

# Traceability of production protects both customers and companies

This article describes an integrated solution for monitoring and management of production processes. A typical system for monitoring and management of production composes a product genealogy that includes a history of product's formation (information about used raw materials, packaging materials, production technological steps, their parameters and deviations from prescribed values). Monitoring and traceability systems also often include information about logistics and distribution. That allows tracking and tracing and also searching and investigation of data from product's genealogy and production series or batches. Such capability is internationally called traceability.

## 1. Introduction

Production information systems, in accordance with the international standard ISA S95 called MES (*Manufacturing Execution Systems*), provide lots of useful functions and significant values to companies. Provided capability and information is possible to use for optimization of all company activities. Although MES utilize similar technology platforms as IT systems for ERP (*Enterprise Resource Planning*) do, they are conceptually different. In the system hierarchy of the company MES fits right above MCS (*Manufacturing Control Systems*), *fig. 1*, as an extension and enhancement of MCS. The primary purpose of production IS is providing operational data for immediate supervision and management of production processes, while ERP systems are used primarily for strategic and planning purposes. MES systems are developed for real-time operations.

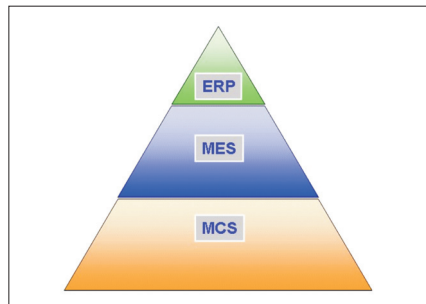
One of the key functions of MES is providing of detail information from the production technology steps and associated processes. Data acquisition function is used to collect characteristic data from the technological steps. Based on the data and information it is possible to build production monitoring systems used to create genealogy of products and support quality of production.

Monitoring of production is often used in the automotive and, especially, in the pharmaceutical industry, where the production quality system is governed by the EU regulations called *Good Manufacturing Practices* (GMP) and their observation is regularly checked by authorized inspection institutions, as well as in the USA by *Food and Drug Administration* (FDA).

These two application fields, although they have different missions, their efforts toward achieving the best quality of their products have a lot in common. Another production that is definitely aware of a need for a monitoring system of their production is the food industry, where beside the traditional quality requirements a new obligation for traceability has been added by (EC) No 178/2002 EU regulation (effective from 1. 1. 2005). That has also been implemented into Czech laws.

## 2. Why systems for traceability?

Each production company with a long term ambitions for the market must have an efficient quality control system in place. Quality control mechanisms can be well supported by systems that monitor and help manage all aspects of the production including its history („product genealogy“). Automated system for monitoring offers production tracking and building of a genealogy in an electronic form as a history of product genesis from raw materials that are developed into semiproducts and to final products, *fig. 2*.



*Fig. 1. Standard company systems architecture, where MES is closely related to MCS (automation of production)*

The following characteristics are the advantages of an automated system for production monitoring and product genealogy in an electronic form: information credibility (independent of a human factor), possibility of long term data archiving, post analysis of the production process using variety of viewpoints and criteria, and, especially, taking advantage of the speed of tracing through the product genealogy and identifying problem areas and causes of quality defects. In such efficient way obtained information allows companies to properly and quickly act in each situation. When appropriate, it enables recalling of the product from the market or from the distribution (e.g., in food industry)

or proceed with a repair of the product even before the defect will show (e.g., in automotive industry). This capability of a production system is called traceability. A fully automated traceability system even offers to identify all necessary data (and its relationships) used for the production and distribution of the product including information about the materials used and means used in the distribution. The production history and the archived data are used for such analysis.

In practice, the subject of tracing can be based on product batches, series, pallets, trays, logistics etc.

## 3. Automated system for production monitoring and traceability

Today's companies already have an existing system for monitoring of their production that is in most cases manual. Typical approach is based on filling of pre-printed reports by individual operators and heads of production lines who record what materials were used, obtained products, process parameters, etc. This approach has a number of disadvantages, e.g., credibility is low (due to possibility of missing or incomplete even incorrect data), slow and complex way of utilizing information caused by paper records, resulting in a high demand for expertise and time needed to analyze and identify the causes of problems, impacting the productivity of administrative and management staff.

Automated production monitoring system is a complete system through the entire production process or for any of its parts (*sub-processes*). Raw materials and all other inputs can be recorded upon their entry into the production process. Typically, barcodes are used for their identification. Technological values obtained in individual production steps/operations can be recorded using terminals appropriately placed in the production and at the packaging (individual, common, pallets, etc). Using suitably generated codes the application of existing identification and marking schemes may be conveniently extended and linked to information systems.

The highest level of an automated production monitoring and traceability system is possible to achieve by integrating information from the automated production control systems and this way monitor production steps and their parameters (automatic charging of materials according to a recipe, movement of material, making semiproducts, attained accuracy of product parameters). At

the beginning and at the end of the production chain it is possible to include information for logistics (about suppliers, series, batches of input materials used in the product, destinations of produced product series and batches, etc.). The creation of electronic genealogy records of products or their batches allows using of powerful functions for bac-

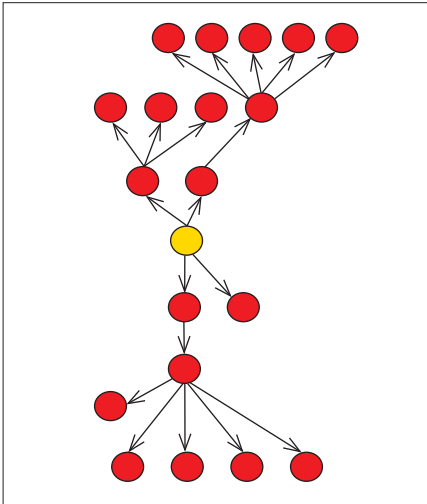


Fig. 3. Traceability – specification of data for backward tracing

ward or forward tracking. Full-value (thorough) traceability helps to find the cause of quality defects.

Backward traceability allows searching of the product genealogy based on a simple query specifying a denotation of the researched product or batch, fig. 3.

A genealogy of a given product is obtained instantly and an analysis can be done directly or using additional information (e.g., results of laboratory tests, tests of raw materials, etc.). Thus, a fundamental cause of the defect can be efficiently determined. When it is known or suspicious that the primary cause of the defect is a problem with a batch of a raw material or semiproduct, it is appropriate to use a *forward traceability* for finding which products or product batches were impacted using poor quality materials (e.g., contaminated).

Backward and forward traceability allow using the above described functions fast discovery of defective products introduced to the market and their recall or repair at a minimum cost. As a result of this process, the customers and consumers are protected from health hazards and damages and the production companies can solve the troublesome situations at low cost and possibly even avoid damages to product's marks or company's image.

#### 4. Implementation of product monitoring and traceability system

Implementation of product monitoring system always requires a custom oriented approach. There are common system modules

that include the basic functionality and support of traceability; however, each company has its specific organizational structure, production technology, and also implementation of electronic systems for material labelling and mechanisms of production control.

Thus, during the system deployment, it is necessary at least to do a customized configuration of the traceability system. For increasing of probability of successful implementation it is important to select a vendor who is experienced and has valid references in this application field. In the beginning of the project there is a need for a consultation about the specifications and a study phase. These phases include definition of concepts and description of proposed solutions that are presented to the customer. When the project specification is approved by all participating departments and its key users the actual implementation of the product monitoring system starts.

It is recommended to select a system architectural approach based on desired standards for the IT technology, as well as for the electronic components. In addition, it is very important to consider vendor's experience with applications of technology control and visuali-

materials including the final product. It records and protocols data that are also linked to the company information system.

The entire application project started with the analysis of the requirements, followed by the specification of individual functions based on the type of the raw materials (green coffee), packaging materials, semiproducts (roasted coffee) and products of different brands and blends. The production monitoring and traceability system provides additional functions for finding quantity of material supplies, semiproducts, and products in stock. The system also creates various production protocols.

Traceability systems are offered by engineering company Compas Automation that is known for its applications of automation in pharmaceutical industry, food industry, and automotive industry (see <http://www.compas.cz>).

Currently Compas offers its full services for implementing production monitoring and traceability systems. That typically includes the initial consulting, analysis, design, and implementation for semi or fully automated solutions. In addition, systems may include means and techniques for denotation of materials and components, semiproducts, final products, and packaging using barcode, RFID, etc.

#### 6. Conclusion

The author of this article refers to the importance of production monitoring and traceability systems and their practical role in the management of today's production, show some of the key capabilities and benefits, and the level of the contribution of these systems in ensuring the desired product quality. The production monitoring enhanced by the traceability has a positive impact toward the customers and helps companies to safe their image and position on the market in today's global competition.

Staff of some manufacturing companies believes that it is sufficient to realize the product labelling for their distribution and incorrectly assumes that such a solution is equivalent to implementation of a traceability system. However, the traceability in conjunction with genealogy of product conception and its development offers much more. The key benefits are the preventions from causing customers undesirable damages and providing the production companies with a tool for uncovering causes of quality problems and supporting their quality control system. The described approach is mandatory for food producers in EU and it is imposed by laws.

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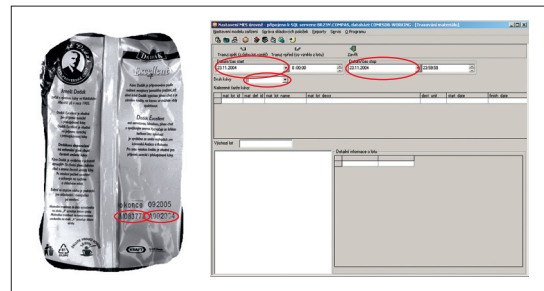


Fig. 2. Illustration of a genealogy of semiproduct creation (yellow node) and its consequent development into a product

zation systems as the traceability is a superior level to the level of manufacturing automation. Naturally, there is also a task of connecting the system with other existing control and information systems of the company.

#### 5. Case study of Traceability for Kraft Foods, Czech Republic

Kraft Foods Valašské Meziříčí is one of the top coffee processing companies in the Czech Republic. Kraft supplies the market with Dadák and Jacobs coffee brands. In the year 2004, this company significantly expanded the existing production technology and began to use technology for the production of special blends of coffee suitable for automated coffee machines – pods. The pod technology was built with high level of recipe automation. The implementation included an automated production monitoring and traceability system from Compas Automation company called COMES Traceability.

System COMES Traceability allows a detail monitoring and supervision of the production process and supports tracing of all ma-