processes, either kept in-house or outsourced, has become very attractive in the last years and is facilitated by better communication technologies (Agrawal et al. 2003). Consequently, this trend is predicted to continue in the next years, which is underscored by Gartner (2007), who predict the worldwide market volume for business process outsourcing to grow from \$160 bn in 2007 to \$235 bn in 2011 with an annual growth rate over 10%.

Another ongoing trend that is facilitated by technological progress is business process automation. As pressure for efficiency increases, firms have to evaluate whether and to what extent business processes

should be automated. Most often a mixture of both – automation and relocation – seems to be most reasonable. Gartner (2008a), for instance, conceives a combination of automation and outsourcing as a way to reach the fullest extent of efficiency and cost reduction and predicts process automation to rise from 10% in 2007 to 55% in 2017 of all processes outsourced (Gartner 2008b). Oftentimes, process automation has become a true alternative to relocation. For example, simple tasks in the financial services domain such as entering paper orders in an order processing system could either be accomplished cost effectively by staff members in low-wage countries or those tasks could be (at least partially) automated. Applying, for instance, optical character recognition (OCR) technologies, the paper orders could be automatically scanned and processed. Therefore, for making sourcing decisions, an integrated decision support model considering relocation and automation is crucial.

Relocation as well as automation bear risk and recent studies show that saving expectations were often not met (Lacity et al. 2000). Two effects are especially important when assessing the risk and the expected return of both alternatives. First, uncertainties concerning effective labor costs, wage developments in foreign countries, and future transaction volumes have to be considered. If, for instance, the risk of rising wage levels is not taken into account, cost savings intended by relocation cannot be realized. False sourcing decisions are the consequence, leading to higher costs than before (Rouse et al. 2004). Similarly, neglecting uncertainties may result in false technology investments for automation as discussed for instance in Benaroch (2001).

Second, social effects that may arise when tasks are relocated or automated have to be considered carefully. For example, relocating the entering tasks outlined in the example above to low-wage countries may have important negative effects (including reputation problems) if at the same time employees are laid off at the original site. While those effects may be unavoidable in bad times, an interesting question is how enterprises can support growth in good times by exploiting the benefits of relocating or automating without provoking negative social effects.

The objective of this paper is to analyze the economic effects of relocation and automation in such a setting (i.e. from an enterprise's point of view) and to contribute a normative decision model proposing an optimal allocation of (parts of) business processes in a risk/return efficient way. Thus, we primarily contribute to sourcing theory by providing an integrated view over the alternatives: retention at the origin site, relocation to a new site and automation. We consider the different cost characteristics of the alternatives taking into account also possible negative effects of cutting jobs and analyze how these alternatives relate to each other. We examine the effects of uncertainty of effective labor costs and transactions volumes in a model via simulation. The applicability of our model is shown by studying a real world case with data from a large financial services provider (FSP).

The remainder of this text is organized as follows: In section 2, we give an overview of related literature. Additionally, this section lays the conceptual fundament for this paper (including the definition of important terms). In section 3, the decision model is presented, analyzed and illustrated by an operationalization. Finally, we provide some managerial implications and limitations of the model (section 4) and conclude in section 5 by giving an outlook to further research.

2 LITERATURE REVIEW

Sourcing decisions can be separated into the organizational and the regional dimension which are to a certain extent independent of each other. With respect to the organizational dimension, outsourcing is defined as the procurement of services from sources that are external to the organization (Lankford et al. 1999). With respect to the regional dimension, near- and offshoring refers to relocating jobs to foreign countries without distinguishing whether the provider is external or affiliated with the firm (Levy 2005). In this text, we generally speak of *relocation* (standing both for near- and offshoring) and focus on the regional dimension since the cost reduction potential of relocating to low-wage countries can be realized both with in-house and outsourcing engagements. Furthermore, we consider automation as an alternative action in our decision problem. Automation refers to replacing human work by computers or machines (Bainbridge 1983). In the following, we will discuss the literature on

relocation and automation in order to elaborate cost structures and risk factors, before we provide an overview of decision models proposed by other authors for sourcing or automation decisions.

In literature, numerous articles on the drivers and criteria for relocation decisions have been published (Farrell 2005, Quélin et al. 2003). Although a number of motives for relocating the execution of business processes such as access to a larger pool of human capital, improved position in global markets, concentration on core business activities or more flexibility in reacting to market changes have been mentioned, the main motive is wage arbitrage due to lower *human resource (HR) costs* (Quélin et al. 2003). This is especially true for countries with high wages such as the US, the UK or Germany because relocation yields enormous cost reduction potential due to large differences in HR costs in comparison to low-wage countries such as India, where wages are about 15 percent of the US HR costs (neoIT 2006). However, relying only on HR costs may lead to false decisions. Further costs as well as different productivity levels have to be taken into account, too. The so-called *loaded costs* per employee consist of costs for HR, benefits, space as well as overheads. In general, the loaded costs only show a difference of about 25-35% (Everest 2005). The *effective labor costs* additionally consider that *productivity levels* may differ from site to site resulting in another mitigation of the cost arbitrage (Criscuolo et al. 2005). The effective labor costs represent the cost efficiency in conducting a process for each site. Relocating business processes (or parts of them) to a remote location usually causes *transaction costs* such as management or communication costs.

Relocating business processes bears risk. In the worst case, underestimating that risk may result in higher costs than expected or may even make back-sourcing inevitable, i.e. re-integrating outsourced or relocated tasks to the origin site (Rouse et al. 2004). Due to global sourcing, risk influence factors like cultural differences, environment, communication, financial markets, technology, intellectual property and law have to be considered for the decision (AT Kearney 2007, Beck et al. 2008, Winkler et al. 2006). As the volume of business processes, which are sourced to low-wage countries, and following the demand at the labor market in low-wage countries is increasing, estimating future wage levels is conjunct with growing uncertainty (Vestring et al. 2005), i.e. especially the effective labor costs are risky. At this point, it is necessary to clarify our perception of risk: In accordance with financial theory (e.g. Copeland and Weston 1988), we understand *risk* as deviation of an expected value. Integrating risk in our decision model consequently means to take into account the uncertainty of input parameters by considering those deviations (in the form of a probability distribution).

Costs for *business process automation* are primarily affected by process-specific soft- and hardware such as acquisition costs or license fees (Alpar 1992). Because of the complexity of some processes, it is not always possible to automate the entire process or it may result in uneconomical high expenses for the latest technologies to rebuild the most complex process steps (Nikolaidou et al. 2001). Thus, by rising degree of automation, the costs increase exponentially. Business process automation bears risk, too. Due to initial investments, particularly uncertain transaction volumes are troublesome because resulting uncertain earnings could lead to reduced revenue and upfront investments may not be amortized (Benaroch 2001). Therefore, one has to evaluate the effects of unstable future transaction volume, which in general cannot be forecasted exactly due to incomplete information.

Relocation and automation of business processes may lead to a reduction of workload at the origin location resulting in costs for reassigning employees to other tasks (including e.g. training costs) or even in layoffs including severance payments (Lee 1997). Furthermore, such situations may result in lower productivities due to decreasing employee motivation (Brockner 1988). Thus, the effects on employees should be considered. In the sequel, we consider severance payments, costs for reassignments as well as trainings and possible effects on productivities as *costs for social effects*.

In the literature, most articles dealing with decision support on sourcing or automation are qualitative approaches (see e.g. Levina et al. 2008, Rouse et al. 2004 for sourcing and Gebauer et al. 1999, Stohr et al. 1997 for automation). There are only few quantitative approaches in related research areas:

- Yang et al. (2007) identify influence factors for sourcing and propose a decision model using the analytic hierarchy process method. Beimborn (2007) analyzes cooperative sourcing with different

independent actors. His analytical models and simulation approaches are based on game and agent theory. Consequently his work and the work of Yang et al. (2007) differ from our approach both in methodologies and in the research questions covered.

- Vom Brocke et al. (2004) and vom Brocke (2007) apply investment accounting methods to support sourcing decisions on business processes. They distinguish three levels of evaluation: the operational level, the budgeting level and the corporate level. At the operational level, in-payments and out-payments are directly related to process design and sourcing decisions. In contrast to our model, their approach requires detailed modeling of the processes and allows decisions for individual process steps in a multi-period model. We are, however, interested in the general relationship between sourcing and automation (and the different characteristics with respect to uncertainty) and therefore apply a one-period model.
- In the classical area of location theory, quantitative decision models can be found applying decision criteria similar to ours. For instance, Hanink (1985) employs a mean-variance approach for finding factory locations considering returns and risks. Similarly in IT sourcing theory Zimmermann et al. (2008) present a method to allocate software development projects efficiently over sites using Markowitz's portfolio theory. In both cases, research questions are different to our contribution as automation is not considered.
- Finally, in the area of business process automation, Wei et al. (1998) propose a quantification of the optimal automation degree considering task load and process complexity. Additionally, Sheridan et al. (2000) propose a method to quantify the expected value of the gain of either human execution or automation. Both approaches neither propose a risk-return-integrated model nor do they consider sourcing or social effects.

Summarizing – to the best of our knowledge – there is no publication that takes an integrative quantitative approach combining sourcing and automation. Thus, we want to fill this research gap.

3 A MODEL FOR SOURCING AND AUTOMATION DECISIONS

Our leading questions in the following are: *Which degree of relocation and automation is optimal for a business process considering the specific cost structures elaborated in section 2? How do costs for social effects influence the decision? How does a combination of two major risk factors – namely the uncertainty of effective labor costs both at the origin site as well as on the new site and the uncertainty of the future transaction volume – affect the optimal relocation and automation degree?* To answer these questions, we introduce a quantitative decision model that is developed in two steps. We introduce a basic model in subsection 3.1. A first analysis provides an in-depth understanding of the underlying optimization problem (under certainty). In subsection 3.2, uncertainty is included into the model, then. The section concludes with an operationalization including a simulation approach.

3.1 Basic Decision Model

Notations and Assumptions

In our one-period model, we consider a FSP that currently conducts a business process at its origin site (in general a high-wage country such as the US or Germany). For each transaction processed, the FSP receives a fixed income E . The FSP plans to reengineer and to re-evaluate the sourcing strategy for the business process. The business process (or a part of it) can be carried out at the origin site, it can be relocated to a new low-wage site or it can be automated. More precisely, we assume that the overall work required to conduct the process can be performed with any possible combination of the substitutive alternatives (retention, relocation and automation). To model this, we introduce the decision variables ω , κ and λ ($\omega, \lambda, \kappa \geq 0$) where ω represents the degree of work conducted at the origin site (retention), λ represents the degree of relocation and κ represents the degree of automation. The variables ω , κ and λ are normalized to 1 ($\omega + \lambda + \kappa = 1$), i.e. their sum represents the complete workload of the business process.

The cost structures of the alternatives differ significantly: “Manual” work at the origin or at the new site causes costs that are assumed to be variable and proportional to the amount of work. For the new site additionally transaction costs T arise due to international coordination. Automation, in contrast, causes a fixed upfront investment depending on the specific degree of automation chosen. These costs are assumed to grow exponentially by γ ($\gamma > 1$) with the degree of automation and with a maximal amount of money A for full automation.

At present, the FSP processes an amount of transactions V_0 at its origin site. In the following period, the FSP has to conduct a number of transactions V_1 . As outlined in the introduction, we are especially interested in situations where the transaction volume is expected to grow, i.e. $V_1 > V_0$. If – due to relocation and/or automation – the new transaction volume conducted at the origin site falls below V_0 , costs for social effects have to be considered, which are assumed to increase proportionally depending on the reduction in volume. The estimated costs for a complete shutdown of the origin site are represented by a parameter S .

Model Description

To reduce writing overhead in the following, we introduce the index n to denote the different sites, work can be conducted at. The origin site ($n=1$) and the new low wage site ($n=2$) are characterized by their productivity P_n and their loaded costs LC_n . To determine the effective labor costs of the business process at a site, we calculate the ratio of loaded costs and productivity as shown in equation 1:

$$1) L_n = \frac{LC_n}{P_n}$$

The overall effective labor costs are $\omega \cdot V_1 \cdot L_1$ for the origin site and $\lambda \cdot V_1 \cdot (L_2 + T)$ for the new site, then¹. Depending on the degree of automation κ , the maximal expenses for automation A and the exponent γ , automation costs are calculated by $\kappa^\gamma \cdot A$. Costs for social effects only arise, if the share of volume retained at the origin site falls below the original volume because in this case the workforce on the origin site would be larger than required. We model this applying the maximum function, i.e. $\max\left(\frac{V_0}{V_1} - \omega, 0\right) \cdot S$. Finally, substituting ω by $1 - \kappa - \lambda$ and expressing the return only depending on κ and λ leads to the following objective function:

$$2) R(\kappa, \lambda) = V_1 \cdot E - \left((1 - \kappa - \lambda) \cdot V_1 \cdot L_1 + \lambda \cdot V_1 \cdot (L_2 + T) + \kappa^\gamma \cdot A + \max\left(\frac{V_0}{V_1} - (1 - \kappa - \lambda), 0\right) \cdot S \right) \rightarrow \max!$$

s. t.: $\lambda \geq 0; \kappa \geq 0; \lambda + \kappa \leq 1$

The optimization problem can be solved by differentiating between the two cases: no costs for social effects occur and costs for social effects occur. Comparing both cases finally delivers the solution to the optimization problem. A general (and not very surprising) finding is that with a prohibitive high cost factor for social effects S and in case costs for relocation are smaller than costs for retention, the optimal automation degree and the optimal relocation degree are chosen so that costs for social effects just do not occur. Additionally, it can be shown that for the case that no costs for social effects occur, it is economically reasonable to automate process steps until the marginal costs of automation reach the marginal costs of human conduction (relocation or retention). Interestingly, an automation degree of $\kappa=0$ is not a feasible solution, i.e. under the given assumptions it is always reasonable to automate at least a marginal share of the process. Since the costs of relocation increase proportionally with λ and the costs of retention increase proportional with $\omega (=1-\kappa-\lambda)$, the relationship between relocation and retention is rather simple: If the sum of effective labor costs at the new site and transaction costs is higher than the effective labor costs at the origin site ($L_2+T > L_1$), then the maximal possible volume

¹ We are aware that there are differences between inhouse-relocation and outsourcing. Nevertheless, production and transaction costs come up for both types, but with a different extent. Therefore, the model is designed to be applicable for both types. The specifications of inhouse-relocation and outsourcing must be set by parameterization.

(considering of course automation) should be kept at the origin site. Otherwise, the maximal possible volume should be relocated (in case no costs for social effects occur this is $\lambda = 1 - \kappa - \frac{V_0}{V_1}$).

Having understood the general structure of the model, we can now extend the model and analyze the effects of uncertainty due to unpredictable effects that may occur during the planning horizon.

3.2 Analyzing the Effects of Uncertainty on the Decision

We consider two important risk factors, uncertainty of the effective labor costs and of the transaction volume, in the model. For this integrated approach, we introduce Assumption 1:

Assumption 1: *To model risk, the effective labor costs \tilde{L}_n and the transaction volume \tilde{V}_1 are assumed to be normally distributed ($N(\mu, \sigma)$) random variables. Risk is hereby understood as possible negative or positive deviation from the given expected value $E(\tilde{L}_n) = \mu_{L_n}$, $E(\tilde{V}_1) = \mu_{V_1}$ and is quantified by the given standard deviation $\sigma(\tilde{L}_n) = \sigma_{L_n}$, and $\sigma(\tilde{V}_1) = \sigma_{V_1}$, respectively.*

As the input parameters \tilde{L}_n and \tilde{V}_1 for the return function are uncertain now, its result \tilde{R} is uncertain, too. This uncertainty has to be considered by the decision maker, who needs to make the decision based on a random variable \tilde{R} (instead of return R as defined in equation 2). This means the specific risk/return position of each allocation (i.e. each possible combination of κ and λ) has to be evaluated. Implicitly or explicitly this is done by a utility function that expresses the decision maker's attitude towards risk and enables calculating the utility of an uncertain result \tilde{R} .

Assumption 2: *There exists a utility-function $u(\tilde{R})$, which assigns a specific utility to every random variable \tilde{R} and which is compatible with the Bernoulli-principle. We assume a risk averse decision maker that maximizes utility.*

Based on a utility function, one can derive a preference function that integrates return and risk and can be used as a decision rule. A classical μ - σ -rule that is compatible – under the constraints of normally distributed random variables (Assumption 1) and a risk averse decision maker – with the Bernoulli-principle (Assumption 2) is given by the following equation (cp. Freund 1956):

$$3) \Phi_R(\kappa, \lambda) = \mu_R - \frac{1}{2} \cdot \alpha \cdot \sigma_R^2 \rightarrow \max!$$

This function calculates a preference Φ_R based on the expected value of the return $\mu_R = E(\tilde{R})$, the risk in realizing the return $\sigma_R = \sigma(\tilde{R})$, quantified by the standard deviation, and the decision maker's attitude towards risk, which is represented by the Arrow-Pratt parameter α . The parameter α is a positive value, which indicates risk aversion (Arrow 1971). The expected return μ_R and the variance σ_R^2 can be derived from equation 2 and from the distribution parameters of the input parameters \tilde{L}_n and \tilde{V}_1 (μ_{L_n} , σ_{L_n} and μ_{V_1} , σ_{V_1} , respectively). However, in contrast to equation 2, determining a closed analytical solution to the optimization problem is not possible, since more than one risk factor is considered at a time (several stochastic random variables are multiplied). Thus, we employ a simulation approach, which is introduced in the following subsection.

3.3 Operationalization and Simulation

Now, we demonstrate how to apply the model in a typical decision situation. The following operationalization is based on a real business case of a FSP. Names as well as all identifying details are omitted and the business case data have been anonymized for reasons of confidentiality.

The A-BANK, a large European FSP, operates all over the globe and plans to reengineer and reorganize several of its business processes. For reasons of clearness, we consider only the process for handling high value payments and checks for business clients which consists of 23 process steps. Besides cost reduction, the reason for reorganizing the process is motivated by an expansion and the number of transactions is expected to grow from presently 1,210,000 to 2,200,000 in the next period.

The following alternatives have been identified by A-BANK for the process under consideration:

- Site 1 – Germany: Up to this point, A-BANK processed their checks at its origin site characterized by high wages, but also high productivity. If less transaction volume than at the beginning is handled at this site, it would result in layoffs and/or partial reassignment of staff to new tasks requiring additional training. Both may result in increased costs and resistance of staff. A complete shutdown of the process at the site is estimated to result in costs for social effects of about €2.5 mn.
- Site 2 – India: A-BANK runs a large shared service center in India. This offshore site has become very popular due to the large and mature talent pool. A disadvantage lies in the cultural differences to Western countries. The labor costs are significantly lower than in Germany, but with a considerable large rate of increase. In addition to labor costs, transaction costs due to international distribution arise. Thus, the total costs for each transaction consist of labor and transaction costs.
- Process Automation: A-BANK is able to implement several process steps with a new software system and can install OCR systems for check handling. There are different levels that differ in the scope of the automation and in the recognition quality. The latter influences the manual effort required in subsequent process steps. For instance, low recognition quality means that (manual) controlling steps are still required in the process. By rising degree of automation, the costs are expected to increase exponentially.

By means of the model introduced before an optimal allocation of the process steps to the different alternatives should be found. A major challenge was to parameterize the model. For the automation costs, the following procedure turned out to be reasonable: For each process step, automation costs were estimated. Similar process steps were clustered by complexity and costs. The analysis revealed that some process steps were easy and inexpensive to automate whereas others were extremely complex or difficult resulting in very high automation costs. Five different types could be differentiated with estimated costs for the automation as shown in Table 1 and Figure 1. Based on the cost estimations, we approximated automation costs to increase exponentially with an exponent γ of 2.0 (cp. Figure 1). The maximal automation costs (parameter A) were determined by the sum of the costs for automating all steps, which were estimated to €21 mn.

Type	Quantity	Estimated workload share concerning the process [%]		Estimated automation costs [€ mn]	
		per step	per type	per step	per type
I	9	4	36	0.14	1.26
II	7	4	28	0.62	4.34
III	5	4.8	24	1.40	7.00
IV	1	5.5	5.5	4.00	4.00
V	1	6.5	6.5	4.40	4.40
Σ	23	-	100	-	21.0

Table 1. Breakdown of the automation costs

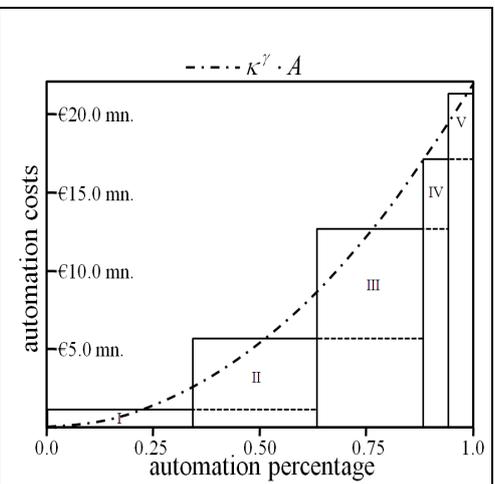


Figure 1. Derivation of A and γ

In order to determine the risk aversion parameter α , we compared the cost estimations and risk surcharges of the business case with the estimated variances of our approach. Based on the ratio of investments to estimated risk, we found a constant risk aversion parameter α with the value of 0.0001 to be reasonable. Figures about transaction volumes were available from the A-BANK. Further parameters such as productivity parameters, loaded costs and costs of social effects could be estimated

based on experience and based on public (e.g. neoIT 2006) as well as A-BANK internal reports. Table 2 summarizes the input parameters for the simulation:

	V_0	V_I	E	P_n	LC_n	T	S	A	γ	σ_{V_1}	σ_{L_n}
Site 1	1,210,000	2,200,000	€4.8	1.1	€5.0	-	€2.5 mn	€21 mn	2	0-20%	3%
Site 2				0.7	€1.9	€0.8					0-20%

Table 2. Model parameters for the simulation

The simulation works as follows: For each possible κ - λ -combination (we iterate over the feasible interval $[0,1]$ for both κ and λ in 0.01 steps), we draw values for the normally distributed random variables \tilde{L}_n , and \tilde{V}_1 using the Monte-Carlo method (according to the distribution parameters σ_{V_1} and σ_{L_n}). With these values, we calculate the return \tilde{R} according to the return function 2). This procedure is repeated 10,000 times (denoted by i). With the resulting 10,000 values for \tilde{R} , we calculate the mean μ_R and the standard deviation σ_R :

$$4) \mu_R = \frac{1}{i} \cdot \sum_i^{10000} \tilde{R}_i \quad \wedge \quad \sigma_R = \sqrt{\frac{1}{i-1} \sum_i^{10000} (\tilde{R}_i - \mu_R)^2}$$

These values are inserted into the preference function (equation 3²). Repeating this procedure for each possible κ - λ -combination, we get a value Φ_R for each κ - λ -combination. Consequently, the κ - λ -combination with the highest value of Φ_R is the optimal allocation for the current constellation of input parameters.

To analyze the influence of increasing risk to the optimal κ and λ , we repeat this procedure with different values for σ_{V_1} and σ_{L_2} , increasing both σ_{V_1} and σ_{L_2} from 0% to 20% by 0.5% and determine the optimal κ - λ -combination for each σ_{V_1} - σ_{L_2} -combination as described above. σ_{L_1} always has the value of 3% during the whole process.

Figure 2 depicts the change of the optimal automation degree (κ) (left plot) and relocation degree (λ) (right plot) for increasing both σ_{V_1} and σ_{L_2} . For illustration purposes, we extracted profile cuts I, II, III and IV (cp. Figure 2) and show them in Figure 3 and Figure 4:

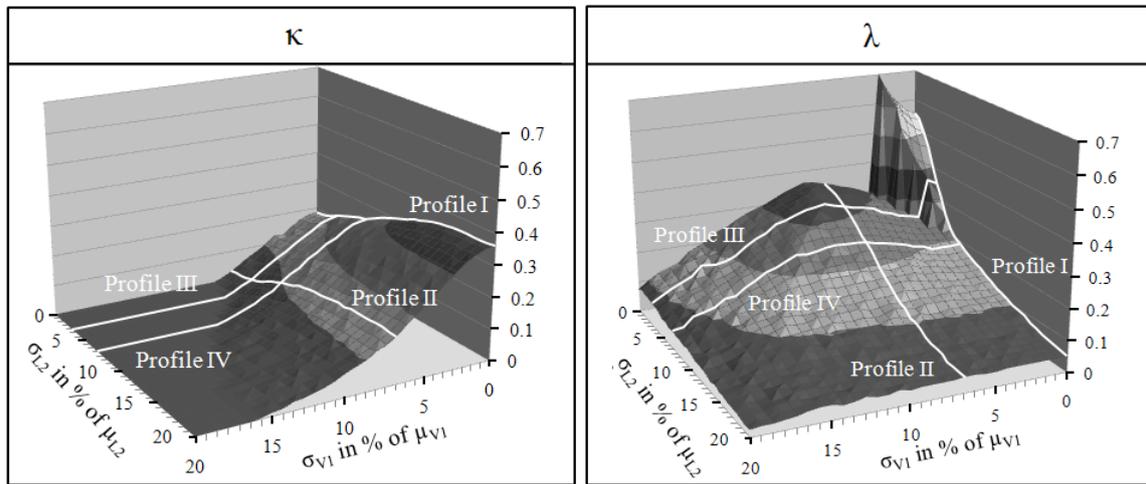


Figure 2. Graphical representation of the results of the simulation

² We are aware that the return R as specified in equation 2 may not be normally distributed in any case (because we multiply several normally distributed random variables and a maximum function). However, an analysis of the distributions in the simulation approach has shown that R is at least approximately normally distributed, i.e. the differences cause little and acceptable deviations in the results.

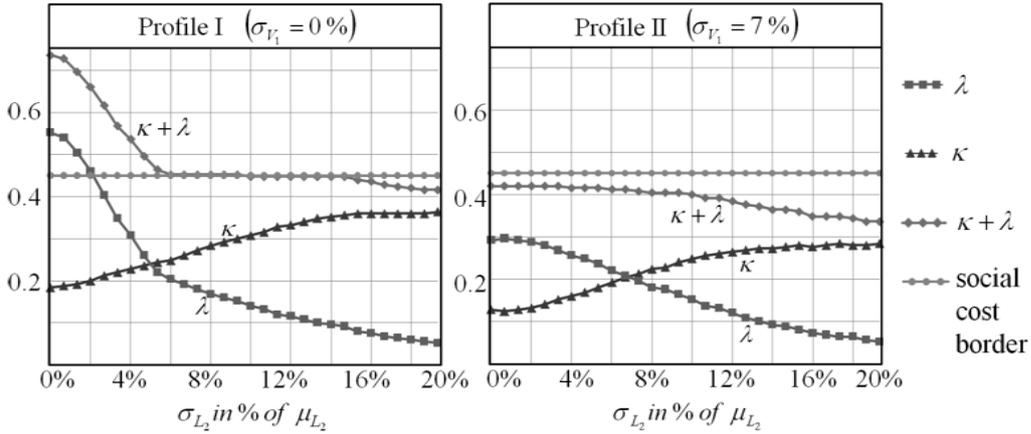


Figure 3. Profile cuts of Figure 2 (Profiles I and II)

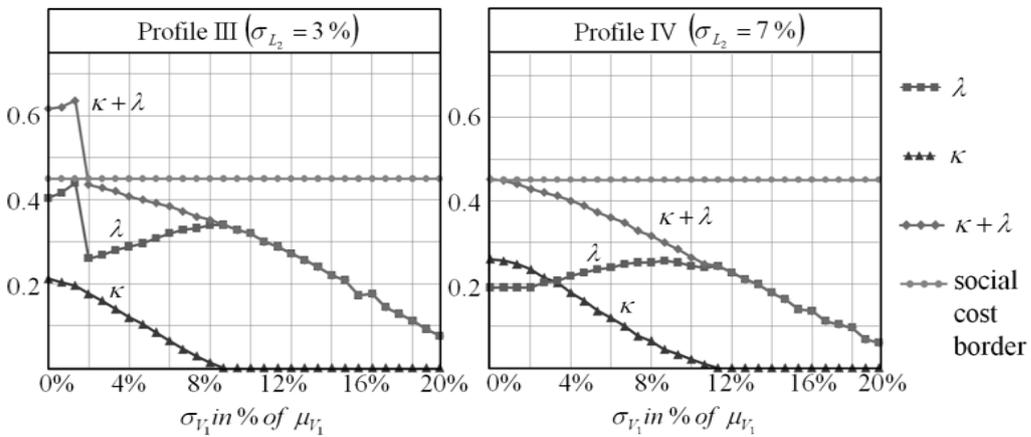


Figure 4. Profile cuts of Figure 2 (Profiles III and IV)

In the following, we analyze the influences of the different risk factors and of costs for social effects. Growing uncertainty of the effective labor costs at the new site σ_{L_2} , e.g. caused by unpredictable wage developments or productivity deviations, in tendency fosters automation as the less risky alternative (κ rises, λ decreases; cp. Profile I). This effect can be observed up to the point where automation becomes too expensive due to increasing process step complexity. After exceeding this point, the automation degree stagnates (cp. Profiles I and II). This means, automation can be seen as a substitute for relocation as long as it is not surpassed in attractiveness by retention. In contrast, rising *uncertainty of the transaction volume* σ_{V_1} leads to a higher share of relocation and less automation. This is due to high upfront costs for automating a process and in turn probably lower earnings resulting from uncertain transaction volumes. Interestingly, when the automation degree κ equals zero, relocation becomes less benefiting, too (cp. Profile III and IV), which means, uncertainty of the transaction volume affects both, automation and relocation.

Considering the effects of *both factors together*, we find that in the area of low uncertainty (low σ_{V_1} and σ_{L_2}), the relocation degree λ reacts very sensitive on deviations (cp. Profile III). This effect, which is especially strong for σ_{V_1} is caused by the linear behavior of relocation costs, i.e. in the area of low uncertainty, little changes may have enormous effects on the optimal allocation resulting in completely different relocation degrees λ . Furthermore, changing uncertainty of the transaction volume σ_{V_1} in general has a stronger impact on the optimal solution than changing uncertainty of effective labor costs σ_{L_2} which is because the first affects both κ and λ (cp. Profiles III and IV). Interestingly, the results in this particular case additionally show that automation is still a viable alternative even with volume risk of 7% (cp. Profile II).

As there is also *uncertainty of effective labor costs at the origin site* ($\sigma_{L_1} = 3\%$ here), retention is no longer a certain alternative to relocation and automation. The effects are the following: With rising σ_{L_2} , the automation degree κ is steadily rising with a small slope (cp. Profile II). The relocation degree λ is affected stronger since retention and relocation have similar cost characteristics. Thus, rising unattractiveness of the first – in terms of risk – directly means higher attractiveness of the latter. This effect is illustrated in Profiles I and III with high values for λ in particular in the range of low σ_{L_2} .

While – even high – *costs for social effects* are accepted when there is no or only low uncertainty (cp. Profiles I and III), increasing uncertainty fosters the effects of these costs since cost reduction potential of relocation and automation becomes uncertain and the costs for social effects also support this trend (cp. Profiles II and IV). In general, we can state that avoiding costs for social effects, for instance by moderate automation and relocation, is a preferable option as the sum of the optimal allocation λ and κ is running on or nearby the *social cost border* (cp. Profiles I and II).

4 DISCUSSION AND LIMITATIONS

Summarizing, uncertainty significantly influences optimal relocation and automation decisions on business processes. One source of uncertainty in today's global economy are effective labor costs. In the near past, for instance, wage levels in countries such as India increased faster than expected, which turned out to be a major problem also for the A-BANK. Our model includes those risks suggesting automation as an interesting alternative, if at the same time the uncertainty of the transaction volume is not too high. In this case, the decision maker should first choose process steps that are easy and inexpensive to automate. A further result is that with increasing risk, taking costs for social effects should be avoided. To put it in other words, the decision maker should have complete information or should at least be able to estimate parameters with the required precision before relocating work to a foreign country and cutting jobs at the origin site. If effective labor costs and the transaction volume are uncertain, the automation and relocation potential should be exploited only up to the point where costs for social effects would arise. If uncertainty is exceptionally high, even staying significantly below this threshold is a favorable strategy. In the light of the current economic crisis with high uncertainty of the transaction volume, the results suggest that postponing costly automation projects and keeping the work at the high wage and less risky site can be the preferred alternative.

The introduced model is based on a set of assumptions. These limitations at the same time define extension potential. First, we assumed infinitely divisible processes. In reality processes may not always be cut as proposed by the model. Still, most processes consist of several steps and can nearly be allocated as optimized. Thus, feasible discrete allocations may lie near the theoretical optimum, also delivering a good economic solution. Our model is especially applicable, when process steps can be more or less independently sourced or automated since interdependencies are not explicitly included in the calculations. Second, we proposed a one-period model which was reasonable to understand the fundamental relationships between sourcing and automation under uncertainty. Extending our model to multiple periods (in terms of a cash-flow oriented perspective) is an interesting direction for further research. Investment accounting methods (as discussed in the literature section) may be a starting point for this extension. Third, specific characteristics of in-house relocation versus (external) offshoring could be considered. Fourth, we assumed normal distribution of the random variables – which is a common assumption in literature (e.g. Hanink (1985)). Nevertheless, our approach could be extended by including empirical estimations of probability distributions which could then be applied in an enhanced model. Last but not least, not all of the results can be generalized and further simulations are required to validate our findings.

5 CONCLUSION

Though relocating and automating business processes bear much economic potential, there are only few quantitative decision support models. In particular, there is a lack of research considering both alternatives in an integrated approach. Thus, in this paper we propose a risk/return based approach to calculate optimal degrees of relocation and automation for individual business processes considering the specific cost structures and risk profiles. In comparison to previous research, this approach comes up with several enhancements: First, we simultaneously consider relocation and automation. Second, such decisions also have effects on the original site since jobs may be abolished. Hence, we consider such social effects by quantifying negative outcomes of disestablishing jobs. Finally, we analyze the influence of uncertainty. Applying the model, the results provide a recommendation for automation or site selection for business process steps. Employing data of a business process of a major FSP, the applicability of this approach is illustrated.

The model provided evidence for several facts. First, automation becomes unattractive, if information of the future transaction volume is incomplete. But, automation is a viable alternative, if the effective labor costs cannot be predicted precisely. Second, relocating process steps is affected negatively both by uncertainty of transaction volume and uncertainty of effective labor costs. Third, taking costs for social effects is only sensible, if the decision maker has sufficient information. This is an interesting finding since it suggests that social effects should be assessed carefully. Finally, not considering uncertainties may lead to false decisions. Summarizing, the analysis of the proposed model for supporting sourcing and automation decisions not only revealed interesting insights, it can also form the foundation for further research.

References

- Agrawal, V., Farrell, D. and Remes, J.K. (2003). Offshoring and beyond. *McKinsey Quarterly*, Special Edition, 24-35.
- Alpar, P. (1992). Automation of Banking Functions and Its Managerial Implications. *IEEE Transactions on Engineering Management*, 39 (4), 378-385.
- Arrow, K.J. (1971). The Theory of Risk Aversion. Arrow, K.J. (Ed.): *Essays in the Theory of Risk-Bearing*, 90-120.
- AT Kearney (2007). Offshoring for Long-term Advantage. Report.
- Bainbridge, L. (1983). Ironies of automation. *Automatica*, 19 (6), 775-780.
- Beck, R., Gregory, R. and Prifling, M. (2008). Cultural Intelligence and Project Management Interplay in IT Offshore Outsourcing Projects. In *Proceedings of the 29th International Conference on Information Systems (ICIS)*, Paris, France, Paper 44.
- Beimborn, D. (2007). Cooperative Sourcing – Simulation Studies and Empirical Data on Outsourcing Coalitions in the Banking Industry. Gabler, Wiesbaden, Germany.
- Benaroch, M. (2001). Option-Based Management of Technology Investment Risk. *IEEE Transactions on Engineering Management*, 48 (4), 428-444.
- Brockner, J. (1988). The effects of work layoffs on survivors: Research, theory, and practice. *Research in Organizational Behavior*, 10 (1), 213-256.
- Copeland, T.E and Weston, J.F. (1988). *Financial Theory and Corporate Policy*. 3rd edition. Addison-Wesley, Reading, MA, USA.
- Criscuolo, C. and Leaver, M. (2005). Offshore Outsourcing and Productivity. Presented at OECD conference on Globalisation of Production.
- Everest Research Institute. (2005). *Global Outsourcing Annual Report*.
- Farrell, D. (2005). Offshoring: Value Creation through Economic Change. *Journal of Management Studies*, 42 (3), 675-683.
- Freund, R.J. (1956). The Introduction of Risk into a Programming Model. *Econometrica*, 24 (3), 253-263.
- Gartner Research (2007). *Gartner on Outsourcing 2007-2008: Business Process Outsourcing*. Report.

- Gartner Research (2008a). BPO Imperatives for Success. Report.
- Gartner Research (2008b). Four Steps to BPO Success. Report.
- Gebauer, J. and Scharl, A. (1999). Between Flexibility and Automation: An Evaluation of Web Technology from a Business Process Perspective. *Journal of Computer-Mediated Communication*, 5 (2).
- Hanink, D.M. (1985). A Mean-Variance Model of MNF Location Strategy. *Journal of International Business Studies*, 16 (1), 165-170.
- Lacity, M.C. and Willcocks, L. (2000). *Global Information Technology Outsourcing: In Search of Business Advantage*. 1st edition. John Wiley & Sons, Inc. New York, NY, USA.
- Lankford, W.M. and Parsa, F. (1999). Outsourcing: a primer. *Management Decision*, 37 (4), 310-316.
- Lee, P.M. (1997). A comparative analysis of layoff announcements and stock price reactions in the United States and Japan. *Strategic Management Journal*, 18 (11), 879-894.
- Levina, N. and Su, N. (2008). Global Multisourcing Strategy: The Emergence of a Supplier Portfolio in Services Offshoring. *Decision Sciences*, 39 (3), 541-570.
- Levy, D.L. (2005). Offshoring in the New Global Political Economy. *Journal of Management Studies*, 42 (3), 685-693.
- neoIT (2006). *Offshore Insights - Market Report Series*, 4 (4).
- Nikolaidou, M., Anagnostopoulos, D. and Tsalgatidou, A. (2001). Business process modelling and automation in the banking sector: A case study. *International Journal of Simulation Systems, Science & Technology*, 2 (2), 65-76.
- Quélin, B. and Duhamel, F. (2003). Bringing Together Strategic Outsourcing and Corporate Strategy: Outsourcing Motives and Risks. *European Management Journal*, 21 (5), 647-661.
- Rouse, A.C. and Corbitt, B. (2004). IT-supported business process outsourcing (BPO): The good, the bad and the ugly. In *Proceedings of the 8th Pacific-Asia Conference on Information Systems (PACIS)*, Shanghai, China.
- Sheridan, T.B. and Parasuraman, R. (2000). Human Versus Automation in Responding to Failures: An Expected-Value Analysis. *Human Factors*, 42 (3), 403-407.
- Stohr, E.A. and Zhao, J.L. (1997). A technology adaptation model for business process automation. In *Proceedings of the 30th Hawaii International Conference on System Sciences*, 4, 405-414.
- Vestring, T., Rouse, T. and Reinert, U. (2005). Hedge your offshoring bets. *MIT Sloan Management Review*, 46 (3), 27-29.
- vom Brocke, J. (2007). Service Portfolio Measurement: Evaluating Financial Performance of Service-Oriented Business Processes. *International Journal of Web Services Research*, 4 (2), 1-32.
- vom Brocke, J. and Lindner, M.A. (2004). Service Portfolio Measurement – A framework for Evaluating the Financial Consequences of Out-tasking Decisions. In *ACM SIG Proceedings of the ICSOC04*, New York, NY, 203-211.
- Wei, Z., Macwan, A.P. and Wieringa, P.A. (1998). A quantitative measure for degree of automation and its relation to system performance. *Human Factors*, 40 (2), 277-295.
- Winkler, J., Dibbern, J. and Heinzl, A. (2006). Success in Offshoring of Application Development- Does Culture Matter? In *Proceedings of the 14th European Conference on Information Systems (ECIS)* (Ljunberg, J. and Andersson, M. (Ed.)), Göteborg, Sweden, 1640-1650.
- Yang, D.H., Kim, S., Nam, C. and Min, J.W. (2007). Developing a decision model for business process outsourcing. *Computers and Operations Research*, 34 (12), 3769-3778.
- Zimmermann, S., Katzmarzik, A. and Kundisch, D. (2008). IT Sourcing Portfolio Management for IT Services Providers - A Risk/Cost Perspective. In *Proceedings of the 29th International Conference on Information Systems (ICIS)*, Paris, France, Paper 133.