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Digital economy and structural change

Rising stars in information and communication technology

- The **quest for more efficiency and security** is reflected in the economy as a whole, but especially in product and process innovations in information and communication technology (ICT). In this report we examine the ten concepts considered to have the brightest prospects in the business segment in terms of their potential to gain widespread use during this decade. The concepts are: **internet telephony** (VoIP), **advanced mobile radio technology** (WLAN, UMTS, WiMax), biometrics, quantum cryptography, Model Driven Architecture (MDA), **decentralised storage** (ILM), **decentralised data processing** (grid computing), **open-source software, outsourcing, and radio tagging** (RFID).
- Vendors of innovative products and processes in information and communication technology can build on growth rates that are clearly above average. The **three most promising concepts are biometrics, open-source software and radio tagging**. However, we believe the public overestimates the potential of internet telephony and grid computing.
- The higher security risks since September 11, 2001 have led to a massive increase in the demand for biometric products in the public and private sectors. **Between 2002 and 2010, the worldwide market for biometric products is likely to grow by a factor of 40** to over EUR 5 bn.
- The allure of the decentralised **open-source approach is its capacity to revolutionise the software market**. In view of both security and after-sales service, lingering reservations about open-source are expected to decrease as the concept becomes increasingly widespread. The idea enjoys support from different directions, which underlines the significance of open-source for the whole IT market.
- Radio tagging offers the possibility of creating a data profile for goods in order to improve flows of information along the value chain. The application possibilities for radio tagging are far more than simply a replacement for bar codes in wholesale and retail. With the resolution of pressing requirements in the areas of technology, regulation and marketing, the overall **market for radio tagging in Europe could grow 10-fold over the next six years** to reach EUR 4 bn.
- The **success of internet telephony in the mass market is questionable**. The insufficient cost advantage, limited reachability of service numbers and the fear of electronic eavesdropping have a sustained dampening effect on its prospects.
- Commercial **success of grid computing is uncertain** in view of the low actual number of upcoming projects.

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Rising stars in information and communication technology

Since the flop of the "new economy" in the equity markets, the mood in the markets for information and communication technologies (ICT) has lightened. New products and processes have altered business in all segments of the economy. In this study, we discuss the ICT innovations considered to have the brightest prospects for business applications over this decade. We differentiate between the ICT trend and the ICT concept as two levels of abstraction. The higher level of ICT trends describes progressive driving factors and companies' strategic goals. The dominant trends will influence ICT innovations throughout this decade and beyond. The lower level of ICT concepts describes concrete products and processes which reflect market trends. The ICT concepts presented in this study raise the expectation of fundamentally changing the business client segment within this decade.[1] We analyse the concepts considered to have bright prospects in terms of potential.

Efficiency and security drive innovation

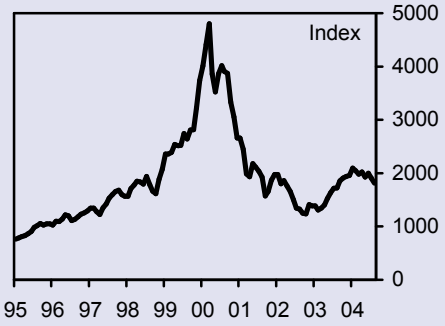
Two major distinct ICT trends have crystallised in the course of the economic, political and technological changes of recent years. For one, the bursting of the "new economy" equity bubble has led decision-makers to focus increasingly on a drive for more efficiency. For another, security has become more and more significant, mainly as a result of September 11, 2001 but also with the advanced complexity of the internet and increasing web attacks. The drive for increased security encompasses the greater reliability of processes (e.g. guaranteed or always accessible bandwidth of data transfer) as well as the confidentiality and integrity of the information. Another particularly relevant aspect of IT security is protection from spying, data sabotage and destruction. Data transmission in the anarchically-organised, anonymous World Wide Web (WWW) is open to spying and attacks from worms and viruses. The dangers are striking. In May 2004 alone, 1,000 new viruses entered the internet – a number only topped back in December 2001. Alongside this, there has been an increase in the number of fraudulent phishing mails (phishing: a word coined from "password" and "fishing") which spy on the confidential details of bank customers (e.g. card number, password, PIN). In Germany alone the number of cases has risen from 300 to 200,000 in twelve months.

The two trends of security and efficiency have a particular impact on product and process innovation in ICT. However, the two trends do not necessarily point in the same direction. At least on a short-term basis, and assuming the status of business as usual, the pursuit of greater efficiency may conflict with investments in security.

Leading ICT concepts in public debate

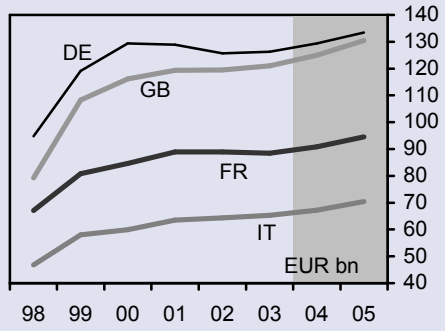
In this report we examine the ten most intensively discussed ICT concepts – which derive from the two determining trends discussed above – to actually gain widespread use. These ten innovative ICT products and processes are:

NASDAQ



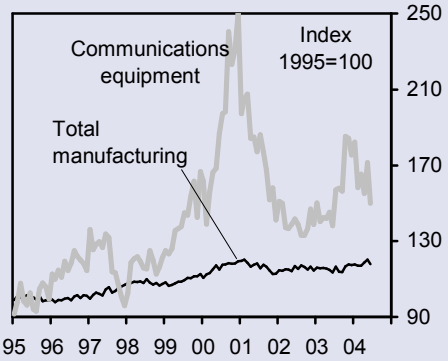
Source: DB Research, 2004

International ICT market



Source: EITO, 2004

Manufacturing output, Germany



Source: Federal Statistical Office, 2004

[1] This study describes particularly relevant ICT concepts, but does not attempt to deliver a complete overview. Because of the differing market focus or the longer time-to-market period, the study does not, e.g. touch on consumer electronics, the semantic web or nanotechnology.

- internet telephony (Voice over Internet Protocol, VoIP)
- advanced radio wave technology, especially Universal Mobile Telecommunication Systems (UMTS), Wireless Local Area Network (WLAN) and Worldwide Interoperability for Microwave Access (WiMax)
- biometrics
- quantum cryptography
- Model Driven Architecture (MDA)
- decentralised data storage, especially Information Lifecycle Management (ILM)
- decentralised data processing, especially grid computing
- open-source software
- outsourcing
- radio tagging (Radio Frequency Identification Transponder, RFID tag).

Ten significant ICT concepts tested for potential to gain widespread use

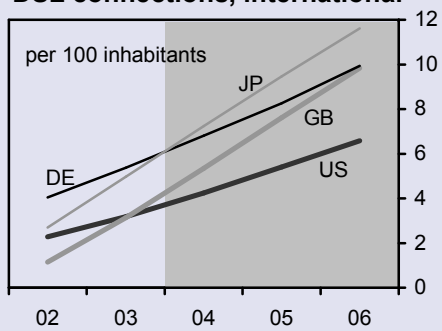
Deutsche Bank Research has already investigated four of the main ICT concepts – namely, advanced mobile telephony[2], biometrics[3], open-source software[4] and outsourcing[5] – in other contexts. Thus we present these four concepts, unlike the other six, only in terms of their recent market-relevant developments.

Voice communication via the internet a hot topic

Boundaries blurred between separate business fields

Innovations in the ICT area are blurring the boundaries between business fields that were once clearly separate. Web providers who specialise in data transport over fixed lines are broadening their applications to include internet telephony (Voice over Internet Protocol, VoIP) and are coming into direct competition with standard voice telephony. VoIP's first launch onto the market petered out in the mid-1990s. Installing the technology necessary at that time was very complex, and in addition the actual speech quality proved to be un-satisfactory. This explains why only 2% of the phone minutes in Germany are generated by the 300,000 registered VoIP connections. Now, however, user-friendly technology and up to 90% cheaper tariffs[6] are enticing customers to make the change from their usual telephone lines to VoIP. Nonetheless, the market success of VoIP depends on two significant factors. VoIP's attraction increases with the spread of innovative broadband transmission technology, especially Digital Subscriber Line (DSL). DSL is the fixed-line technology particularly relevant to small and medium-sized enterprises (SMEs). Only broadband telecommunication networks can currently guarantee the quality of VoIP services in terms of real-time data transmission. VoIP's attraction also increases with the number of expensive calls abroad. Thus VoIP is aimed predominantly at large companies with locations all over the globe.

DSL connections, international



Source: EITO, 2004

2 See Heng, Stefan (2004): Mobile telephony – cooperation and value-added are key to further success, in: Deutsche Bank Research, E-conomics No. 42, Frankfurt.

3 See Grüneich, Armin (2002): Biometrics – Hype and Reality, in: Deutsche Bank Research, E-conomics No. 28, Frankfurt.

4 See Hofmann, Jan (2002): Free software, big business? Open-source programs tightening their grip on industry and the public sector, in: Deutsche Bank Research, E-conomics No. 32, Frankfurt.

5 See Schaaf, Jürgen (2004): IT outsourcing: between starvation diet and nouvelle cuisine, in: Deutsche Bank Research, E-conomics No. 41, Frankfurt.

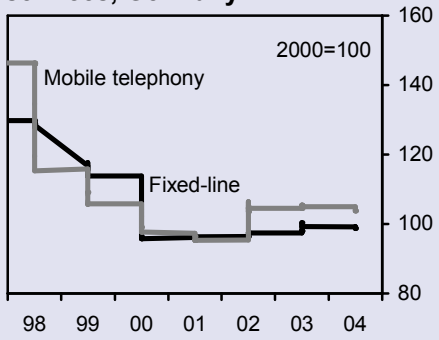
6 There is only a sizeable cost difference when telephoning abroad at peak time. The tariffs for off-peak local connections differ only by a few cents.

These companies find it worth investing in a VoIP infrastructure because their running telephone charges are so high and the operation of their own network is so expensive.

It can be called into question whether VoIP can reach the mass market, apart from international companies and private technology enthusiasts. Its success depends on the strategy of traditional network companies in terms of their products (specifically DSL) and customer charges in fixed-line and mobile telephony. Several factors have a sustained dampening effect on VoIP's prospects: the only minor difference from fees charged to customers in already established systems, limited access to emergency and service numbers, as well as potential customers' fear of wiretapping and unsolicited advertising. As a result, VoIP has much smaller potential as an independent service outside the provider's inclusive service package than had been hoped for initially.

Voice telephony by means of the internet is a prominent example of the convergence of technology areas that used to be clearly distinct. VoIP addresses the issue of cost reduction and thus reflects the trend towards efficiency. The security aspect, specifically in the form of information confidentiality, is not that important from the standpoint of the current typical VoIP user – but it will gain significance in future.

Consumer price index, telecom services, Germany



Source: Federal Statistical Office, 2004

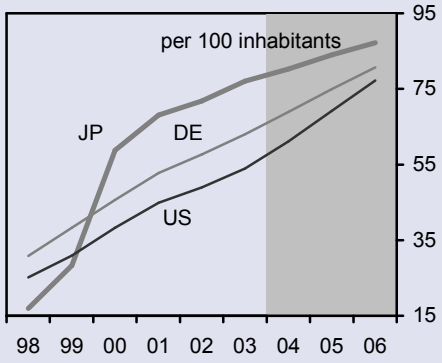
Steady increase in wireless ICT

Mobile telephony is conquering the market for data communication

Competition in the segment is not limited to fixed-line voice telephony. Mobile telephony – originally conceived for voice communication – is conquering the market for data communication with innovative applications. Data communication in the business client spectrum is conducted largely with stationary user terminals. Usually a desktop PC or notebook is connected via fixed access to the company's data network. Before the end of this decade, advanced applications such as remote task management and invoicing will sweep the market. Travelling salesmen in particular want wireless capacity-intensive services, like comprehensive databases, that are easy to use.

However, the integration of mobile solutions into companies' existing ICT structures can often prove difficult owing to the varying system-related demands of producers of user devices, of network equipment and software. Enhanced desktop applications may not necessarily be transmitted to portable terminals, particularly the very small Personal Digital Assistant (PDA). A number of mobile terminals are being equipped with mainstream company software, but there are still questions regarding graphic presentation and broadband data transmission.

Mobile phone penetration, international



Sources: EITO, DB Research, 2004

While mobile networks do not yet support the vision of seamless mobile offices, the end of the decade may see a quantum leap in mobile transmission technology. Wireless Local Area Network (WLAN), with its 54 Mbit/s transmission rate, is particularly suited for broadband data communication. This transmission speed is 1,000 times greater than in analogue fixed-line networks and comparable to DSL fixed-line technology. A stumbling block for the further spread of WLAN is the small cell size, which only allows data transmission within a maximum radius of 500 m. Uninterrupted connection delivery during transfer between WLAN cells has yet to be guaranteed. Besides the unresolved technical challenges, the stand-alone tariff models adopted by the providers are also causing the market relevance of WLAN to decline. As long as competing WLAN operators fail to harmonise their invoicing models, the market for stand-alone WLAN solutions will inevitably remain small. The

combination of WLAN and Universal Mobile Telecommunication System (UMTS), the third generation (3G) of mobile transmission technologies, will make a positive contribution in the next few years. Moreover, Worldwide Interoperability for Microwave Access (WiMax), a mobile technology, will be available to the user by the end of this decade. This advance in mobile telephony, still in trial phase, has a transmission rate of 70 Mbit/s with a cell average of up to 50 km given ideal conditions. WiMax is therefore opening the door to new markets for all aspects of data telephony.

Need for action on communication of confidential information

The new generation of mobile phones and the observed convergence of mobile technologies (convergence of voice and data transmission) are a milestone on the path to seamless communication and more efficient work processes. Mobile phone technology continues to face challenges in terms of the security aspect, though. There is particular need for action in the communication of confidential information and the area of guaranteed, always accessible transmission capacity.

Quantum cryptography provides confidentiality

Security of a system proved primarily in business-as-usual conditions

The convergence of information and communication technologies places demands on those responsible for corporate security, with the weakest link in the chain determining the security level for the system as a whole. Security is always a concern for the whole company, but especially for IT processes and IT infrastructure. However, the security of a system is not proved just in the spectacular cases of defence against hackers, worm and virus attacks, or the disaster recovery and business continuity plans in the catastrophic case of destroyed infrastructure. More often, it is the daily work processes – especially confidential data transfer and the authentication of business partners – that determine the security level of a system.

Quantum conditions transmit confidential information

Confidentiality and integrity of information are key business principles. Companies constantly need to implement more and more complex coding processes in order to stay safely ahead of hackers. The physical method of quantum cryptography provides a new way of encoding confidential data that breaks away from the costly race to find the most secure method of mathematical encoding. In comparison to coding by Public Key Infrastructure (PKI), quantum cryptography does not include a code key which could be attacked by hackers. Instead of mathematical combinations, quantum cryptography transmits information by means of certain quantum conditions. Electronic eavesdropping physically alters the quantum conditions and thus the information itself. In this way the attack is exposed immediately. Quantum cryptography is likely to be rolled out in the commercial market by the end of this decade. At present, it still faces problems with the transmission of data over long distances. If this requirement can be dealt with, the financial and insurance industries in particular stand to be the prototypical users of this security technology and will show strong demand. This very promising circle of potential customers opens lucrative market potential to quantum cryptography.

Users from financial and insurance industries

Politics fostering biometric breakthrough

Biometrics as a weapon in war on terror

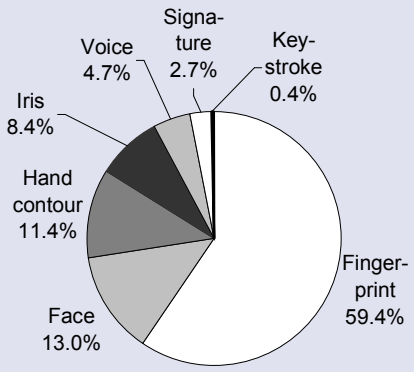
In the broad field of security, biometrics emerges repeatedly alongside quantum cryptography as a major development. Depending on its area of use, biometrics is aimed at the identification and/or authentication of the user, based on the person's physical and behavioural characteristics. Biometric characteristics include the fingerprint, facial geometry, the characteristic pattern of the iris, the geometry of the hand and even motor movement when typing or

walking. At present, biometric systems fail to recognise one person in 50. If this failure rate can be reduced further, biometric fingerprint recognition, especially, has extensive possibilities for use in the mass market.

Government authorities around the globe are working intensively to make further strides in the development of biometrics. The US government initially planned to deny entry to travellers without a visa from October 2004 onwards unless their passports contained biometric data. Meanwhile, Congress has postponed this deadline, although the demand for passports containing biometric data still exists in principle. Political decisions following September 11, 2001 – war on terror and international organised crime – have played a significant role in the upsurge in this area. According to *Frost&Sullivan* estimates, the worldwide market for biometric products amounted to EUR 150 m in 2002; by 2010 it could exceed EUR 6 bn.

Quantum cryptography and biometrics have long been recognised as suitable security solutions by decision-makers in the public and private sectors. However, over the entire period, investment in both concepts is not sufficiently met by operating profit in the accounts. Nonetheless, quantum cryptography and biometrics present major opportunities, not least making necessary security precautions more efficient. Here they reconcile the two often contradictory trends of security and efficiency.

Starting points for biometric systems



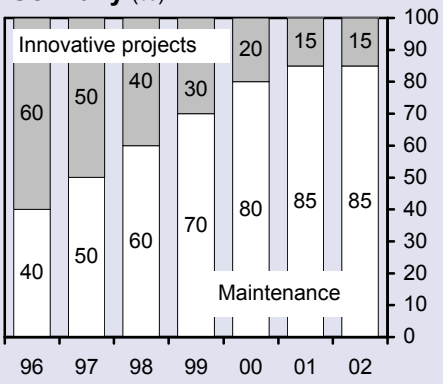
Source: International Biometric Group, 2004

Automation of programming

The share of spending on the upkeep of IT systems has clearly increased over recent years. At the same time, systems have to be upgraded with dramatically reduced budgets. Company decisions have thus come to focus not only on security but also on the cost-effective development of software components. As seen before in the traditional industry sectors, automation and standardisation are now making headway in the area of software. Automated programming on the basis of Model Driven Architecture (MDA) offers a new point of departure. In developing programs, MDA moves away from simple coding and towards creative models. The goal is to link information semantically in order to create specifically-adapted software. In effect, MDA addresses the cost-intensive errors frequently encountered in programming. The associated production failures add up to EUR 50 bn a year in the US.

According to the new MDA concept, complex machine codes will no longer be developed or input by humans. Instead, a programming machine will gather concrete customer demands and compile a tailor-made system from modular software components. MDA has already made a public sensation thanks to a cooperative venture launched by several Spanish technical institutes. Their project claims to halve development times and reduce the error rate by five-sixths. The programming machine has already found pilot users with an American stock exchange and a Spanish airline among others. Thus, MDA has moved beyond the level of pure academic research and is fundamentally changing the IT market. Its aim is to redesign work processes, and thus it particularly reflects the efficiency trend. It has no bearing on the security trend.

Distribution of IT expenditure in Germany (%)



Source: McKinsey, 2003

IT between centralisation and decentralisation

The exorbitant growth of data flows – Deutsche Bank servers alone deal with five million e-mails daily – necessitates innovative concepts for saving and processing data. The vast majority of commercial users argue for the concept of centralised management

Data flows necessitate new IT concepts

and decentralised storage capacity known as Information Lifecycle Management (ILM). ILM assumes that the storage capacities are managed centrally from one place, but not that all storage capacities are physically centred in one place. *Cap Gemini Ernst&Young* found that 90% of German companies rate ILM as the optimum way to utilise their resources. The management consultants *Lünendonk* discovered that almost one in five of the 180 German companies from various sectors polled was about to introduce ILM. Ideally, the centrally managed ILM infrastructure should store the information only once and only as long as necessary. Storing data through decentralised IT resources thus increases efficiency. A side effect is that a centralised system administrator can simplify measures to improve the security of the whole system, and lead to a better general result.

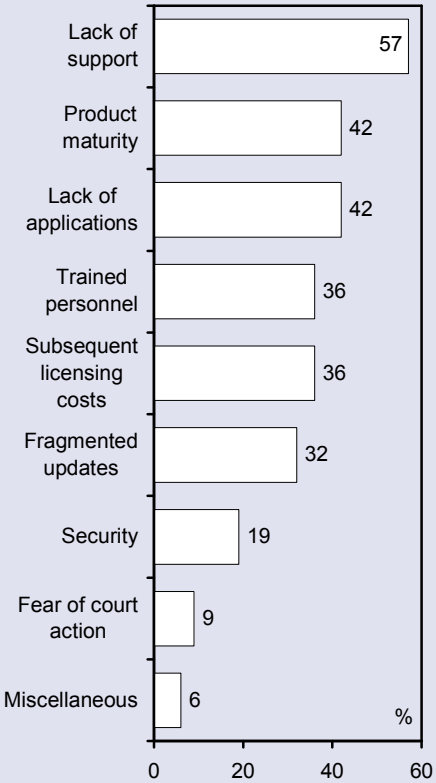
Avoiding redundancies in data storage

Fascination for centrally-used decentralised capacity

Many small, decentralised IT units combined

While ILM is aimed at data storage by means of clearly delimited IT resources, grid computing is faced with the more complex challenge of processing data through a decentralised IT network. Grid computing made a sensation with *SETI@home*, which is coordinated by the University of California. *SETI* searches for radio signals from space as evidence of extraterrestrial intelligent life. The research network consists of 5 million PCs in 226 countries. Grid computing basically involves connecting a clearly defined, virtual group of decentralised IT units to create a large computing capacity. The starting point is the realisation that private users utilise less than a third of their PC's available computing power and less than two-fifths of its memory capacity. But irrespective of the cost advantage of using decentralised hardware, the disadvantage of complex administration has to be taken into account. Grid computing is only suited for processes that are strongly standardised, clearly structured, easily separated into organisational units, not very complex in cooperation and, moreover, not security relevant. Grid computing is utilised predominantly in academic circles. Commercial grid applications have been the exception so far, not least because of the security aspect and the complex administration. Thanks to the support of the European Commission, which has invested EUR 58 m in the framework of its research programme, and the increasing interest of major software houses, grid computing is orienting itself more strongly towards the commercial area. However, owing to the systemic limits, the commercial market remains small. Even the projection of *Grid Technology Partners*, a market research institute, is very optimistic – their forecast for 2005 is sales of just under EUR 4 bn.

"What are the biggest problems for open-source software"*



*Multiple answers possible
Basis: 85 North-American companies with open-source software
Source: Forrester Research, 2004

Open-source revolutionises software market

Similar to grid computing in data processing, open-source technology follows a decentralised approach in the development of IT. The term “open-source” describes a new model of product development and is not limited to a particular (inexpensive) kind of software. Open-source components are mainly applied in server operations but also in the areas of desktop applications, desktop operating systems and embedded systems[7]. Corresponding to the open-source concept, product licences are free of charge. Nevertheless, the user has to bear the costs if he or she demands documentation, support services or versions specifically tailored to

[7] See Heng, Stefan (2001): Embedded systems – An (inconspicuous) key technology in the ascendancy, in: Deutsche Bank Research, E-conomics No. 11, Frankfurt.

his or her open-source products. There is controversial debate about security, after-sales service and the real cost advantage of open-source software. The decentralised approach of the open-source model may speak both for and against the quality of the result. It is, therefore, not surprising that well-known private research institutes make conflicting recommendations with regard to commercial software offers and open-source solutions.

Irrespective of the continuing debate, public administrations are already making strong use of open-source products. Besides the German parliament (Bundestag), a large number of local authorities intend to switch servers and even desktop applications to open-source products. If everything goes according to plan the IT architecture of the public administrations of federal, state and local authorities will mainly be based on open-source by the end of the decade. Confidence in open-source technology is also growing in the private sector. While only one out of seven German companies integrated open-source software in their systems last year, one out of six currently provides a budget for open-source technology. The strong commitment of the large software houses and the joint initiative of the governments of Japan, China and South Korea in support of open-source are evidence that it creates the enthusiasm required to revolutionise the software market further.

Open-source software reduces IT costs and thus reflects the trend for efficiency. However, due to its decentralised approach open-source is partly seen as a potential threat to security – in most cases there is no real risk, however. Due to the potentially insufficient support for open-source software as a result of decentralised structures, users still shy away from open-source technology. Reservations about open-source are likely to weaken considerably with its further spread, though. The support from different directions – from the public administrations of several countries to well-known software houses – underscores the potential for widespread use and the significance of open-source for the whole IT market.

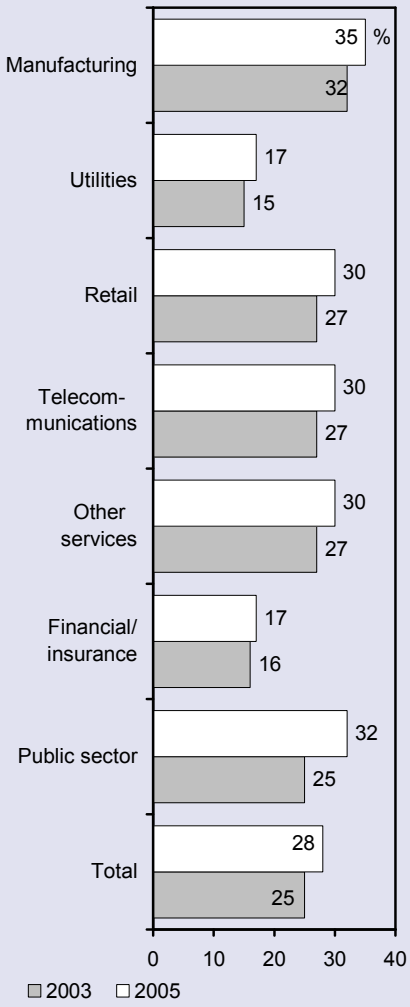
Outsourcing: learn to make savings which make sense

In times of reduced budgets, outsourcing, especially offshoring, is an attractive option for companies in the quest for more efficiency. Usually outsourcing aims to reduce fixed costs and to benefit from specialisation. An additional major target of offshoring is the wish to exploit wage differentials. The expected savings potential from outsourcing is partly overestimated, however. Large companies, especially, often reach dimensions in internal business which enable them to benefit from economies of scale and specialisation. What is more, not all business processes can be outsourced without problem. Outsourcing offers a good option if the process to be outsourced is strongly standardised, clearly structured, easily separated in the organisation and not very complex in cooperation. Each company which considers outsourcing thus has to check in detail in which processes the achievable cost advantages outweigh the disadvantages of the loss of control in the process as a whole. Outsourcing is targeted at cost-cutting and thus reflects the effort to implement more efficient structures. It often raises questions as to the security, confidentiality and reliability of processes – in most cases with no good reason, though.

Radio tagging attaches data profile

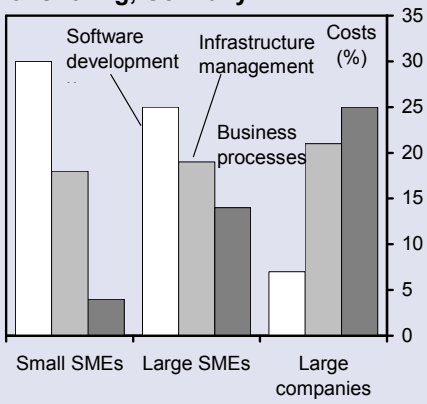
Radio tagging (Radio Frequency Identification Transponder, RFID) offers the possibility of tagging goods with data profiles in order to improve the flow of information along the value chain. The general

Linux servers by sector, Germany



Source: Techconsult, 2004

Savings potential from offshoring, Germany



Source: Soreon Research, 2003

public mostly discusses RFID tagging as a replacement for bar codes on pallets and retail goods. The application possibilities of radio tagging go much further, though. The range of well-known RFID users is already widely spread.

RFID technology helps to optimise business processes

Various wholesalers and retailers, the logistics section of the Volkswagen group but also the Main Library of Vienna and the Vatican Library bet on RFID. Until recently, the British chain store *Marks&Spencer* sewed RFID tags into their garments. The objective was to optimise inventory management at the point of sale with regard to size and colour. The German *Metro Future Store* in Rheinberg has also implemented RFID technology to trace the product data of the food offered and to reduce checkout time at the cash desk. The freshness guarantee and shorter waiting times enhance service standards for customers. A pilot project of *VW's* logistics section focused on the enhancement of inventory management. The company invested EUR 550 m and showed that RFID steps up the speed of warehousing 20-fold compared with the traditional bar code. On the basis of RFID technology the goods can be tracked accurately along the value chain. Furthermore, replacement purchases declined by two-fifths and the levels of shrinkage were reduced by one-third. The Main Library of Vienna has invested EUR 675,000 in RFID since 2001 and equipped 300,000 media products with smart tags. Half of the users have so far chosen the option to borrow books and benefit from self-checkout at the exit gates – an innovation which has enhanced efficiency and comfort. The technology applied by the Main Library of Vienna is similar to the concept chosen by the Vatican Library. The Roman Catholic church has equipped 150,000 books of its public reading room in Rome with RFID tags. The data relating to the author, subject and year of publication stored on the chip are to avoid that books are put on the wrong shelves. In the past, a Vatican Library inventory check would have taken a month. As a result of the implementation of the RFID system, this task only takes half a day. Projects in trading, in libraries, logistics and event organisation offer considerable potential for efficiency gains. Nevertheless, practical tests have shown that RFID technology has to be configured to the respective process and cannot be offered as a cheap standard solution.

Retail trade targets higher service standards

The vision of data profiles on the basis of RFID tags comes up against its limits in software for data processing. Demand is focusing on software solutions that channel the huge quantities of data collected by RFID tags and process them for application as planned. Furthermore, the limited RFID power level is an obstacle to a wider spreading of the technology especially in Europe. While the US allows a power level of 2 watts for RFID tags, the accepted level in the EU is only half a watt. This regulatory restriction is based on differences in the assessment of harmful effects electromagnetic radiation may have on humans. The EU's decision in favour of a strongly limited power level reflects concerns on the part of consumers, although this implies a shorter radiation scope and very small potential for the wider use of RFID technology. However, besides low power levels, strict electrosmog guidelines and insufficient software, data protection regulations – especially in Germany – stand in the way of a quick success of RFID chips. Consumer protection associations paint the horror scenario of the "glass client" and in some cases call to prevent too detailed data collection by jamming. As a result of the image problem of RFID, some companies have already given up their pilot projects in this field.

Price of 1MByte main memory (DRAM)

Year	Price (EUR)	Equivalent
1973	75,000	
1977	5,000	
1981	400	
1984	130	
1987	20	
1990	7	
1995	3	
2001	0.08	
2005	0.03	
2017	0.01	

Sources: BMBF, DB Research, 2004

The overall success of RFID technology in the mass market mainly depends on chip prices. If technical progress continues to lead to strong falls of IT hardware prices RFID has great market potential provided that the technological and legal challenges are met and private customers become increasingly aware of the advantages with the help of marketing. With the changeover to merchandise tagging, the RFID market in US retail trade alone is likely to grow 15-fold from the current level to EUR 2 bn by 2010. In the same period, the total market for RFID products in the EU-15 will grow roughly 10-fold to EUR 4 bn.

Radio tagging will benefit from the extended application possibilities of electrical engineering as a result of the increasingly small structures of electronic components. Radio tagging reflects the quest for more efficiency. The assessment of the correlation between the implementation of RFID tags and the security standard achieved strongly depends on the observer's viewpoint, however. Sellers regard radio tagging as a good chance for more security, especially with regard to the protection of their goods from theft and loss. By contrast, some consumers associate the vision of data profile with the horror scenario of a "glass client" and the end of confidentiality in the shopping process.

Almost all that glisters is gold

The various product and process innovations of ICT reconcile the two major trends efficiency and security. Even though some of the technical, economic and regulatory obstacles have not been removed yet, almost all ICT concepts that are considered to have the brightest prospects by the general public will become increasingly widespread over this decade. The three most promising ICT concepts are biometrics, open-source software and radio tagging. The open-source approach has led to profound changes of the market for commercial software solutions. Between 2002 and 2010, the worldwide market for biometric products is likely to grow by a factor of 40. The overall market for radio tagging in Europe could grow 10-fold between 2004 and 2010. Compared to these three extremely promising outperformers, the upward potential of the two ICT areas internet telephony and grid computing, which are usually considered to have bright prospects, is overestimated by the general public. Especially the fee strategy of the traditional telecommunications companies does not suggest a rapid, groundbreaking success of internet telephony in the mass market. The great commercial success of grid computing is questioned by the limited application possibilities.

The market penetration of ICT is increasing in all business areas – even though spectacular headlines are less frequent than a few years ago. The increasing push for security and efficiency in the economy as a whole evidently enhances the adoption of new ICT. Vendors of innovative product and process innovations in the ICT area can thus build on growth rates that are clearly above average.

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Correlation between ICT trends and ICT concepts

	Efficiency	Security
Internet telephony (VoIP)	++	-
Advanced mobile telephony	+	-
Biometrics	+	++
Quantum cryptography	+	++
Model Driven Architecture (MDA)	++	Ø
Decentralised storage (ILM)	++	+
Decentralised data processing (grid computing)	++	-
Open-source software	+	+ / -
Outsourcing	+	-
Radio tagging (RFID)	++	+ / -

++: Strongly positively correlated
+: Positively correlated
Ø: Neutral
-: Negatively correlated

Source: DB Research, 2004

ICT market potential / potential for widespread use

Internet telephony (VoIP)	→
Advanced mobile telephony	↗
Biometrics	↑
Quantum cryptography	↗
Model Driven Architecture (MDA)	↗
Decentralised storage (ILM)	↗
Decentralised data processing (grid computing)	→
Open-source software	↑
Outsourcing	↗
Radio tagging	↑

↑: Strong upward potential
↗: Upward potential
→: Moderate potential

Source: DB Research, 2004

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