Feasibility and Usage of RFID in Small and Medium-sized Companies in Germany and the Netherlands

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This article describes results of an analysis of RFID projects carried out in cooperation of small and medium sized Enterprises (SME), Fontys Hogescholen, Venlo, Netherlands and Niederrhein University of Applied Sciences, Moenchengladbach, Germany. Main content and questions are:
Who can be a driver and main beneficiaries of the potential of RFID for SME?
What are the main objectives to use RFID?
Which RFID applications are suitable?
Which RFID technologies are used in SME?
Keywords: Radio Frequency Identification, Case studies in SME, RFID applications, asset management, Identification of objects, UHF, HF, RFID, RFID Hardware, Cost-Benefit Analysis

1. INTRODUCTION

Small and medium-sized enterprises (SME) make up the majority of companies in Germany and the Netherlands (99.5% in Germany and 99.7% in the Netherlands)[1]. Although these companies are mostly owner-managed, with few levels of hierarchy and mainly with its specialized range on the global market, SMEs are often restrained regarding the introduction of new information and communication technologies.[2] As reasons for this lack of know-how, integration costs in existing systems or lack of technology maturity can be seen.[3]

From the idea and the need to support small and medium-sized enterprises in the implementation and application of RFID technology, a 3-year lasting project started in 2010 in cooperation with Dutch and German partners, placed in the area of the Euregions at the border of Germany and the Netherlands. The project is funded under the European Regional Development Fund of the European Union INTERREG IVA.

Previously, a RFID master plan was designed for the region.[4] On basis of preliminary investigations the needs of SMEs were staked.

The following industries are determined as appropriate targets:

- Textile industry
- Food industry
- Agricultural industry
- Health care
- Logistics/production.

They represent the most important economic sectors in the region. The project ensures high-

[1] Europäische Union Eurostat: http://epp.eurostat.ec.europa.eu, 2010

[2] Strüker, J. , Gille D. and Faupel, T.: RFID Report 2008, p. 11

[3] Rhensius, Deindel 2008, p. 49f.; Strüker et al 2008, p. 26f

[4] Braun, M.: Masterplan RFID-NRW-NL, 2008

quality jobs and ensures a sustainable, growing technology-region.

Above mentioned master plan was the basis for the current project "RFID application and support" (RAAS). It aims to make the innovation potential of RFID more accessible to SMEs and thereby to strengthen the competitiveness of local companies in the German/Dutch border region. Particularly to small and medium enterprises, the economic and technical benefits of RFID are not known. Often the implementation effort is too high and enterprises just have no know-how to implement RFID into business processes.

The main questions of research activities are:

- Which factors favour the introduction of RFID for SME?
- Which processes are suitable for SME for an optimization using RFID?
- Will RFID replace previous technologies or is RFID a tool for supporting new business processes"?
- Which RFID technologies are successfully used in SME?

To answer the research questions, a qualitative comparative analysis was carried out in 23 small or medium-sized companies based in Germany and the Netherlands.

The selection of companies was mainly built of SMEs, which have been addressed by project partners to get a representative mixture in size, branch and standard processes. In addition some support asking companies where involved too.

1.1.WHAT IS RFID?

Radio Frequency IDentifcation (RFID) enables non-contact automatic data collection of objects by radio transmission. Each RFID System can be characterized according to the following characteristics:

- Unique identification of objects using electronic identification number and stored data;
- non contact and wireless data transmission on a radio frequency channel without need of visual contact;
- Sending process is done on demand, thus data of one object are only sent if an authorized reader initiates this process.[5]

Due to the technical characteristics (visible and contactless electronic data exchange, storage capacities, to re-writeability and further functionalities, such as e.g. sensors), this technology brings a significant high added value compared to established identification technologies such as bar code, 2D matrix code or magnetic stripe.

Various radio frequencies, the necessary hardware designs and their energy supply as well as provided interfaces and software applications - in addition to carried out standardisation – enable the use of RFID technology in all kinds of applications and under varying environmental conditions. Former physical challenges such as the absorption of liquids, the reflection of metal, heat or chemicals have largely been overcome.

1.2. BENEFITS OF RFID

Saving time and money plays a central role in this technology. Inventory in real time, completeness check and that of origin are further established areas of application for RFID. In addition, also using quality improvements and increasing safety, for example in maintenance, access, or compliance with hygiene in health care. The implementation of RFID can also improve exchange of data and collaboration of companies within a supply chain. Because of that global trading groups or automobile manufacturer use RFID already and expect their suppliers to implement this technology as well, for example by using RFID tags on pallets, cartons or the individual products.

The use of RFID is not limited to individual industries or applications. Due to its various possibilities it can be used everywhere where products or objects have to be identified and managed. RFID is therefore a cross-cutting technology.

[5] Abts, D./Mülder, W.: Grundkurs Wirtschaftsinformatik, 7th Ed., Wiesbaden 2011, p. 185

Bundesamt für Sicherheit in der Informationstechnik: Chancen und Risiken des Einsatzes von RFID-Systemen, Bonn 2005 (http://bsi.de/fachthemen/rfid/RIKCHA_barrierefrei.pdf), 25.08.2008, p.13

The technology has proven its advantages within the last years and is standardized in the most relevant areas worldwide.

1.3. RFID in Germany and the Netherlands

On a worldwide comparison Germany and the Netherlands are among the countries with a widespread use of RFID.[6]

Companies already taking advantage on RFID applications for years are in particular wholesalers such as the Metro, a strong driver in Germany for RFID technology, REWE (D), Albert Heijn (NL), logistics providers and parcel services such as DHL, UPS. Textile manufacturers (Gerry Weber, Mexx, ESPRIT) and textile service providers (laundries and working clothes rentals), automobile manufacturer in Germany, are also been going on for years with RFID as well as service sectors like security services, libraries, or recreational facilities (swimming pools).

Falls on closer look, in the past and today the driver and the main beneficiaries of the potential of RFID can be found within large companies.

Smaller suppliers of large business groups or car manufacturers mark their outgoing goods by RFID; of it in the long run only the customer profits by simplification of his incoming goods and for further logistic completion (Slap & Ship). The internal processes of the suppliers remain untouched by the marking of the own products.

1.4. RFID in SME

After EU definition small and medium sized enterprises (SME) have up to maximally 50 million euros annual turnover and/or a balance sheet total of under 43 million euros and have less than 250 full time employees. SME not exclusively differ from large-scale enterprises by turnover figures, number of co-workers or balance sheet total.

Regarding the application type of RFID, SME differ from larger enterprises through

- smaller degree at automation
- smaller number of necessary identification points (read-in units)
- less identification objects.

For these reasons - after our thesis - the advantages sink in the context of a view of cost use with SME. Our goal is it to find out whether these criteria are actually a cause for the small spreading of RFID with SME and which further factors can positively affect the spreading degree of the RFID of employment with SME.

In the context of our investigations and experiences in co-operation with SME many „soft factors“ play a role with the use of RFID. From organizational view smaller enterprises are missing personnel capacities, e.g. over headquarters to procure a comprehensive information status and thus know-how about RFID. Due to RFID suppliers assume smaller turnover potentials at smaller enterprises, SME fall out of supplier's sales target group. SME are addressed and confronted with RFID directly thereby more rarely. Apart from the lower information status about RFID drivers of RFID innovation play an important role. If the owner/managing director of a SME is not open to innovations, an important driver is missing. On one hand this causes direct consequences on acceptance behaviour towards innovations of the SME employees, on the other hand internal innovative impacts are disturbed. RFID projects are often person driven. Employee change can endanger progressing of RFID projects.

2. ANALYSIS RFID IN SME

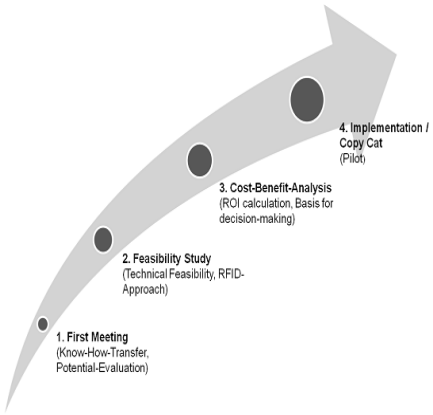
In the following analysis, the previous discussions and projects within the context of the INTERREG project RAAS were analysed qualitatively. The analysis is based on 43 first meetings and 23 projects.

2.1. RESEARCH METHOD

Within our research the method of approach to companies is shown in figure 1.

[6] UEAPME 2011 - European Association of Craft, Small and Medium-sized Enterprises, http://www.rfidsme.eu/index.php?option=com_content&view=article&id=9& Itemid=9, 09.06.2011

Figure 1: Method of approach



Methodically the projects are accomplished within the research project RAAS in 4 stages (cp. Fig. 1).

Projects start with a „first meeting“. Problems and objectives of SME in relation to identification, security and quality, information on RFID potential and first ideas of applications and improvements are topics of a first meeting. The first visits are usually combined with a site inspection. Relevant contacts are members of management boards and/or logistics and/or IT Manager, who are in charge of process optimization for their SME.

Next step is a „feasibility study“, an examination of technical feasibility in a planned RFID utilization. At this step one specified potential application will be examined to find out which RFID systems (frequency, tag construction, antenna construction, interfaces, software) are suitable.

A „cost benefit analysis“ determines economic efficiency of the focused application.

Final step is a concluding „RFID implementtation/Copy Cat project.“ SME are supported and accompanied within an RFID implement-tation process. As result of each step a recommendation of “go further” or “no go further” with RFID is provided to SMEs.

More scientific knowledge which will review the ideas laid down at the beginning and answer open questions derive from the project results.

2.2. ANALYSIS OF RFID-CASE STUDIES

2.2.1. IMPULSE AND DRIVER FOR RFID

Thesis 1: RFID suitable and interested enterprises look actively for solutions.

So far in project’s context 105 enterprises were contacted. Five types of establishing contacts can be differentiated here:

- Enterprises contact us
- Enterprises were addressed by us (Cold call)
- Enterprises originate from our existing network from innovation oriented enterprises
- Enterprises participated on meetings/conferences.

Figure 2: Impulse for RFID

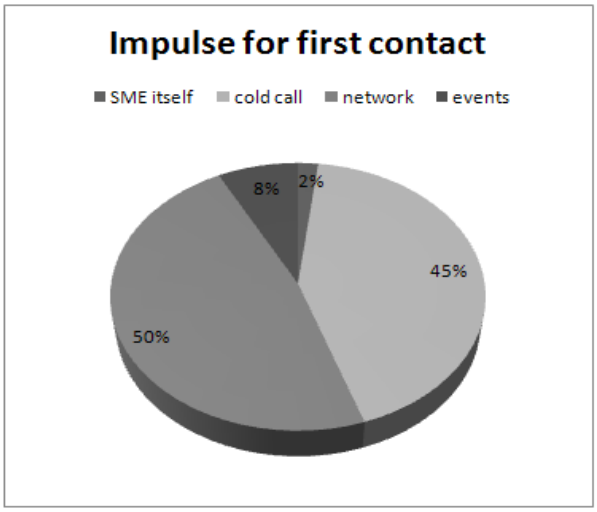


Figure 2 shows clearly that SME are almost completely unresourceful in terms of acquiring support for RFID projects. Often – especially in Germany – it is required to approach SME via Cold Calls. In the Netherlands the impulse for taking RFID into account is triggered as result of networking activities. Within this context participating members of this network make contact with RFID as a tool while searching for problem solving solutions.

Thesis 2: RFID projects are driven by the management in most cases.

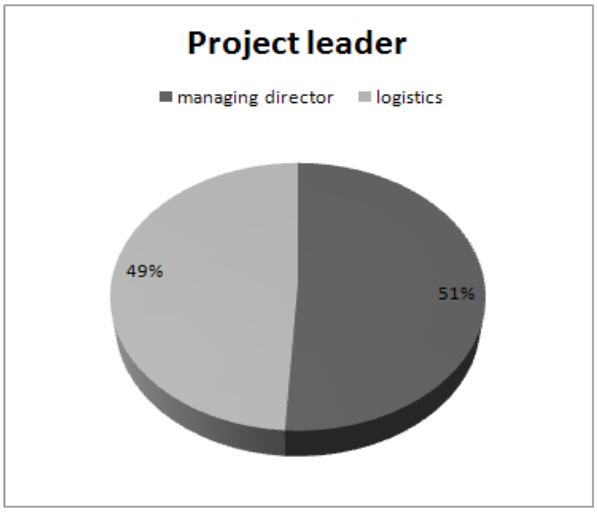
Counterparts at enterprises were derived as result of 105 contacts on the subject of RFID and 43 first meetings with know-how transfer and initial potential estimation subjects. They can be distinguished between division relation and process owner.

Table 1: Department's first contact person (n=43)

Department 1. contact person	**First Meeting**
Managing director	49 %
Logistics	28 %
Production	9 %
Quality management	7 %
Procurement	3 %
Sales	2 %
IT	2 %

Factor of success for RFID projects is a driving forth commitment by the management. On the second place are the logistics divisions which initiate RFID projects by far before other divisions do. This is proven by the following table. It displays project managers of 23 RFID projects that have been started directly after first meetings.

Figure 3: Project leader RFID

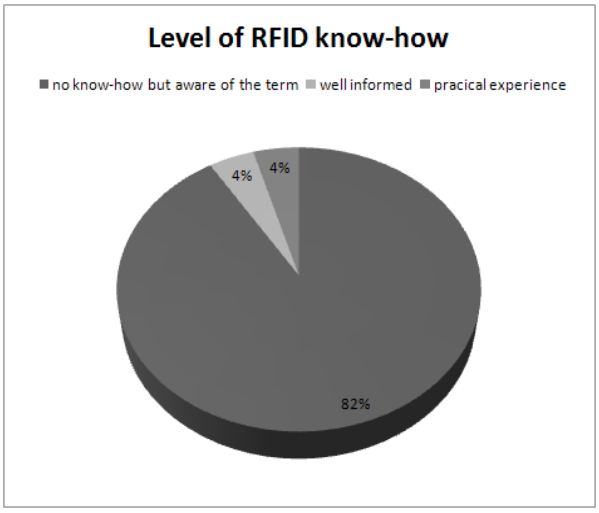


Crucial for the start of an RFID project is the management's support followed by logistics divisions that are especially interested in solutions in the scope of identification.

Next 23 completed and current RFID projects will be analyzed in more detail.

Thesis 3: RFID know-how among SME is small scaled.

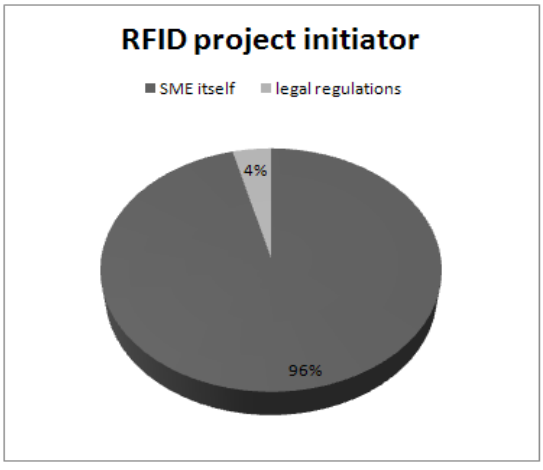
Figure 4: Level of RFID know-how (n=23)



Only a minor part of examined enterprises is well informed about RFID technology. In context of starting a project with objective to improve identification and controlling of objects via RFID it is important to know that there are alternatives to common technologies. Therefore existing RFID know-how at enterprises is a crucial factor of success. Enterprises with little expertise shall be clarified about RFID potentials to generate usage scenarios.

Thesis 4: RFID projects get initiated forcedly by customer demands.

Figure 5: RFID project initiator



The previously mentioned thesis – RFID projects by SME get started because of third party demands – cannot be confirmed by this analysis. Over 95 percent of the SME start such projects to meet their own demands. This circumstance indicates that those enterprises perceived RFID benefits for themselves. Thus own benefit is a factor of success.

Thesis 5: Cost-benefit ratio of RFID applications in SME is adverse.

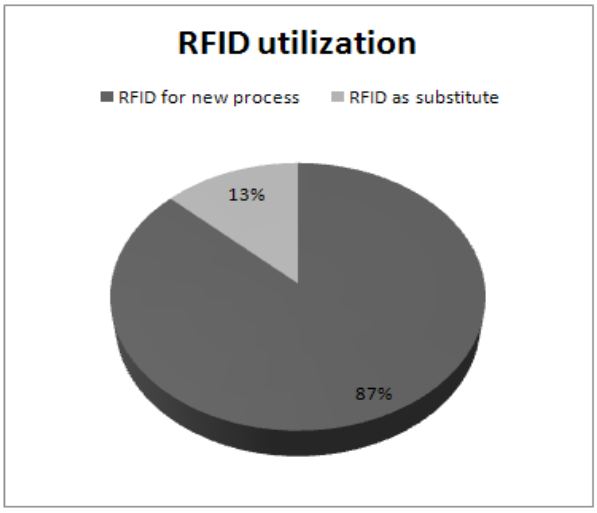
Table 2: PBP of RFID projects (n=23)

Payback Period (PBP)	In %
No ratio	17 %
PBP after 3-5 years	5 %
PBP after 0-3 years	22 %
PBP not relevant (safety issues/de jure)	8 %
Unknown	48 %

RFID projects, with which Payback period (PBP) is already known, largest part PBP is shorter than expected life span of their RFID system. For some SME this computation is not relevant, since legal regulations or the safety aspect fade out the costs/use considerations. The number of SME with which a long PBP is to be expected, is not negligible. Here is to find out, which qualitative factors can justify the RFID application not considered yet in cost-benefit analysis. In general a short Payback period favours the employment of RFID.

Thesis 6: RFID is implemented mainly to new business processes and not as replacement for existing identification technologies

Figure 6: RFID utilization

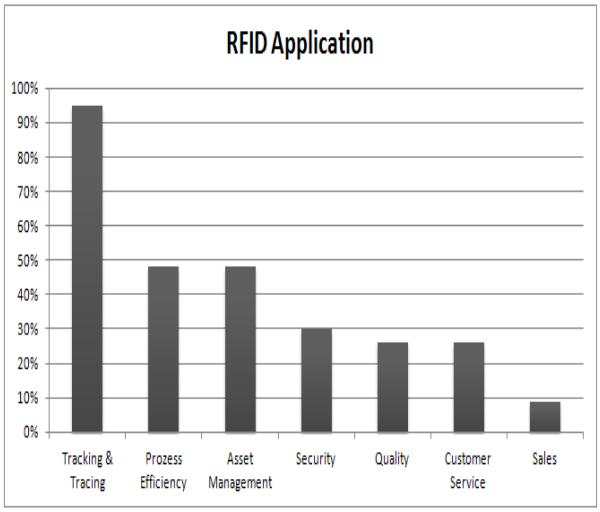


RFID supported processes have to be differentiated into new processes and processes already existing. Only in few cases RFID is introduced as replacement for existing technologies (for example bar code or manual recordings). New processes, which cannot be supported by conventional technology, form a majority of RFID projects.

2.2.2. SUITABLE RFID APPLICATIONS FOR SME

Based on analysis of projects accomplished so far SME plans to implement RFID for the following applications:

Figure 7: Usage for RFID technology



Here it shows up clearly that optimization of traceability of objects forms the most important motivation for employment of RFID technology. In second place stand increase of process efficiency and improvement of the Asset management. Security seems to have no importance, but regarding industry branches as Health Care and Food, security and safety possess high relevance.

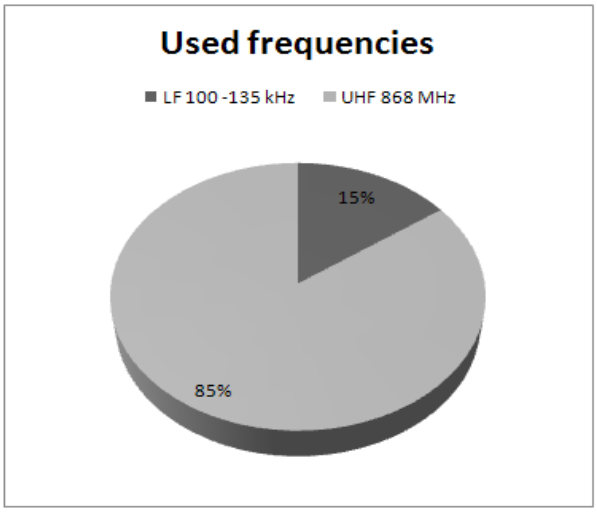
3. RFID TECHNOLOGIES USED BY SME

An analysis of used RFID technologies is to answer the question whether for SME a certain kind of technology is used frequently and thus appears suitable.

Assigned designs of transponders

Transponders are offered in different designs. As a function of environmental influences, kind of object, material and size as well as type of mounting suitable designs for a RFID system are to be selected.

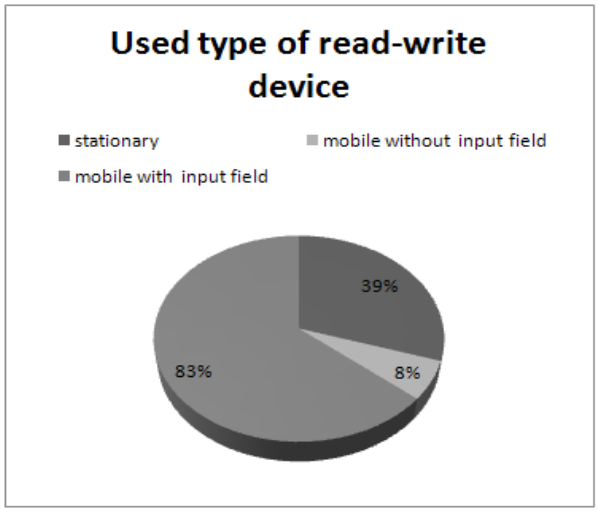
Figure 8: Used construction form



In context of projects accomplished transponders for metal environments and Smart labels result particularly frequently. Metal environments mean hard environmental conditions regarding water/cleaning, temperature and chemical treatment. Here RFID is more durable than e.g. bar code markings as identification technology. From this it can be derived that RFID is well suitably for harsh environments actual in particular in combination with metal. The employment environment of Smart label or Wet label usually hardly differs of that of bar codes. Smart labels apply frequently, where the deposited information is also optically selectable. This design is therefore particularly suitable with objects, which go through a Supply chain, with which not all members are using RFID systems.

Energy supply for RFID transponders

Figure 9: Read/write characteristics



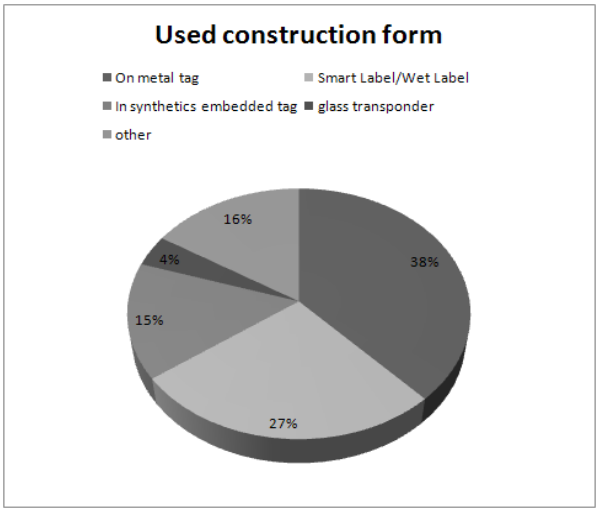
SME's desire to store own identification numbers on the transponders is rare. Half of SME would like to get given ID numbers and are not dependent on own sets of numbers. The necessity to use stored numbers several times or to be able to rewrite own sets of numbers, occurs only with few SME. The conclusion thus:

- majority of once marked objects remains married with a transponder
- traceability is sure by constant ID marking of the object
- high reading speed should be ensured by the avoidance of recording procedure
- volume of necessary data exchange is kept smaller with the read/write process.

Used frequencies

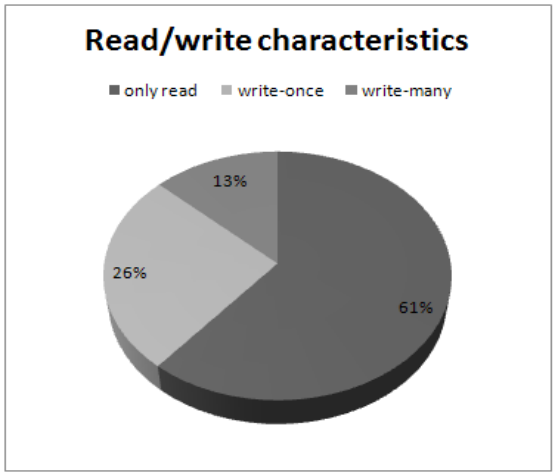
Most of SME use UHF systems for data transmission. Important reasons are a larger range, lower costs of hardware, higher standardisation of UHF technology and thus exchangeability of the RFID hardware. Some SME use LF transponder, HF technology (125 kHz) or Microwave frequency (2.45 GHz) are not used at all.

Figure 10: Used frequencies



Used Readers

Figure 11: Used type of read-write device



The clear trend showed up the use of mobile RFID readers with enter option for adding information/data to identification objects. For example for accomplished activities on objects in context of Asset management or process transactions.

Thus within this it shows that flexible employment of the devices is desired. That can be interpreted as proof of fact that mainly new processes are supported by RFID technology. Stationary applications point to a higher degree of automation, which can be supported by every other identification technology.

4. RESUMEE

As result of our researches it became obvious that RFID technology in many cases is a well suited table technology to support new processes by this kind of identification method. Giving SME a strong idea of benefits of RFID support in relation to other identification technologies motivation to work on RFID projects increase enormously.

Viewing the results of cost-benefit analysis the numbers of positive ones face a large number of negative results. Causally for it SME can earn smaller absolute savings in contrary to larger enterprises.

Therefore flexible employment of RFID hardware and employment of mobile devices are substantial success factors. In addition application of low cost and highly standardised UHF technologies and reduction on few data exchanges may deliver many promising RFID applications also for SME.

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