PACKAGED ERP SOFTWARE: A STUDY OF FUTURE REQUIREMENTS

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Abstract

CIOs and CEOs are confronted with the key question of choosing the right ERP software for their company. The evaluation process tends to be painstaking as the outcome usually affects the competitive ability of the business and thus the future of the company itself. Packaged software has become so powerful in recent years that it fulfils the requirements of companies from different industries after a thorough customization process. Nevertheless, case studies and anecdotal evidence show that in many cases ERP implementation projects are demanding and that results do not meet expectations. This triggers the question of whether and how ERP vendors are addressing the perceived problems of ERP users. Is there work in progress that will help facilitate the selection and implementation of ERP packaged software for users? Will there be tools available to adopt ERP modules to the specific business processes of a company and – taking into account that processes are likely to change over time – will there be mechanisms available to adapt the software to changing requirements (in the literature discussed as "agility")? These are the questions that stimulated an in-depth study of the German-speaking ERP software market. In a qualitative study based on thirty interviews with ERP developers we tried to draw a picture of the value proposition of future ERP software.

Introduction and Literature Review

Service-oriented architectures (SOA), Web services, XML and modularity are keywords which have been circulating for some years in the business software world. According to the experts, modern enterprise software should be service-oriented and constructed in a modular form, communicate via Web services and the overwhelming variety of different interchange formats for business documents should be brought to an end by recognized XML standards.

"Business information systems can be either designed as custom applications or purchased as off-the-shelf standard solutions" [Scheer/Habermann 2000]. The latter is called "packaged ERP software" in this article. According to the literature, today most companies turn to packaged software when looking for an enterprise solution. Holland and Light already recognized this trend almost 10 years ago, "companies are radically changing their information technology strategies by purchasing prepackaged software instead of developing IT systems in-house" [Holland/Light 1999, p. 30]. The question which presents itself however, is much more far-ranging. Is a business solution sustainable if it does not fulfill the above mentioned requirements?

This question is difficult to answer, because, despite the prominent sounding buzzwords, there are many systems in active use which are more than six years old [Schmitt 2007] and have hardly any or none of the desired principles. They function nevertheless and support the company to the required degree. Especially in small and medium-sized companies, the introduction of a new system, or rather the migration of the old onto a new platform is accompanied by high costs in relation to turnover and, naturally, by associated risks [Scott/Vessey 2002]. The results of an SME study show that "the most important criterion used in selecting an information system is the best fit with current business procedures." [van Everdingen et al. 2000, p. 29] If a new system is needed, one should know exactly what the system can achieve in terms of performance and how it will achieve this performance. A recent study confirms

that "[…] companies often face the dilemma of whether to adapt to the software and radically change their business practices or modify the software to suit their specific needs." [Dalal et al. 2004, p. 84]

Further questions refer to the chosen delivery model: In-house applications, Application Service Providing (ASP) or Software as a Service (SaaS)? Why buy software with the hardware, if the software can simply be rented? Is this sustainable? And can a rental model actually produce the performance that users were familiar with from the old systems?

Additionally, the sustainability of the supplier of such complete solutions plays a role. Recently, large companies such as SAP, Oracle and Microsoft have been carrying out acquisitions which expand the portfolio of these software providers [Alexander 2007]. Security in the collaboration with the software partner can therefore be seriously endangered through company closure or takeover. This can have far-reaching effects because business software, by means of constant updates, must always be adapted to market demands (e.g. current jurisdiction and taxation laws).

These are all considerations which concern customers of business software producers. The further development of software by the supplier is driven internally by the will to improve but also from external pressure to keep pace with the competition. Innovative system architectures, new technologies, comprehensive business models and assertiveness in the market – developers try to differentiate themselves from their competitors in every sector. This competitive pressure leads to the situation where systems do not remain in their old form but are constantly altered and newly designed.

These considerations in mind we decided to perform a study on the future requirements of packaged ERP systems. The underlying research question was the following:

How are future packaged ERP systems going to look like?

In order to answer this question, an empirical study of the ERP market in the German-speaking area of Europe was performed. We applied a qualitative (interviews with *ERP vendors*) research methods to guide our discussion. In order to be able to draw a picture of the state-of-the-art in ERP research, we started our research process with a preliminary query of the EBSCO database using the search word "ERP", "enterprise resource planning", and "enterprise systems". The search resulted into more than 40 articles of which 22 where interesting in the context of our research. Most of the papers stem from three special issues on ERP/enterprise systems (two in EJIS and one in CACM). Among the ones that we did not include, there were many articles on performance measurement / cost-benefit analysis which are important topics for ERP but were not within the scope of our research. It is interesting to note that many authors underline the unvaried importance of enterprise systems for the competitiveness of companies and thus the importance of the topic for IS research. The following list contains an overview of the topics treated in the selected papers:

- ERP implementation: 10

- Process modeling: 3

- ERP system agility: 4

- ERP adoption: 2

- Miscellaneous (cultural aspects of ERP: 1, open source ERP systems: 1, ERP integration: 1)

The vast majority of the articles deals with ERP implementations [Holland/Light 1999; Akkermans/van Helden 2002; Markus et al. 2000; Scott/Vessey 2002; Gosain et al. 2005; Biehl 2007]. Two of these articles report on ERP implementation failures [Iacovou/Dexter 2005; Wei et al. 2005], two papers are specialized on upgrading ERP systems [Beatty/Williams 2006; Min Khoo/Robey 2007]. There is a noticeably large number of *case studies* used in the articles to illustrate the findings. Process modeling [Scheer/Habermann 2000; Dalal et al. 2004; Delen et al. 2005] and ERP adoption [van Everdingen et al. 2000; Hwang 2005] focus on the need of the company to plan and adapt to the possibilities of the software system. The articles dealing with system agility show the need for flexible systems with regard to future requirements [Smith David et al. 2003; van Oosterhout et al. 2006; Overby et al. 2006]. It was interesting to see that none of the articles dealt with how or *where* companies operate their business software. The implicit assumption was that ERP software is operated by the user itself. With the latest discussion of Application Service Providing (ASP), Software-as-a-Service (SaaS) as well as "on demand software" on our minds, we decided to also study the mode of operation (and thus the possibility for outsourcing) of future ERP systems.

Background of the Empirical Studies

Our empirical study was carried out in the years 2006/2007 and investigated the German-speaking ERP market. The study examined the *vendor side* [Frick 2008] with the help of a questionnaire. The intention was to show as comprehensive as possible a picture of future requirements of ERP systems. The findings of the study serve as the basis for the following discussion.

The vendor survey had the goal of defining current buzzwords such as SaaS, Web services or SOA in the framework of scientific observation and to evaluate their potential for future development. For this purpose, a multi-layer model was developed, on which basis the characteristics of an operational application system can be represented. In the framework of another extensive literature search, the important aspects of an ERP system were thematically classified [Frick 2008].

It was shown that the research questions of the ERP system to be observed could be classified into system aspects, which contained conceptual and technical viewpoints as well as examining possible application scenarios and market relevant developments. This framework represented therein all of the characteristics of an ERP system which were focused on. In an initial workshop with an established ERP vendor the thematically interesting focal points were then systematically structured and sketched as the first exemplary representation of an ERP system.

In total, four aspects of an ERP system could be identified (see figure 1):

- *Architecture*: This aspect embodies methods of planning design possibilities and the system conception in terms of functional and integrative mechanisms.
- *Technology*: This aspect highlights necessary tools for internal operation and external integration [Volkoff et al. 2005].
- *Operation*: Here, the various application and distribution possibilities of the systems are investigated.
- *Market*: The last aspect differentiates between user and vendor side, in which surroundings a commercial software provider must face numerous challenges.
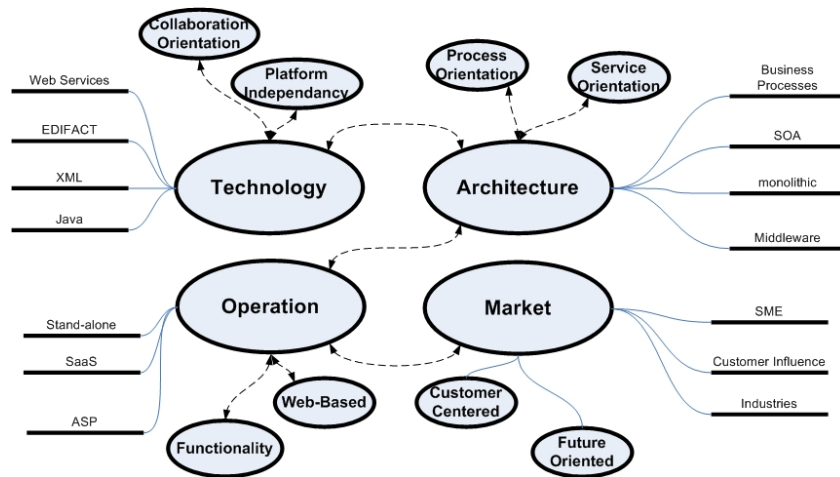

Figure 1: The four main aspects of ERP systems which where examined in the study

Questions on these four aspects were summarized into interview guidelines. They were trialed in three pre-tests with selected ERP vendors in Germany and Switzerland regarding the completeness and length of the interviews and optimized according to the content and time-effectiveness. The questions were then used for the remaining interviews with selected ERP vendors. 130 ERP system vendors in Germany were invited for an interview, in which 32 companies took part. This corresponds to a response rate of 24.6 %.

The Future Promise of ERP Packaged Software

Altogether, *four important trends* clearly emerged from the collected interviews for the future development of standardized ERP software:

- The *process design* of the value creating activities will play a significantly more important role in the future.
- *Service-oriented* system concepts support therein a flexible and agile application design which constitutes a sustainable technological basis within the framework of
- a *Web-oriented alignment* of business activities and the growing associated
- *collaborative cooperation* with other companies.

These four aspects will be looked at more closely in the following section.

Process Orientation

The divide between the coming demand for systematized process design and the modeling availability of ERP vendors is growing. The requirement for continuous process support [Liebhart 2007, p. 91] can be, at least on the visual level, fulfilled by the vendor. According to Delen et al. [2005, p. 107] "the synergistic combination of descriptive graphical models created using enterprise modeling methods […] can deliver substantial results." Today, 51 % of the questioned software companies offer appropriate modeling possibilities, whether through connection of existing tools or by means of self-developed display methods. However, it will remain at the stage of visualization (of business processes) for the next few years. The next step, a coupling of process and application level in the framework of a process-driven code generation, is still seldom implemented. Only 25 % of the vendors currently enable code generation from modeling. The offers range from workflow rules to whole class diagrams. The remaining software companies see no practical benefits in code generation, a procedure, which in their opinion, is simply impossible because of the internal dependence of an ERP system, as the following quote from a provider shows: "ERP systems are too complex to make business process modeling worthwhile." [Frick 2008]

The call for a system which adapts itself to the business processes of the user will remain the exception in the coming years. The underlying architecture, necessary to achieve such freedom and power of design would have to be component-oriented and also service-oriented up to current standards [Sprott 2000; Allweyer 2005, p. 345], so that the functionalities connected with the processes can, without any problem, be rearranged according to the restructuring carried out in the model.

The already existing potential in service-oriented architectures (SOA) in conjunction with standardized process mapping (e.g. BPMN and BPEL) has, because of a lack of support from process modeling standards, not yet been exploited. Only 25 % of vendors currently support process standards. A service orientation, as we later report, has actually already been implemented by many companies or will be in the near future. However, an orchestration of the services over and above the planning level is only possible to a very limited degree. This applies to internal as well as cross-company processes.

As a result, there will be an increasing demand for lean and role-based processes which will be met by a limited range of potentially agile software. A lack of process standards will further force integration projects with partners towards individual adaptations [Dalal et al. 2004]. The complete development from function-oriented to process-oriented application systems will take longer than five years.

Service Orientation

Services have established themselves as an important or even central building block in the system conception. 53 % of the questioned vendors stated that they have integrated services into their system architecture, whether as integral service-oriented architecture (SOA) (28 %) or just as a SOA capability (25 %). With integration mechanisms like Web services, used above all as a function integrator with widespread use (71.8 % of vendors), and the necessity of connecting old legacy systems to new ones, functionalities encapsulated in services bring considerable added value which will be used in the future.

However, services act as a conceptional basis for only 28 % of the vendors. Primarily, their benefit is gained from their possibility of offering functionalities externally. The reasons for this lie partly in differing definitions of SOA,

which are internally seen as propagated by large producers such as SAP, IBM or Microsoft and therein make a standard architectural basis difficult. On the other hand, such a consistent new conception means a reprogramming or even new programming of many system components. The possibility of avoiding this expenditure and offering the required service over a service level will be used more often in the coming years. Although it sounds strange, an interview partner expressed it as follows: "We can't **do** SOA, we **are** SOA."

This potential is reflected in the term "Software as a Service" (SaaS). Solutions on a rental basis have, since their hype at the end of the 1990s, found their way back into the customer's awareness. SaaS has established itself as its own term for an operation model next to Application Service Providing (ASP) and will increasingly emerge as a possible solution from the software companies. Although SaaS is often equated with ASP, the differences between the earlier ASP (classic licensed software is made available over the Net to a customer) and SaaS (a software designed for Web use serves several customers) are so clear that it can be defined as its own operation model. Only 45 % of the questioned providers still want to operate an in-house solution in five years' time. Although hosting solutions such as ASP (possible with 56.2 % of the vendors) or SaaS (possible with 31.2 % the vendors) increasingly find their way into the range of the software companies, the in-house variant remains the main pillar of the product range.

This trend is in step with the large vendors such as SAP or Oracle. They brought out the first rental solutions onto the market which were directed at small and medium-sized companies. In doing so, it is crucial to increase customer confidence in such a rental solution. The security and integrity of the data play an important role in this context. The distribution of the software mostly takes place through a combination of direct distribution and partner distribution (65 %), whereas maintenance normally happens through the software companies themselves (56 %). Because of this, mutual trust can be built up at least in the areas of support and maintenance. Large vendors like SAP and Oracle are seen as crisis resistant, therefore their initiatives in SaaS could also increase customer confidence and in this way promote a future expansion.

Web Orientation

The need for Web-capable and highly scaleable systems will increase. 77 % of the questioned users are aiming towards a much more cross-company or rather cross-location network within five years. [Felley 2007] The current trend in application development indicates that this demand is met by the ever increasing use of already existing net infrastructures. 75 % of the companies now offer a browser-based access to their system, 28.1 % of them use browsers as the only client variant. Terminal solutions like the one from Citrix are still used in at least 50 % of the systems, whereby exclusive access is only given in 21.8 %.

Browsers will assume, in general, a stronger role as native clients in applications. Already, browsers are being used partly or exclusively as an interaction point between the customer and the system. Because of cost-free access they constitute an attractive alternative to proprietary terminal solutions such as Citrix. They cannot replace these solutions in the short term, because currently, apart from the classic Thin-Client implementation, security mechanisms, load balancing etc. are offered. But with many vendors, browser access will be provided at least for part of their system.

Within the framework of Web orientation, XML also plays an important role as XML documents can be displayed without special conversion directly in the browser. In comparison to the classic EDI standards, XML as a basis for business documents is optimized for the Internet, an open and worldwide standard, simple to learn, easily understandable and easy to adapt to every purpose via its flexible scheme definition [Mertens 2003, p.19]. Every questioned provider supports XML. In connection with Web services, XML is used in 71.8 % of the systems.

As various hardware and software conditions can prevail within one company (e.g. various locations, acquisitions of subsidiaries and so on), platform independence is an important system feature for flexible and Web-oriented software. Although 84.3 % of the providers support Windows as the most common operating system, 59 % describe their system as platform-independent. The penetration of Microsoft operating systems in the client sector as well as a growing proportion in the server sector does not mean that the supplied ERP systems also promote exclusive Microsoft operating system support. On the contrary, the increased use of Java (in 43.7 % of the systems) is continuing, in response to the stronger orientation towards a Web-capable system. Despite the dominance of Microsoft, platform independence is in demand and will remain so. Java will further gain importance in the systems in this context as a platform-independent and widespread language in the Web.

With regard to the n-tier structure of an ERP system in use (classically 3-tier – client, application server, database), four of the questioned software companies go one step further and integrate the Web server as an independent module in their n-tier architecture. The focus change to a Web-oriented system will progress further through the use of the cost-free and extended infrastructure of the Internet in the coming years as the following quote from a provider confirms: "The development towards applications that are flexible and available over the Web will continue." This will also help to meet increasing requirements regarding improved agility [Osterhout et al. 2006; Overby et al. 2006].

Collaboration Orientation

With an increased demand for process-, service- and Web-oriented software, there automatically exists a need for effective and standardized integration with other application systems. 35 % of users will invest in a Web-capable data access for customers and vendors within the next 5 years. More than 25 % would like the continuous integration of electronic data exchange.

As the survey of providers showed, the number of available interfaces required for their own system is, however, still confusingly large. Also on the process level, there are no general standards which could ease integration. Individual projects for connection remain the norm for the time being. Nevertheless, one integration possibility was often mentioned: Web services. In the context of the broader expansion of XML as an integration tool for applications they seem to be gaining in significance. Thereby the use of Web services does not primarily reflect service-oriented architecture (SOA) as a basic concept, but rather serves as the purpose of document exchange or as function interface to the application system. Their use takes place on the basis of general Internet standards like HTTP and XML for application-internal communication [Kuschke and Wölfel 2002, p. 100]. Thereby, they can be very easily integrated into the existing Web architecture and used within it. They offer a standardized interface accessible over the Web which can, in terms of collaboration, significantly ease cooperation between different systems.

Because of the many internal functional dependences in the systems examined (84 % of the vendors), a component-oriented architecture of ERP systems is currently not centre stage in development. Here, service-oriented and service-capable systems in development or in conversion are characterized. The common middleware frameworks like J2EE and .NET even arrive with the infrastructure to implement a component orientation consistently, combined with a fully fledged authorization concept which enables a role allocation for external users. However, because of the good external integration possibility, there exists no reason to conduct a looser integration from the joining of internal modules.

In B2B integration there still remains much need for development in the coming years. Approaches such as the diversified use of Web services in conjunction with a service-oriented application landscape offer great potential for future collaboration projects: "The future lies in collaborative work" (quote from a provider).

Summary of Study Results

During the interviews, technical themes in particular have emerged as the main focus of discussion, whether it is XML, platform independence, SaaS or Web services. Vendors are focusing their attention on new technologies when the focus is on high quality software. 65.6 % of the vendors regard their system as particularly attractive because of its technological advance. The current discussion about Web capability or SOA contributes to this.

Proximity to customers is today only an important differentiating competitive factor for 18.7 % of the vendors. This aspect particularly will play a larger role in future. With the expansion of SaaS availability, the danger arises that the vendors will moves further away and become more distant from the customer because personal contact is no longer necessary. At the same time, a trend towards more individually designed offers is recognizable: "From our viewpoint the trend towards specialization in terms of sector-focus will continue further" (quote from a vendor). By their own account, the larger providers such as Microsoft or SAP want to promote a significantly more customer-intensive support via their partner network. The divide between both of these developments constitutes a great challenge for ERP providers in the coming years.

For the future, 37.5 % of the providers estimate an advanced consolidation as most likely. In particular, acquisitions by large providers will continue. In the eyes of the questioned companies, the development of the market seems to clearly indicate a decrease in the number of providers. Exactly which group this will affect seems to be

controversial. The niche suppliers are convinced that their excellence in their particular sector will protect them from great competition because cross-sector systems do not have the depth of function which their customers need. Companies supporting several sectors are trying to fall back on their special characteristics like, e.g. an innovative operation model or the concentration on small companies with 5-25 users. It seems that standard software in the SME sector, especially in the smallest companies, is not lucrative. Individualization and attending to particular customer needs is, according to many of those questioned, essential for success in this segment.

59 % of the vendors want to increase their market share in the next few years. This contradicts the statement that there will be an advancing consolidation in the ERP market. One hopes to be protected in one's position, but the large software companies such as Oracle and Microsoft are progressively buying up companies. It is especially through a SOA that connections of new systems are simplified, so that, using Oracle as an example, many providers have been acquired and functions that were lacking have been supplemented [Rettig 2007]. For smaller ERP companies, this means either securing a particular advantage in the market through niche excellence or to join forces and form a kind of "cluster" with other ERP companies in order to make a takeover unattractive: "It will be more important to link with others in the future" (quote from a supplier).

Conclusions and Limitations

In view of the process, service, Web and collaboration orientation necessary for the users, the providers have, to some extent, already met the corresponding technological and organizational requirements. However, in some areas there is still a clear need for development.

Process orientation is already implemented in terms of a visual representation, it has not, however, come into its own yet as a standard organizational tool. Particularly in continuous process design and in the implementation of process standards there are still deficits requiring intensive further development. Modeling should not remain on the simple visual level but should, together with a service-oriented application system, allow for a reorganization of functions above the planning level. There are already corresponding approaches (BPMN, BPEL, etc.), although they are only used by a small proportion of the questioned companies. Additionally, there are standardized processes for cross-company process modeling for which implementation is lacking.

It is also the case that the users of a modeling tool must be made aware of its potential. Those responsible for the processes in the company must not shy away from the technical challenges but rather recognize the benefits. Whether the vast majority of the affected have already done this, was not the aim of this study to clarify. There are further possibilities for research here, e.g. in regard to a more intuitive and more simply comprehensible GUI (graphical user interface) in order to ease the entry into modeling.

In the service-oriented areas, the necessary measures for a continuous application provision are to a large extent already implemented. Nevertheless, there are various aspects which still require further attention. SOA is still not clearly defined by all the companies questioned. However, the service idea is at least known of as a rough concept by all those questioned. Based on services, legacy systems can more easily be used again, new operator models can be operated and acquisitions can be more easily integrated into the existing system. Nevertheless, a disciplined service administration is needed to ensure clarity, security etc., especially for large scale use.

As well as the well-known operating models in-house and ASP, SaaS should be mentioned as a new variant. Although it is a hosting model like ASP, it is clearly different from an ASP model in several characteristics and shows great potential for users. There are three classic advantages of packaged software as opposed to individually programmed software [Gluchowski et al. 2008, p. 11]:

• Low costs despite high procurement costs (no individual software development costs)

• Time saving (fast procurement and adaptation in comparison to the development of individual software)

• Long term security (reputable providers generally use valid standards and constantly develop their products further)

SaaS packages provide further potential in all of the three areas than classic license-based software packages. It is cheaper because only the rental cost has to be paid in order to use it. It saves more time because the software is already installed and offers great future potential because of their constant maintenance and upgrading. There are, however, two points against extensive use: Firstly, customer confidence in a pure rental solution is lacking because security aspects and the submission of company data is regarded as critical [Lixenfeld 2008, p. 1]. Secondly, an

individual adaptation of the system is hardly possible or not at all. These two considerations require great attention. In regard to possible individual adaptations it would be interesting to examine to what extent the partner network with special solutions could enrich standardized software for certain customers (both technical and organizational).

A clear trend towards pure Web-oriented systems is emerging. Flexibility, scalability and application development aligned to a Web use will require additional attention from the providers in the coming years. Platform independence will play as great a role as future virtualization offers or the generally recognized use of Web services. They allow communication between different systems, although with regard to Web capacity this is only possible with a clear directory service. Moreover, security aspects such as encryption or transaction security are included. The efforts must be continued so that the standards which already exist can be improved.

In regard to B2B integration there are still too many different interfaces which make a simple connection to foreign systems difficult. On the process level especially there are hardly any generally recognized standards in use. There is still much potential here for further development. On the application and data base levels, however, Web services offer an alternative. They cannot replace the underlying mass of exchange standards, but they can at least make them available in standard form in the sense of a service.

In the case of internal integration (Enterprise Application Integration - EAI), the consistent development on the application level of limited integration, which does not consider the control flow and the superordinate business processes [Allweyer 2005, p. 342], to a BPM (Business Process Management) is one of the most important tasks for ERP providers.

Web-based systems and the merging of several information sources as decision support lead to another topic which is much discussed at present: mashups. These are a further developed form of Web integration and present new contents through a combination of already existing data. They can considerably accelerate, e.g. decision paths through the merging of distributed information. Just how practical this is for the company must be shown by further research.

Around three quarters of the companies see themselves gaining market share in the future. This however, contradicts the statement that a progressive market consolidation is expected. This consolidation, however, is more likely to happen because of the growing pressure from global players like SAP or Oracle who want to enter the SME market. SOA and its possibility for simple application integration is one of the reasons for the current market consolidation. Oracle alone acquired 41 companies within 48 months [Hill 2007]. The scenario that some providers in the SME sector will form so-called ERP clusters in order to arm themselves against the ever harder competition does not seem unrealistic. New technologies can even accelerate this process, as the expansion of Web services in the context of SOA has shown. One provider summarized it as follows: "As far the market goes, it's: evolution not revolution!"

The present article presents a detailed analysis of the future requirements of ERP software in the German-speaking market based on an empirical study. We were confirmed in our believe that this topic still needs further research by the editors of the EJIS special issue on packaged software: "In summary, we believe there is a need to theorize about packaged software and its place within the field of information system." [Light/Sawyer 2007] By following a qualitative research approach, we intended to shed light on the research question of how future packaged ERP systems are going to look like. Our research has several limitations. Firstly, the discussion is focused on the German-speaking area and it is questionable if the results can be applied to other countries due to cultural implications [Soh et al. 2000; Davison 2002]. Secondly, although the return rates were very favorable, the study is subject to the usual constrains regarding statistical representativeness. 30 interviews with vendors can only reflect a small portion of the complete universe of German-speaking ERP users and vendors.

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