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IT STANDARDIZATION AND INTEGRATION IN MERGERS AND ACQUISITIONS: A DECISION MODEL FOR THE SELECTION OF APPLICATION SYSTEMS

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Abstract

Mergers and acquisitions (M&A) have been an important topic in strategic management for years and have therefore been the subject of comprehensive research work as well. However, the post merger integration seems to be a key factor for the success of the whole deal. One objective of many transactions is the realization of synergy potentials, especially from the consolidation of the information technology (IT). Unfortunately only few research work on IT integration in M&A projects can be found.

With this paper, we want to contribute to this topic by focusing on the integration of application systems in merged companies. First of all, we will give an overview of 4 general integration strategies suggested by the literature. Secondly, we will present a decision model for the selection of application systems, which is based on the well-known standardization problem. Afterwards a procedure is being introduced which shows how the decision model can be applied in the context of M&A projects.

Keywords: M&A, standardization, integration, decision support.

1 INTRODUCTION

Within the framework of M&A projects, a substantial task is the integration and reorganization of information and communication systems. For example, decisions have to be made whether particular IT systems should persist or give way to the implementation of new systems. If necessary, employees have to be convinced and trained and business processes might have to be changed. Starting point for the integration are (at least) two system and application landscapes of the merging companies. Subjects of integration decisions might be IT infrastructure, corporate application systems, databases and data warehouses, IT staff as well as the organization of the information processing. In this article we will focus on corporate application systems since they constitute the core of the information and communication systems.

The efforts related to the IT integration can be outweighed by a number of opportunities: for example, a centralization of IT departments can generate significant savings. Furthermore, the merger can serve as a motive for the introduction or development of new innovative systems.

Various strategies can be applied if information and communication systems are merged in corporate acquisitions. One possibility is to aim at a complete standardization, e.g. by the company-wide implementation of a certain Enterprise Resource Planning (ERP) system. As an alternative, a best-of-breed strategy can be chosen, meaning that the best software solution is implemented for each division of the company, which might then be linked by Enterprise Application Integration (EAI) solutions. Although several publications on these strategies exist, most of them only provide rough recommendations.

In this article we will introduce a decision model which provides support in selecting application systems in the context of M&A projects. The objective is to offer concrete normative decision support for the choice of these systems based on the specification of the model parameters.

In the second section we will introduce some alternative integration strategies and discuss basic advantages and disadvantages from an economical point of view. Subsequently, selected types of company mergers and their impact on IT integration strategies will be examined. The third section is dedicated to the presentation of a decision model for the choice of application systems in M&A projects. In section four we will provide a conclusion and an outlook on further research work.

2 IT INTEGRATION IN MERGERS AND ACQUISITIONS

2.1 Strategies in IT integration

The literature basically differentiates between four main strategies for IT integration in M&A projects (Brüning, Pedain and Deasley 2002, Duthoit et al. 2004, Johnston and Yetton 1996, Keller 2004, Pedain 2003):

- Absorption
  The information systems of one merging partner will be chosen as standard for the merged company. If for example one of the merging partners (A) is so far using a certain standard software in his divisions and the other merging partner (B) is applying various individual solutions, the absorption strategy would in that case mean that all divisions of the merged company (C) use the standard software of A. By migrating B’s data and processes to the new solution, B’s system will be completely replaced. On the one hand, the general advantages of this approach are the relatively low risk, the reduced related costs and its comparatively short time to completion (Johnston and Yetton 1996). On the other hand, the absorption strategy might lead to a low level of acceptance among the users. This can be traced back to necessary additional training efforts and an impression of lost functionality (Duthoit et al. 2004). Another disadvantage is the fact that the displaced

system will be completely given up, without considering that some of the components might be better than the ones of the selected system.

- Best-of-breed
  ‘Best-of-breed’ denominates an approach where the best subsystems of each partner are selected from the entirety of all systems of companies A and B. These subsystems are taken over into the systems of company C. However, the problem is to identify the best solution for each purpose. This is even more complicated since the functional ranges of the single components of both system landscapes usually do not correspond exactly. Different opinions in both companies’ departments on which is the better subsystem (whereas each one would usually prefer his own one) make the decision even harder. Moreover, this kind of integration increases the expenses for interfaces considerably. These expenses can be reduced by employing EAI technologies (Lee, Siau and Hong 2003, Linthicum 2000), but still the best-of-breed approach will generally lead to comparatively high costs and tends to bring about a lower speed of integration.
- Co-existence
  ‘Co-existence’ refers to cases where both information systems are operated in parallel but more or less independently. Interfaces between the two systems are only created in a small number of cases, e.g. to integrate data of financial reporting. Although this approach can be implemented quickly, it has one significant disadvantage: due to the persistence of the original systems no synergy potentials can be realized from the consolidation of the IT. However, this strategy can be appropriate as interim solution or if certain conditions apply.
- Greenfield
  According to the greenfield approach a new system landscape is developed for the merged company C without using the existing systems. However, this new system landscape does not necessarily require the development of an individual software. It could also mean the company-wide introduction of a new standard software. This offers the possibility of a fundamental adjustment of the systems to the new requirements and of getting rid of legacy systems. At the

Integration strategy	Characteristics	Advantages	Disadvantages
Absorption	- selection of one of the existing system landscapes - migration of the other company’s data and processes	- short project time and low effort - limited project risk - low operating costs due to standardization	- low user acceptance - limited coverage of functional requirements - loss of powerful components of the displaced system
Best-of-breed	- mixture of the best components of both systems	- good coverage of functional requirements - high user acceptance	- difficulties in component evaluation - high expenses for interfaces - increased project risk
Co-existence	- retention of both companies’ system landscapes - minimum integration through few interfaces	- short project time and low effort	- synergy potentials can not be realized - high operating costs due to co-existing systems - increased complexity in future M&A
Greenfield	- introduction of a completely new system landscape - development of a custom software or implementation of a standard software	- optimal coverage of functional requirements - high user acceptance - optimal IT architecture	- long project time and high effort - high training effort - limited project risk

Table 1. Different aspects of IT integration strategies

same time, modern technologies can be applied. However, the high costs for this greenfield strategy have to be borne in mind. Another negative fact is that the conceptual design and development of this ‘ideal solution’ is extremely time-consuming. Nevertheless, this approach can be appropriate if both merging partners work with outdated system landscapes which do not correspond to the modified demands in functionalities, extensibility, maintainability and scalability or if a new development had been planned prior to the merger. In this case an interim solution should be created that links at least parts of the co-existing old systems by interfaces.

Duthoit et al. (2004) introduce another variant. They recommend the bundling of the individual subsystems of each partner into closed packages, the so-called clusters. The respective clusters of both partners should map the comparable functionalities. In comparison to the best-of-breed strategy, this reduces the number of units to be compared. What distinguishes this approach from the absorption strategy is the fact that first-class subsystems of both companies can be jointly used after the merger.

Kromer and Stucky (2002) examined the importance of different integration strategies in an empirical study among companies in Austria, Germany and Switzerland. Their results show that in approximately two-thirds of all surveyed mergers the application landscapes have been standardized completely or in integral parts according to the absorption strategy. In one third of the cases both systems were maintained in co-existence. The study revealed no examples where the greenfield approach or the best-of-breed strategy were applied.

2.2 Determinants of IT integration

In the following section we will discuss different types of corporate mergers and relative sizes of the companies involved as essential factors of the IT integration. First of all, we therefore consider the relationship between the merging companies in terms of their relative position in the supply chain. This is a criterion to classify three types of mergers and acquisitions: horizontal mergers, vertical mergers, and conglomerate mergers (Certo and Peter 1988, Sudarsanam 2003).

A horizontal merger describes a transaction between two companies of the same industrial sector which operate on the same level of the supply chain. It usually targets to an improved competitive position and to realizing synergy benefits of scale and scope economies.

Vertical mergers take place between companies of different levels of the supply chain within the same industrial sector. Thus they refer to the prolongation of the (internal) supply chain directing to procurement or distribution. The aims of vertical mergers are the reduction of transaction costs, the acquisition of company-specific functions as well as improved access to procurement and sales markets.

A conglomerate merger denominates an amalgamation of companies from different industrial sectors. Usually a diversification or expansion strategy, which shall reduce the dependency from particular business areas or realize opportunities on new markets, is the motivation for this kind of merger.

Besides the aforementioned types of mergers and acquisitions, the relative size of the companies involved in the transaction has a significant influence on the integration strategy. Within a take-over where one company is dominating the other, the scope of decisions is more limited per se than in a ‘merger of equals’. If the corporate strategy of the dominating partner focuses on repeated acquisitions of smaller companies, the dominance is even enforced.

Against this background, the next section will be about a decision model to identify the optimal IT integration strategy in M&A projects.

3 A MODEL FOR THE SELECTION OF APPLICATION SYSTEMS IN M&A PROJECTS

3.1 Basics of modelling

This model is based on the representation of companies as networks, i.e. on basis of vertices (nodes) and edges. In the following we assume that nodes stand for divisions of a company like accounting, HR, etc. Edges represent the information relationships between these divisions. On this basis we can depict the results of various IT strategies. Figure 1, however, concentrates on the absorption strategy and the best-of-breed strategy.

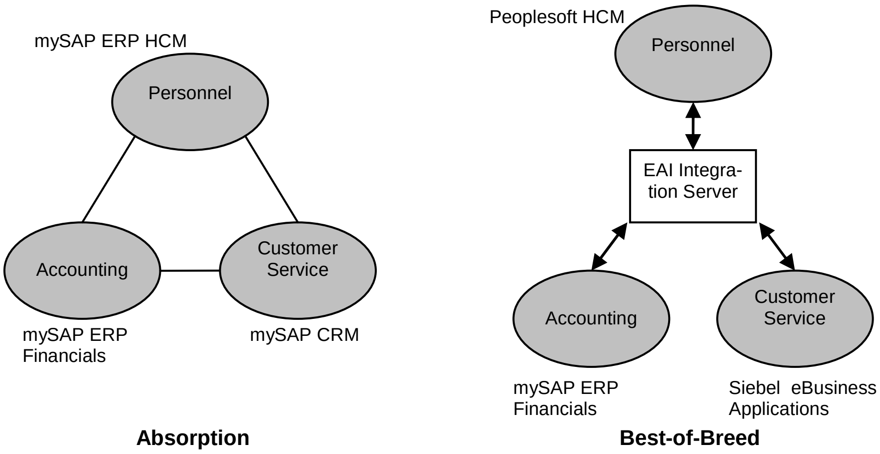

Figure 1. Absorption vs. best-of-breed

The left side of Figure 1 depicts a network in which all nodes use the SAP standard. Assuming that one of the merging companies implemented a standardized SAP application landscape, this could be interpreted as the result of an absorption strategy. The network on the right shows the result of a best-of-breed strategy. Each division employs the standard which best supplies its needs.

How can these IT strategies be evaluated in the context of M&A projects? For this purpose we will get back to the basic concept of the so-called standardization problem (Buxmann et al. 1999, Domschke and Wagner 2005, Schade and Buxmann 2005), which arises in situations where several actors need to exchange information. Using the same communication standard, actors can benefit from decreased information costs as a result of cheaper and faster communication as well as from eliminating errors and avoiding media discontinuities. Besides, standardization allows exchanging more and better information and thus leads to an improved basis for decisions. But standardization does not only lead to benefits: they are opposed to drawbacks resulting from the costs for the implementation of the standard.

While the conventional standardization model is used to select communication standards, it shall now be extended to support the decision on the implementation of application software. For this purpose the basic utility has to be included in the model. The basic utility of a good results from its functionality and is independent from its utilization by other users (Buxmann 2001). For communication standards the basic utility is obviously zero – there is no advantage of a telephone or a certain EDI standard if nobody else uses this standard. In contrast, application software provides a basic utility which is independent of the number of other users of the system.

In the context of the standardization problem, a company's information systems including their communication relationships are described as undirected graphs (see Figure 2). In our model, let *V* be the set of vertices (nodes) and let *E* be the set of edges of the standardization graph.

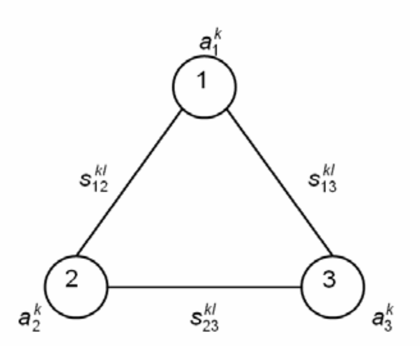

Figure 2. IT landscape consisting of 3 systems

The decision model is supposed to select one of the available standards for each business unit. We assume that it does not make any sense to employ more than one software e.g. in HR. At the same time exists a multitude of application standards which can be deployed in almost every business unit. For instance, ERP systems provide solutions for financial accounting, controlling, logistics, HR, etc. Furthermore, "standards" exist which can only be applied in a single or a few departments, e.g. production planning systems. In the following let S_i be the set of standards which can be implemented in node *i*, for instance the set of software solutions for production planning.

Furthermore, we assume that standard *k* will lead to a basic utility of u_i^k when it is implemented in node *i*. Thus the basic utility is node-specific and standard-specific. In this way we can for example represent that ERP software is having a higher utility in financial accounting than in production planning. In addition, standardization costs c_i^k incur, which are node-specific and standard-specific as well. These standardization costs include the full costs for the implementation of the standard, e.g. costs for licenses, development, customization or data migration. The net basic utility of a standard in a specific node corresponds to the difference between basic utility and standardization costs, i.e. $a_i^k = u_i^k - c_i^k$.

However, the best-of-breed strategy would be the optimal solution when only the net basic utility is considered. One would just have to identify the solution where the difference between basic utility and standardization costs is maximal for each node.

But this solution does not have to be optimal for the entire company, since information is exchanged between the nodes. This information exchange causes information costs due to transport, media breaks, etc., which normally are higher in heterogeneous software environments. Under these circumstances network effects arise since a higher number of implemented modules leads to a higher number of supported communication relationships. Here network effects denominate the (positive) dependency of a standard's utility from the number of its users (Farrell and Saloner 1985, Katz and Shapiro 1985). Obviously the utility of standard software like Microsoft Office or OpenOffice will increase with the number of users, since users can easily exchange files.

In our model these network effects are operationalized as follows: We assume that information is exchanged along edge [*i*,*j*], which leads to information costs. These costs can be reduced by using compatible standards while the provision of additional information can contribute to an increased value. In the following, we refer to the sum of increased information value and cost savings as network effect utility. We assume that a network effect utility of s_{ij}^{kl} is generated along edge [*i*,*j*] if node *i* implements standard *k* and node *j* implements standard *l*. Normally a high network effect utility will be realizable between two nodes if both of them use the same standard, e.g. the same ERP system.

If two entirely incompatible standards are used, the network effect utility is zero. The general formulation using s_{ij}^{kl} allows depicting that a better compatibility exists between two standards and therefore a higher network effect utility can be realized than by using two other standards. In contrary to the classic standardization problem, this allows us to depict partial compatibility.

On this basis the optimization model shall be introduced in the following.

3.2 A decision model for the selection of standards

The objective of the model is to maximize the sum of node-based net basic utilities and the realizable network effect utilities. However, there is often a trade-off between these two objectives. The selection of application systems which maximize the sum of net basic utilities in each node – in other words: a best of breed strategy – will usually lead to lower network effect utilities. Vice versa a company-wide deployment of a certain standard will often yield to a high network effect utility, but in most cases these systems are not optimal for all business units.

In the following we will introduce an optimization model to maximize the sum of net basic utility and network effect utility.

We define binary decision variables x_i^k for all $i \in V$ and $k \in S_i$. x_i^k takes a value of 1 if and only if standard *k* is introduced on node *i*. Further we introduce binary decision variables y_{ij}^{kl} for all $i, j \in V$ with $i < j$ as well as $k \in S_i$ and $l \in S_j$. y_{ij}^{kl} takes a value of 1 if and only if nodes *i* and *j* use standards *k* and *l* respectively for exchange of information and therefore a network effect utility can be realized.

Using these variables the problem can be formulated as an integer program as follows:

$$\text{Max. } \mathrm{F}(\mathrm{x}, y) = \sum_{i \in V} \sum_{\substack{j \in V \\ i < j}} \sum_{k \in S_i} \sum_{l \in S_j} s_{ij}^{kl} \cdot y_{ij}^{kl} + \sum_{i \in V} \sum_{k \in S_i} a_i^k \cdot x_i^k \qquad (1)$$

s.t.

$$y_{ij}^{kl} - x_i^k \le 0 \qquad i, j \in V \text{ with } i < j \;,\; k \in S_i,\; l \in S_j \qquad (2)$$

$$y_{ij}^{kl} - x_j^l \le 0 \qquad i, j \in V \text{ with } i < j \;,\; k \in S_i,\; l \in S_j \qquad (3)$$

$$\sum_{k \in S_i} x_i^k = 1 \qquad i \in V \qquad (4)$$

$$\sum_{k \in S_i} \sum_{l \in S_j} y_{ij}^{kl} = 1 \qquad i, j \in V \text{ with } i < j \qquad (5)$$

$$x_i^k \in \{0,1\} \qquad i \in V,\; k \in S_i \qquad (6)$$

$$y_{ij}^{kl} \in \{0,1\} \qquad i, j \in V \text{ with } i < j \;,\; k \in S_i,\; l \in S_j \qquad (7)$$

Objective function (1) maximizes the net overall utility of corporate information systems. The term $\sum_{i \in V} \sum_{k \in S_i} a_i^k \cdot x_i^k$ represents the net basic utility of all vertices which results from the basic utility and the standardization costs. The network effect utility is incorporated in the expression $\sum_{i \in V} \sum_{\substack{j \in V \\ i < j}} \sum_{k \in S_i} \sum_{l \in S_j} s_{ij}^{kl} \cdot y_{ij}^{kl}$.

Constraints (2) and (3) guarantee that the network effect utility s_{ij}^{kl} can only be realized if node *i* implements standard *k* and node *j* implements standard *l* respectively. Constraint (4) enforces that each node implements exactly one standard. Constraint (5) assures that the network effect utility s_{ij}^{kl} will be realized in the objective function's value, even in instances of the model where it can be negative.

The model described above can be regarded as a modification of the well-known standardization problem to focus on application systems. This is being accomplished by implementing the concepts of basic utilities and partial compatibilities.

So far the model only refers to one network. In the following section we want to show how it can be applied in the context of M&A projects.

3.3 Applying the model to M&A projects

As in section 2, we assume that two companies A and B shall merge to a company C. The first step of an IT integration project consists of an analysis phase, which comprises a comprehensive survey of the IT solutions of both companies. In addition to these existing solutions, new system alternatives can be taken into account as well. In order to apply our model, the standardization graphs of company A and B and all their parameters have to be inquired. This includes identifying relevant departments of both companies, whose information systems are subject to the standardization considered here. When identifying these departments, those which shall affiliate after the merger should obtain the same labeling for their nodes in both graphs.

With respect to the application of our standardization model the analysis phase can be split in the following steps:

1. Determining the set of nodes *V*,
2. identifying the sets S_i ,
3. identifying the weights of nodes, i.e. the net basic utilities a_i^k ,
4. determining the set of edges *E*,
5. identifying the weights of edges, i.e. the network effect utilities s_{ij}^{kl} .

In addition, it has to be examined if new communication relationships open up due to the merger. For instance, this could happen if a department of one merging company has to exchange information with a department of the other merging partner. These communication relationships are referred to as the set of edges ${}^{+}E$. For these relationships the network effect utility has to be determined in dependency of the standards applied. This network effect utility shall be denoted ${}^{+}s_{ij}^{kl}$ below.

This analysis phase is followed by the decision phase. In this phase the standardization graph of the merged company C can be derived from the standardization graphs of company A and B. Subsequently the decision model has to be applied to the derived graph.

For an automated derivation of company C's standardization graph, we act on the following assumptions:

- The net basic utility of a standard in a department of the merged company corresponds to the sum of the net basic utilities in the equivalent departments of both merging partners.
- The network effect utilities of C can be calculated by addition of the corresponding values of the merging companies A and B.

Of course, these assumptions constitute a simplification of the real facts. Our approach is exemplarily geared to these assumptions, but basically it can be transferred to any other dependency between the weights of nodes and edges.

According to these assumptions the standardization graph for company C can now be generated in a two-step process. Firstly, we have to join the sets of nodes and the sets of edges respectively.

Secondly, we need to sum up the weights of corresponding nodes and accordingly the weights of corresponding edges. A formal description of the automated generation of the graph is presented in the appendix to this paper.

In the following we will illustrate the union of graphs by considering two examples. In both cases we suppose that two standards are available, which can both be employed in every department. Hence every node is marked with two weights, the net basic utilities a_i^1 and a_i^2, and every edge is marked with four weights, the network effect utilities $s_{ij}^{11}, s_{ij}^{12}, s_{ij}^{21}$ and s_{ij}^{22}. For the sake of simplicity theses weights are depicted as vectors and matrixes in Figure 3 and Figure 4.

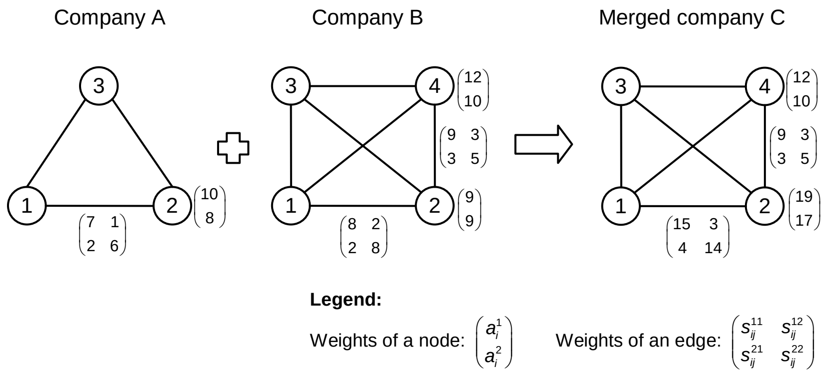

Figure 3. The union of graphs in a horizontal merger

Figure 3 shows the union of graphs for a horizontal merger. Departments 1 to 3 exist in both companies involved. These departments are subject to fusion after the corporate merger. In company B an additional department 4 exists.

After the merger the new company consists of all four departments. Since communication relationships between all departments already existed in company B, no further relationship can evolve in the merged company.

As we see in the example of node 2, the net basic utility of a certain standard in a certain department can be derived by summing up the corresponding values of the merging partners. The network effect utility arising between two departments due to a particular pair of standards can be calculated accordingly as we can see in the example of edge [1,2].

In contrast, net basic utilities and network effect utilities can be taken over directly from one merging partner if the corresponding department or communication relationship did not exist in the other company. The weights of node 4 and edge [2,4] exemplify such a case.

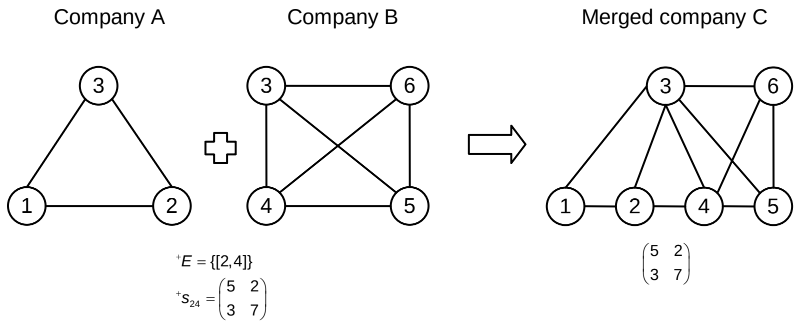

Figure 4. The union of graphs in a vertical merger

The second example refers to a vertical merger (Figure 4). In this case we assume that only the departments 3 of both companies shall affiliate. All other departments remain unchanged since there are no counterparts in the other company.

All existing communication relationships are also taken over from the merging partners to the merged company. Additionally, information has to be exchanged between departments 2 and 4 in the merged company. Thus edge [2,4] has to be included in the merged company's graph and it is ${}^{+}E = \{[2,4]\}$. The weight of this edge is given in matrix form as ${}^{+}s_{24}$.

4 CONCLUSIONS AND FURTHER WORK

In the context of IT integration in M&A projects, a multitude of decisions has to be made. Besides HR the strategies of IT integration have to be mentioned in particular. So far the literature generally gives rough recommendations, which abstain from a model-based background. Empirical findings and experiences, e.g. form the banking sector, suggest that usually the application systems of the dominating company in the merger are selected.

In this article we introduced a model to support such fundamental decisions in matters of IT integration in M&A projects. The basis of this model was the standardization problem, which has been extended by these three dimensions:

- the basic utility to support decisions between different application systems,
- the concept of partial compatibility, as well as
- the explicit consideration of M&A projects by the derivation of the standardization graph of the merged company from the corresponding graphs of the merging companies.

The main problem in the utilization of the model consists in the high costs for the provision of information. Hence one should consider the trade-off between the benefit of applying the model and the costs caused by the application. Since the costs of IT integration in M&A projects are generally very high, the employment of a formal model seems to be worth considering. A simplified application of the model provides another opportunity. With this option only selected parameters of the model could be collected extensively while others could be roughly estimated.

Based on the model introduced in this paper, we currently develop a prototype for the computer-aided employment of the model. This prototype shall provide decision support as well as sensitivity analyses in terms of 'what-if' and 'how-to-achieve' analyses. On this basis we will deduct normative statements on the optimal integration strategy for each parameter constellation. For example, a question to answer in this context is how the selection of application systems in the merged company is influenced by the proportional sizes of the merging companies. Such simulative and analytical considerations shall contribute to a better methodical foundation of IT decisions in the context of M&A projects.

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Appendix

Assuming that two companies A and B shall merge to a company C, the standardization graph for company C can be generated as follows: Take the graphs ${}^{A}G = \left[{}^{A}V, {}^{A}E, {}^{A}s, {}^{A}a \right]$ and ${}^{B}G = \left[{}^{B}V, {}^{B}E, {}^{B}s, {}^{B}a \right]$ of the merging companies as well as ${}^{+}E$ and ${}^{+}s_{ij}^{kl}$ (cf. section 3.3) as granted. The graph ${}^{C}G = \left[{}^{C}V, {}^{C}E, {}^{C}s, {}^{C}a \right]$ of the merged company can be composed by the union of graphs ${}^{A}G$ and ${}^{B}G$. This can be accomplished by:

- the union of the sets of nodes ${}^{C}V = {}^{A}V \cup {}^{B}V$,
- the union of the sets of edges ${}^{C}E = {}^{A}E \cup {}^{B}E \cup {}^{+}E$,
- the definition of the weights of edges ${}^{C}s_{ij}^{kl} = \begin{cases} {}^{A}s_{ij}^{kl} + {}^{B}s_{ij}^{kl} & \text{, if } [i,j] \in {}^{A}E \cap {}^{B}E \\ {}^{A}s_{ij}^{kl} & \text{, if } [i,j] \in {}^{A}E \wedge [i,j] \notin {}^{B}E \\ {}^{B}s_{ij}^{kl} & \text{, if } [i,j] \in {}^{B}E \wedge [i,j] \notin {}^{A}E \\ {}^{+}s_{ij}^{kl} & \text{, if } [i,j] \in {}^{+}E \end{cases}$ and
- the definition of the weights of nodes ${}^{C}a_{i}^{k} = \begin{cases} {}^{A}a_{i}^{k} + {}^{B}a_{i}^{k} & \text{, if } i \in {}^{A}V \cap {}^{B}V \\ {}^{A}a_{i}^{k} & \text{, if } i \in {}^{A}V \wedge i \notin {}^{B}V \\ {}^{B}a_{i}^{k} & \text{, if } i \in {}^{B}V \wedge i \notin {}^{A}V \end{cases}$