FACTA UNIVERSITATIS
Series: **Mechanical Engineering** Vol. 7, N° 1, 2009, pp. 73 - 80

AUTOID BASED INTEGRATED PRODUCT TRACEABILITY ALONG THE PRODUCT LIFE CYCLE

UDC 658.511.2

Şeref Erkayhan

Business Development - Product Lifecycle Management
SEEBURGER AG - Edisonstr. 1, D 75015 Bretten, Germany
E-mail: s.erkayhan@seeburger.de

Abstract. *The product components and related data today represent a unit only in the early phases of the product life cycle, this means that they build a virtual product unit in the phases of development and construction. In the late phases of product lifecycle, e.g. production, use and end of life, the product unit is split, separated the physical product from the related product data. This is exactly the point, where AutoID opens new doors and provides new solutions. Many enterprise use AutoID in their processes to identify product components, to find, differentiate and trace them. In a AutoID managed product life cycle, the generated product data can be read automatically and forwarded to different software applications e.g. quality management (CAQ) or product data management (PDM) systems. Thus, the product number recorded on a RFID tag allows the immediate access to the product information required from the data base. Especially the integration of product components and product data has a huge innovation potential. The use of AutoID in the product life cycle eliminates the separation of physical product components and the related information. In this way, the product data related to a certain product make an impact on all phases of the product life cycle and revolutionize the gain of information and the subsequent conclusions related to the product planning, development, production and deployment until recycling. Finally, the information which tracks the product along its complete life cycle creates the individual product. This paper presents a PLM-oriented solution for integrated product traceability based on AutoID-Technology, which was developed in the SEEBURGER AutoID-Labs in Bretten.*

Key words: *Autoid based integrated product traceability, product life cycle*

1. INTRODUCTION

Many kinds of product data like drawings, models, lists, plans, protocols or specifications are created and needed along the entire of product lifecycle, from the basic ideas of a product until its recycling. Using, consolidating and complementing this data set is an ongoing task. This task gets more and more important and demanding with every step in the lifecycle of a product.

Received January 28, 2009

Product lifecycle management (PLM) is a concept for integrated business processes, software applications, organizational units, resources as well as product data along the entire product life cycle. The overall target for a PLM concept is to integrate the applications e.g. PDM, ERP, CAQ, MES according to process relevance, resulting in availability of all product data generated along the entire of product life cycle at the right place at the right time and in the appropriate quality and quantity.

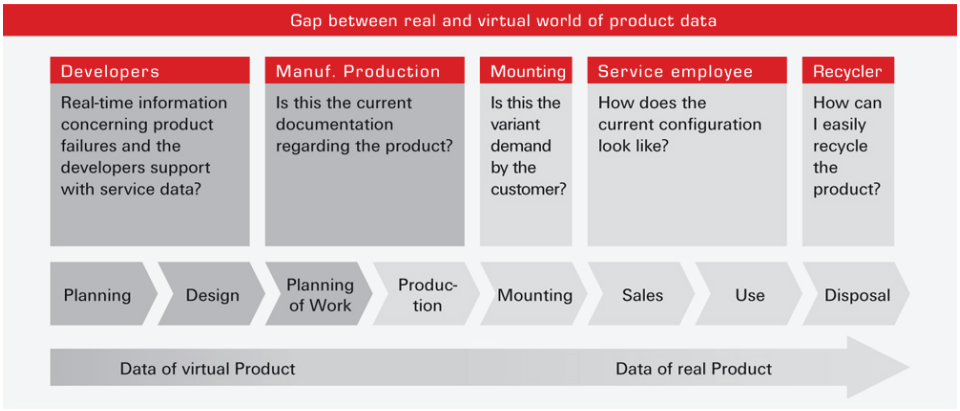

Fig. 1 Figure displays the gap between data of virtual product in the early phases of lifecycle and data of the real product in phases of production, mounting, sales, use and disposal

Today, the product data fails to be available along the entire of product lifecycle due to the fact that product components and corresponding product data is only available at an early stage of the product lifecycle, such as development and construction, united in a virtual product unit [1]. At any later stage of the product lifecycle – production, use and disposal – the physical product unit will be separated from the corresponding product data (Fig. 1). As a result, changes, product history, information regarding quality or any other product data are not instantly available anymore.

The challenge for companies at present is to cope with internal and external material and information flows. These are getting more complex due to ongoing outsourcing processes and highly developed company networks. The coordination of the flows is very difficult without the support of modern information technology and information systems [5].

Additionally the challenges such as tightened laws and regulations, expensive product recalls and the resulting damage done to the companys image force many companies to ensure the traceability of their products. By a closer look on todays existing solutions according to product traceability leads to the conclusion, that often only partial aspects are considered and comprehensive holistic attempts, which cover all relevant aspects (processes, data, ID technologies, IT infrastructure), are not yet available [3].

In this point, integrated AutoID technology allows companies to tap huge potentials. Especially when it is used to combine the real product or its components with the corresponding product data, AutoID offers innovation potentials. AutoID technology allows streamlining of this work insofar as to make individual products with all specific information in its life cycle. For example, the unique product number on an RFID tag makes it possible to access relating product information previously entered in an IT application quickly.

The potentials of AutoID technology in product life cycle are showcased in the following example of the automobile industry, by a complete process from the order, planning, production to the recycling of the car.

2. Customized Products: Build to Order Process

Within the past few years, the buying behaviour of car customers in Europe has been changed significantly, demanding for heavily customised products previously configured by the customers [2]. Regarding the automobile industry, this is a process starts with the customer based configuration and order of a car and finishes with the delivery of the assembled product. This process requires collaborative working of many companies, organizational units with different IT systems and product data. This process can be divided in different sub processes, for example, configuration, availability check, order, production and delivery (Fig. 2).

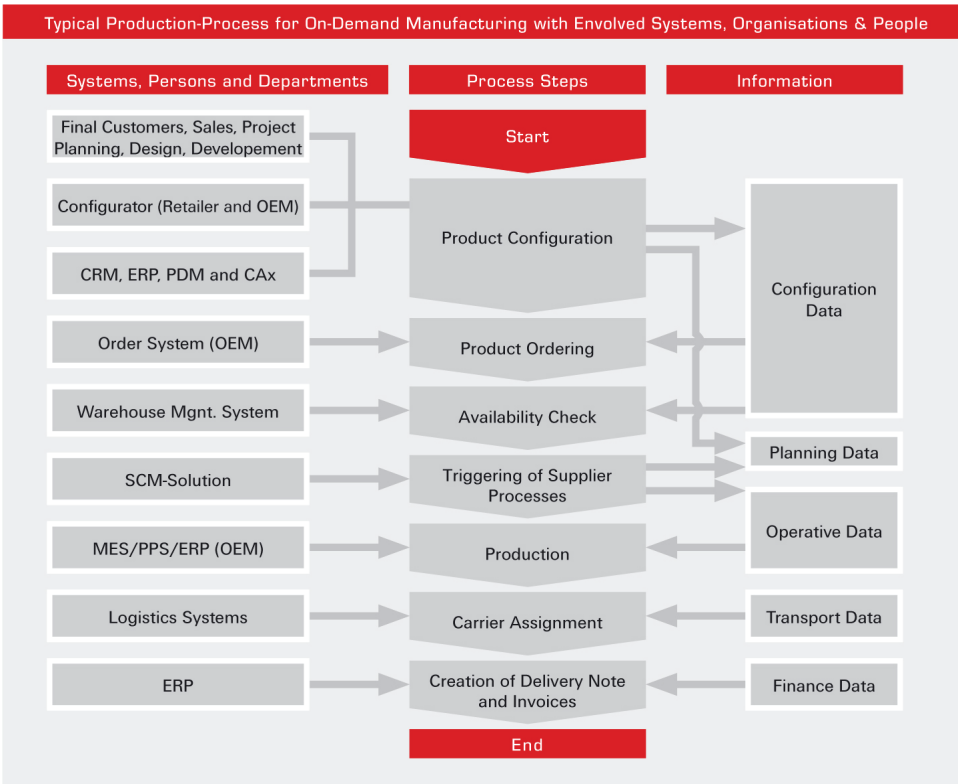

Fig. 2 Example of "build-to-order" process, including used IT systems, organisational and informational units

Although the actual production time of a car is only six to eight days, it takes an average of more than 40 days for the customer to wait until his custom produced car arrives. Besides the amount of time required for production, the remaining time is devoted to logistics, technical and business processes.

In the above case, AutoID technology can be used with to identify the custom order including the configuration of the car. The ordered car will be identified by a unique RFID tag along the entire of its life cycle. The same RFID tag could mark the bodywork at the same time. Fixed to the bodywork, the RFID tag would identify the car throughout the whole production cycle, allowing for automated identification at any single manufacturing stage during production (Fig. 3).

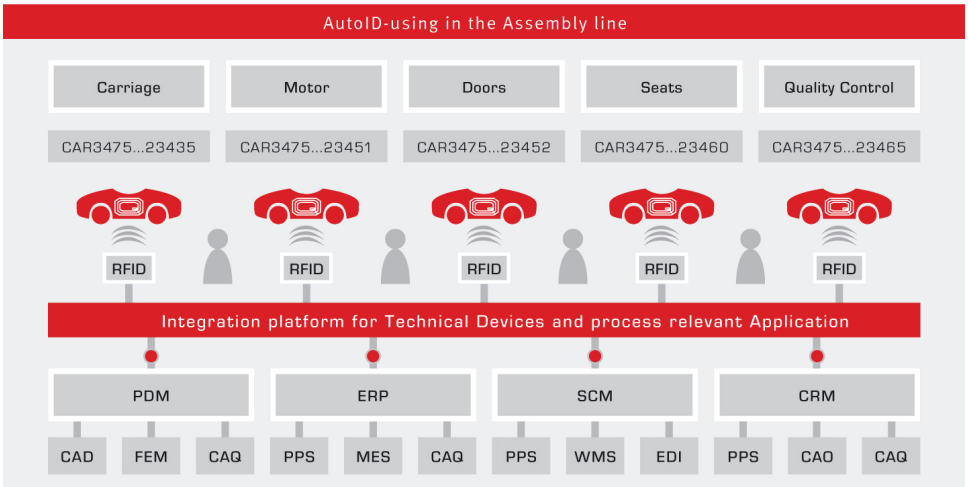

Fig. 3 An RFID tag, fixed to the bodywork, contains all relevant data regarding the production of the car, allowing for instant identification of the bodywork. This simplifies production management, documentation and quality control

By integrating manufacturing execution systems (MES), it is now possible to update status information of production orders as well as to transmit all necessary data for production to the manufacturing stations, such as worksteps and quantity lists etc.

Using RFID readers at every manufacturing station is an ideal way of reading the serial number of product components and to assign them to the corresponding production order. This is also a simple way of storing and getting any other process relevant information. Using integrated MES-information, the worksteps can be determined according to the corresponding manufacturing stations, – e.g. which component in which version has to be assembled – depending on the data on the RFID tag. This simplifies the entire production process, especially by assembling products with many different options by cars with more than 200,000 possible configurations. Required information by the assembly worker can be provided context-related through mobile personal digital assistants (PDAs) or computer terminals, e.g. to confirm the single worksteps during assembly process, to register possible failure notifications and to initiate relevant quality or recall processes.

The following example shows the broad range of possibilities of AutoID technology in a manufacturing process with RFID-supported quality control: In this process, RFID tag will be applied to a differential gear which goes through a number of manufacturing worksteps. It will be identified automatically, all process relevant IT applications will be started automatically and the manufacturing process will be documented.

3. RFID-Supported Quality Control in Manufacturing

The example in Fig.4 shows the automated starting of process relevant IT applications at different manufacturing stations, for example at the measuring station – starting the CAQ solution, selecting the corresponding testing plan, generating the correct testing order and saving the testing data. In order to execute the quality control process, the RFID gateway – a software solution – starts the CAQ solution (computer-based quality control) and transfers the RFID ID during the process. In return, the RFID gateway receives and stores an identification code, referring to the CAQ process. Using this identification code, CAQ order, measuring and analysis results can be recalled through the CAQ solution at any later step of the manufacturing process. The same data is still available after delivery when looking for the cause of a fault of defective assembly elements or when products of a defective shipment have to be identified.

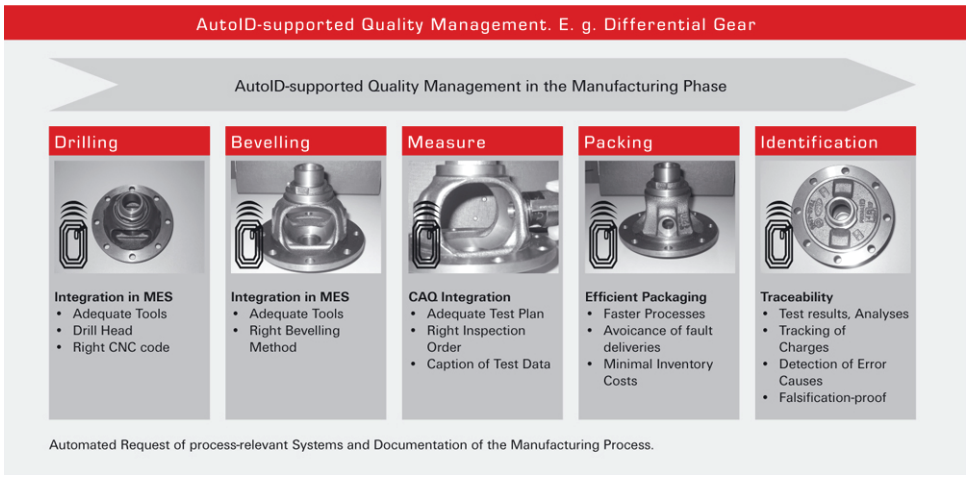

Fig. 4 Automated start of process relevant IT applications and documenting the manufacturing process of a differential gear with an HF-RFID tag

By becoming the corresponding realtime information in the manufacturing process, it is not only possible to register the manufacturing process of any single car, but to quickly correct possible faults as well. Even variations of the configuration (if the delivered product differs from the custom order) will be documented. As a result, production will become more effective and the quality level will rise, followed by less extra work, less complaints and less recalls.

4. Mobile PDM During Usage And Disposal Cycles

The mobile availability of up-to-date product related data during usage and disposal cycles is relevant for services during these lifecycles of the product, because all kinds of product information will be required and generated during maintenance and service processes as well.

The information stored on the RFID tag makes is easy to identify product components and assign them to the identification codes which are already available on a PDA or a small

PDM system [4], allowing for quick diagnosis of errors and for speeding up relevant processes. Service associates can be provided with specific information (product history, stock list, service contracts) through the integration of the corresponding IT applications (Fig. 5).

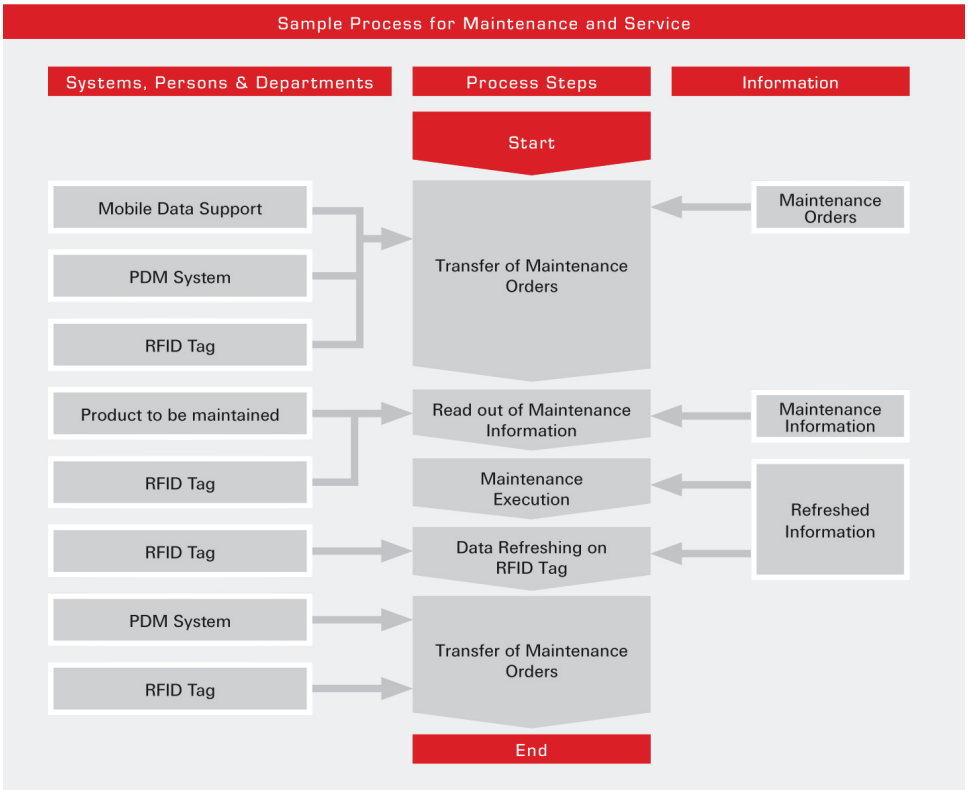

Fig. 5 Sample process of RFID-supported usage of product data in the maintenance and service

The replacement parts required for repair can be identified, checked for availability and ordered immediately if necessary. Installing or building out components or replacement parts will be registered automatically as well and can be transferred to the corresponding IT application afterwards. After product maintenance, the data of the corresponding IT applications can be updated and made available to development and construction departments to point out updated product requirements. Such administration functions regarding maintenance, repair and upgrading are already available today from several suppliers of PLM solutions and are called »Requirement Management & Traceability« (RMT) and »Maintenance, Repair and Overhaul« (MRO).

5. Tracking and Tracing of Product Components

EU guidelines and national laws require increasing product and component transparency from manufacturing companies. This is especially important for the automobile industry concerning issues like product liability and recalls, applying to both manufacturers

and suppliers. According to the German national agency for automotive, there are 109 recalls concerning 1.4 million cars in 2004.

AutoID supported PLM solutions can solve this problem. When process involved IT applications register the relevant product data like components, shipments or any other process relevant information as well as the product configuration by the customer, it is possible to comprehend the production of any single product or any shipment, based on the coded information stored on the RFID tag. The Transponder on the product calls process relevant application with the all needed information e.g. which component from which supplier was used in the finished product. Expensive recalls action can be so restricted since the unique number can identify only the defective products. The whole production process can be tracked down to the supplier through any manufacturing stage, identifying the problem origin.

Product- and customer-related information of individual components within complex products is not only relevant for maintenance, service. Disassembly and recycling of complex products containing a huge variety of different components and materials is a problem as well, especially when sorting out hazardous material. Recycling processes could also benefit from integrated AutoID technology combined with PLM solutions by including instructions for disassembly, recycling and hazardous material – available for mobile recall on corresponding devices.

6. Integrated Information Management Based on AutoID

This example shows the advantage of instant availability of product information at any stage of the product lifecycle. Considerable improvements can be made regarding variant control, lead time, costs of production and reaction. This is only possible if the product components exchanges information concerning its manufacturing, assembly and recycling with the involved IT systems as well as providing the information to the corresponding devices (e.g. PDA) of the associates. While isolated solutions might be the right tool for their application, they still need to be integrated in order to realize a continuous process.

This is where the integration technology comes into play, connecting the product components through unique identification with the process involved IT systems regarding manufacturing, quality control or product management etc. In this way IT applications can cooperate smoothly and efficiently through the identification code of the RFID tag.

RFID Gateway – a software solution - makes it possible to collect and concentrate information of RFID readers and the integration platform to transfer the information to superior IT applications (ERP, PDM, MES, etc.). Such an integration platform integrates business processes in a lifecycle-oriented manner, based on international standards like SOAP, XML, BPEL and web services. It is the cooperation between those standards which finally allows for the required platform independent automated execution of business processes.

6. Conclusions

Product life cycle management is not a single software solution. It is a company specific concept and there are many solutions available which need to be integrated based on this concept for a whole company wide information management. This paper describes a fully integrated, AutoID based traceability solution throughout the entire product life cycle. The Identification of a product and its components based on RFID technology. The traceability of the product and of its components is based on the information, which is di-

rectly saved on the process relevant application. Product and its components integrated with AutoID technology enable a continuous traceability. The information of a real product or its component is overall available and can be used to track and trace the product throughout the entire product life cycle.

REFERENCES

1. The Use of RFID enables a holistic Information Management within Product lifecycle Management (PLM), Erkayhan, S.; RFID Eurasia, 2007 1st Annual, Publication Date: 5-6 Sept. 2007
2. Intelligent Logistics for Innovative Product Technologies as Part of the EU 5-Day Car Initiative, W. Sihn1, J. Bischoff, M. Esterházy, CIRP-38th International Seminar for Manufacturing Engineering, 2005
3. Integrated Product Traceability along the Supply Chain in the Automotive Industry, Abramovici, M.; Bellalouna, F.; Flohr, M. Proceedings of the 15th CIRP International Conference on Life Cycle Engineering, The University of New South Wales, Sydney, Australia, 17-19 March 2008
4. Context of Use in Mobile Support Systems for Maintenance Work, Research project m-pdm mobile product data management, Krannich, D.; Friedrich, J.; University of Bremen, 7th International Conference on Human Computer Interaction with Mobile Devices and Services, University of Salzburg, Austria, 19 to 22 September 2005
5. Gentelligent Factory Structures and Assembly Control, P. Nyhuis, F. Fisser, M. Schmidt, Institute of Production Systems and Logistics, Leibniz University Hanover, I*PROMS 2008 Conference

INTEGRISANO I NA AUTOID-U ZASNOVANO PRAĆENJE PROIZVODA TOKOM CELOG ŽIVOTNOG CIKLUSA

Şeref Erkayhan

Proizvodne komponente i sa njima skopčani podaci danas predstavljaju celinu jedino u početnim fazama životnog ciklusa proizvoda; to znači da one izgrađuju virtualnu proizvodnu jedinicu u fazama razvoja i konstruisanja. U potonjim fazama životnog ciklusa proizvoda, na primer, proizvodnji, upotrebi i okončanju proizvoda, proizvodna jedinica se razdvaja i odvaja se fizički proizvod od sa njim povezanih podataka o proizvodu.

To je upravo mesto na kome AutoID otvara nova vrata i pruža nova rešenja. Mnoga preduzeća koriste AutoID u svojim procesima kako bi identifikovala komponente proizvoda, kako bi ih pronašla, razlikovala i pratila. U jednom životnom ciklusu proizvoda kojim upravlja AutoID, izvedeni podaci o proizvodu mogu se automatski čitati i prosleđivati raznim softverskim aplikacijama, na primer, sistemima upravljanja kvalitetom ili CAQ-u ili sistemima upravljanja podacima o proizvodu. Otud, broj proizvoda zapisan na RFID etiketi omogućava neposredni pristup informacijama o proizvodu koji se traže iz baze podataka. Posebno integracija komponenti proizvoda i proizvodnih podataka ima ogroman inovacijski potencijal. Upotreba AutoID-a u životnom ciklusu proizvoda eliminiše razdvajanje fizičkih komponenti proizvoda i sa njima skopčanih informacija. Na taj način, proizvodni podaci koji su vezani za određeni proizvod utiču na sve faze životnog ciklusa proizvoda i predstavljaju revoluciju u dobijanju informacija i potonjim zaključcima vezanim za planiranje, razvoj, proizvodnju i distribuciju proizvoda sve do recikliranja. Konačno, informacija koja prati porizvod tokom celog njegovog životnog ciklusa stvara individualni proizvod. Ovaj rad predstavlja PLM-orijentisano rešenje za integrisno praćenje proizvoda zasnovano na Auto-ID tehnologiji koja je, pak, razvijena u laboratorijama SEEBURGER Auto-ID-a u Bretenu.

Ključne reči: *Integrisano proizvoda zasnovano na Auto-ID-u, životni ciklus proizvoda*