

Importance and Use of Information Technology in Small and Medium-Sized Companies

PETRA SCHUBERT AND UWE LEIMSTOLL



INTRODUCTION

The question of whether information and communication technology (ICT) can create value is one of the central topics of the information age. Most people would probably respond to this question with a spontaneous 'yes, of course'. Already, we cannot imagine a world without mobile phones, PDAs and, of course, the Internet, the vast resource of information that we have at our disposal. Whereas the personal question of value from electronic media (e-value) will almost always be affirmative in the Western world, we are likely to see a different image when we look at the economic equation in companies. In the specialized press experts dispute the significance that ICT has so far achieved within companies. Within this debate there are often two diametrically opposed opinions. One faction, following Porter and Millar's theories from 20 years ago, believes in the particular potential of ICT to attain a competitive advantage (Porter and Millar 1985, Porter 2001). The other faction has the view that the diffusion process of ICT is, in the meantime, so developed that it is already a 'commodity' in a company (that is a basic utility

available to all) and that it has, therefore, lost its effectiveness as a strategic instrument of differentiation. The discussion gained momentum in 2003 when Carr published a *Harvard Business Review* article entitled 'IT Doesn't Matter' (Carr 2003) and later a more extensive book on the topic with a slightly adjusted title 'Does IT Matter?' (Carr 2004a). The article was followed by a whole flood of counter-arguments that were collected on his personal website (Carr 2004b). The bottom line of the discussion was that there are many opinions and little solid mechanisms to back them up. This paper contributes to the discussion on e-values in that it examines the role that ICT plays in SMEs today with the objective being to discover whether there are different types of SMEs, which can be differentiated from each other in terms of their use of ICT.

For this purpose we conducted an empirical study in Switzerland in the year 2005. The focus was on small and medium-sized companies as well as small and medium-sized organizations (e.g., hospitals, public administration, schools). The sample resulted from various considerations of the study partners. First, the chosen size range (10 to 249

A b s t r a c t

The following paper presents results from a longitudinal study about the importance and use of information and communication technology (ICT) in Swiss small and medium-sized companies (SMEs). In an empirical survey, 989 questionnaires were collected and analysed (return rate 17%). The results were weighted according to company size and industry sector and are representative for Switzerland. The findings show that Swiss SMEs – in their self-assessment – manage to gain (competitive) advantages from the deployment of information and communication technology. ICT is universally used (even) in (small and medium-sized) companies. There is a high degree of inter-organizational ICT use. ICT know-how and awareness are strongly rooted in management. The general conclusion is that IT matters for Swiss SMEs.

Keywords: empirical study, SME, ICT use, ICT strategy, Switzerland

A u t h o r s

Petra Schubert

(schubert@uni-koblenz.de) is Professor for Business Software at the Department of Informatics of the University of Koblenz-Landau. Her research focus is in the area of enterprise information systems with a focus on collaborative business and the use of ICT in SMEs.

Uwe Leimstoll

(uwe.leimstoll@fhnw.ch) is Lecturer for IT Management and e-business at the School of Business of the University of Applied Sciences Northwestern Switzerland. He is in charge of different research projects in the field of personalization, Web assessment, and information systems in SMEs.

employees) in the secondary and tertiary sector (industry and services) represents 94% of Swiss companies which have 10 or more employees and constitute, therefore, a large proportion of the Swiss economy. Second, other empirical studies (e.g., IBM 2005, Impulse 2005, KPMG 2005, silicon.de 2003) are often only concerned with large companies, which have different conditions and structures from small and medium-sized companies. Different conditions and structures are also found in 'very small companies' with 0–10 employees. Both of these 'marginal groups'; *large* companies and *very small* companies were, therefore, excluded from this study.

OBJECTIVES OF THE STUDY

Central to our discussion of the significance of ICT are the results of an empirical study (Schubert *et al.* 2006). From the basis of theoretical considerations, hypotheses were formulated and tested, and the evidence of dependency between company size, sales volume, business environment, establishment of ICT in the organization and the use and relevance of ICT were analysed. The investigation was carried out in 2005 and represents the first step in a longitudinal study on the topic of the 'Relevance of ICT Investments for Swiss SMEs'. The survey which is described in this article (Schubert *et al.* 2006) was the second study of this kind.

In a first step, it was the aim to find out whether SMEs intend to follow strategic goals with the use of ICT and accordingly achieve competitive advantage. The following questions were raised and analysed:

- Which objectives could be achieved by SMEs with the help of ICT?
- How deeply has ICT penetrated SMEs? How established is ICT in company management?
- Which level of expertise is available? What is the status of acceptance of employees?
- For which kind of SMEs does ICT have a strategic significance, for which kind only an operative significance?
- In which area of an SME is ICT particularly important? (functions/range)

The following section provides a brief overview of the background of the study and the terms used. The research design is then presented including the method of investigation and the characterization of the control sample. Selected results of the descriptive analysis are then presented. The main section contains the analytical findings. Hypotheses are tested and discussed. The paper ends with a summary and an outlook to future research.

BACKGROUND AND TERMS USED

We take the term information and communication technology (ICT) to describe the entirety of hardware,

software, networks, as well as the personnel to whom the provision and upkeep of the system is entrusted. In this way, the use of technology as well as the organizational and strategic aspects of application and use of the information systems are considered.

Figure 1 provides an overview of the terms with mention of the management concepts, applications, and involved parties which formed the basis at the conception of the questionnaire. It is a general framework for the description of business software and corresponding management concepts in a systematic way. Within the figure there is a view of a real/specific company in the centre (sketched through the dotted line). The company has an ERP system with which the activities in various departments can be integrated. At the same time, the ERP system is almost always the connection point for the integration of external applications. The terms contained in the figure were not used explicitly in the questionnaire but were put in place for the evaluation of the results. A detailed discussion of the overview of terms in the context of business software can be found in Wölflle and Schubert (2005 – in German) and in Sigrüst and Schubert (2004 – in English).

RESEARCH DESIGN

Method of investigation

The present study concentrates on the analysis of companies with 10 to 249 employees in the secondary and tertiary sector (industry and services). It covers therein a total of 38,016 companies. The Federal Office for Statistics drew a stratified control sample of 5,796 companies from this total, based on sector and company size.

The establishment of contact with the companies took place in several phases and with various measures. The basis of the survey comprised of a standardized online questionnaire in German and French with predominantly closed questions. The questionnaire was developed in cooperation with business partners and tested several times in pre-test interviews. It was aimed at members of senior management in small and medium-sized Swiss companies and other organizations.

Because of extensive Internet access in Swiss SMEs a print version was not sent by post in the first stage. However, a print version of the questionnaire was available on request. The companies were made aware of the survey by post. After a period of time, a reminder was sent. Following a further time period, companies who had not answered were contacted by telephone. Those companies who were prepared to be interviewed were directly interviewed there and then. The interviews followed the original questionnaire. The process is mapped in Figure 2.

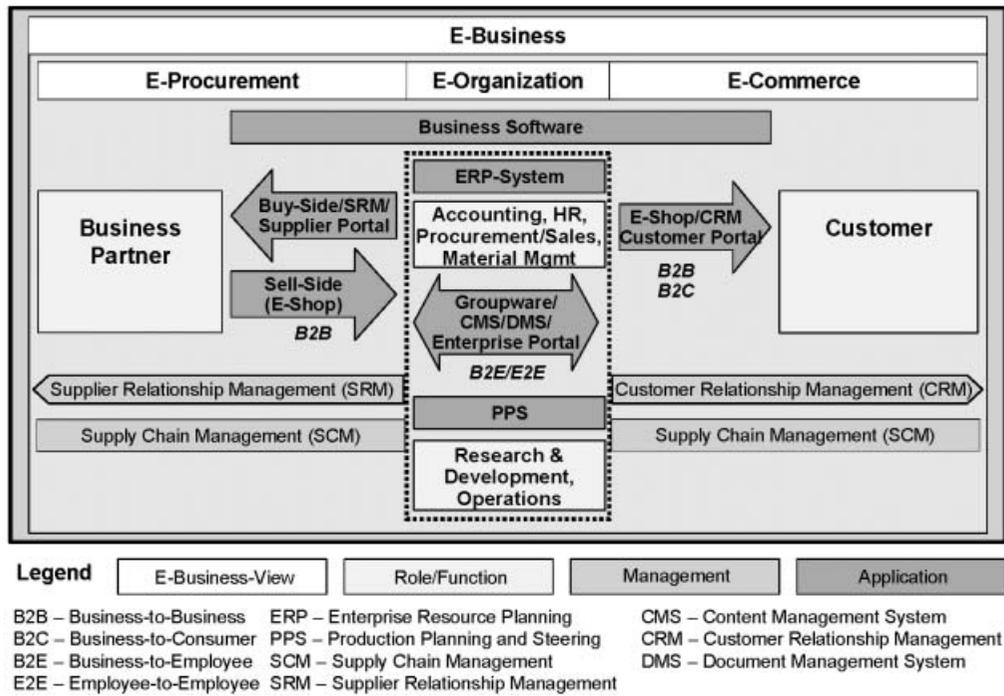


Figure 1. Overview of terms used in the context of business software.
 Source: Wölfle and Schubert (2005: 18)

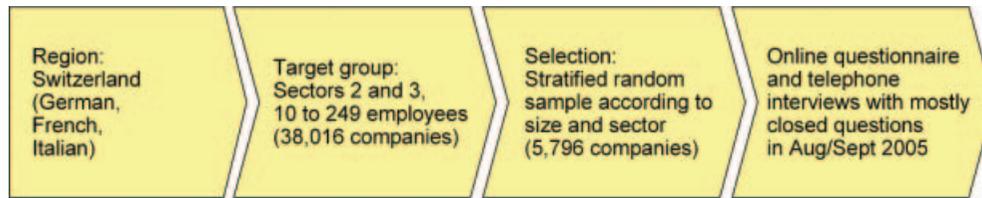


Figure 2. Research steps

Altogether, 1,101 companies participated in the study either by completing the questionnaire (638) or by being interviewed (463). This corresponds to a return rate of 19%. After discarding the questionnaires that could not be analysed and classified, we were left with 989 questionnaires to evaluate. This corresponds to a return rate of 17.1%. Not every company answered every question; this means the given number of valid datasets (N) in the graphics and tables is sometimes smaller.

A comparison of the distribution of those companies which answered with the total in Switzerland shows that the companies with 10 to 49 employees are proportionally very under-represented. This is due to the fact that small companies are much more frequently presented in the total than larger companies. The distribution according to sector, however, shows a better correspondence with the total. Public administration, power and water supply, and processing industries are exceptions.

In order to ensure that the results were representative in terms of size and sector distribution, the data were weighted according to company size and industry sector

(Kromrey 2002: 281). Weighting factors were based on a comparison between the control sample and the total. The weighting brings the size and sector distribution of the control sample in line with the size and sector distribution of the total.

Characterization of the control sample

In order to convey an impression of the control sample, this section describes some fundamental characteristics of the respondents and the companies. The results in this section are not weighted.

Most of the respondents are members of senior management. 30% of the questionnaires were answered by CEOs, 35% by CIOs, and 24% by other executives in commercial and technical areas. Only 11% of the respondents have other functions in the company. In smaller companies with 10 to 49 employees, the majority of the respondents were CEOs (42%). In larger companies with 100 to 249 employees CIOs prevail

(53%). The differences are highly significant ($\alpha \leq 0.0005$). In companies with 50 to 99 employees CEOs and CIOs are evenly represented.

The distribution of companies according to their size shows a balanced picture. The company size was measured from the number of employees, by which the full-time equivalent was calculated. The majority of the businesses in the control sample (39.6%) have between 10 and 49 employees. 29.0% of the companies have 50–99 employees, 31.3% have 100–249 employees (see Figure 3).

Companies from the secondary (industry) and tertiary sector (services) are represented in the control sample; almost all business fields. The largest proportion is taken up by *Manufacturing and industry* (30.4%), followed by *Trade and repair of used goods* (10.3%) as well as *Public Administration* (10.0%) (see Figure 4).

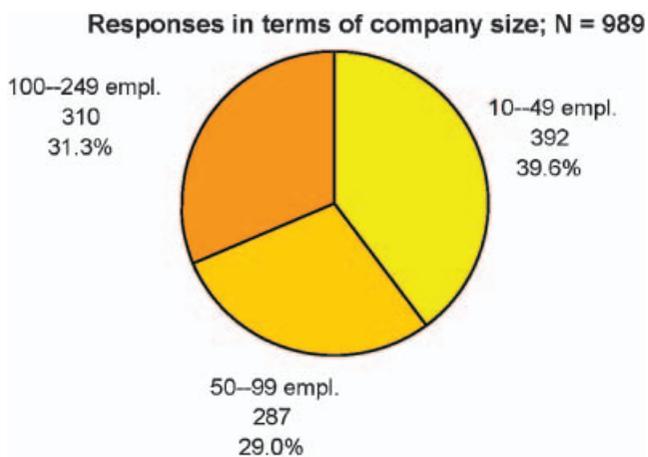


Figure 3. Companies in the sample according to the number of employees (full-time equivalent)

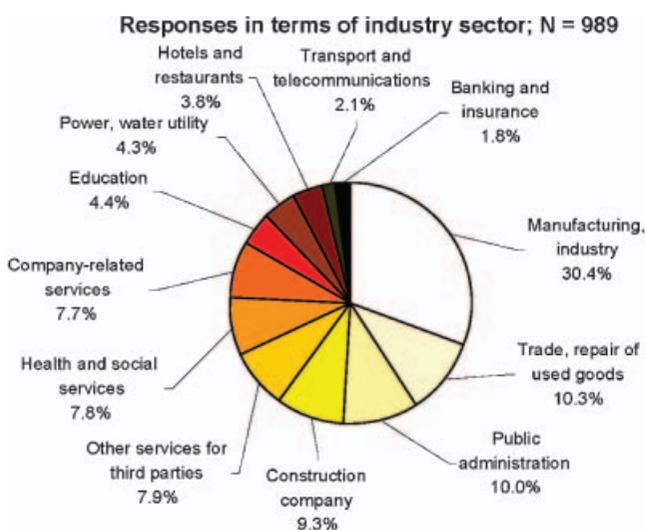


Figure 4. Companies in the sample according to industry sector

The distribution according to size and sector in the control sample does not correspond to the Swiss total, in which the small companies comprise a larger proportion (5 times more than medium-sized companies). The results of the descriptive analysis are based, therefore, on data which are weighted according to the company size and the sector as explained above. In this way, representative conclusions about SMEs in Switzerland are presented.

DESCRIPTIVE ANALYSIS

The following three sections highlight the *use* and *organization* of ICT as well as the aspect of ICT and competitive strategy. The ‘ICT Deployment’ subsection portrays the effects that can be achieved and the intensity of ICT use in different areas of the company. ‘Establishment of ICT’ examines organizational aspects of ICT in the organization, and the subsection ‘ICT and Competitive Strategy’ investigates whether Swiss SMEs can achieve competitive advantage with the help of ICT. To this end, a comparison of competitive strategies and support of these strategies with ICT was drawn.

ICT deployment

The importance of ICT for a company can be expressed in many ways. The following paragraphs use the variables ‘Achievement of objectives’, ‘Intensity of ICT use’ and ‘Extent of ICT support’ to describe the importance of ICT in SMEs. The objectives that can be principally pursued with ICT are multifaceted and can hardly be investigated in their entirety. In Figure 5, some selected objectives that refer to operative business processes, processing times and access to information are shown.

The results show that operative business processes are effectively supported with the help of ICT. Achieving the objective of *smoothly operating business processes* found more agreement (87.1%) than *low cost operations* (80.1%). In most of the companies, *processing times* are reduced with the use of ICT. The effects achieved in *order processing* (78.7% agreement) outweigh the effects in *production* (68.0%). The differences between the company sizes are not significant.

ICT solutions are now so developed that the majority of the SMEs state that *employees have access to required information* at any time (79.4%). The high agreement regarding *management access to decision-relevant information* is certainly surprising. Altogether 85% of SMEs agree that they have access at any time to decision-relevant information, e.g., key performance indicators (48.7% fully agree, 36.3% tend to agree). The differences between larger and smaller companies in this respect are rather slight and not significant.

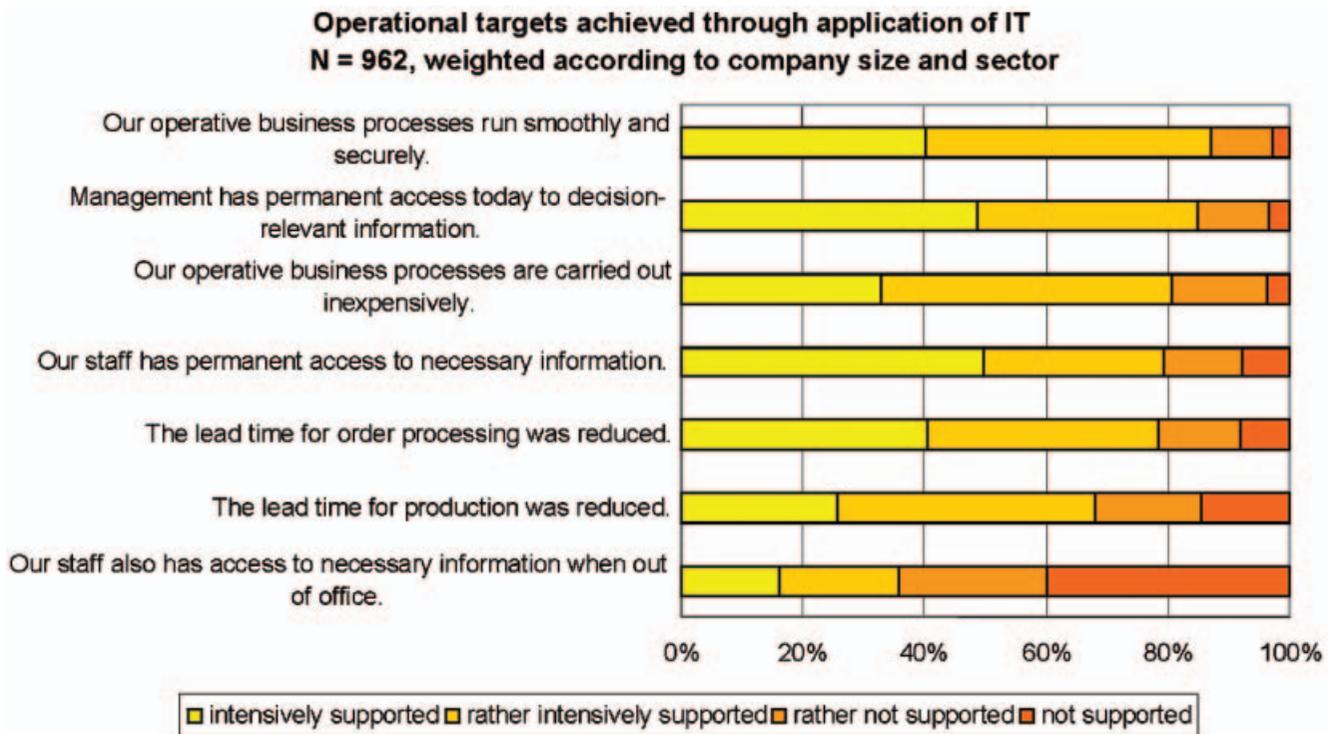


Figure 5. Operational targets achieved through application of ICT

Altogether, the questioned companies were, to a high percentage, in agreement that the mentioned objectives can be reached through the use of ICT. It can then be concluded that SMEs are quite capable of supporting their business processes successfully and in a targeted manner through ICT.

In order to find out in which company areas and processes ICT has been widespread up to now, ten company areas were decided upon. They are essentially oriented on Porter's Value Chain, to which an additional structuring of primary and secondary activities was carried out (Porter 1985). *Primary activities* according to Porter are Inbound Logistics, Operations (Production), Marketing and Sales, Outbound Logistics, and Customer Services. *Secondary activities* include Procurement, Technological Development, Human Resource Management, and Company Infrastructure.

The company areas listed in Figure 6 are likewise based on this structure. Finance and accounting, Human Resources Management, Management, as well as Internal Services can be counted as secondary activities in Porter's sense (Porter 1985). Procurement and Purchasing, Product Development, Material and merchandise management, Production, Marketing and distribution as well as Customer service belong to the primary value activities.

The results in Figure 6 show that the secondary activities, with the exception of Internal Services, are more strongly supported by ICT than the primary activities. This can be explained in that the processed

transactions in the secondary activities are as a rule more strongly structured and they, therefore, constitute the traditional area of ICT use.

The most intensive use of ICT is in the classical sectors of *finance and accounting* (almost all responses: 94.9% of the SMEs support this sector intensively or rather intensively, companies with 100–249 employees reach 98.4% here), followed by *Human Resource Management* (80.5%) and *Management Information Systems* (77.7%). All these activities can be counted among the secondary activities.

This result confirms the results of the first study (Dettling *et al.* 2004). In the question about the future use ('foreseen intensity of use two years from now') the modules Finance, Human Resources, Controlling, and Management Information Systems were mentioned most often. The frequency, however, did not achieve the value of the current study.

Out of the primary activities, Customer Service is the most strongly supported by ICT (65.3%) (Figure 6). It is followed by more or less identical results by Marketing and Distribution (62.8%), Procurement and Purchasing (63.0%) as well as Production (62.8%). In the order of choices the categories of 'rather not supported' and 'not supported' are additionally taken into consideration. The grading of Internal Services (59.6%) as well as Material and Merchandise Management (58.5%) is also rather low. The area of Product Development is least supported by ICT, an area where, as a rule, less structured or unstructured activities and processes prevail.

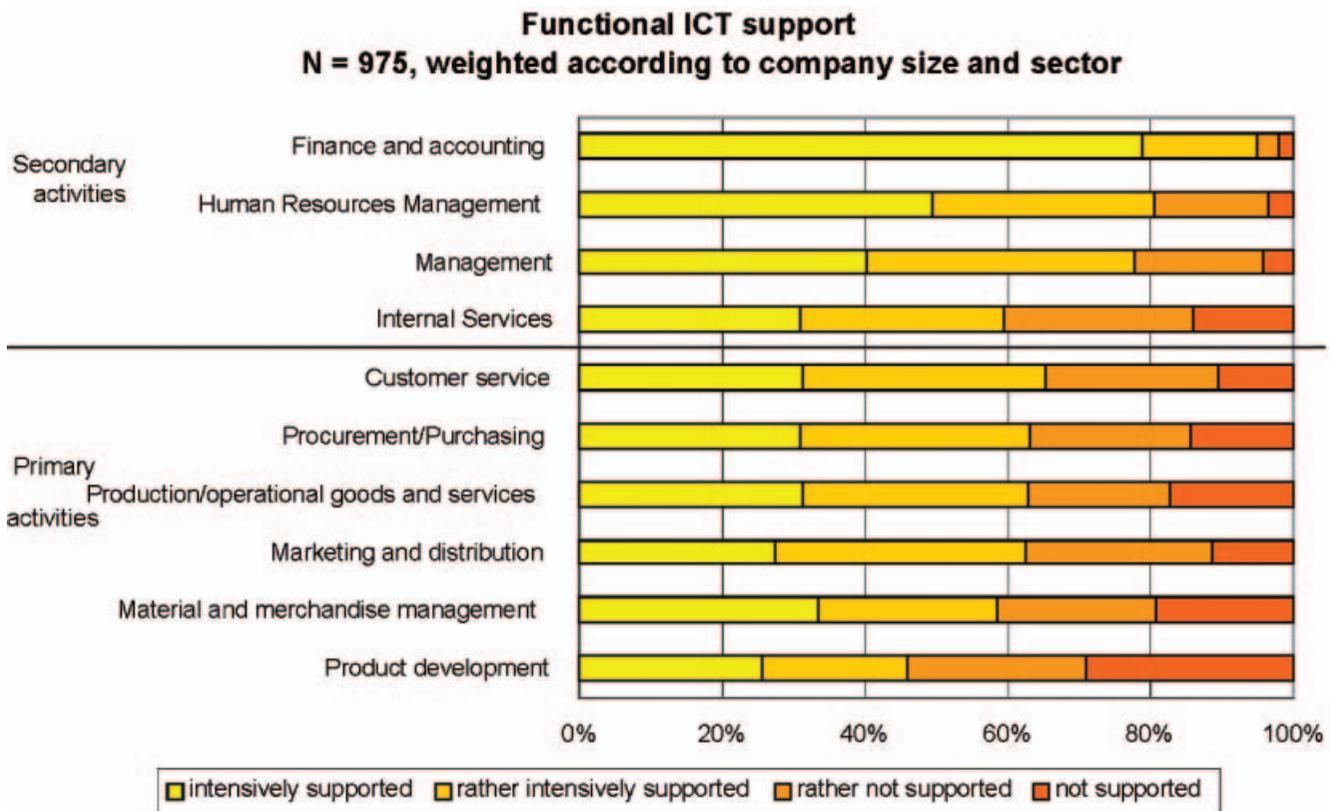


Figure 6. Areas and processes supported with ICT

Establishment of ICT

The figures in the previous paragraphs show that ICT is important for the majority of Swiss SMEs. The high rate of ICT skills in the company and especially in the top management is an additional indicator for the importance of ICT. Swiss companies show a high skill level combined with ICT responsibility rooted in top management.

The pervasiveness of ICT was measured qualitatively with a set of different criteria. The criteria and their values are displayed in Figure 7. We were surprised to see that employees enjoy working with computers in most companies. To confirm this, there are only a few companies in which employees express a reservation or fear when working with computers. These statements are largely independent of company size.

IT security seems to be a top priority. 85.6% of the respondents stated that IT security is important for them. More than three quarters of the companies believe that the person responsible of ICT should be a member of the top management. The tight connection between ICT and management is also expressed by the fact that 71.9% of the respondents agree that the ICT knowledge of their top managers is high, and 63.5% believe that ICT skills are on a high level throughout the whole company. These values demonstrate that ICT has permeated the majority of SMEs and has become a well

established instrument for the support of business tasks. ICT training, in contrast, does not seem to have a high relevance.

ICT and competitive strategy

The decisive success factor in competition, for the questioned SMEs, is the *quality of products and services* (Figure 8). Of the companies, 63.4% fully agree with this statement, 29.9% rather agree (altogether 93.3% agreement). The *quality of complementary services* has an agreement rate of 87.8% (51.3% fully agree, 36.5% rather agree). Also at a high level (86.3%) is the concentration on the *needs of niche markets*. *Unique product features* play an important role in competition according to three-quarters of the SMEs.

With an agreement rate of 58.7%, the arrangement of *inter-company coordination and transaction processes* mentioned as a strategy for creating competitive advantage scores second place. Both small and medium-sized companies have recognized the potential of inter-company processes to improve competitiveness in their field and actively use it to differentiate themselves from others. In this field, ICT is particularly relevant between business partners.

Only 34.3% of the SMEs state that they would stand out from the competition because they are *low cost*

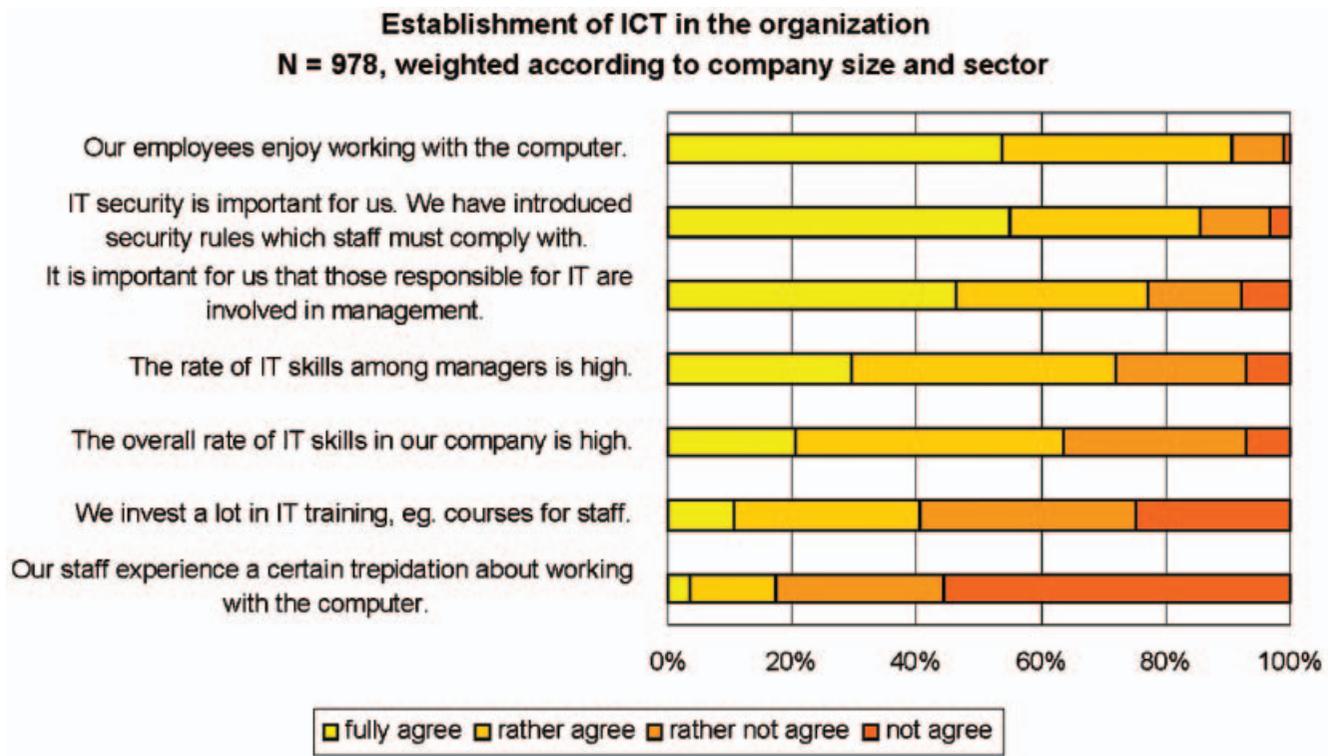


Figure 7. Establishment of ICT

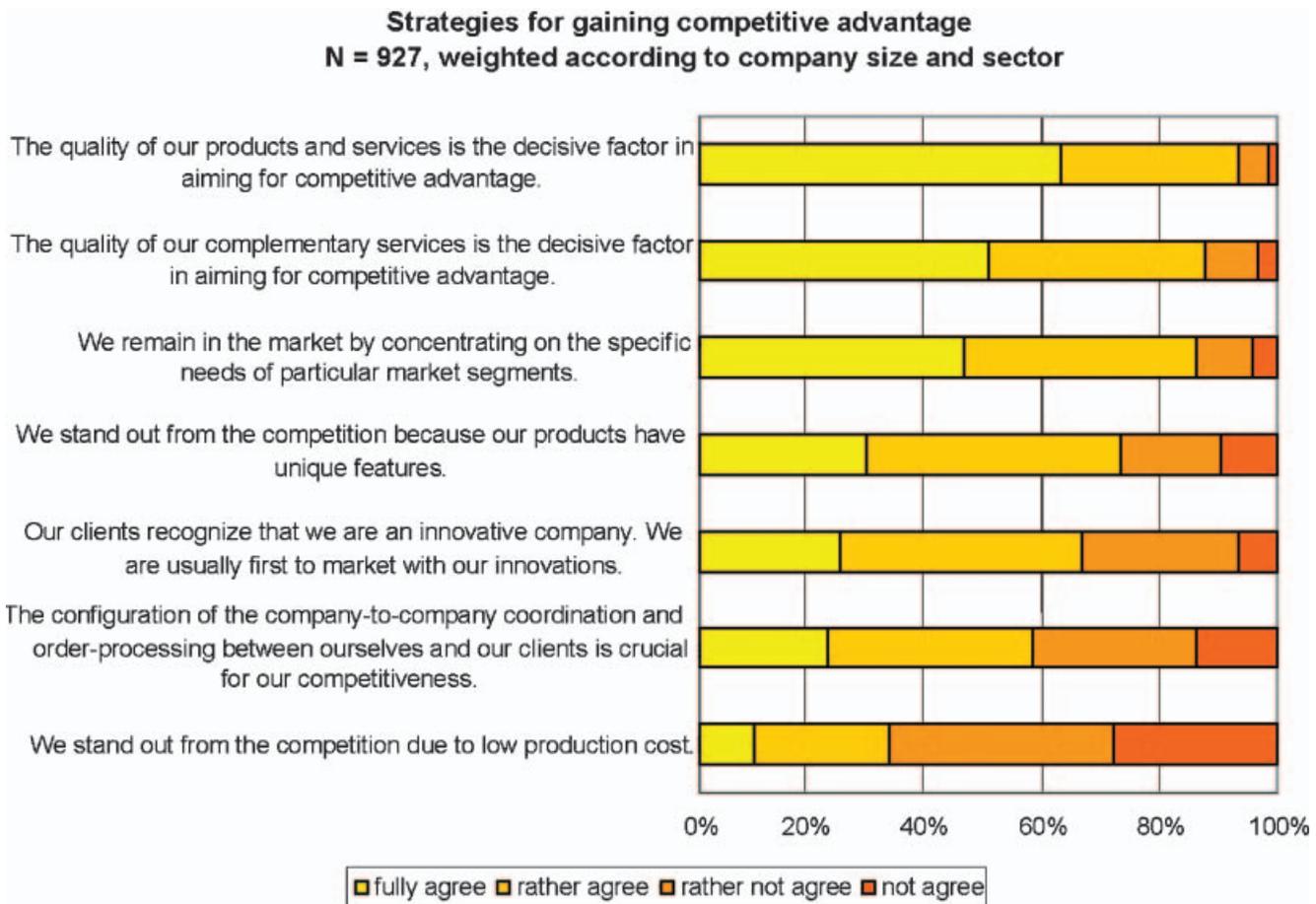


Figure 8. Strategies for gaining competitive advantage

suppliers. This is consistent with the image of Switzerland as a production location for expensive and high-quality products. Because of the high numbers of positive responses which occurred in other statements, it can be concluded that hardly any companies pursue a strategy based on mere price leadership.

The high level of agreement of the statements in total makes it clear that most of the companies follow several strategies in order to achieve competitive advantage. Quality and particular features of products and services are most often mentioned.

A comparison of the Swiss SMEs' competitive strategies (Figure 8) and the ICT-achieved effects of these strategies allows us to recognize a certain structure (Figure 9). In the attribute combination of *strategy* and *ICT support*, the following strategies receive the highest valuation (order corresponds to the characteristic/attribute combination valuation):

- Quality leadership in products (4)
- Quality leadership in services (5)
- Niche strategies (3)

These strategies are highly significant in the achievement of competitive advantage. Simultaneously, ICT use allows for the implementation of the strategies. It follows that these strategies bear a high strategic potential of ICT in SMEs.

A second group of strategies has a rather lesser significance in competition and is also, on the whole, supported by ICT to a lesser degree (order corresponds to the valuation of attribute/characteristic combination):

- Implementation of innovation (7)
- Support of inter-company processes (6)
- Differentiation advantages (2)

Figure 9 draws a comparison between the strategic alignment and the possibility to support the strategy using ICT. The 'perfect world' would be represented by a diagonal drawn from the lower left to the upper right of the figure where (in the assessment of our respondents) the importance of a strategy and the possibility to support this very strategy coincide. In the figure, we identify three different areas in respect to this diagonal. Area 1, 'cost leadership' is above the diagonal and thus 'over-equipped'. Area 2, comprising 'differentiation advantages', 'support of inter-company processes', and 'implementation of innovation' is close to the diagonal (well equipped). Area 3, with the most important strategies 'niche strategies', 'quality leadership in services', and 'quality leadership in products' falls below the diagonal and bears room for improvement.

The cost advantages that are to a large extent achieved by ICT use, play a rather subordinate role in the achievement of competitive advantage. Although ICT constitutes an important instrument for achieving cost advantages, its use cannot, to that effect, be described as strategic. Cost saving is, therefore, better regarded as an operative potential of ICT.

ICT is becoming an operative as well as a strategic significance in Swiss SMEs. The strategic potential lies primarily in the improvement of products and service quality as well as the support of niche strategies. The operative potential lies primarily in cost reduction. As for

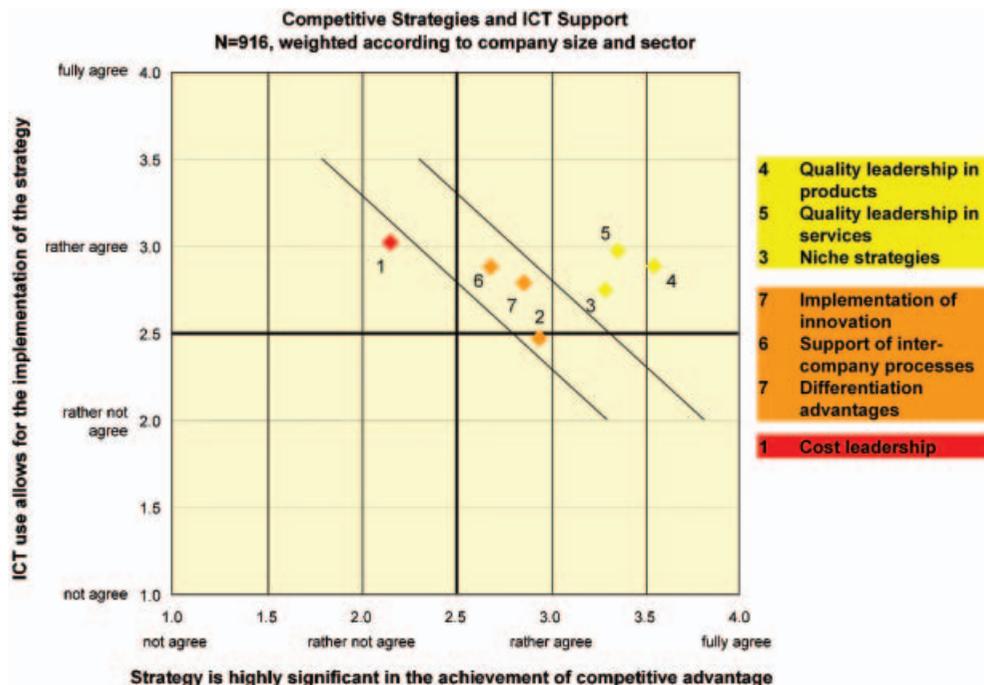


Figure 9. Competitive strategies and ICT support

Table 1. Assignment of the contingency coefficient

Contingency coefficient (CC)	Strength of association
$0.0 < CC < 0.1$	Not appreciable
$0.1 \leq CC < 0.2$	Weak
$0.2 \leq CC < 0.3$	Medium
$0.3 \leq CC$	Strong

the use of ICT to achieve innovation, to support inter-company processes, and to create distinctive advantage, it is impossible to generalize. Only the (particular) orientation of a specific company can determine here whether the operative or strategic significance predominates.

Of all things, the strategies that are stated to be most important for Swiss SMEs are obviously the ones that are most difficult to support by ICT. This third area (below the diagonal) represents an interesting potential for software vendors where future efforts for the improvement of business software could be aligned.

DISCUSSION OF ANALYTICAL FINDINGS

In this section we examine some factors that influence the importance of ICT for the company. We pose the question whether the organization of ICT has a significant influence on the achievement of company objectives.

The analysis of this section is based on a pairwise comparison of variables (bivariate analysis). We used the

nonparametric Pearson’s Chi-Square Test (Backhaus *et al.* 1996, Sachs 1992) which is well suited for the analysis of ordinal data (Stier 1999: 42 ff.]. Usually, an independence test is performed. The results are regarded as significant in the case that the probability of error is equal or smaller than 0.01 (1%). The association between two variables is measured with the Pearson’s contingency coefficient. Table 1 shows the assignment of the value of the contingency coefficient and the verbal description of the strength of association. Detailed results can be found in Tables A1–A5 in the appendix.

Determinants of the importance of ICT for SMEs

Due to the large number of responses (989) almost all test values are significant. This means that the probability of error is quite low for the results of our hypotheses tests. Although significance is high, the contingency coefficient is in many cases only low to middle. The following figures show the correlation between different areas of questions in the sample. The arrows show the dependency relations. The dotted or solid line indicates the intensity of the association.

In a first step, questions regarding *product and market situation* were taken as the exogenous factors in order to examine whether they have an influence on the *importance of ICT* in a company. The underlying hypotheses displayed in Figure 10 were examined. The formulated hypotheses make categorical data available in contingency tables (Steinborn 1993). Pearson’s chi-square test was used for the statistical analysis of the

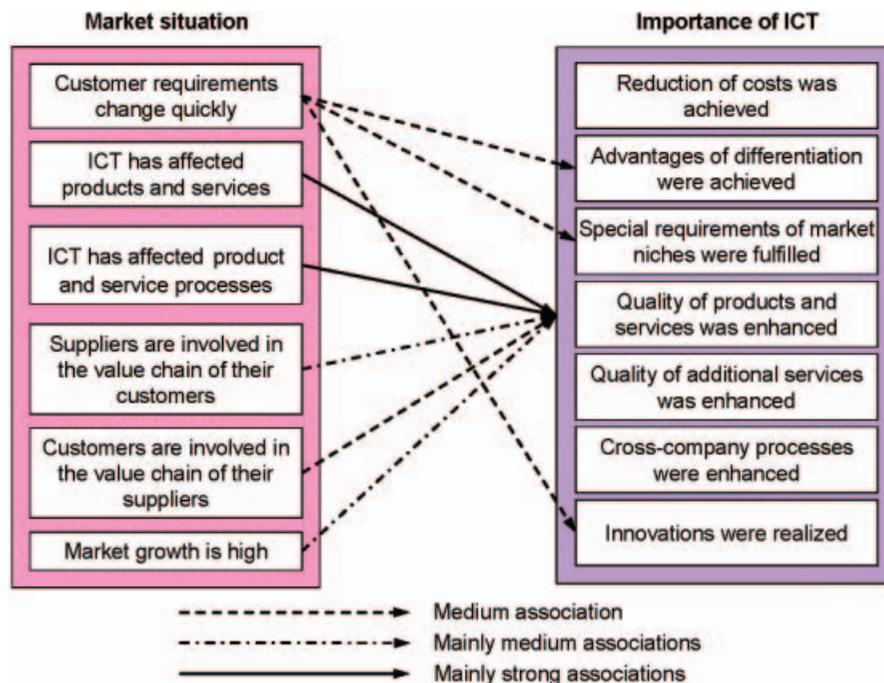


Figure 10. Contingencies between *market situation* and *importance of ICT*

contingency tables (cf. Backhaus *et al.* 1996, Sachs 1992). It allows qualitative conclusions on the dependency between two attributes (independency test) as well as the identification of respective levels of significance.

As we can see from Figure 10, almost all relations show a medium to strong relationship between the factors. The *importance of ICT* is higher in companies where *customer requirements* change quickly and where ICT has become an *integral part of products and services* or the *production processes* are characterized by ICT. Furthermore, ICT is more important for SMEs in which either *suppliers or customers are closely involved* in the value adding process. The market growth in the target markets also affects the importance of ICT. In companies focusing on markets with high growth rates the importance of ICT is more important to support strategies than in other companies.

In a second step, we looked at the influences of *company size* and *development of sales volume* on the *importance of ICT* (Figure 11). We expected company size to have a major impact on the use of ICT. This assumption, however, was not as clearly confirmed as we anticipated. There is a weak association between *company size* and *achievement of objectives* (correlation coefficient: 0.141) and another weak correlation regarding *staff access to necessary information* when out of office (CC: 0.141). All other values are not significant.

The results for the relationship between *company size* and *intensity of use* in different functional areas were also disappointing. *Internal services* (CC: 0.192), *procurement/purchasing* (CC: 1.161), *material and merchandise management* (CC: 0.183) showed at least weak correlations.

In this section we also asked for the *extent of ICT support* in the functional areas. The values were measured with a decreasing range from *company-to-company*

support, cross-company support, limited area support, to no support at all. The *range of ICT support* is less dependent on *company size* than we expected. The two areas *Accounting* (CC: 0.205) and *Management* (CC: 0.244) showed a medium correlation. *Human Resources Management* (CC: 0.188), *Internal Services* (CC: 0.190), *Procurement/Purchasing* (CC: 0.176), *Material and merchandise management* (CC: 0.198), *Production/operational goods and services* (CC: 0.172), and *Customer service* (CC: 0.148) are characterized by weak correlations.

In the second part of Figure 11 we intended to confirm a dependency between the *development of sales volume* and the *importance of ICT*. *Development of sales volume* has only a weak relationship with the *reduced lead time for production* (CC: 0.187). Another weak relationship could be found with *intensity of use* (CC: 0.180). All other values are not significant. None of the relationships between the *development of sales volume* and the *extent of support* are significant.

Establishment of ICT and ICT achievements

In a third step, we investigated the associations between the *establishment (penetration) of ICT* in the company and the resulting *targets that could be achieved* by using information technology (Figure 12). *Investments in ICT training* (CC: 0.297) and the *awareness of IT security* (CC: 0.261) are two factors that influence the feeling about *well-informedness of the employees* of the company. This supports the assumption that the better people are trained in the use of technology the better their access to the necessary information. It can be confirmed that companies with a *high level of IT security* have a stronger feeling that their *operative business processes run smoothly and securely* (CC: 0.296).

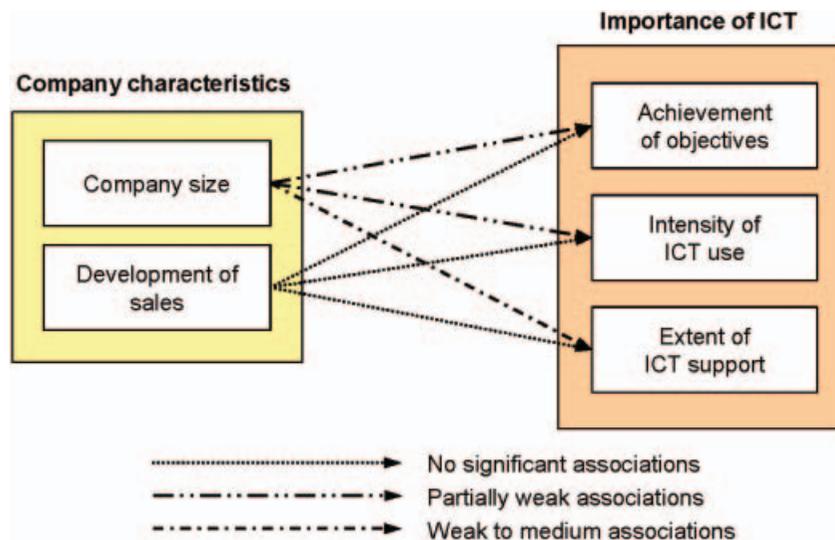


Figure 11. Contingencies regarding the *importance of ICT*

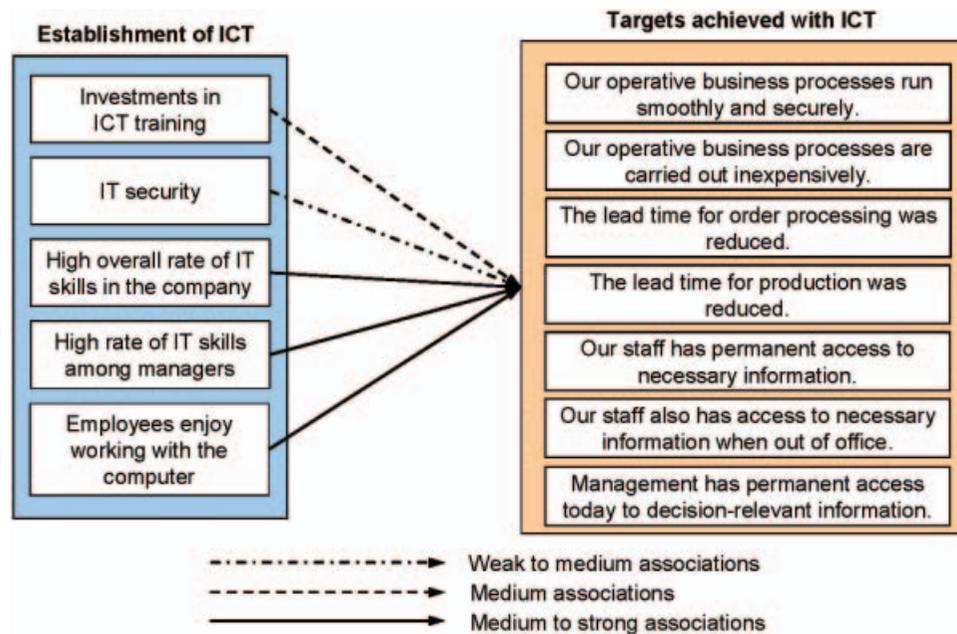


Figure 12. Contingencies between *establishment of ICT* and *ICT achievements*

The majority of respondents felt that the employees in their company enjoy working with the computer. Since this seems to be common in Swiss companies, it is plausible that we could not measure a special influence on the *achievement of ICT targets*. An existing *high overall rate of IT skills in the company* has a medium to strong impact on all other *targets achieved*. It is thus the highest impact factor for successfully deploying information technology in the tests we have performed so far.

CONCLUSIONS AND FUTURE RESEARCH

The paper contributes to the discussion about the value of ICT for companies. We have shown that there are noticeable dependencies between company characteristics and the degree in which a company succeeds in reaping benefits from the use of ICT. Swiss SMEs – in their self-assessment – manage to gain (competitive) advantages from the deployment of information and communication technology. The Netreport is, however, limited in its suitability to explain *how* companies can exploit ICT. It is a *quantitative* study and can only reveal *that* companies manage to gain competitive advantages. Driven by the interest of *how* companies actually achieve this competitive advantage we performed a subsequent *qualitative* study looking at 16 case studies of Swiss companies. We found out that each of these companies had figured out a *very specific* way of supporting their value-generating business processes with ICT (Schubert 2006). Their business processes (and thus their source for business excellence) seem to be almost impossible to copy by potential competitors.

According to the best knowledge of the authors, there has never been a comparably extensive and long-term-oriented series of studies about ‘ICT use in Swiss SMEs’. The findings have a high explanatory power due to the large amount of responses; more than 1,000 questionnaires were returned (989 could be used). The results are representative for Switzerland with regard to company size and industry sector.

In summary, the results show that the use of ICT is on a surprisingly high level in Swiss SMEs. This is above all reflected in the following outcomes:

- ICT is extensively used (even) in (small and medium-sized) companies.
- There is a high degree of inter-organizational ICT use (inter-organizational systems).
- ICT is strongly rooted in management (high involvement and skills of managers).
- ICT successfully supports competitive strategies (=IT matters!).

In the first part of the questionnaire we asked the respondents about the characteristics of their current business environment. The predominant amount of Swiss SMEs offers customer-specific products and services that are recurrent and clearly specifiable. ICT is deployed in order to efficiently support customer-specific orders. The decisive success factor for competitive advantage is the quality of products and services. The competition in the target markets is fierce (quoted by almost all participants). Companies need to stand up to powerful competitors. At the same time, markets suffer in most cases from a low growth rate. ICT is, therefore, mainly used for *increased efficiency and process*

optimization. Since the increase in sales is difficult, the optimization of production and business process becomes the centre of attention. Requirements of customers regarding products and services are constantly and quickly changing. This hints at high demands towards adaptiveness both in terms of product changes as well as the adaptation to inter-company coordination processes. Not only production processes but also the products themselves are to a large extent permeated by ICT.

The second part of the questionnaire was geared at the actual deployment of ICT. The findings confirm that operative business processes are effectively supported by ICT. Many companies feel that they have smooth and secure processes. Information systems are today apparently so mature that the majority of respondents claim that employees have access to required information at all times. In total, the companies agree that the proposed objectives can be achieved with the help of ICT. We conclude that SMEs are by all means capable of using ICT purposefully and successfully to support their business processes.

In part three the participants were asked about the organization of their ICT. It could be shown that a number of small companies do not have employees who are especially dedicated to ICT. These companies either do not use ICT or have totally outsourced ICT to service providers. As a general rule, hardware is renewed every one to three years, at least all four to six years. This shows, that the majority of respondents work with quite current IT equipment. It is remarkable that most employees enjoy working with the computer. IT security is a top priority in many companies. ICT skills are surprisingly high on the management level. It can be noted that investments in ICT training are quite low at the moment.

We assume that there is a slight systematic distortion of the results because the participants that took (deliberately) part in the survey had an above-average interest for ICT questions and had been intensively involved in ICT issues in the past. The authors are confident that this possible distortion was levelled with the help of the telephone interviews (47% of the responses). People called on the telephone might have a lesser predisposition for ICT than the ones that actively complete written questionnaires.

The final objective of our study on ICT use in SMEs is the identification of typical ICT company patterns. The resulting clusters are intended to be characterized by a combination of *observable characteristics* and the *typical attitude* towards strategic and operational use of ICT. Let us assume the following example (Figure 13): a company operating in the manufacturing industry (140 employees) has most of its customers in Germany. This company would – by means of matching it with a cluster of similar companies – have a high likelihood of not using ICT very intensively, tend to spend little in ICT training

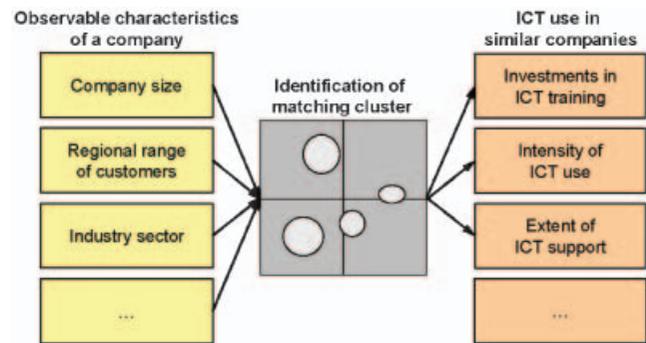


Figure 13. Search for typical ICT company clusters

and could be characterized by a high level of ICT outsourcing.

We are thus trying to develop an ‘ICT classification’ for SMEs. Looking at their typical peer group they could run a ‘fitness test’ on their ICT deployment and find out if ICT could benefit their business more effectively.

The building of clusters and typical ICT company profiles aims at two additional target groups: (1) It should offer orientation for *ICT consultants*: knowing the external characteristics of a lead customer they should get an idea how to best serve him. What are the typical needs and opportunities for such a company? (2) The second target group are *ICT vendors*. They should be able to improve their products and services knowing better what their customers actually need.

The study in 2005 presented a first step towards the identification of clusters. The future surveys will validate and refine the profiling of companies. The longitudinal orientation of the research helps to gradually improve the theoretical model that is currently developed.

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APPENDIX

Table A1. Contingency table regarding market situation and importance of ICT

<i>Criterion 1</i>	<i>Criterion 2</i>	χ^2 *)	<i>df</i> **)	α ***)	<i>CC</i> ****)	<i>Association</i>
Customer requirements reg. products & services change quickly	Reduction of costs was achieved	15.519	9	0.01	0.130	weak
	Advantages of differentiation were achieved	40.134	9	0.0005	0.213	medium
	Special requirements of market niches were fulfilled	52.471	9	0.0005	0.239	medium
	Quality of products and services was enhanced	36.382	9	0.0005	0.196	weak
	Quality of additional services was enhanced	32.367	9	0.0005	0.187	weak
	Cross-company processes were enhanced	32.438	9	0.0005	0.188	weak
	Innovations were realized	41.074	9	0.0005	0.211	medium
ICT has affected products & services	Reduction of costs was achieved	66.192	9	0.0005	0.260	medium
	Advantages of differentiation were achieved	86.875	9	0.0005	0.305	strong
	Special requirements of market niches were fulfilled	75.580	9	0.0005	0.282	medium
	Quality of products and services was enhanced	130.213	9	0.0005	0.352	strong
	Quality of additional services was enhanced	100.545	9	0.0005	0.318	strong
	Cross-company processes were enhanced	98.670	9	0.0005	0.316	strong
	Innovations were realized	90.527	9	0.0005	0.303	strong
Production processes are characterized by the application of ICT	Reduction of costs was achieved	80.604	9	0.0005	0.285	medium
	Advantages of differentiation were achieved	96.988	9	0.0005	0.320	strong
	Special requirements of market niches were fulfilled	110.513	9	0.0005	0.335	strong
	Quality of products and services was enhanced	173.613	9	0.0005	0.399	strong
	Quality of additional services was enhanced	136.566	9	0.0005	0.364	strong
	Cross-company processes were enhanced	111.971	9	0.0005	0.335	strong
	Innovations were realized	97.028	9	0.0005	0.314	strong

*) Pearson's Chi-square; n.a.=test not applicable

**) Degrees of freedom

***) Residual probability of error α ; results are assumed to be significant, if $\alpha \leq 0.01$ (1%); n.s.=not significant

****) Pearson's contingency coefficient

Table A2. Contingency table regarding market situation and importance of ICT (continued)

<i>Criterion 1</i>	<i>Criterion 2</i>	<i>Specification of Criterion 2</i>	χ^2 *)	<i>df</i> **)	α ***)	<i>CC</i> ****)	<i>Association</i>
Company size	Achievement of objectives	Our operative business processes run smoothly and securely	2.702	6	n.s.	0.053	n.s.
		Our operative business processes are carried out inexpensively	4.459	6	n.s.	0.069	n.s.
		The lead time for order processing was reduced	2.721	6	n.s.	0.055	n.s.
		The lead time for production was reduced	17.352	6	0.01	0.141	weak
		Our staff has permanent access to necessary information	15.960	6	n.s.	0.127	n.s.
		Our staff also has access to necessary information when out of office	18.524	6	0.005	0.141	weak
		Management has permanent access today to decision-relevant information	5.705	6	n.s.	0.077	n.s.
Intensity of ICT use		Finance and accounting	n.a.	6			
		Human Resources Management	16.548	6	n.s.	0.129	n.s.
		Management	16.567	6	n.s.	0.130	n.s.
		Internal Services	36.409	6	0.0005	0.192	weak
		Procurement/Purchasing	24.936	6	0.0005	0.161	weak
		Product development	12.263	6	n.s.	0.123	n.s.
		Material and merchandise management	29.774	6	0.0005	0.183	weak
		Production/operational goods and services	10.564	6	n.s.	0.109	n.s.
		Marketing and distribution	5.801	6	n.s.	0.081	n.s.
Customer Services	6.841	6	n.s.	0.086	n.s.		
Extent of ICT support		Finance and accounting	41.519	6	0.0005	0.205	medium
		Human Resources Management	34.963	6	0.0005	0.188	weak
		Management	59.008	6	0.0005	0.244	medium
		Internal Services	33.950	6	0.0005	0.190	weak
		Procurement/Purchasing	28.741	6	0.0005	0.176	weak
		Product development	14.964	6	n.s.	0.135	n.s.
		Material and merchandise management	35.608	6	0.0005	0.198	weak
		Production/operational goods and services	26.379	6	0.0005	0.172	weak
		Marketing and distribution	13.085	6	n.s.	0.122	n.s.
Customer Services	20.211	6	0.005	0.148	weak		

*) Pearson's Chi-square; n.a.=test not applicable

**) Degrees of freedom

***) Residual probability of error α ; results are assumed to be significant, if $\alpha \leq 0.01$ (1%); n.s.=not significant

****) Pearson's contingency coefficient

Table A3. Contingency table regarding company size and the importance of ICT

<i>Criterion 1</i>	<i>Criterion 2</i>	χ^2 *)	<i>df</i> **)	α ***)	<i>CC</i> ****)	<i>Association</i>
Suppliers are involved in the value chain of their customers	Reduction of costs was achieved	29.584	9	0.001	0.187	weak
	Advantages of differentiation were achieved	53.046	9	0.0005	0.255	medium
	Special requirements of market niches were fulfilled	61.994	9	0.0005	0.270	medium
	Quality of products and services was enhanced	46.097	9	0.0005	0.232	medium
	Quality of additional services was enhanced	48.356	9	0.0005	0.240	medium
	Cross-company processes were enhanced	46.004	9	0.0005	0.235	medium
	Innovations were realized	33.671	9	0.0005	0.202	medium
Customers are involved in the value chain of their suppliers	Reduction of costs was achieved	34.498	9	0.0005	0.201	medium
	Advantages of differentiation were achieved	62.206	9	0.0005	0.273	medium
	Special requirements of market niches were fulfilled	55.079	9	0.0005	0.254	medium
	Quality of products and services was enhanced	43.178	9	0.0005	0.224	medium
	Quality of additional services was enhanced	63.601	9	0.0005	0.271	medium
	Cross-company processes were enhanced	42.683	9	0.0005	0.225	medium
	Innovations were realized	45.937	9	0.0005	0.233	medium
Market growth is high	Reduction of costs was achieved	30.766	9	0.0005	0.185	weak
	Advantages of differentiation were achieved	53.626	9	0.0005	0.248	medium
	Special requirements of market niches were fulfilled	50.170	9	0.0005	0.237	medium
	Quality of products and services was enhanced	55.273	9	0.0005	0.244	medium
	Quality of additional services was enhanced	30.697	9	0.0005	0.186	weak
	Cross-company processes were enhanced	44.506	9	0.0005	0.223	medium
	Innovations were realized	51.537	9	0.0005	0.239	medium

*) Pearson's Chi-square; n.a.=test not applicable

**) Degrees of freedom

***) Residual probability of error α ; results are assumed to be significant, if $\alpha \leq 0.01$ (1%); n.s.=not significant

****) Pearson's contingency coefficient

Table A4. Contingency table regarding development of sales and the importance of ICT

<i>Criterion 1</i>	<i>Criterion 2</i>	<i>Specification of Criterion 2</i>	χ^2 ^{*)}	<i>df</i> ^{**)}	α ^{***)}	<i>CC</i> ^{****)}	<i>Association</i>
Development of sales	Achievement of objectives	Our operative business processes run smoothly and securely	n.a	12			
		Our operative business processes are carried out inexpensively	n.a	12			
		The lead time for order processing was reduced	n.a	12			
		The lead time for production was reduced	n.a	12			
		Our staff has permanent access to necessary information	n.a	12			
		Our staff also has access to necessary information when out of office	n.a	12			
		Management has permanent access today to decision-relevant information	n.a	12			
Intensity of ICT use	Finance and accounting	Finance and accounting	n.a	12			
		Human Resources Management	n.a	12			
		Management	n.a	12			
		Internal Services	n.a	12			
		Procurement/Purchasing	n.a	12			
		Product development	n.a	12			
		Material and merchandise management	n.a	12			
		Production/operational goods and services	n.a	12			
		Marketing and distribution	n.a	12			
Customer Services	n.a	12					
Extent of ICT support	Finance and accounting	Finance and accounting	n.a	12			
		Human Resources Management	n.a	12			
		Management	n.a	12			
		Internal Services	n.a	12			
		Procurement/Purchasing	n.a	12			
		Product development	n.a	12			
		Material and merchandise management	n.a	12			
		Production/operational goods and services	n.a	12			
		Marketing and distribution	n.a	12			
Customer Services	n.a	12					

*) Pearson's Chi-square; n.a.=test not applicable

**) Degrees of freedom

***) Residual probability of error α ; results are assumed to be significant, if $\alpha \leq 0.01$ (1%); n.s.=not significant

****) Pearson's contingency coefficient

Table A5. Contingency table regarding the establishment of ICT and ICT achievements

<i>Criterion 1</i>	<i>Criterion 2</i>	χ^2 *)	<i>df</i> **)	α ***)	<i>CC</i> ****)	<i>Association</i>
Investments in ICT training	Our operative business processes run smoothly and securely	39.427	9	0.0005	0.200	medium
	Our operative business processes are carried out inexpensively	59.706	9	0.0005	0.246	medium
	The lead time for order processing was reduced	64.149	9	0.0005	0.251	medium
	The lead time for production was reduced	71.780	9	0.0005	0.278	medium
	Our staff has permanent access to necessary information	92.596	9	0.0005	0.297	medium
	Our staff also has access to necessary information when out of office	75.511	9	0.0005	0.277	medium
	Management has permanent access today to decision-relevant information	43.227	9	0.0005	0.209	medium
IT security	Our operative business processes run smoothly and securely	91.627	9	0.0005	0.296	medium
	Our operative business processes are carried out inexpensively	47.584	9	0.0005	0.221	medium
	The lead time for order processing was reduced	34.921	9	0.0005	0.192	weak
	The lead time for production was reduced	38.731	9	0.0005	0.208	medium
	Our staff has permanent access to necessary information	70.541	9	0.0005	0.261	medium
	Our staff also has access to necessary information when out of office	55.688	9	0.0005	0.240	medium
	Management has permanent access today to decision-relevant information	84.922	9	0.0005	0.286	medium
High overall rate of IT skills in the company	Our operative business processes run smoothly and securely	94.888	9	0.0005	0.301	strong
	Our operative business processes are carried out inexpensively	77.591	9	0.0005	0.278	medium
	The lead time for order processing was reduced	56.571	9	0.0005	0.242	medium
	The lead time for production was reduced	62.382	9	0.0005	0.261	medium
	Our staff has permanent access to necessary information	105.265	9	0.0005	0.314	strong
	Our staff also has access to necessary information when out of office	92.748	9	0.0005	0.304	strong
	Management has permanent access today to decision-relevant information	84.026	9	0.0005	0.285	medium
High rate of IT skills among managers	Our operative business processes run smoothly and securely	57.723	9	0.0005	0.241	medium
	Our operative business processes are carried out inexpensively	88.422	9	0.0005	0.296	medium
	The lead time for order processing was reduced	76.992	9	0.0005	0.281	medium
	The lead time for production was reduced	70.619	9	0.0005	0.277	medium
	Our staff has permanent access to necessary information	72.328	9	0.0005	0.266	medium
	Our staff also has access to necessary information when out of office	69.443	9	0.0005	0.268	medium
	Management has permanent access today to decision-relevant information	102.027	9	0.0005	0.312	strong
Employees enjoy working with the computer	Our staff has permanent access to necessary information	103.794	9	0.0005	0.312	strong

*) Pearson's Chi-square; n.a.=test not applicable

**) Degrees of freedom

***) Residual probability of error α ; results are assumed to be significant, if $\alpha \leq 0.01$ (1%); n.s.=not significant

****) Pearson's contingency coefficient