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# Strategic Importance of RFID – The CIO Perspective

## An Empirical Analysis in Germany

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### ABSTRACT

RFID is currently considered a hot topic in the IT arena. It is described as major enabling technology for automated contactless wireless data collection, and as an enabler for the real-time enterprise, a future vision of enterprise information systems. But little is known about the perceived strategic importance of RFID among IT decision makers, current RFID usage and areas of application, or companies' intentions to invest in RFID. In this paper we intend to fill this gap. We convey a quantitative survey among CIOs in Germany across various industries. We present empirical insights on CIOs' perceptions of RFID regarding its strategic importance, the relevance of RFID compared to other IT topics, and their RFID visions for the future of their company.

### Keywords

RFID, IT strategy, IT investments, survey, RFID vision, CIO

### INTRODUCTION

Radio frequency identification (RFID) is currently widely discussed throughout scientific and non-scientific media. Although it is not a new technology - the first publication dates back to 1948 - it has only recently come to public awareness. New auto-ID technologies, most notably RFID (Sarma, 2004), have drawn the attention of many companies within various industries due to factors such as: the need for more efficiency and security in supply chains, enhanced technologies, cost pressure, standardization initiatives, and prominent promoters such as Wal-Mart, Metro, and Tesco. When the Society of Information Management (SIM) conducted its last survey of IT executives, RFID was among the top 20 developments in application and technology (Luftman, 2005).

This study aims to explore CIOs' perspective on RFID technology. After a short introduction into technology and application areas, it is investigated if CIOs see strategic importance in RFID and how they plan to act in regard to this issue. The research is conducted within an independent, non-profit German CIO network organization.

### Technology

RFID is a technology for automatic identification and data collection (Auto-ID). It allows an object or person to be automatically identified at a distance, using an electromagnetic exchange (Want, 2004; Finkenzeller, 2002). In comparison to other well-known Auto-ID technologies such as the barcode, RFID offers various advantageous characteristics to the user (Agarwal, 2001):

- § Unique identification: Applying e.g. the "Electronic Product Code" (EPC) standards, RFID tags can not only identify classes of products, but individual items.
- § No line of sight: RFID tags can be read without direct line of sight, and even if the tag is covered, dirty or otherwise obscured from view.
- § Bulk reading: If they are in range of a reader, multiple RFID tags can be read at the same time.
- § Storage capacity: RFID tags can store significantly more information than just an identification number.

§ Dynamic information: RFID tags with read-write capability allow information to be updated or changed whenever necessary.

However, RFID is not yet a mature technology. There still are a number of issues that remain to be solved:

§ Effects of metal and liquid: Tags operating on radio frequency are not completely unaffected by materials in their close vicinity. Signals can be attenuated or detuned by metals or liquids.

§ Multiple Standards: In the past, several different frequencies and standards have been used for RFID solutions. Although the standardization organization EPCglobal has now designed a comprehensive new framework, it will take some time to establish.

§ Amount of data: Collection and communication of enhanced object information inevitably leads to huge amounts of data. It is unclear how this data should best be integrated into the enterprise information systems. A common approach is to endorse ERP systems with RFID middleware. Moreover, enterprises still lack reasonable services, i.e. do not know what to do with the additional data.

### **Improve Efficiency, Enable New Solutions, Open Door to Real Time Enterprise**

RFID has the potential to accelerate, enrich, and automate in short, change the information flow in business processes. Contemplating its characteristics, it is not difficult to derive potential to improve process efficiency and effectiveness. Non line of sight avoids an object having to be turned several times before the tag can be read, as is often the case with barcode labels. This requires less manual intervention. Tags can still be read when the respective objects are already assembled or integrated in a product. Moreover, multiple reading reduces process lead time. Increased storage capacity allows enhanced product data to be stored on the tag, and the ability to add information during an object's life cycle. In combination with sensors, the tag could carry additional up-to-date information, about things such as temperature, humidity or pressure in the object's environment (Haller and Hodges, 2002). Accurate information and identification increase process transparency, making processes more secure.

But the potential of RFID goes beyond improving the efficiency of existing processes. RFID can enable new products, services and solutions. Potential application areas are versatile and spanning various industries. RFID can, for example, be used to improve issues in asset/product tracking, industrial warehousing, product handshaking, anti-counterfeiting, safety and security, condition monitoring, positioning/locating, theft or tampering detection (Wilding and Delgado, 2004b)<sup>1</sup>. In the following, selected examples will illustrate this point:

§ Healthcare: Combating counterfeit drugs. Individual identification and seamless tracking of drugs from production to consumer would ensure their authenticity, thus protecting consumers from harmful or useless drugs, as well as making it more difficult for counterfeiters to place their products on market. The U.S. Food and Drug Administration rates RFID as the most promising technology to achieve these goals (U.S. Food and Drug Administration, 2004).

§ Automotive: Facilitating highly targeted call-backs. If a specific delivery unit of a specific car component turns out to be defective, automotive manufacturers usually have to call back all cars of a certain type produced in the critical time span. If each component could be traced individually during the complete assembly process, the manufacturer would know exactly which cars carry the relevant components, thus avoiding expensive and useless inspections of all other vehicles. Enterprises like BMW see this as a major opportunity to cut call-back cost through RFID usage.

§ Retail: The intelligent shopping cart. Without spending a considerable amount of time inquiring, consumers often cannot be sure about characteristics and ingredients of the products they are buying. But this data can be highly relevant if the consumer suffers from diseases, such as allergies or diabetes. Doubts would be removed if the shopping cart could read the information stored on the RFID tag on the respective product and display it to the shopper, possibly along with allergy warnings or preparation suggestions. Metro Group already experiments with smart shopping carts in their RFID pilot store.

§ Transport / Logistics: Logistic enterprises often must transport sensitive goods under specific conditions, e.g. frozen food or vaccines. RFID tags with sensors could allow inspecting and thus controlling if those conditions were met throughout the entire transport, increasing product security and providing both logistician and client with accurate information.

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<sup>1</sup> For an overview over selected case studies, see Wilding et al. (2004a)

In the above-mentioned and in many other cases, RFID can enable enterprises to bridge the gap between the real world and its representation in information systems (Haller et al., 2002; Fleisch, 2005), thus building the road towards the “real time enterprise”, promising optimized processes, better decisions through higher data quality and better integration of supply chain partners.

## LITERATURE REVIEW

### The Strategic Importance of RFID

Michael Porter describes strategy as “performing different activities from rivals’ or performing similar activities in different ways” and emphasizes that although operational effectiveness is crucial for profitability, it is not strategy (Porter, 1996). Hence, Metro’s success in improving operations and cutting cost through RFID (Collins, 2005) and the automotive industry’s report about positive return on investments of RFID solutions (Kraft and Schauler, 2005) may not be of strategic nature yet, but applications are still developing (Lange, 2004), and, as shown in the previous sections, indeed can enable a company to offer new services its competitors cannot offer. Various major consulting firms stress the impact of RFID on strategy. According to Gartner, RFID could not only revolutionize the way items are tagged and traced through distribution channels (Roussel, Fenn and Linden, 2005), but also hold “great potential for reshaping business strategies” (Woods, Peterson and Hirst, 2003). But beyond consultants, vendors, and analysts, what do (future) users think? Research questions 1 and 2 address this topic:

RQ 1: What is the diffusion rate of RFID?

RQ 2: How do CIOs assess the strategic importance of RFID?

### Determinants on Perceived Strategic Importance

The first sector to use RFID technology was military (Schmid, 2004), but bit by bit it made its way to other industries. Companies place hopes in RFID’s potential to optimize and rationalize supply chain management (Lange, 2004). ABI research projects that certain industries will be particularly active in the field of RFID, including consumer packaged goods and retail, automotive, military and homeland defense (Maselli, 2003). This suggests that certain industries are more inclined to adopt RFID, forming the basis for research question 2:

RQ 3: Do characteristics of the responding companies such as industry and size influence the perceived strategic importance of RFID?

Diffusion of innovations theory identifies five attributes of innovations influencing their adoption: relative advantage, compatibility, complexity, trialability and observability (Rogers, 1995). Supposing that adoption will only take place if an individual sees a certain importance or usefulness in an innovation, these factors could also influence the perception of strategic importance of an innovation, in this study RFID. Trialability is the degree to which an innovation may be experienced. The better the individual understands how the innovation works under his or her own conditions, the more likely he or she will be to adopt it. Observability is the degree to which the results of an innovation are visible to others. Although the diffusion of RFID is currently low (Lange, 2004) many companies have launched pilot projects, thus creating a certain trialability. Along with vendor’s demonstration projects and other available information, these pilot projects provide observability for others. Consequently, research question 3 refers to RFID experience:

RQ 4: Does the level of experience with RFID influence the perceived strategic importance of RFID?

Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes (Rogers, 1995). A similar approach is taken by Davis in his technology acceptance model (TAM), describing perceived usefulness as a determinant on adoption (Davis, 1989). Perceived benefits have also proved relevant in Iacovou and Benbasat’s study about the adoption of EDI (Iacovou and Benbasat, 1995) and as well were considered in Sharma and Citrus’ research on the adoption of RFID (Sharma and Citrus, 2005). In this study, relative advantage would describe potential benefits and improvement due to RFID in comparison to barcode technology. Hence, research question 4 addresses perceived potentials of RFID:

RQ 5: Do perceived potentials of RFID influence the perceived strategic importance of RFID?

### Willingness to Invest in RFID

Since wholesalers such as Wal-Mart in the USA, Metro in Germany, or Tesco in the UK, and public authorities as the US Department of Defense have declared RFID a key technology, market forecasts outbid one another (Lange, 2004). Frost &

Sullivan predicts a growth in the RFID marketplace of over 30 percent until 2010 compared to 2003 (Frost & Sullivan, 2004), Accenture even 40 percent (Accenture, 2005). In a recent study, AMR research finds 69 percent of respondents planning to evaluate, pilot, or implement RFID. They also forecast a market growth of about 40 percent, to be reached within two years (Reilly, 2005). Research question 6 aims to verify if potential users share this view; research question 7 links the above described strategic importance with the willingness to invest.

RQ 6: Do CIOs plan to invest in RFID?

RQ 7: Does the perceived strategic importance influence the willingness to invest in RFID?

**RFID in Comparison to Other IT Topics**

In the SIM’s 2004 study on application and technology developments IT decision makers are most concerned about (Luftman, 2005), RFID was found to rank 17th, suggesting it is a highly relevant matter, but not of primary concern. To put the results of the afore-mentioned research issues into perspective, RFID’s position among the respondent’s IT priorities will be examined in research question 8.

RQ 8: How important is RFID in comparison to other IT topics?

**RESEARCH DESIGN**

The research questions deduced from literature review were supported by the findings from 15 semi-structured interviews with IT executives in various industries. Design and execution of the survey are based upon the model describing the phases to gain information by Nieschlag, Dichtl and Hörschgen (2002), a very established model in German social sciences. The model was applied and customized to fit the research questions addressed in this study. The study was conducted in a non-commercial German CIO network, the “CIO Circle”. All 450 members, representing virtually all industries, were sent a personal invitation to take part in the survey. **Error! Reference source not found.** summarizes important design parameters of the study undertaken, whereas Figure 1 illustrates the survey execution.

Research framework	Explorative study
Research method	Online survey
Period	11th November 2005 – 2nd January 2006
Universe	Members of the “CIO Circle”, a non-profit CIO networking organization (approx. 450 members)
Sample type	Census
Approach to contact potential participants	Personal e-mail invitation containing personal unique access code for survey website
Rate of return	Approx. 25 % (114 data sets)

**Table 1. Study Design Parameters**

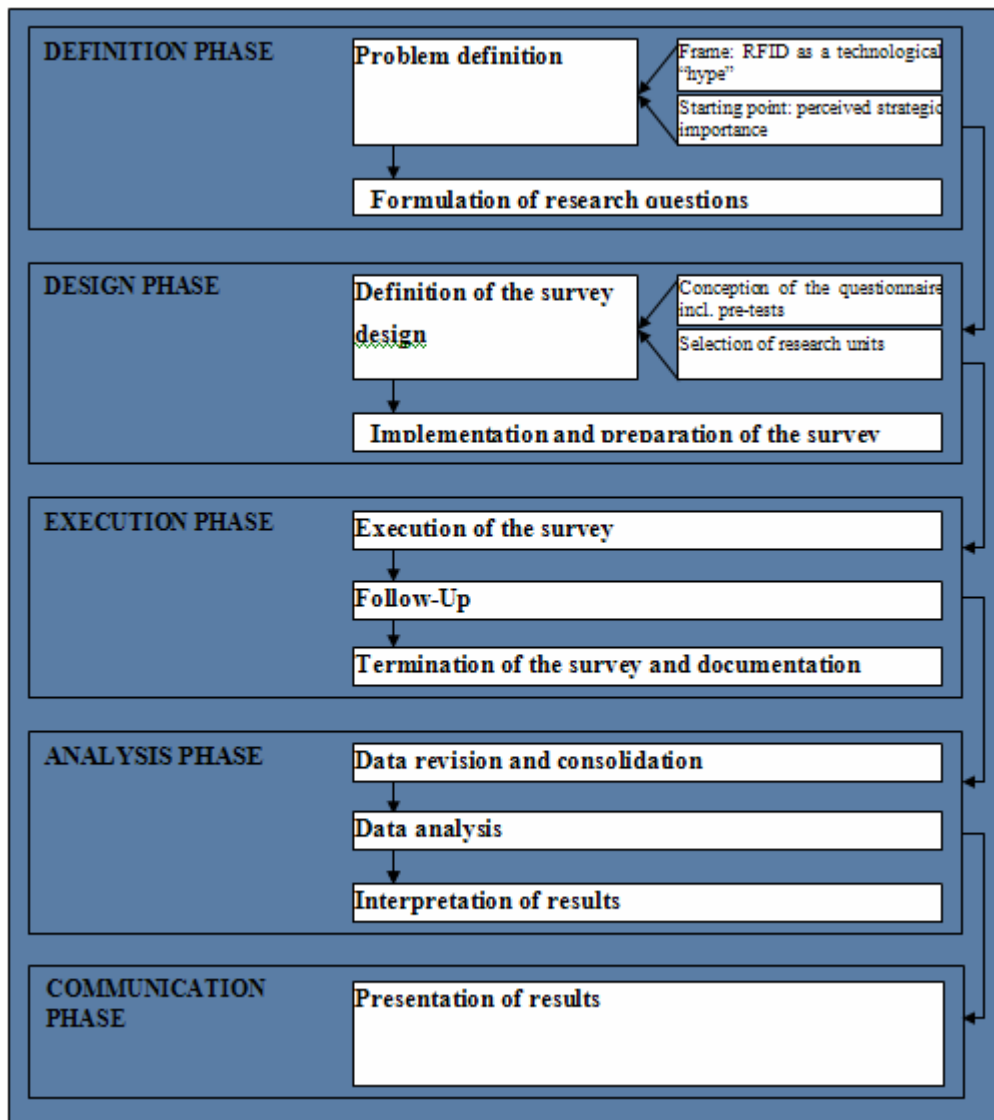


Figure 1: Survey Execution and Process (Source: Adapted From Nieschlag et al., 2002)

**EMPRICAL FINDINGS**

**Characteristics of Participants**

In total, 114 members of the CIO-Circle participated in the survey, of which all but one were male. The age group 41-50 had the highest representation (57.9%), followed by the group 31-40 (28.9%). Asked for the main business activities of their company<sup>2</sup>, participants indicated manufacturing (28.1%), service (19.3%), transport / logistics (17.5%), automotive (16.7%), retail (14.0%), consumer goods (11.4%), consulting (9.6%), IT (8.8%), pharmaceuticals / healthcare (8.8%), other (18.4%). Company sizes measured in number of employees varied; the majority (61.4%) had less than 2500 employees, 17.5% exceeded 10000 employees. Most respondents were chief information officers (CIO) (77.2%).

<sup>2</sup> Multiple answers possible, percentages add up to more than 100%.

**Results: RFID Diffusion (RQ 1)**

Concerning their knowledge of potential applications of RFID, most of the participants described it as good or very good (42.1%), 36.0 percent as average and the rest as poor or very poor (13.2%).

The experience with RFID systems among the respondents was low. Only a very small number have currently implemented a RFID system in their company (7.0%). Some more were planning (10.5%) or building (6.1%) an RFID application. About a third was conducting tests (33.3%). Another third had not yet thought about the topic (33.3%). The remainder had conducted tests, but then decided to reject the technology (9.6%).

**Results: Strategic Importance of RFID (RQ 2)**

The participants were directly asked to assess the strategic importance of RFID for their company on a 5-point scale (“totally agree”=1 to “do not agree at all”=5). Seventy-three people answered the question. No particular tendency is revealed, the answers are almost evenly distributed across all categories (mean=3.05). To gain more insight, the respondents were then asked for their opinion on RFID influencing their core competencies. Similar to the assessment of strategic importance, on average the respondents neither agree nor disagree that RFID could influence their core competencies, with a slight positive tendency regarding the better exploitation of existing core competencies (mean=2.78), and a slight negative tendency regarding the buildup of new core competencies (mean=3.33). Nevertheless, they tended to agree that through RFID they could generate competitive advantages (mean=2.61) (for details about all other statements, see appendix, Table 3 and Table 4). As these results all go in line with the strategic importance, in the following sections only the strategic importance will be further analyzed.

Looking beyond the present, almost all respondents (91.0%) expect the importance of RFID for their company to rise in the near future (Figure 2). Sixty-eight percent of the 75 persons who answered the following question believed that RFID will become critical for the success of their company in the future. Fifty-five percent even believed this to be the case in less than 4 years.

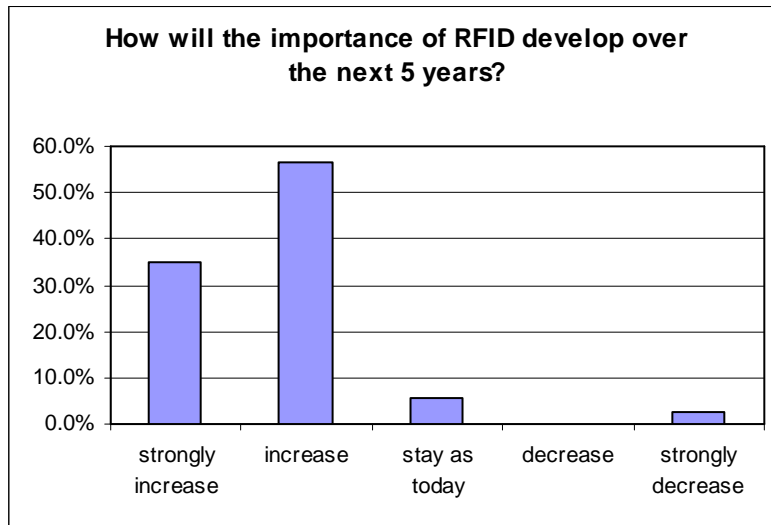


Figure 2: Future Importance of RFID (n=74; Source: Own Illustration)

**Results: Determinants of Perceived Strategic Importance (3-5)**

*Characteristics of company and respondent (RQ 3)*

Figure 3 analyzes the perceived strategic importance by industry. Although the differences are not drastic, it shows that perceived strategic importance of RFID indeed does vary between the industries. Pharmaceuticals, logistics, retail, and automotive tend to attribute a positive strategic importance to RFID, while other industries, e.g. manufacturing, assess it more negatively.

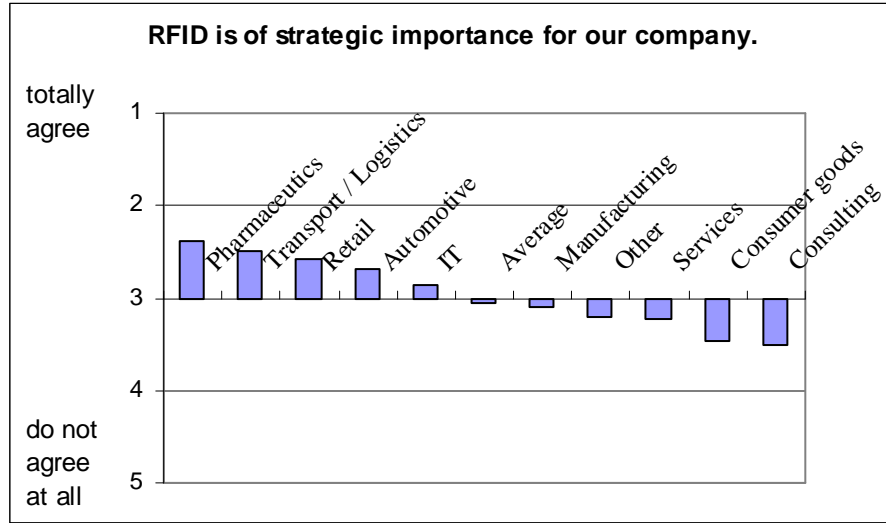


Figure 3: Strategic Importance of RFID by Industries (n=114)

When analyzing the strategic importance by company size, the means suggest it is rated the higher with the larger the company size. A correlation analysis using Spearman’s rank correlation coefficient confirms this, indicating a modest negative relationship between company size and “RFID is of strategic importance for our company”<sup>3</sup> (r=-.371, p=.001).

Regarding characteristics of the responding persons such as age and individual knowledge about RFID, no significant correlations with the perceived strategic importance can be found.

*Experience with RFID (RQ 4)*

When crosstabulating the RFID experience of the companies with the perceived strategic importance, a comparison of the means reveals different values in all of the categories (see Table 1). Companies with tests in progress on average had a neutral opinion of the strategic importance of RFID. Of those who had already conducted tests, companies who do not intend to apply the technology also did not believe in its strategic importance. In contrast, a positive tendency was noticed for those intending to adopt the application. Those most convinced of RFID’s strategic importance were companies currently implementing the system. This group even surpassed those companies already applying it.

RFID Experience	Strategic Importance of RFID	
	Mean	Std. Dev
Applies RFID	2.38	1.408
Implementing RFID	1.67	1.033
Conducted tests, intends application	2.42	1.311
Tests in progress	3.19	0.995
Conducted test, does not intend application	4.70	0.675

Annotation: 5-point scale from “totally agree”=1 to “do not agree at all”=5; n=73

Table 1: Cross Table of RFID Experience & Perceived Strategic Importance (Source: Own Illustration)

*Perceived Potentials of RFID (RQ 5)*

On average all participants agreed on the presented potentials of RFID (see Table 2).

<sup>3</sup> 5-point scale from “totally agree”=1 to “do not agree at all”=5



RFID has the potential to...	Mean	Std. Dev
Reduce errors (n=75)	1.81	0.817
Accelerate the flow of goods (n=73)	1.88	0.927
Automate / reduce manpower (n=75)	1.93	0.811
Consistency in the integration of data across the supply chain (n=74)	2.15	1.043
Improve quality (n=75)	2.16	1.027
Improve customer service (n=75)	2.16	0.959
Reduce inconsistencies in stock (n=74)	2.2	1.047
Optimize stock keeping (n=74)	2.38	1.069
Reduce counterfeits (n=69)	2.59	1.204

Annotation: 5-point scale from “totally agree”=1 to “do not agree at all”=5

**Table 2: Perceived Potentials of RFID (Source: Own Illustration)**

A correlation analysis using Spearman's rank correlation coefficient was conducted to measure whether perceived potentials influence the perceived strategic importance. A highly significant positive relationship can be found between “improve quality” ( $r=0.379$ ;  $p=0.001$ ), “accelerate the flow of goods” ( $r=0.336$ ;  $p=0.004$ ), “optimise stock keeping” ( $r=0.436$ ;  $p<0.001$ ) and the perceived strategic importance. The results also indicate a significant positive relationship between “automate” ( $r=0.284$ ;  $p=0.016$ ), “reduce errors” ( $r=0.278$ ;  $p=0.018$ ) and “improve customer service” ( $r=0.245$ ;  $p=0.038$ ). For the other statements, no significant relationships could be found.

#### Results: Willingness to Invest in RFID (RQ 6-7)

On a 5-point scale (“totally agree”=1 to “do not agree at all”=5) the participants were asked to comment the statement “we will invest in RFID”. On average, the participants tended to agree to this (mean=2.41; std. deviation=1.122). A correlation analysis using Spearman's rank correlation between “RFID is of strategic importance for our company” and “we will invest in RFID” showed a highly significant strong positive correlation ( $r=0.784$ ;  $p<0.001$ ).

Asked how they think the RFID budget of their company will develop over the next years, on average all participants expected it to rise, the strongest rise expected in about 3 years. Then it will go down again, nevertheless being higher than today. When analyzed separately, with slight variations, this trend is also true for the single industries. Pharmaceuticals is an exception as it does expect the RFID budget to grow more five years from now.

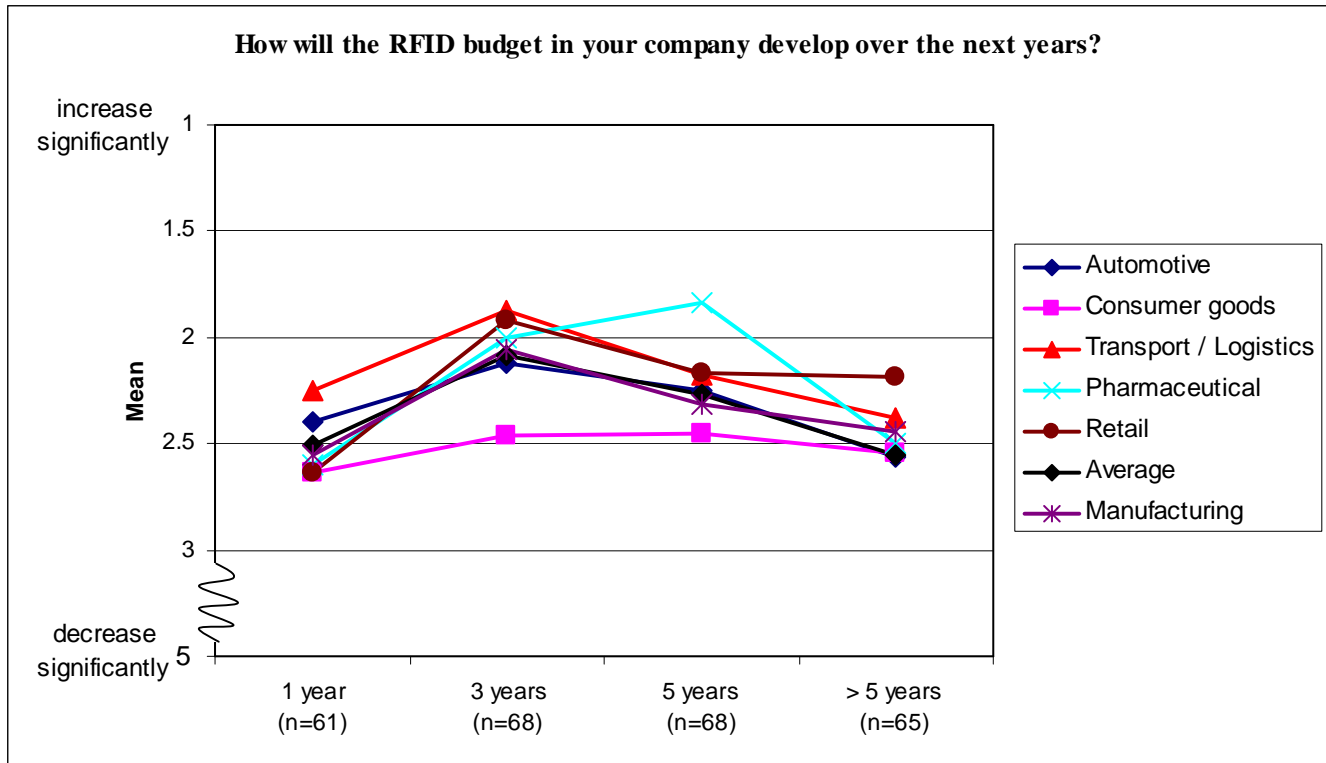
#### RFID and Top IT Topics (RQ 8)

The statement “RFID is one of our top IT topics” (5-point scale from “totally agree”=1 to “do not agree at all”=5) was rated on average with 3.69 (std. deviation=1.115). To put this into perspective, the participants were asked in an open question to specify the three top IT topics their company dealt with at the moment. A hundred and eleven participants followed the request, of which 8.1% persons mentioned “RFID” among the top IT topics. About seventeen percent mentioned “tracking & tracing” or similar expressions. CRM and IT integration followed.

#### Preparing for the Future: RFID Visions

In an open question, the participants were asked to provide their RFID vision for their company. Most of the statements could be easily grouped into the following four types of visions.

Type 1: The visible enterprise. Respondents in that group (about 30%) hope for real-time information and identification throughout the supply chain, creating complete transparency of all processes relevant to the company at any time. Statements in this category tend to be highly abstract, e.g. one respondent expressed: “RFID-enabled continuous and integrated information chain including suppliers and partners – the vitreous enterprise”.



**Figure 4: RFID Budgets (Source: Own Illustration)**

Type 2: Selected areas of application. Respondents in this group (about 14%) also expect RFID to optimize certain processes, but their agendas are more precise, often suggesting a few specific areas of application. For instance, one participant thinks RFID holds potential for “warehouse management with position sensing by transponders in the ground”.

Type 3: Replace barcode. A relatively small percentage (about 5%) aims at replacing existing barcode technologies first, maybe later considering enhanced applications of RFID.

Type 4: No vision. About 25 percent explicitly state they had no RFID vision. In most cases, either they do not see any benefits in RFID (e.g. “It is not relevant for our main processes”) or the companies have decided to take an expectant, observant position (e.g. “curiously observing, costs still too high” or “there’s no need for us to be an early adopter”). Twenty-three percent provide no statement at all. The remaining 3 percent could not be classified.

**CONCLUSION**

This research presented quantitative data on IT decision makers’ view of RFID across various industries and company sizes. Among the participating companies, RFID diffusion is very low. Many IT decision makers have heard about, and took interest in it, but are still far from implementation.

The opinion on the strategic importance of RFID is divided. The judgments seem to be influenced by industry, company size and perceived potential of the technology. Pharmaceuticals and logistics, retail, and IT affirm that RFID is of strategic importance to them, whereas manufacturing, consumer goods, and consulting do not share this opinion. The bigger the size of a company, the higher it rates the strategic importance of RFID. Hope for quality improvement, acceleration of the flow of goods, and optimization of stock most attract CIOs to RFID.

Across all industries, companies expect their RFID budgets to rise over the next years, especially within the next 3 years. As expected, a higher perception of strategic importance correlates positively with a higher willingness to invest in the technology.

However, RFID is not a topic of high priority on companies’ IT agendas. The high-level concepts often associated with RFID in the media or in consulting, above all the “real time enterprise” or the “internet of things” have not yet found their way into companies’ RFID visions. The greater number of them does not even think it necessary to define a vision at all. On the other

hand, virtually all participants state that the importance of tracking & tracing and RFID will rise significantly over the next years. The technology might well turn out to be a sleeping giant.

Figure 5 summarizes the findings of the study.

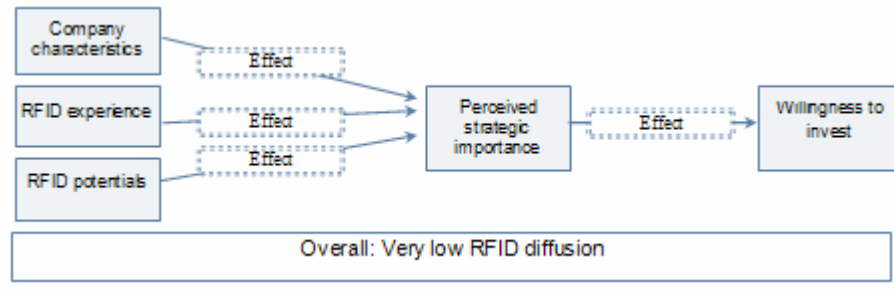


Figure 5: Results of the Survey (Source: Own Illustration)

## RECOMMENDATIONS AND SUGGESTIONS FOR ACTION

So what are potential users and vendors to do about RFID? We will deduce several recommendations for both groups.

### Recommendations for Potential RFID Users

Companies should look beyond the technology level when dealing with RFID. It will not only be a new technology to replace an old one, but will affect many more processes, products, and services. For many companies, instant action is not necessary. But as RFID's importance is on the rise, companies are well advised to keep watch of the RFID activities of business partners or other relevant stakeholders. As in the case of retail, where Wal-Mart or Metro demanded RFID application from their suppliers, or in pharmaceuticals where the US Food and Drug Administration recommended RFID to prevent counterfeiting, companies may be forced to react quickly. Instead of acting just because of forced compliance, companies should explore how RFID-enabled solutions could generate competitive advantage if properly integrated into their IT strategy.

### Recommendations for RFID Vendors

RFID vendors should not underestimate the complexity of the RFID topic. Customers appreciate the operative benefits that might be achieved through this technology, but they do not link it to abstract, possibly strategic long-term concepts such as real time enterprise. Vendors must improve their way of communicating RFID as an enabler for these visions and explain its impact on IT processes and IT strategy if they want to convince customers that RFID is more than just another technology. Some industries, e.g. healthcare, logistics, and retail are more ready for RFID than for instance manufacturing, and should be addressed first. Big companies are probably easier to win for the technology than smaller ones.

## LIMITATIONS OF THE STUDY AND OUTLOOK

The explorative research approach of the study brings along certain limitations. First, due to the self-selection of the participants, the research results are not necessarily representative. Second, the survey recorded individual perceptions which might not entirely reflect reality. Third, we cannot be sure that all participants share a common understanding of the term "strategic importance", which may have biased results. Fourth, the study did not test cross effects of variables. Further research should attempt to determine strategic importance as a construct of different aspects instead of asking for it directly. Moreover, it should examine further factors that may take influence on the perceived strategic importance of RFID and intermediating variables.

## REFERENCES

1. Accenture (2005) Pushing the Pace - How Leaders Are Putting RFID to Work, Accenture, München.
2. Agarwal, V. (2001) Assessing the benefits of Auto-ID Technology in the Consumer Goods Industry, Cambridge University Auto ID Centre, Cambridge.
3. Collins, J. (2005) Metro Group Reaps Gains From RFID, *RFID-Journal*, 24.1.2005.
4. Davis, F.D. (1989) Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology, *MIS Quarterly*, 13, 3, 319-339.
5. Finkenzeller, K. (2002) RFID-Handbuch, (3. ed.), Hanser, München
6. Fleisch, E. and Mattern, F. (2005) Das Internet der Dinge - Ubiquitous Computing und RFID in der Praxis, Springer.
7. Frost & Sullivan (2004) World RFID-based Application Markets, Report A686-11, Frost & Sullivan, Palo Alto.
8. Haller, S., and Hodges, S. (2002) The Need for a Universal SmartSensor Network, Cambridge University Auto ID Centre, Cambridge.
9. Iacovou, C., and Benbasat, I. (1995) Electronic Data Interchange and Small Organizations: Adoption and Impact of Technology, *MIS Quarterly*, 19, 4, 465-485.
10. Kraft, J. and Schauler, C. RFID setzt sich durch, *Information Week*, 2005.
11. Lange, V. (2004) Perspektiven für die Nutzung der RFID-Technologie in Supply Chain Management und Logistik, *IM*, 19, 4, 20-26.
12. Luftman, J. (2005) Key Issues for IT Executives 2004, *MIS Quarterly*, 4, 2, Juni 2005, 269 - 285.
13. Maselli, J. (2003) ABI: RFID Market Poised for Growth, *RFID-Journal*, 18.07.2003.
14. Nieschlag, R., Dichtl, E., and Hörschgen, H. (2002) Marketing, Duncker&Humboldt, Berlin.
15. Porter, M.E. (1996) What is Strategy?, *Harvard Business Review*, 74, 6, 61 - 78.
16. Reilly, K. (2005) AMR Research Survey Finds 69% of Respondents Plan to Evaluate, Pilot, or Implement RFID in 2005, AMR Research, 20.07.2005.
17. Rogers, E.M. (1995) Diffusion of Innovations, The Free Press, New York.
18. Roussel, A.-M., Fenn, J., and Linden, A. (2005) Gartner's Radar Screen Pinpoints Hot Technologies Likely to Grab Investors' Attention, Gartner Research, Stanford.
19. Sarma, S. (2004) Integrating RFID, *QUEUE*, October 2004, 50-57.
20. Schmid, F. (2004) Radio Frequency Identification Standards - Produkte - Vorgehen in Projekten, *IM*, 19, 4/2004, 6-11.
21. Sharma, A., and Citurs, A. (2005) Radio Frequency Identification (RFID) Adoption Drivers - A radical Innovation Adoption Perspective, *Proceedings of the Eleventh Americas Conference on Information Systems*, Omaha, NE, USA, 2005.
22. U.S. Food and Drug Administration (2004) COMBATING COUNTERFEIT DRUGS, U.S. Food and Drug Administration.
23. Want, R. (2004) The Magic of RFID, *QUEUE*, October 2004, 40-48.
24. Wilding, R., and Delgado, T. (2004a) RFID Demystified: Company Case Studies, *Logistics & Transport Focus*, 6, 5, 32 - 42.
25. Wilding, R., and Delgado, T. (2004b) RFID Demystified: Supply-Chain Applications, *Logistics & Transport Focus*, 6, 4.
26. Woods, J., Peterson, K., and Hirst, C. (2003) Maturing Open RFID Applications Will Reshape SCM, Gartner Research, Stanford.

## APPENDIX

Statistics	Industry										
	All	Autom.	CG	Log.	Pharma.	IT	Manuf.	Retail	Service	Consult.	Other
	Mean										
RFID is of strategic importance for our company.*	3.05	2.69	3.46	2.50	2.38	2.86	3.10	2.58	3.22	3.50	3.20
By using RFID, we can open up competitive advantages.*	2.61	2.25	3.15	2.11	2.13	2.63	2.52	2.42	2.80	3.17	2.82
RFID helps us to build up new core competencies.*	3.33	3.19	3.54	2.50	3.38	3.13	3.43	2.83	3.20	3.67	3.18
RFID helps us to better exploit existing core competencies.*	2.78	2.38	3.15	2.33	2.13	2.75	2.90	2.50	2.90	3.50	2.64
How will the importance of RFID develop over the next 5 years?***	1.78	1.69	1.83	1.67	1.63	1.50	1.70	1.58	2.00	2.83	1.73

Annotation:

\*5-point scale from "Totally agree"=1 to "Do not agree at all"=5

\*\*Annotation 5-point scale from "Strongly increase"=1 to "Strongly decrease"=5)

**Table 3: Strategic Importance of RFID by Industries (Mean)**

Statistics	Industry										
	All	Autom.	CG	Log.	Pharma.	IT	Manuf.	Retail	Service	Consult.	Other
	Standard Deviation										
RFID is of strategic importance for our company.*	1.32	1.08	1.33	1.20	0.92	1.68	1.41	1.44	1.64	1.76	1.55
By using RFID, we can open up competitive advantages.*	0.78	0.48	0.39	1.03	0.52	0.76	0.57	0.67	1.25	1.17	0.65
RFID helps us to build up new core competencies.*	1.23	1.13	0.99	0.96	0.83	1.85	1.25	1.51	1.62	1.72	1.33
RFID helps us to better exploit existing core competencies.*	1.28	1.05	1.27	1.29	1.19	1.36	1.36	1.53	1.55	1.51	1.40
How will the importance of RFID develop over the next 5 years?***	1.31	0.96	1.34	1.28	0.83	1.67	1.26	1.45	1.66	1.64	1.43

Annotation:

\*5-point scale from "Totally agree"=1 to "Do not agree at all"=5

\*\*Annotation 5-point scale from "Strongly increase"=1 to "Strongly decrease"=5)

**Table 4: Strategic Importance of RFID by Industry (Standard Deviation)**