2008

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Abstract

Results from a longitudinal empirical study on the use of information technology (IT) in Swiss small and medium-sized enterprises (SMEs) form the basis of this paper. In the recent survey, 917 questionnaires were collected and analysed. Selected findings are presented in ten conclusions which were drawn from the analysis of the responses. We see that the degree of information integration is very high in Swiss SMEs. Surprisingly, secondary process areas are better integrated across the company than primary process areas. The electronic exchange of data is quite common in SMEs and is performed, in many cases, at an international level. Swiss SMEs see the customer-oriented processes as important for their future competitiveness. On the other hand, they lay great importance on a well-working accounting process and the effective access to a management information system. Most SMEs embrace IT as a way to improve their business. Many of them are open for new technological developments and intend to further improve the interplay between software and processes. There is a strong association between the level of data integration in customer-related process areas and innovation. The integration level in supplier-related processes, on the other hand, has a weak influence on the innovativeness of a company.

Keywords: Empirical Study, SME, Switzerland, Business Processes, Innovation

1 Introduction

The theme of the 21st Bled Conference is "Overcoming Boundaries Through Multi-Channel Interaction". Despite significant progress in software development, organizations still face a number of significant challenges when connecting disparate business systems and services. Traditionally, the challenge of electronic business networking has been addressed through the deployment of electronic data interchange (EDI). Despite recognition of the challenges associated with connecting disparate systems and services, business software does not normally provide a standard tool suite

for the easy facilitation of electronic exchange processes; thus the problem of overcoming "boundaries" still remains. Most of today's Enterprise Resource Planning (ERP) systems provide technical interfaces to databases (e.g. ODBC, JDBC) or services (e.g. Web Services) but few of these systems come with standard business document interfaces (e.g. for xCBL, cXML, ebXML, OpenTrans, RosettaNet, or EDIFACT). Recent studies show that there is still the need for a specialized integration project every time companies want to electronically connect to a business partner [Schubert 2008].

Our study was stimulated by an interest in the behaviour of small and medium-sized enterprises (SMEs) regarding investment in ERP modules with a special emphasis on electronic data interchange. The aim of this research is to investigate typical attitudes and behavioural patterns of firms planning ERP-related investments. The main objectives of the present study were:

- Investigating the level of integration in different process areas
- Measuring the reach of electronic data interchange with market partners
- Studying the importance of IT support in certain business areas for future competitiveness

The paper is structured as follows: We begin with a brief review of the literature to provide background and context to the study. An overview of the theoretical framework used to guide the research is given. We then present the research design including the method of investigation and the characterisation of the sample. We selected findings on the integration level in different process areas, the reach of electronic data interchange with market partners, and the importance of certain business areas for future competitiveness. For each of these topics, conclusions are drawn. Following them, we analyse the respondents' assessment of IT-supported business processes and the association between IT support and perceived innovation. The final chapter contains a summary and an outlook on future research.

2 Research Field

The current paper addresses three different areas of literature: (1) ERP systems and business value, (2) business collaboration (or, more specifically, EDI), and (3) the specific characteristics of SMEs. The three areas are introduced in the following sections.

2.1 Literature Review

The focus of our study is on Enterprise Resource Planning systems, i.e. the class of information systems which supports primary and secondary processes in a company. A recent analysis of industry case studies showed that software systems can help companies to effectively support their core processes and thus help sustain competitive advantage [Schubert 2007].

There has been ample discussion in the literature whether or not ERP systems (or more generally referred to as enterprise systems) outweigh their at times substantial financial investment [McFarlan 1984; Porter and Millar 1985; Carr 2003; Peppard and Ward 2004; Rettig 2007]. "Although the business value of ERP implementations has been extensively debated in trade periodicals in the form of qualitative discussion or detailed case studies, there is little large-sample statistical evidence on whether the benefits of ERP implementation exceed the costs and risks" [Hitt et al. 2002, p. 72].

The second topic area, business collaboration, is not only about the exchange of electronic documents but goes further by looking at the support of transactions and business processes between companies. ERP systems are usually the core systems

which need to be connected through (standardised technical and business) interfaces. The term "business collaboration" is not clearly defined in the literature. In the field of information systems the term usually refers to the IT support of business processes spanning company locations or different companies [Wölfle 2007]. It is connected to a broad set of similar terms such as inter-organizational systems [Klein 1996; Alt and Fleisch 2000], electronic data interchange (EDI), B2B-Integration [Linthicum 2001], business networking [Österle et al. 2001] or networkability [Wigand et al. 1997].

Electronic Data Interchange (EDI), and with it the streamlining of the purchasing process, has been a research topic for almost 20 years. There have been many studies on the effects of the electronic support in business processes which were published in leading journals [e.g. Iacovou et al. 1995; Lim and Palvia 2001; Dai and Kauffman 2002; Lee et al. 2004; Beck et al. 2005].

Business processes are usually supported by specialised business software modules. We aimed to investigate the degree of data integration for these modules. In previous studies, two dimensions of integration have been explored: scope and reach [Keen 1991; Weil and Broadbent 1998]. In our study, scope corresponds to the level of data integration within and across boundaries (4.1) whereas reach refers to the regional factor (within home country or across borders) (4.2).

The sector of small and medium-sized enterprises (SMEs) is a significant sector for most developed Western economies [Beaver and Prince 2004; Meckel et al. 2004]. The adoption and use of business software by SMEs has been the subject of a considerable body of literature in the past few years. In an extensive literature review, Parker and Castleman [2007] identified more than 120 journal articles published between 2003 and 2006. The 2003 Observatory of European SMEs states that "… the vast majority of enterprises in Europe (99.8 %) are SMEs" (measured in employees, full time equivalent, FTE), and SMEs are crucial for continuing strong economic performance in Europe [European Commission 2004]. The importance of the SME sector is evidenced by the fact that in most developed countries it constitutes more than 90 % of the total business establishments, making research in this area essential.

2.2 Research Framework

Using themes derived from the literature on ERP systems and business processes we developed a theoretical framework which we worked from to develop the study questionnaire and the underlying research questions (see Figure 1).

Porter's discussion of the value chain is still one of the most useful and often cited classification approaches in literature [Porter 1985]. Following Porter, the business processes which characterise the underlying business model in such a way that they constitute a competitive advantage naturally tend to be primary processes. These are processes that contribute directly to the fulfilment of customer needs. A company also needs to manage secondary processes in order to maintain its operations. These supporting activities do not always contribute to the value generation of the company but are needed in order to run the company.

In a former representative study on SMEs, responding companies indicated that they primarily used ERP systems for supporting activities [Schubert et al. 2006]. The most intensive use is found in the classical areas of Accounting and Finance (94.9 %), followed by Human Resource Management (80.5 %) and Management (77.7 %). These findings are consistent with the results of a another study [Dettling et al. 2004], in which the modules Accounting and Finance and Human Resource Management and Controlling were used most intensively.

2.3 Taxonomy

The taxonomy which was developed for the current study incorporates elements of the eXperience taxonomy to business software [Schubert and Wölfle 2007]. We used the eXperience classification of business relations between players in the value chain. The resulting process model (Figure 1) shows a specific company in the centre of the figure (dotted line) and the specific location of the processes in the value chain of the company. The primary processes start with the customer contact (sales process), followed by internal processes such as order processing and procurement, and terminate with an eventual customer service.

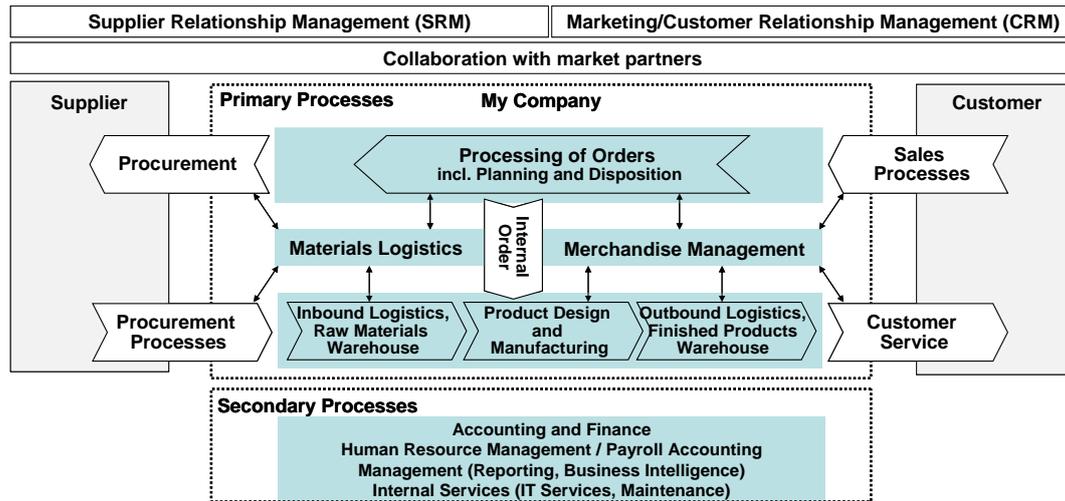| Supplier Relationship Management (SRM)	Marketing/Customer Relationship Management (CRM)

Collaboration with market partners

Figure 1: Taxonomy of Processes

The process areas correspond to measurable items in the questionnaire we used in the survey (3.1). For the purpose of orientation and reference, we will display the numbers of the items from the questionnaire in the following paragraphs and in the figures below (in brackets).

The first four processes – Accounting and finance (01), Human resource management/Payroll accounting (02), Management (Reporting, Business Intelligence) (03), and Internal services (04) – are secondary processes which are necessary to maintain the business.

Sales processes (11) are the contact points with the customer where orders are taken. Today, orders are typically received through multiple channels (such as telephone, fax, Web shop, e-mail). In the following process "Processing of orders" (10) the orders are planned. If the products cannot be delivered from stock, activities in this phase either result in the initiation of an external procurement process and/or an internal production order. There are various types of ways that companies plan and process their orders (e.g. built-to-stock, built-to-order). This is why business software modules supporting order processing often need to be specialized for specific industries. For a detailed description on different kinds of order management see Ruile [2006].

Materials logistics/merchandise management (07) is a core process which has interfaces to sales processes, order processing, procurement, logistics, manufacturing, as well as customer service. The description of the products and the underlying bill of material play a role in all primary business processes and thus act as a point of integration between the other processes.

Procurement and procurement processes (05) are initiated if goods (merchandise) or raw materials/components need to be bought from third parties. Once all the necessary

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goods/materials are available, the manufacturing process (09) is initiated. If products are first time made-to-order, a prior product design (08) is necessary. In some cases, the process does not end with the delivery of goods/services to the customer but extends into customer service (13) to handle questions, maintenance, and further customer requirements.

The processes of Supplier Relationship Management (SRM) (06) and Marketing/Customer Relationship Management (CRM) (12) are both located on the strategic level. They reflect the support of the firm's relationships to both sides of the value chain. Collaboration with market partners (14) is a cross-company supply chain function which facilitates electronic information exchange between the parties.

3 Research Design

To address the research questions it was necessary to make an empirical investigation because no suitable and current data was available. The following sections describe how the survey was performed.

3.1 Method of Investigation

This study focused on companies with 10 to 250 employees in the business sectors two (industry) and three (services). It covered a universal set of 39,918 companies. The Swiss Federal Statistical Office (SFSO) drew a stratified random sample of 4,639 companies from this universal set, based on sector and company size (Figure 2). We used computer-aided telephone interviews (CATI) for the collection of the data. The basis of the survey was a standardised questionnaire in German and French with predominantly closed questions. The questionnaire was developed in cooperation with business partners and trialled several times in pre-test interviews. It was aimed at members of senior management in small and medium-sized Swiss companies and other organisations.
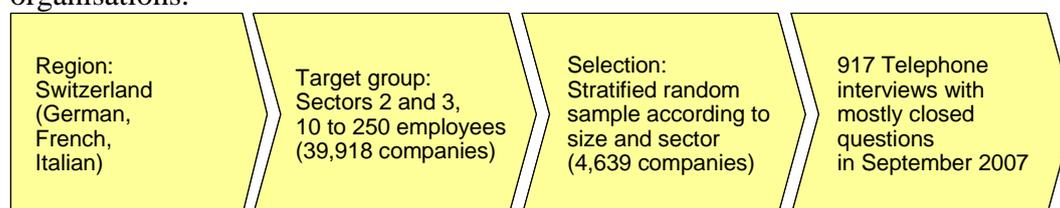

| Region: Switzerland (German, French, Italian) | Target group: Sectors 2 and 3, 10 to 250 employees (39,918 companies) | Selection: Stratified random sample according to size and sector (4,639 companies) | 917 Telephone interviews with mostly closed questions in September 2007 |

Figure 2: Research Steps

3.2 Return Rate and Weighting

Altogether, 917 companies were interviewed. This corresponds to a return rate of 19.8 %. Declaration of company size and business sector were mandatory. We used this information to classify the questionnaires and to weight them according to company size and business sector. All 917 questionnaires were suitable for further analysis. Not every company answered every question. As a result the given number of valid cases (N) in the graphics and tables is sometimes smaller than 917.

A comparison of the distribution of those companies which answered with the universal set shows that the companies with 50 to 100 employees are under-proportionally represented as compared to the Swiss universe. The distribution of sectors, however, shows a better correspondence with the universal set.

In order to ensure that the results are representative in terms of size and sector distribution, the data is weighted according to company size and business sector [Kromrey 2002, p. 281]. Weighting factors were based on a comparison between the

sample and the universe. The weighting brings the size and sector distribution of the sample in line with the size and sector distribution of the universe. Figure 3 shows the weighting factors which were used to calculate the weighted results.

Business Sector	Company Size [number of employees (full-time equivalent)]		
	>=10 & <50	>=50 & <100	>=100 & <=250
Manufacturing, Industry	2.6674	0.4604	0.3073
Power, Water Utility	0.1682	0.0582	0.0477
Construction Company	5.4334	0.7274	0.2193
Trade, Repair of Durable Goods	2.8134	0.2493	0.1266
Hotels and Restaurants	2.9021	0.2584	0.1127
Transport and Telecommunications	1.3494	0.2512	0.1072
Banking and Insurance	0.9115	0.1577	0.1214
Company-related Services	4.0164	0.7715	0.2197
Public Administration	0.6560	0.2078	0.1464
Education	1.3256	0.4055	0.2540
Health and Social Services	2.3707	0.6356	0.3227
Other services for Third Parties	1.5227	0.1620	0.0769
Source: Swiss Federal Statistical Office (SFSO); own calculations			

Figure 3: Weighting factors according to company size and business sector

The weighting causes the smaller companies (10 to 49 employees) to increase in importance. Consequently, the weighted results differ from the gross results wherever the answers of this particular group diverge from the other two groups.

3.3 Characterisation of the Sample

This section describes some fundamental characteristics of the respondents and the companies. In order to portray the sample unchanged, the results in this chapter are not weighted.

Nearly all respondents are members of senior management: 55 % of the questionnaires were answered by CIOs, 23 % by CEOs, and 19 % by other executives in commercial and technical areas. Only 3 % of the respondents have other functions in the company. In smaller companies with 10 to 49 employees, many more respondents were CEOs (38 %). In larger companies with 50 to 99 and 100 to 249 employees CIOs prevail clearly (60 and 73 %). The differences are highly significant. This is an indicator that even SMEs tend to acknowledge that IT management requires particular skills and thus a special role in management.

The distribution of companies according to their size shows a balanced picture. The company size was measured in "number of employees" (full-time equivalent): 38 % of the companies have between 10 and 49 employees, 29 % between 50 and 99, and 33 % between 100 and 250 employees.

Companies from business sectors 2 (industry) and 3 (service) are represented in the sample; almost all business fields. The largest proportion is taken up by Manufacturing and industry (16 %), followed by Trade and repair of durable goods (15 %) as well as Public administration (8 %).

4 Findings

This chapter describes some selected results of the study. The descriptive analyses are based on weighted data and for that reason they are representative for Swiss SMEs according to company size and business sector (3.2).

4.1 Level of Integration in the Process Areas

The respondents were asked whether the process areas are supported by information technology (IT) and at which level of data integration they are supported. Possible

categories were "cross-company data exchange", "cross-area data exchange", "only within one process area", and "no IT-support at all". This refers to the dimension scope of integration [Keen 1991; Weil and Broadbent 1998].

While the general level of support is very high there are only little differences in the degree of integration among the process areas. The average level of integration is the following:

- Cross-company data exchange (25 %)
- Cross-area data exchange (30 %)
- Only within one process area (25 %)
- No IT-support at all (15 %)

Process areas which show a high level of cross-company data exchange are collaboration (which can be expected due to the very nature of collaboration), internal services (e.g. IT services, infrastructure management, maintenance) and accounting and finance (Figure 4). Today, most SMEs in Switzerland use electronic links to banks which explains the high values for the accounting area. IT services and infrastructure management are often supported by third parties with the need to exchange data with these partners (e.g. an IT supporter).

Areas with a high degree of cross-area data exchange are order processing, production, marketing, and materials logistics/merchandise management. Order processing is a process that runs through different departments of the company and thus needs to be integrated across different business areas. Production and marketing both depend on data from other areas. As pointed out in the research framework, materials management is an integration function which shares information with many other business software modules.

When looking at Figure 4, it is interesting to see that secondary process areas (as introduced in our research framework) show a higher level of integration than primary processes. This result corresponds with similar findings from 2004 [Dettling et al. 2004] that the use of business software for secondary processes is more advanced in Swiss SMEs than for primary processes.
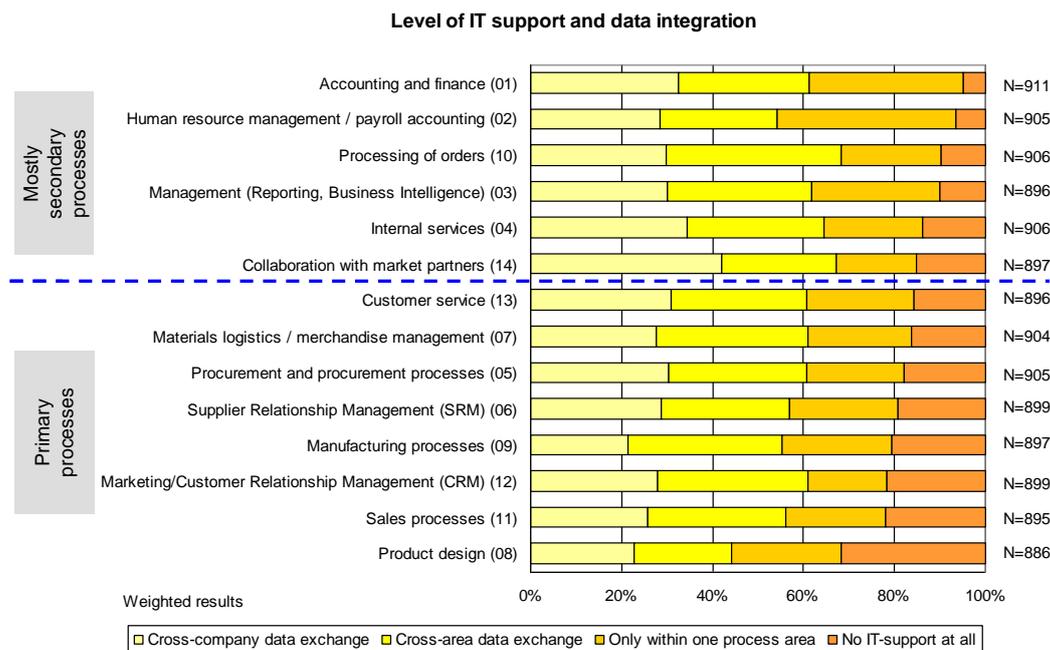
Level of IT support and data integration

Figure 4: Level of integration according to business process areas

This leads us to the first two conclusions:

Conclusion 1: The degree of data interchange (information integration) is quite extensive in Swiss SMEs.

Conclusion 2: Surprisingly, secondary process areas (as introduced in our research framework) are better integrated across the company than primary process areas.

4.2   Electronic Data Interchange with Market Partners

We investigated the intensity and the reach of electronic data interchange (EDI). This refers to the dimension reach of integration [Keen 1991; Weil and Broadbent 1998] as described above. For each category of business partners "customers", "suppliers", and "cooperation partners", respondents were asked to indicate whether they use electronic data interchange

- within Switzerland (regional),
- within Europe
- worldwide or
- if they do not exchange data electronically with partners.

The findings show that more than 80 % of Swiss SMEs exchange data electronically with business partners, which is a very high rate. The majority of exchanges takes place between partners within the country (more than 50 % of the SMEs). Twenty percent of the SMEs exchange data with partners in Europe, 15 % even with partners worldwide which means that more than one third of the SMEs exchanges data internationally in an electronic form. The most frequent form is an exchange of data with customers but there are only small differences in comparison to suppliers and cooperation partners (cf. Figure 5).

Conclusion 3: The electronic exchange of data is today quite common in SMEs and is, in many cases, carried out internationally.

Conclusion 4: As already seen in studies from 2006 and 2007, the majority of business activities takes place within the home country [Schubert et al. 2006; Schubert/Leimstoll 2007]. This is also reflected in the electronic data interchange with other parties where more than 50 % of the electronic exchanges take place within the country.
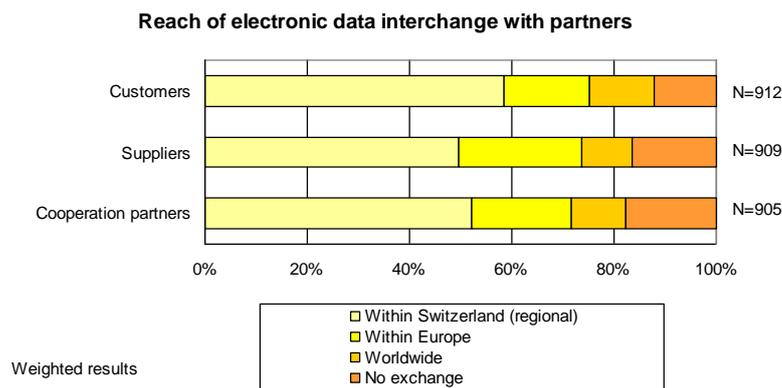

Figure 5: Reach of electronic data interchange with partners

4.3   The Importance of Business Areas for Future Competitiveness

In addition to the analysis of the current support of business processes by information technology, we investigated the importance of the process areas with the aim to see which areas will be crucial for SMEs in the future and if there is a difference between the current support and the future importance. Companies were asked if process areas

are going to be important for the company's future competitiveness on a scale from „important" to „unimportant".

All process areas were mostly classified as "rather important" or "important". The answers do not show great differences among the areas (Figure 6).

The most important process areas are:

- Customer service
- Order processing
- Management (reporting, business intelligence)
- Accounting and finance

Areas on the lower end of the importance scale are:

- Materials logistics/merchandise management
- Supplier relationship management (SRM)
- Procurement processes
- Product design

Again, it is interesting to see that two secondary processes come out on top among the first four areas. It is good to see that SMEs seem to value the importance of the direct customer support (customer service) and the processing of orders. In a different study in Switzerland, IT-supported order processing was seen as a way to create excellent processes which help to differentiate one company from the other [Schubert 2007].
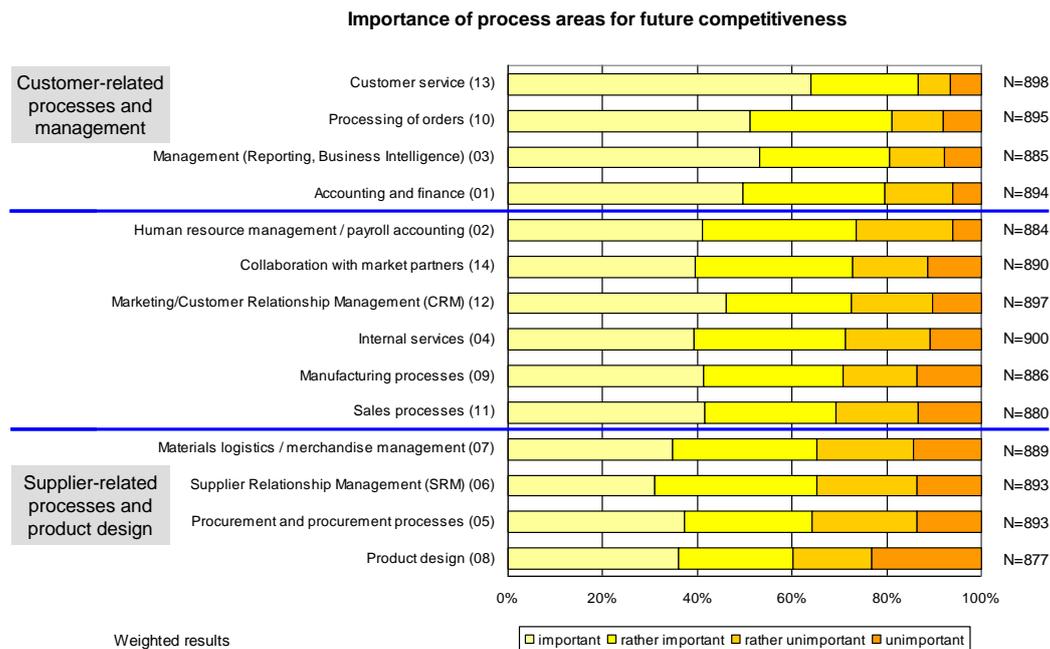
Importance of process areas for future competitiveness

Customer-related processes and management		
Customer service (13)		N=898
Processing of orders (10)		N=895
Management (Reporting, Business Intelligence) (03)		N=885
Accounting and finance (01)		N=894
Human resource management / payroll accounting (02)		N=884
Collaboration with market partners (14)		N=890
Marketing/Customer Relationship Management (CRM) (12)		N=897
Internal services (04)		N=900
Manufacturing processes (09)		N=886
Sales processes (11)		N=880
Materials logistics / merchandise management (07)		N=889
Supplier-related processes and product design	Supplier Relationship Management (SRM) (06)	N=893
	Procurement and procurement processes (05)	N=893
	Product design (08)	N=877

0% 20% 40% 60% 80% 100%

Weighted results ☐ important ☐ rather important ☐ rather unimportant ☐ unimportant

Figure 6: Importance of process areas for future competitiveness

Conclusion 5: Swiss SMEs see the customer-oriented processes *customer service* and *order processing* as important for their future competitiveness. On the other hand, they lay great importance on a well-working *accounting process* and the effective access to a *management information system*.

Conclusion 6: All processes with regard to *procurement* or the *relationship with the suppliers* are seen as less important.

4.4 Assessment of IT-Supported Business Processes

The last part of the questionnaire included questions related to the general assessment of IT-supported business processes in the companies. The question regarding the application of new technologies in the area of business software was recently debated in the scientific community. With her article "The Trouble with Enterprise Software", Cynthia Rettig stimulated a lively discussion in the blogosphere on the effectiveness of ERP systems [Rettig 2007]. The bottom line of the article was that ERP systems are too complex and implementation costs too high to ever produce a fair ROI. She suggests the implementation of Service-Oriented Architectures as a possible way out of the dilemma. In our study, we wanted to find out if SOA and related changes in technology are an issue for SMEs. For a detailed explanation of SOA we refer to [Liebhart 2007].

We asked the respondents to indicate their level of agreement with the statements shown in Figure 7. The responses to the statements varied. Three-quarters of the SMEs are willing to apply new technologies (e.g. SOA) if they help them to better support their business processes. They also believe that they need to design their business processes to be more flexible and more customer-specific in the future. More than half of the companies intend to further automate their business processes.

Two thirds of the SMEs were actually able to gain competitive advantages with the use of IT. Half of the respondents believe that their business processes have been optimized and are not going to change much in the future.

Negative statements such as "software limits the flexibility of processes" were rejected by most companies. It is good to see that less than 20 % of SMEs see information technology as a "petty evil".
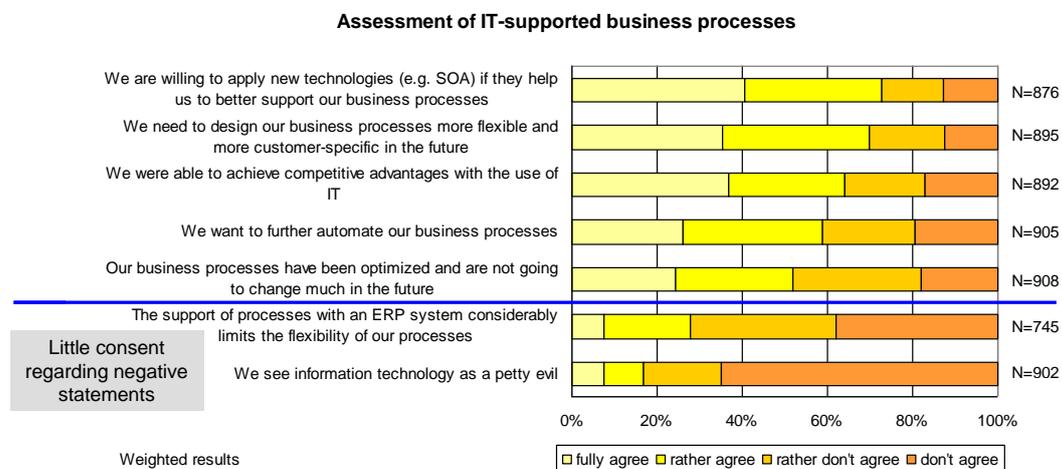

Figure 7: Assessment of IT-supported business processes

Conclusion 7: Most SMEs embrace IT as a way to improve their business.
Conclusion 8: Many of them are open for new technological developments and intend to further improve the interplay between software and processes.

4.5 Information Technology and Innovation

As could be seen from the study results [Leimstoll/Schubert 2008], Swiss SMEs see process innovation as the second most important activity to be competitive in the target market. Only the quality of their products scores higher on the importance scale. Two thirds of the respondents claim that they have managed to gain competitive advantages with the deployment of IT (Figure 7).
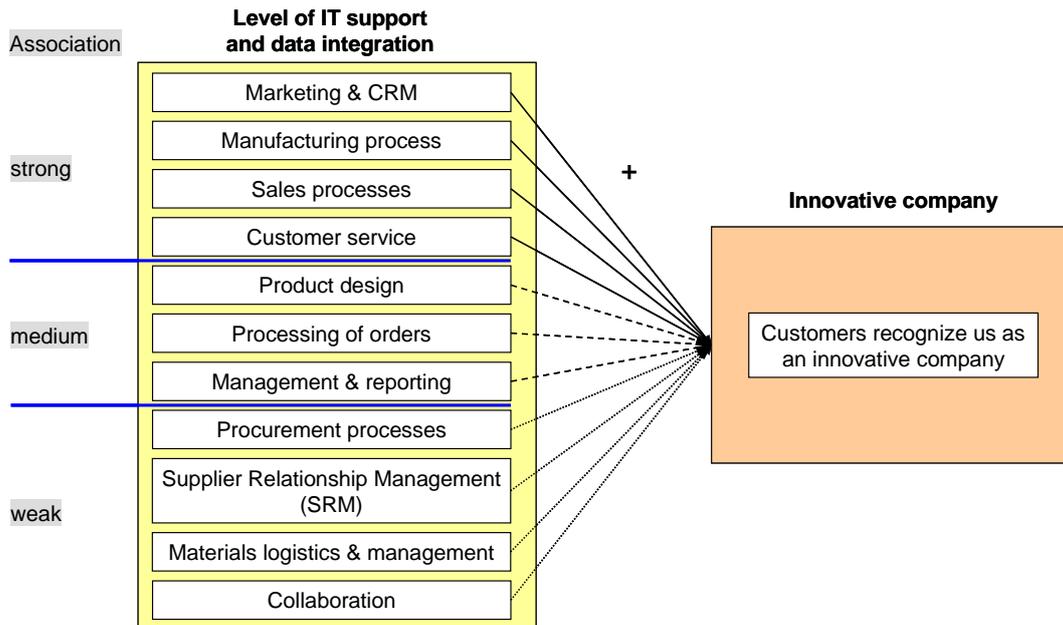
Figure 8: Association between integration of business processes and perceived innovation

Figure 8 shows the relationships between the scope of integration in certain process areas (4.1) and the perception of the company as an innovative business by its customers. As can be seen, companies which reached a high level of data integration in marketing and CRM, manufacturing, sales and customer service processes are seen as more innovative by their customers than other companies.

All shown relationships are highly significant at least at the 0.1 % level with the exception of procurement processes (0.4 %). Pearson's chi-square test was used for the statistical analysis of the dependency between the attributes.

Conclusion 9: In customer-related process areas there is a strong association between the scope of integration and innovation.

Conclusion 10: In supplier-related processes, on the other hand, the scope of data integration has a weak influence on the innovative image of a company.

5   Summary and Future Research

The paper contributes to the current body on literature on the business value of ERP systems. We developed and used a theoretical framework for the development of the questionnaire. From the collected data, ten conclusions were drawn and discussed which deal with (1+2) the scope of integration in different business process areas, (3+4) the reach of electronic data interchange with business partners, (5+6) the importance of certain business areas for future competitiveness, (7+8) the assessment of IT-supported business processes, and (9+10) the association between the scope of integration and perceived innovation.

The following is a summary of the overall findings:

- The support of business processes with information technology is quite advanced in Swiss SMEs. Many of these companies use business software that supports data integration even beyond company borders.
- SMEs recognize the benefits of information technology and are very open to the use of integrated business software.

- The further improvement of processes is a big topic for SMEs. Flexibility, customer-orientation and automation play an important role in this context. This is in accordance with the confirmatory statement that they need to use process innovation to stay competitive (second important among the market-related issues).
- In many of the SMEs (40 %) electronic data interchange (EDI) is a current topic. More than 80 % already process data electronically between company borders and to a great percentage even internationally.
- Information technology is a relevant competitive factor for Swiss SMEs.
- The use of information technology for certain (especially customer-related) business process areas contributes to the innovative image of the companies towards their customers.

This study represents another milestone in a longitudinal research project on the topic of "ICT use in SMEs". Each year, the authors were able to explore in more depth the data gained from this extensive and long-term-oriented series of studies. In this year, our focus was on the IT support of business processes. The findings have a high explanatory value due to the excellent response rates; 917 interviews were collected in this fourth round. The results are representative for Switzerland with regard to company size and industry sector.

In future research, we will continue to analyse the vast amount of data collected in the last three years. Also, we intend to further link our research with previous literature on IT use and value generation [e.g. McFarlan 1984; Keen 1991; Peppard and Ward 2004; Weill and Broadbent 1998].

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