Chapter 6 : Tailoring of ERP Systems

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6.1 Introduction

Enterprises today are faced with the globalization of markets and fast changes in the economy. In order to be able to cope with these conditions, the use of information and communication systems and technology is almost mandatory. Specifically, the adoption of enterprise resource planning (ERP) systems as standardized systems encompassing whole enterprises becomes an important factor in today's business (Gronau 2001). Due to the saturation of ERP markets targeting large-scale enterprises, ERP system vendors today also concentrate on the growing market of small and medium-sized enterprises (S&MEs) (Deep, Guttridge, Dani & Burns 2008; Koh & Simpson 2005). This results in a high fragmentation of the ERP market and high diffusion of ERP systems throughout enterprises of nearly every industry and every size (Winkelmann & Klose 2008; Winkelmann & Leyh 2010).

As a reaction to these changes in the ERP market and the high number of potentially new customers in the S&ME segment, an adjustment and/or a simplification of ERP systems took place. ERP manufacturers modified their systems in order to reduce their complexity. However, these manufacturers could not, and still cannot, satisfy the needs and requirements of S&MEs with these "light versions" of their systems, which were originally designed for large-scale enterprises. As the differences between large enterprises and S&MEs are quite substantial (Welsh & White 1981), a pure reduction of functionality does not fit the high specialization of many S&MEs. As a result ERP system manufacturers developed specific systems for smaller enterprises, and even systems addressing different lines of business. But still these systems – within their standardized specification – cannot be rolled out in enterprises without modifications.

However, not only S&MEs have to modify their ERP systems. There is always a gap between the ERP system's capabilities and the company's requirements. Thus, either ERP system adjustments, or an adaption of the company's structures and processes are necessary. A third alternative is implementing the standard ERP system package and coping with the existing gaps and problems. But mostly, in almost all ERP implementation projects (for large-scale enterprises and for S&MEs), some degree of system adjustment and modification is required. Even though the standard ERP systems is designed to work in various organizations or even in different industries, often not all needed functions are provided (Rothenberger & Srite 2009; Soh, Sia & Tay-Yap 2000).

Therefore, the focus of this chapter is the modification of ERP systems - the so-called tailoring. The tailoring of ERP systems can be classified into different types – starting with the configuration of the system and ending with changes of the source code. A detailed explanation of the different tailoring types will be presented within this chapter, as well as some cases related to large-scale enterprises, and the results of interviews with three German S&MEs that have implemented an ERP system.

To present our results, the chapter is structured as follows. After this introduction, tailoring is classified along different types with respect to complexity and depth of the performed system modifications. These types will be described in detail as well as their potential impact on the enterprises using the respective tailoring options. In a third section, ERP tailoring within large-scale enterprises and S&MEs is discussed. Here, the results of interviews conducted within three German ERP-using S&MEs are presented, addressing the tailoring activities performed during system implementation. The chapter concludes with a summary on the tailoring of ERP systems.

6.2 ERP Tailoring Types

The term "tailoring" can mean "cutting" or "adapting" and is not only associated with ERP systems. In the case of ERP systems, tailoring can be seen as the adaption of the "blank" or standard ERP system to fit the company's individual needs and requirements in order to match the system with the company's business processes and structures. ERP systems are usually designed and developed according to the best practices within a market or market segment. As such they are intended to either achieve a good fit for the enterprises already following these best practices, or to function as a template to guide organizational adaptation. However, enterprises differ from one another more than assumed, and practices that are considered to be the best under certain assumptions might not necessarily be the best for such a large number of enterprises (Klaus, Rosemann & Gable 2000).

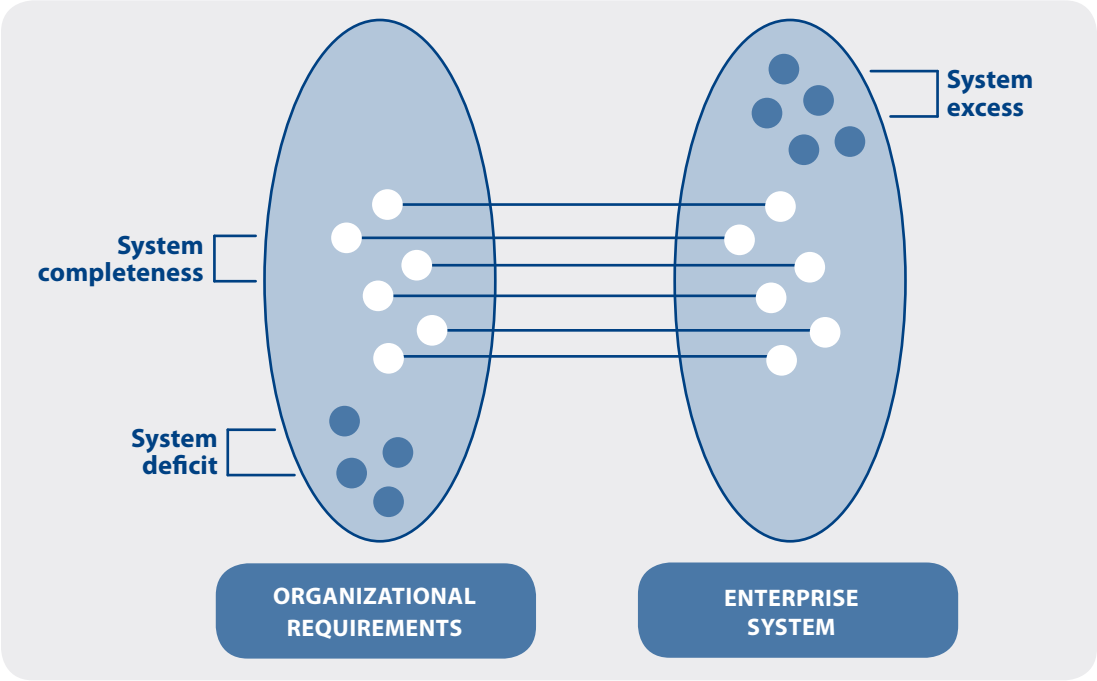
Thus, an adaption of the system becomes mandatory for all enterprises who do not intend to follow the template as suggested. Even despite a careful and thoughtful selection and implementation of an ERP system, it is not possible that all requirements of an enterprise can be totally fulfilled by the respective ERP system and its standard configuration (Hesseler & Goertz 2007). Additionally, the functionality and the fit of an ERP system also largely depend on the expertise the system provider gained on previous customer implementations, since missing functions identified during those implementation processes will be integrated into the ERP system for future use. Therefore, even ERP systems from the same vendor differ within the same industry segment.

A well selected ERP solution covers only about 80 to 90 percent of an enterprise's requirements and needs.

The remaining 10 to 20 percent, the so-called system deficits **(cp. Figure 1)**, have to be realized through tailoring and its different adjustment opportunities. However, the advantages, benefits, and impacts of the different tailoring types for the enterprise or even the respective users are very difficult to assess.

Even if system deficits are low, system excess is another reason to adjust. ERP systems usually offer alternative functionality to choose from, or functionality not needed at all by a specific enterprise. Selecting the major parts needed is also a type of adjustment we address but do not call tailoring. System excess on a lower level of detail, however, can be covered by what we call configuration later on. For the rest of the chapter we focus rather on mechanisms and their application in order to cover system deficits, and only briefly cover reduction of the overall functionality.

Figure 1 - Causes for ERP Misfit (adapted from Rosemann, Vessey, Weber & Wyssusek 2004)



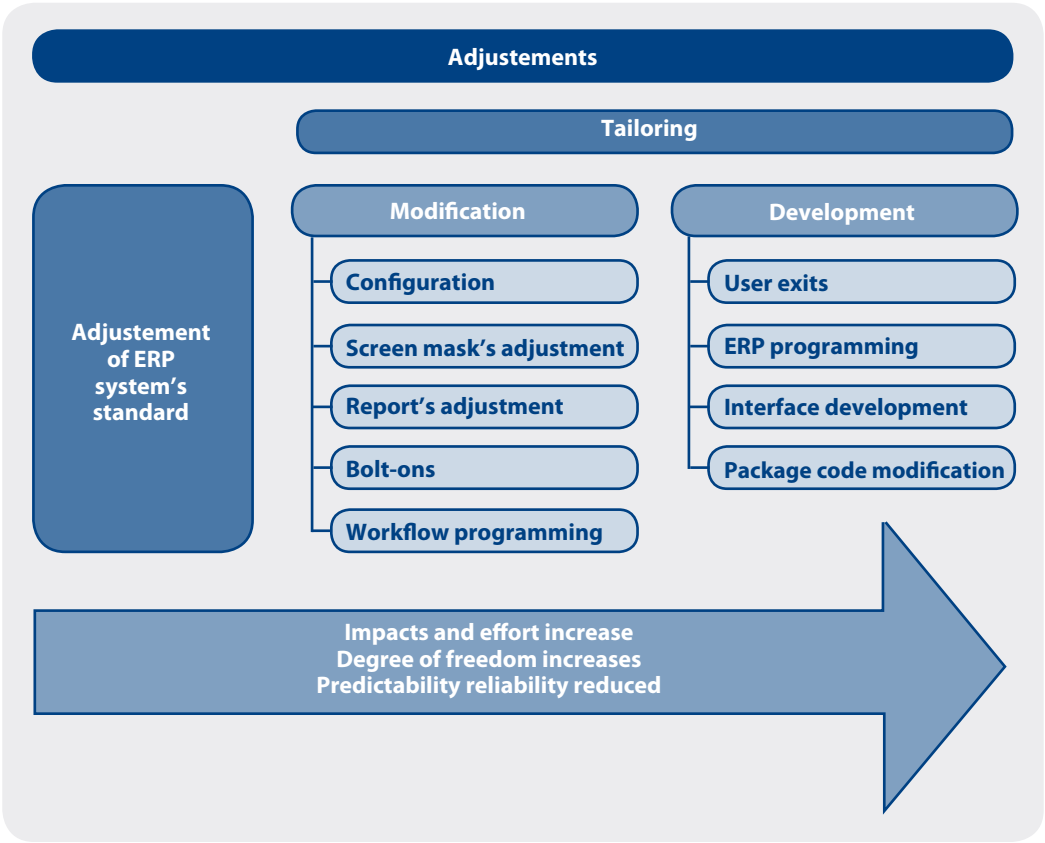
An important assumption we build on for the rest of our paper is that the misfit must not be too severe to be covered by tailoring. This means the misfit must not be deep, exogenous, and pervasive at the same time. This assumption is based on work by Sia & Soh (2002) who suggest a severity assessment of ERP-organization misalignment along two dimensions. They differentiate between surface structure, which is related to the interface between users, and system and deep structure which covers the system's underlying conceptual perception of reality. Misfit relating to deep structure is severe and harder to fix. In the other dimension they differentiate between different degrees of context specificity. They argue that most systems have implicit country biases (e.g., European countries), sector biases (e.g., private sector), industry biases, (e.g., manufacturing) and even biases in organizational practices. Again, one source of misfit is harder to cover.

These are the exogenous factors arising from country, sector or industry specificity. In addition, these external sources of specificity are often also pervasive in nature. Usually, misfit that stems from exogenous and pervasive factors and relates to the deep structure of a system cannot be aligned via tailoring any longer. If severity is too high we must assume that the wrong system was chosen. For the rest of the paper we assume that this is not the case. Based on this assumption, the following tailoring types may be applied to adjust an ERP package to meet the requirements of a specific organization.

According to Brehm, Heinzl & Markus (2001) the opportunities for adjustment of an ERP system cover a whole range of options, which we have grouped into modifications and developments, as shown in **Figure 2.** It is shown that the adjustments of the ERP system's standard are not a direct part of tailoring.

These adjustments mostly address system excess and are mostly included in, and depend on, the ERP system's selection process. A detailed description of all tailoring types is given in the following subsections. Additionally, it can be seen in **Figure 2** that the degree of freedom increases from left to right. This means that the options on the right-hand side allow departing from what was pre-defined to a larger extent. On the other hand, to achieve such a degree of freedom, much more effort is necessary (e.g., for developing specific functionalities). Additionally, each adjustment impacts the ERP system in a different way. In particular, some tailoring types in the development category change the ERP system's source code, which can heavily influence its standard functions and overall behaviour. Therefore, the predictability of a system's behaviour and its performance are reduced, and potentially its reliability as well.

Figure 2 - Overview of Tailoring Types



To decide which tailoring types are necessary or useful for a specific company, several factors / questions should be considered (Brehm et al. 2001):

- What benefits are achieved with the respective types of adjustment?
- How many tailoring types will be used and how are they combined?
- Are there dependencies among the used tailoring types?
- How well can the needed changes be implemented?
- In which way are data and system structures affected by the intended tailoring?
- How well are the adjustments documented?

6.2.1 ADJUSTING THE ERP SYSTEM'S STANDARD

Often, the basic adjustment of an ERP system's standard is also called modularization. This is one of the first opportunities to adapt an ERP package. It can be done before and during the implementation process, as well as during the operating phase of the ERP system. The term modularization comes from the structural design of most ERP systems, which are designed in a modular fashion. Functionalities that are similar, or needed to fulfil a more complex task, are developed and structured together in so-called modules. The enterprise can then choose the respective modules to cover the necessary functionalities of their business processes (Davenport 1998). Often, the ERP systems are "delivered" by the vendor with all modules. Then, only the necessary modules are activated during the implementation process. The modules not needed stay deactivated and therefore, the enterprises have no access to those functionalities. Activating them would require further investments and expenditures (Kohnke & Bungard 2005; Stahlknecht & Hasenkamp 2005). After the successful implementation of the ERP system, resulting from the ERP system's modular design, the enterprise possesses the flexibility to react to growth or changed requirements with the activation of the yet needed modules. Thus, this module integration can be seen as an advantage of an ERP system's design, since a lot of functions are already integrated into the ERP system's standard; even if not needed in the beginning. However, in many cases the use of each module has to be paid for separately (Davenport 1998).

This modularization and the selection of modules is one step towards increasing the degree of coverage of the company's requirements. Or the other way round, via deselecting of modules not needed system excess is reduced. However, it has to be mentioned that some modules are mandatory when implementing an ERP system. For example, nearly all modules in the ERP system "SAP" first require the definition of many organisational elements of the financial and controlling module in order to work properly. Therefore, even if the company does not intend to use the financial and controlling module, it still has to be activated with regard to other modules. Thus, module selection is not a trivial task.

However, with this "pre-configuration" many requirements can be fulfilled basically, especially the requirements of smaller enterprises. Hence, the adjustment of an ERP system's standard reaches its limits if the requirements and needs become too complex. Therefore, other adjustments have to be performed to fulfill these tasks. Within these adjustments, the ERP system is modified beyond standard constraints. Thus, these adjustment types are part of what we call tailoring **(cp. Figure 2)**.

6.2.2 MODIFICATION

Tailoring types *Configuration, Screen Mask Adjustment, Report Adjustment, Bolt-Ons*, and *Workflow Programming* belong to the modification category **(cp. Figure 2)**.

Configuration: Configuration of an ERP system means choosing among the reference processes (provided within the standard of the ERP system) and setting the parameters in the ERP system, without changing the source code (Kyung-Kwon & Young-Gul 2002). Configuration is necessary to choose between different ways of executing pre-defined processes and functions in the software package (Brehm et al. 2001). This means that dynamic aspects like business processes, and static aspects like the organization´s structure, are implemented using standardised approaches by setting the specific parameters. Configuration includes defining country-specific attitudes (e.g., currency or language), the definition and structuring of hierarchy levels, departments, sales offices, and competencies as well as defining data structures and business processes or workflows (Hansen & Neumann 2009). Therefore, the opportunities of setting parameters comprise an enormous amount of tables that have various pre-defined adjustments. Due to the huge amount of opportunities, it is not always obvious if setting a certain parameter limits the options for setting other parameters in other modules, or even in the same module itself. This complexity implies that it is almost impossible for "normal" employees (especially in S&MEs due to their strong resource limitation) to get an overview of all configuration parameters and their interdependencies. Thus, for a configuration of ERP systems, external consultants or vendor support are mandatory. Additionally, configuration options vary greatly from one ERP system to another. For example, while SAP provides thousand of configuration elements, some small ERP systems provide little or no configuration options.

Often within papers or articles the term "customizing" or "customization" is used as a synonym for configuration. This term was influenced and introduced by ERP market leader SAP. SAP named the configuration of their ERP systems "customization" and due to their systems' strong dissemination this, SAP-driven terminology is adopted by many practitioners and researchers; especially by those having a German background. However, in publications not influenced by SAP parlance, the term customization is often used for what we call tailoring in this chapter (e.g., Soh et al. 2000). In order to avoid misunderstanding, in this chapter we will use the term "configuration" for the setting of pre-defined parameters, and we will not use the word customization at all.

Screen Mask Adjustment: By adjusting screen masks the ERP system is personalized and configured for specific user groups, or even for individual users. This is done to improve and facilitate the user´s job performance. Adjustment of screen masks includes :

- fading in or out specific tables, rows or columns
- creating user-specific menus
- changing colors, forms or pictures
- adding specific buttons
- changing the whole screen layout with regard to user needs
- changing, adding or deleting input fields and output masks
- etc.

Therefore, the functionality of specific menus can be pre-determined by pre-allocating fields or setting barriers or filters for data and input options. These adjustments can be set user-specific or allocated to several user groups.

Again, this tailoring type is accomplished (as configuration) without coding. Mask adjustments are usually done via respective mask editors that are part of almost any ERP system.

Report Adjustment: The ERP system often provides standard reports for fundamental analysis. By using report generators provided by the ERP system, individual and company- specific reports that are not part of the standard ERP system can be created. For example, these changes can be changing the layout of reports by adding the company's logo or adding and/or deleting specific fields. Most systems provide (similar to the screen mask generators) report generators that are easy to use even for end users. Therefore, no consultant or employee of the IT department is necessary to create or change reports. All users (depending on their authorization) can create their own reports, and make report adjustments as needed to fulfil job requirements. Additionally, some ERP systems have integrated report tools from third party vendors (e.g., Crystal Reports), which can be modified too.

Bolt-Ons: Bolt-ons are software products from third-party vendors or the ERP system manufacturers themselves. Bolt-ons are developed and designed to implement additional specific functions on top of the ERP system's functionality, to satisfy customer needs. These software packages must usually be licensed as additional products. They are adapted to the core of the ERP system. By using bolt-ons, enhanced program functions, or even modules, can be integrated into the respective ERP system with little effort. These packages encompass best practice approaches, and are often standardised for certain industry sectors. They have to be integrated with the ERP system using defined interfaces, requested from the ERP manufacturer, or that are already part of the ERP system (Watts, Mabert & Hartman 2008). Bolt-ons can support reducing system deficits by narrowing the gap between existing functions and additional requirements. However, not all needs and requirements can be satisfied with bolt-ons. Typical examples of bolt-ons are e.g., customer resource management (CRM) systems, manufacturing execution systems (MES), or warehouse management systems (Botta-Genoulaz & Millet 2005), which can be considered full-blown applications themselves, or smaller packages that offer additional industry-specific functionality or solve specific business problems, such as high- end product configurators, shop solutions, etc. However, there are also bolt-ons intended to solve technical problems or to function as tools (e.g., workflow tools, business intelligence tools). Some ERP vendors have a formal certification process for third party vendors, to ensure the quality and security of the bolt-ons.

Workflow Programming: According to Gadatsch (2009) a workflow is a formally described and totally or partly automated business process. It encompasses all temporal, technical, and resource-based specifications and requirements, which are necessary for the automation and control of processes on the operational level even if they include steps that need human intervention. In such processes steps are actively initiated by the system, which monitors and routes the overall process. A simple workflow scenario example could be an alert for product return. If a customer is dissatisfied with the product and sends it back to the manufacturer, an automatic workflow could be established. Here, the responsible customer representative of the sales department automatically receives a system-generated email when the product returns from the customer.

Process orientation within ERP systems may be supported by workflows as well as the promise of efficiency improvements. The adjustment of workflows is a specific type of tailoring, because it is almost impossible to "hard" code workflows into the ERP system in such a way that they can be adapted by setting parameters within the configuration. Therefore, ERP manufacturers try to use dedicated workflow tools for implementing easily adaptable workflows. They are often integrated as bolt-ons using pre-defined interfaces of the ERP system (Cardoso, Bostrom & Smeth 2004). However, the degree of integration of such a workflow component into an ERP system may differ. In some cases, workflow modules that only support ERP internal business processes are considered an integral part of the ERP system,. In other cases, there are almost autonomous workflow packages, which support the business processes implemented by bolt-ons or by any other software package. Today almost every ERP system possesses an integral workflow module which does not prevent customers from using an autonomous one instead or in addition .

6.2.3 DEVELOPMENT

Adjustments that are considered software development can be used to implement heavy changes, and usually have a large impact on ERP system standards. This section covers tailoring types *User Exits, ERP Programming, Interface Development*, and *Package Code Modification* **(Figure 2)**.

User Exits: A user exit is an interface defined and provided by the ERP manufacturer for merging and connecting programs developed by its customers. These programs are mostly algorithms for solutions of specific problems. Again, system deficits are reasons why this tailoring type is needed. As opposed to bolt-ons or workflow programming, user exits are used to integrate programs that are explicitly developed by the ERP implementing company or its contractors. Therefore, access to data objects and to specific programming sections is made available by the ERP vendors to enable these adjustments. However, no changes of the ERP system's source code are allowed. Programs connected via user exits are only add-ons or enhancements to the original source code, and the exit once provided by the manufacturer is usually not removed in later versions or releases. Therefore, in contrast to the other tailoring types described below, making use of user exits does not severely threaten maintainability of the ERP system. However, this may depend on the complexity and side effects of the included code.

ERP Programming: This tailoring type is used for programming additional applications that are not part of standard ERP functionality, and may include additions that go far beyond what can be accomplished via user exits. This tailoring type is similar to that of user exits, as once again the original ERP system source code is not changed. In contrast to user exits, the added code is written in the same programming language the manufacturer used to program the ERP system itself, which is not necessarily the case with programs added via user exits (Brehm et al. 2001). Examples of such ERP programming languages are ABAP for SAP or C# for Microsoft Dynamics AX. Using this type of adjustment, programming of missing functions is possible – from small programs and add-ons, to full-grown applications, almost any enhancement is possible.

Interface Development: Interface programming offers the opportunity to connect or integrate legacy systems that still exist in the enterprise. Sometimes, an ERP system cannot replace all legacy systems at once. Thus, an interface has to be developed for the remaining legacy systems to incorporate some of their data into the ERP system (Brehm et al. 2001). Such legacy systems may be large applications that are hard to phase out, and in most cases reengineering them via ERP programming is not financially feasible. They must thus be integrated via interface development, which may cause huge effort since these specific interfaces are not part of the standard ERP system. Therefore, detailed knowledge of the ERP system's processing logic and data structures, and the legacy systems is needed. Otherwise the interface cannot be designed optimally. Some ERP manufactures support interface development by providing so-called APIs (application programming interfaces), which can reduce the effort, and sometimes also the complexity, of this tailoring type. Instead of interfacing applications, point-to-point modern middleware solutions, or enterprise application integration (EAI) tools can be deployed as well. In these cases integration of separate applications becomes much easier, as standardized adapters, changes of the provided source code, are the main "activity". Contrary to other tailoring types of this group, package code modifications are not used to develop add-ons like user exits or ERP programming. These adjustments change already-existing objects for ERP packages provided by EAI vendors, and applications connected to the centrally-run EAI system, just once instead of interfacing them point-to-point. These solutions are intended to solve integration problems on a larger scale. As such we do not include them under tailoring of an ERP system. The so-called portals are another solution. They can be seen as another tailoring option within interface development. The use of portals permits some screen adjustments, and the possibility of linking an ERP with other software (mostly email, calendar, etc.).

Package Code Modification: This tailoring type, often shortened to "modification", is the method through which structures of the standard ERP system are changed directly. Code modifications require that source code be provided, that the vendor allows changing it, and that he provides tools for accomplishing and supporting package code modifications (Hesseler & Goertz 2007). These changes can be minor ones, or could include extensive modifications of whole modules. This tailoring type has to be considered the most dangerous form of adjustment. Thus, ERP manufacturers and external consultants often try to avoid these modifications, since they bear heavy risks. They threaten the correct performance of the ERP system, and are very expensive in terms of maintenance, as changes may be corrupted by updates or overwritten by new versions. Doing without these vendor-provided updates in order to secure modifications heavily contradicts the value proposition of packaged systems. Only in the case of open source ERP systems where comparable vendor support is not available can modifications be considered less harmful. While many open source ERP systems are maintained as professionally as commercial systems, code modifications should be an exception rather than a rule for them as well. Overall, the risks of package code modifications make some vendors forbid, orsanction them severely by excluding customers from support or by exclusion of liability.

6.3 Tailoring Cases

6.3.1 LARGE-SCALE COMPANIES

As mentioned above, tailoring ERP systems has to be done regardless of company size. Each company implementing an ERP system has to modify and adjust the system according to company needs if it does not want to adapt organizational structures and processes, or does not want to live with the gaps and problems. Compared with S&MEs, large-scaled enterprises mostly have more resources, knowledge, and budget at hand to adjust the ERP system. Thus, for them even the more complex tailoring types such as interface development or ERP programming are within their "range" and capabilities. However, this is still not a trivial task. There are plenty of negative scenarios that show how severe wrong ERP adjustments and other failures within ERP implementation projects can be. For example, the companies Volkswagen and Whirlpool faced substantial delivery delays that arose after the implementation of an ERP system. The sales of Hershey Foods were reduced by 19 percent because the ERP implementation occasionally caused "chaos" within not only the sales department but other departments as well. The pharmacy enterprise FoxMeyer Drugs even had to announce insolvency due to the unsuccessful ERP implementation (Barker & Frolick 2003; Hsu, Sylvestre & Sayed 2006; Scott & Vessey 2000). These are only some examples of ERP implementation failures. Here, wrong tailoring decisions were not the only reasons for unsuccessful projects. However, many cases in the literature emphasise the importance of the tailoring decision. It is essential to determine to exactly what extent the ERP system can fulfil the company's needs within its "standard", and to what extent tailoring has to be conducted. Tailoring is also seen as an essential critical success factor (CSF) for the ERP implementation project. In many studies or literature reviews, a minimized configuration or adjustment of the ERP system is seen as a factor for the ERP project's success, and these studies often point out the impact of ERP system tailoring on an enterprise (e.g., Al-Mashari & Al-Mudimigh 2003; Holland & Light 1999; Motwani, Mirchandani, Madan & Gunasekaran 2002; Nah, Lau & Kuang 2001; Skok & Legge 2002; Somers & Nelson 2001).

Again, there are plenty of examples and cases that point out the tailoring decisions of large-scale enterprises (e.g., Bhattacherjee 2000; Davenport 1998; Light, Holland & Wills 2001; Sarker & Lee 2003; Scott & Vessey 2000; Xue, Liang, Boulton & Snyder 2005; Yusuf, Gunasekaran & Abthorpe 2004). Some specific examples include Hewlett Packard, who developed a customized application in the ERP's native language for a process they felt was a core processe. Elf Atochem changed their own structure to take advantage of new capabilities of the ERP rather than force the ERP to fit their organization. Dell adopted different systems for different processes, and another company even dropped SAP when they discovered it could not be tailored sufficiently. All of these cases show that the tailoring decision is not an easy one. However, a study of Mabert, Soni & Venkataramanan (2003) shows that large-scale companies are much more willing to adjust their ERP systems than S&MEs.

Factors that influence those decisions are stated by Hossain & Jahed (2010). For example, there are the basic conditions within the enterprise itself (costs, time frame, user needs), the ERP system (complexity, functionality, and maintenance) and the experience and skill of external consultants and the system vendor. All these factors influence the tailoring decision within large-scale and smaller companies. The basic conditions are especially essential influencing factors within S&MEs.

6.3.2 SMALL AND MEDIUM-SIZED COMPANIES

Due to the limited resources S&MEs can provide for ERP implementation projects, tailoring for them is very difficult to perform and handle. Therefore, in this subsection we concentrate on smaller companies. Since there are only a few cases available in the literature, we conducted a multiple case study within three selected German S&MEs that have implemented ERP systems.

6.3.2.1 Data Collection Methodology

Direct face-to-face interviews were chosen for data collection, since this form of interview generates potentially useful sources of information. A half-structured and partly standardised interview procedure was selected. This means a questionnaire was developed as a guideline for the interviews.

But depending on the specificities of the case or the interview partner, it was also possible to ask different or additional questions that were not part of the questionnaire. Questions could also be reformulated during the interview or even replaced, e.g., if communication problems or misunderstandings arose.

Employees of three German S&MEs were selected as interview partners. These included a medium-sized company dealing with energy and water management, a medium-sized enterprise trading technical goods, and one small company in the manufacturing industry. **Table 1** gives an overview of the selected companies.

Table 1 - Overview of Companies Interviewed

	COMPANY A	COMPANY B	COMPANY C
Industry Sector	Manufacturing	Energy and water management	Commerce
Number of Employees	7	25	40
Sales Volume	1.3 billion EURO	18 billion EURO	10 – 12 billion EURO
ERP System	Industry-specific ERP system	SAP – industry specific	Industry-specific ERP system

The interviews in companies B and C were conducted with the employee responsible for IT. Since there was no IT "specialist" in company A (because of the company's size), the interviewee was the directing manager of the enterprise.

6.3.2.2 Interview Results

All of the interviewed enterprises already possess a fully implemented ERP system used in daily business. Companies B and C replaced their previous ERP systems by implementing their current ones. Thus, these two companies have already successfully conducted two ERP implementation projects.

Company B is the only enterprise out of those interviewed that implemented a solution from world market leader, SAP. Here the industry-specific solution SAP for *utilities* is used. Within this ERP system, Company B uses the modules for *maintenance, customer management*, and for *sales*. Companies A and C have implemented industry-specific ERP systems that were not specified in detail. Both are using modules for *inventory management* and *accounting*. Additionally, company C implemented the ERP manufacturer toolbox. With the help of this toolbox, ERP system adjustments can be done. Other software systems besides the ERP systems are used within the companies as well. For example, an additional calculation and planning program is used in company A. Company B still uses the old ERP system parallel to the new one. Overall, it becomes obvious that the companies are all using only specific modules of the systems, not the whole systems themselves. Therefore, they all have **adjusted the ERP system standards** (**Figure 2**).

Different reasons for the ERP implementation were given by the interviewees. Company A implemented the ERP system in order to be able to handle daily business. According to the interviewee, an ERP system is needed for handling their enormous data sets of customers, do calculations, and accounting. Company B had to replace the old system when the company merged with a larger one. Thus, they had to implement the same ERP system as the large enterprise in order to build synergies, and reduce interface problems. Company C replaced its old ERP system because of missing actuality. Due to new and improved technologies, which were not used in the old system, a new ERP system was implemented.

Regarding the direction of adjustments, all enterprises said they adapted the organization and its processes more than they adjusted and modified the ERP systems.

It was stated that the adaptations always referred to the processes and functions of the ERP systems, since these are already optimized as standards and implemented as best practices in the respective modules. A large process optimization project like a business process reengineering project could not be identified in the companies.

Furthermore, adjustments and modifications of the ERP systems took place, too. Company A and company C changed the design of different standard forms and other documents (e.g., receipts or vouchers). This can be done as part of the **configuration** of ERP systems. Additionally, company A needed special macros around reports which were not available in the standard ERP system. This **report adjustment** was done by the ERP manufacturer and incurred additional costs to the ERP implementation project. Company C did some adjustments by **extended reporting**. As they had implemented the ERP manufacturer's toolbox, they used that for **screen mask modifications**. In addition, **interfaces** to old ERP systems or other legacy systems had to be **developed** in all three enterprises.

To sum up, company C made the most adjustments. In addition to system configuration, several **interfaces** had to be **developed** by the ERP manufacturer to add certain functions. Furthermore, company C required a specific stock structure **(ERP programming)** which had to be developed by the ERP manufacturer. Afterwards, the ERP manufacturer added these additional stock functionalities to the standard ERP and provided them with the new release for all its customers. Within company B, adjustments had to take place due to specific product requirements **(ERP programming)**.

Regarding the question of competitive advantages, all companies stated that implementing an ERP system provides clear competitive advantages, as standard ERP system are best practices and therefore "improve" company processes as well. Thus, implementing an ERP system provides clear advantages in relation to other small companies, which often have not implemented an ERP system. This fact is also supported by a study conducted in 2009 among 124 German S&MEs. Only 35 of the participating companies had implemented an ERP system (Leyh, Betge & Strahringer 2010).

6.4 Discussion and Conclusion

In comparing the interview results with other papers, many points of consensus are found. For example, Mabert et al. (2003) point out that smaller companies are more likely to adapt their business processes or organizational structure instead of adjusting an ERP system's best practices. This is supported by the interviews too. At least, all companies adapted their business processes according to the standard ERP systems. Furthermore, no **Workflow programming** or ERP **package code modification** were done by the interviewed companies or their ERP manufacturers. However, this was done by many large-scale companies (cp. different literature cases). Most of the adjustments of the S&MEs were based on a configuration tailoring type, where specific parameters were set, or tables changed, according to company requirements. The reason only moderate changes and adjustments were seen is the implementing of best practices during the rollout of an ERP system. That was seen as one of the best ways to keep up in a competitive environment. Therefore, no deep adjustments were necessary.

Further system adjustments took place using Interface development or ERP programming tailoring types. Here, as in the literature, the companies experienced some problems in using these tailoring types, and feared incurred expenditures and effort. The additional functions and interfaces needed by the enterprises were not developed by employees of the ERP implementing companies. Since the necessary know-how was not available, and the effort for acquiring this knowledge was not justifiable, these tasks were handed over to the ERP manufacturers. This can also be found within the literature. Often, tailoring based on types in the development category (cp. Figure 2) is done by ERP manufacturers themselves. This helps to avoid self-programmed features interfering with system updates, new releases, service, and support contracts. Form adjustments **(Configuration)** and improvements by **modifications of screen masks** were accomplished in all of the examined enterprises and most of the literature cases. Again, it can be stated that enterprises that do not possess their own IT-department or the necessary knowledge, need the support of external consultants, even for easier adjustments such as those in the modification category (cp. Figure 2). Only one of the interviewed companies possessed the know-how to make the changes themselves.

In summary, the investigation showed that the readiness for tailoring ERP systems often depends on the size and resources of the companies. Additionally, the companies are influenced by external consultants, a lack of human resources and expertise, and financial restrictions when making their tailoring decision (Hossain & Jahed 2010).

Here, every tailoring type should be analyzed in relation to costs and benefits. Therefore, **adjustments of the standard ERP** and tailoring types in the **modification category** are mainly done within S&MEs. The expenditures and risks of these types are often well assessable and show a positive cost benefit relation. Adjustments in the **development category** are often only done if necessary for performing the company's core processes, and if it is the only way to gain or to keep competitive ability. However, tailoring based on theses types should be done by external specialists or the ERP manufacturers themselves. If it is not possible or reasonable to adjust the ERP system, there is still the opportunity to adapt the company and its business processes. Hence, tailoring and organizational adaptations often entail each other. Most ERP system implementations require tailoring as well as changes to business processes and structures.

Regarding S&MEs, the interviews with the three German S&MEs can only be seen as a starting point for further research projects. Additional research has to be done e.g., regarding tailoring within different industry sectors of S&MEs. Regarding large-scale enterprises, new technologies and strategies should be focused on, too. As there are always new innovations in the range of ERP systems, tailoring types have to be updated according to new technologies and approaches. For example, approaches such as *Software as a Service (Saas), Service-oriented Architectures* or *Best of Breed Sourcing* could be examined regarding necessary and possible tailoring.

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Questions

1. What possibilities exist to compensate for the gap between ERP system capabilities and the company requirements ?
2. What is the difference between tailoring and adjusting the standard ERP system ?
3. What different tailoring categories exist ?
4. What is the "bolt-on" tailoring type ? How is this type defined ?
5. What are the differences between ERP programming and package code modification ?