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Abstract
The article demonstrates the need for a methodical procedure in a systematic selection and implementation of RFID systems in production and logistic environments. The systematisation process is described in detail. The goal of these investigations is the development of an operations handbook, which allows companies to reduce efforts during project realisation. The research is focused on the requirements of small and medium-sized enterprises (SMEs). The focus of this paper is on the development of process reference models and the results generated so far.

1 Introduction
The increasing number of products and product variants as well as shorter product life-cycles entails in large-scale fluctuations in the production demand and output [1]. A major challenge producing such goods lies in the management and tracking of product related data and its transmission to the machinery and workforce [2]. Lately this has lead to a rising use of new technologies, such as Radio Frequency Identification (RFID), to support production facilities and the workers within [3]. Intelligent Auto-ID systems, such as RFID, enable a smooth flow of information in order to increase the efficiency of material and logistic systems.

Previously, RFID systems have been customised installations, originating from a large number of vendors, technologies and fields of application. Due to the growing maturity and standardisation of the RFID technology in addition to the increase of implemented installations, the systems' prototypical characters were reduced. Therefore the focus is shifted to the creation of complete and integrated systems [4].

2 Objective
Despite the numerous advantages and the functionality of the RFID technology (e.g. read/write capabilities, readability through various materials, insensitivity against dirt) companies still have major difficulties in selecting and subsequently implementing RFID systems in production and logistic environments.

The problem for many companies is the fact that they can only rely on few case-specific studies of different industrial enterprises. Company specific boundary conditions, such as process sequences and order processing, are often ignored, although this information is relevant for the success of RFID projects. Therefore, enterprises are unable to accomplish adequate cost-benefit analyses and have difficulties to correctly select and implement RFID systems. This deficits of a methodical proceeding can result in a failure of RFID projects [5,6]. These findings are supported by a study of the IZT - Institut für Zukunftsstudien und Technologiebewertung gGmbH, which identified the relevant constraints for enterprises implementing the RFID technology (Figure 1).

Figure 1: Constraints regarding the application of RFID systems in enterprises [5]

The major constraints were the lack of knowledge regarding the technology and the fact that reclaimable reference implementations were unavailable.
3 Methodical Proceeding

Due to the previously mentioned problems of systematically identifying and assessing possibilities of various RFID applications, the research work is aiming for the development of a methodical proceeding to select and implement economically and technically adequate RFID systems. The implementation method consists of the following work packages:

- Integrated analysis of process sequences and the subsequent development of process reference models
- Criteria identification for typical scenarios at small and medium-sized enterprises
- Structured selection procedure for RFID systems according to the technical and physical boundary conditions in production environments
- Method for the selection of technically and economically adequate as well as company customised RFID systems

The objective is the determination of structured utilisation scenarios for different requirements in industrial enterprises and an appropriate cost-benefit analysis of the specific application area. Based on the results of the process specifications and the utilisation scenarios, a methodical catalogue of requirements for application areas of the RFID technology is defined.

The subsequent step will classify RFID systems into categories, depending on their particular application purposes and environmental conditions in industrial enterprises. Experimental studies are carried out, which analyse effects of production and logistic environments (e.g. metallic environments, electric fields of machine tools) on the operating performance of RFID systems. The result is a structured selection procedure for RFID systems that takes the different company specific requirements into account.

Based on the previously mentioned work packages, a systematic and structured method for the selection of technical and economical suitable RFID systems is derived.

With the results of this research project, SMEs shall be in the position to easily accomplish a cost-benefit analysis concerning potential applications of the RFID technology in specific production environments. Hence, enterprises can use the methodical proceeding to consequently save personnel, technical and financial resources.

4 Development of a Process Reference Model

As a basic requirement for the development of a systematic and methodical proceeding for the selection and implementation of RFID systems, a process reference model is developed. The reference model consists of various specific characteristics of process sequences and order processing in enterprises that are relevant for the utilisation of the RFID technology in production and logistic environments in SMEs. Those relevant features are used in the ongoing research work as a standard basis to identify qualified and standardised application areas of the RFID technology according to sets of features.

Process sequences in production environments depend on many different factors (e.g. the type and the quantities of
specific products, the processing of production and assembly processes as well as the market requirements) [7]. The combination of the aforementioned factors and specific limiting conditions of enterprises require individual strategies for the organisation of the order processing. The processes in production and logistic environments and the applied type of order processing can be grouped into characteristic typologies, which are specific to those enterprises with similar challenges and features in process sequences. Several methods and parameter structures to systematically classify production sequences and order processing will be discussed in regard to the relevance for an application of RFID systems in production and logistic environment.

After the general analysis of typical characteristics in production sequences and in order processing, the special characteristics of small and medium-sized enterprises are investigated. SMEs face specific limiting conditions in production environments and order processing, which vary significantly from large-scale enterprises. In most instances SMEs are oriented towards small piece numbers and a high product variance. The single-part and small-batch production requires a customer-specific processing of orders throughout the whole order processing [8]. The application of the RFID technology is especially promising for make-to-order production and a versatile product range. These characteristics have to be considered for the development of the process reference model. Due to the strong customisation, numerous product types and non-standardised processes, the RFID technology provides a lot of chances for small and medium-sized enterprises in terms of improving existing production processes and order processing.

Based on the results of the different possibilities to systematically structure process sequences and order processing regarding potential RFID applications as well as the analysis of the characteristic limiting conditions of SMEs, a typology is developed. The single characteristic and the actual form of appearance in an individual enterprise can be matched to a predefined type in the developed methodology.

5 Conclusions and Perspective

This article shows that enterprises have major difficulties in selecting and implementing technical and economical adequate RFID systems in production and logistic environments. The need for an integrated approach for a methodical proceeding is detailed and the systematic procedure in the research project is presented. As a first step and basis for the future work, a process reference model for process sequences and order processing was developed. The developed characteristic typology will be validated with various small and medium-sized enterprises.

6 References