Electronic Tools Management for Metal and Wood Industries

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Abstract – In our research we inspected and revealed the possibilities of applying the electronic tools management for metal and wood industries. By virtue of this, there is no doubt about it, that this is a very important area in improving the competitiveness of metal- and wood industries. In the price of a product, the costs of tooling and tool management represents quite high rate. Because of that, the aim of these new tool management systems is to cut down the tool management costs but with improving the production process by necessity, they also cause increased product quality. This increased product quality principally materialize in the more precise surface finishes and more accurate sizes, which meet today's market demands.

Keywords: tool / tool management / RFID

1. ADMINISTRATION OF THE RFID BASED TOOL-MANAGEMENT SYSTEM

We introduced the RFID based tool-management system at two companies. One of them is a metalworking company where the different kinds of products in different sizes produced by 10 rams. The number of the used tools exceeds the 1000 pieces, while the number of applied press stamps is 10-15 times more.

We also introduced this system at a smaller woodworking company what produces numerous semi-finished and finished products with CNC routers. Usage of the tools compared to the size of the company is significant.

The maintenance costs of the tools is high for both companies and the whole process of the tool-management is rather also uncontrolled. For solving this problem, the application of Eprom memories arose to trace accurately the path of the tool and for the secure storage of data.

2. DATAFLOWS OF THE TOOLS

2.1 Database of tools

We modelled the tools with some of the specific data like the standard sizes, construction design, and stored in a database. These technical data depends on the tool-material, the strength characteristics, which have to be take into consideration during the tool design.

2.2 Tool inventory

The selection, move and maintenance of the necessary tool set for a given product to be prepared, or for a machine or group of machines to be operated is called the tool inventory.

The phases of this administration starts with the procurement and ends with the disposal of the used tools.

The inventory as in the metal industry, or in the wood industry is only paper based. Because of the missing register the causes of the occurring tool breakages which are most likely could be avoided for example with constructional modifications. In this filed the metal industry has already taken some significant steps towards the solution.

The type of the inventory is mainly determines the technology of the given field of factory. The modular design of the system reduces the number of the tools to be in the stock and increases the flexibility of the tooling.

2.3 Determining parameters of the tool inventory

The tool inventory not only has a task to recognize the tools, but to serve information at any time it needs. For the rams snd CNC routers some tool information are always important, like type, place, cutting parameters.

The typical data transfer requirements:

a.) Data have to be read and write automatically from and to the tool bodies, because manual data input/output takes very long time and the risk of data corruption is high.
b.) Stored data should be identifiable and non-volatile.
c.) Stored data could have accessed from other related fields of the producing process.
d.) Tool data should have record only once so it saves time.

3. APPLYING CHIPS

3.1 Modern tool-management system

Tools have to be identified on the rams and CNC routers with the related specific data. For this we have electronic media on the tool holders. The most important tool data have to be stored in the chips. The high performance controls have modern tool management systems which supports for examples the CNC-PLC programming. The chip located on the tool holder can be read with a special reader. Nowadays for the reading the secured, non-contacting RFID chips are used.

There are two types of systems today:

- systems only for read,
- systems for read and write.

3.2 RFID (Radio Frequency IDentification)

The system consist of the following parts (Figure 1):

- transponder: chip, as the data holder,
- transmitter and receiver (reader/writer),
- evaluation unit,
- computer system for storing and processing the data.

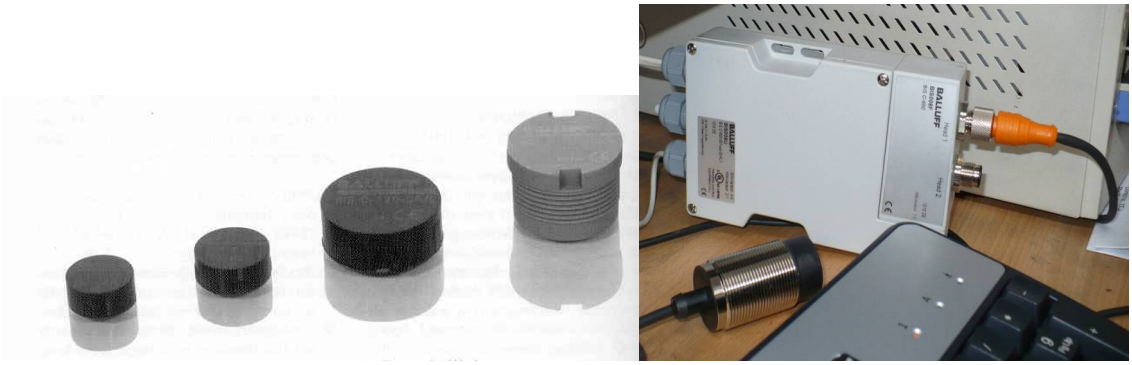

Figure 1. EPROM media, Read/Write head and evaluation unit

3.2.1 Transponder installation possibilities for metal- and woodworking tools

In the metal industry the complex tools assembled from many parts are common. The simplest is to handle them as a block.

The cutting tools of the wood industry we payed attention to the CNC tools. The installation into the tool itself is usually impossible, but the clamping cartridge is appropriate for this.

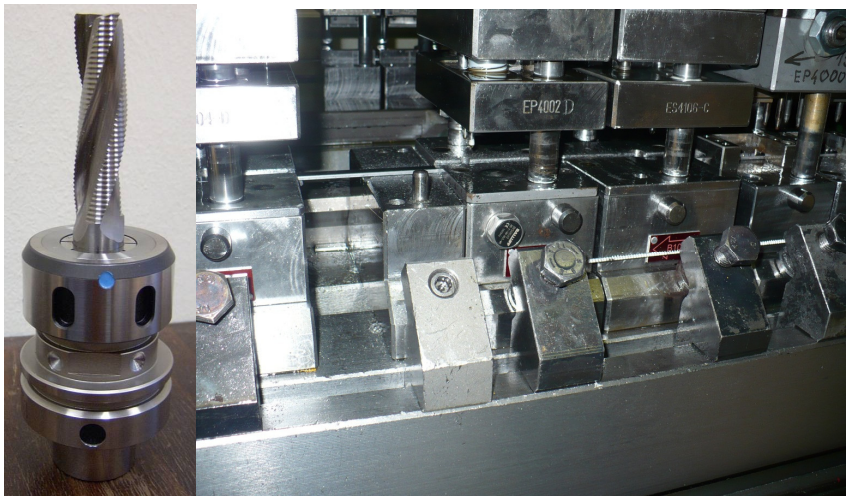

Figure 2. Chip placings

3.2.2 Chip read-write system

The read-write system uses 256-1024 byte capacity media to store the tool data. With this we can store, update, complete, and transmit. The read-write units can be used independently and install anywhere in the factory. The elements of the identification system can be seen on *figure 3* .

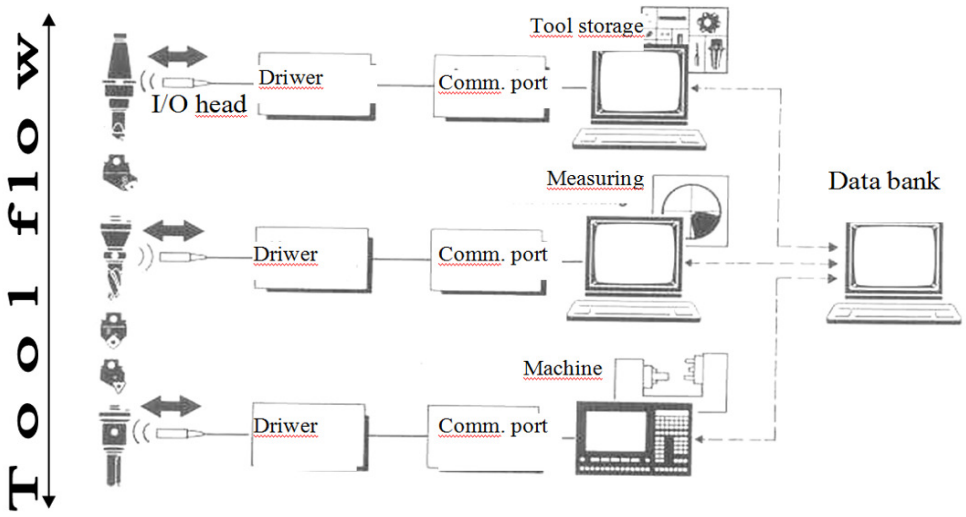

Figure 3. Read-write system installed into the tool

Because of the usage data of the tool is stored in the chip installed into the tool body, continuous connection with the central computer is not needed. The data inside the chip is updated before and after the tool starts and finishes the cutting.

4. TOOL LOGISTICS OF A METALWORKING COMPANY

A tool lifecycle tracing system (*figure 4.*) have been successfully installed with 5 pairs of tools.

4.1 Tool data system now

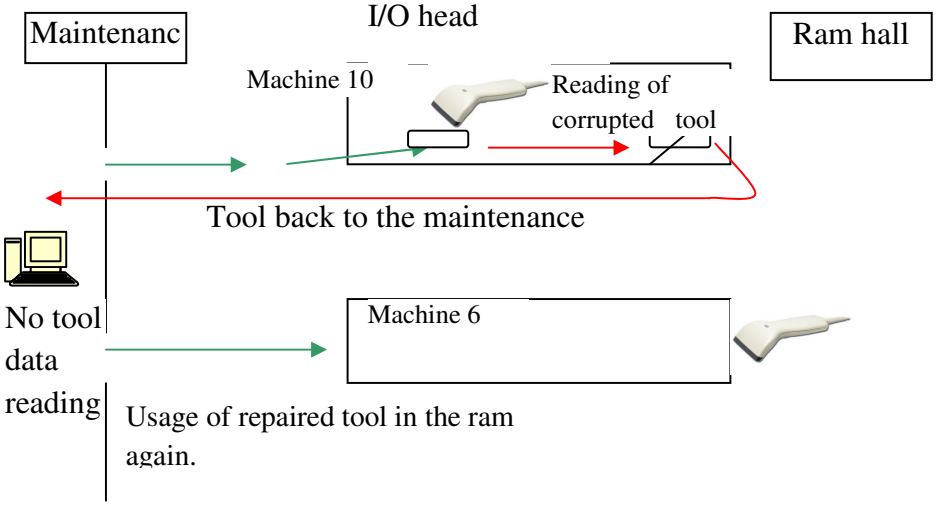

Figure 4. Tool life cycle

The applied manual data read/write can contain numerous uncertainty:

- time spent in the ram
- number of the presses done.

It also causes uncertainty, that the produced number of products is a nominal value, because it doesn't include the number of waste. In the following – *figure5.* – according to the data of the system– a lifecycle of a metalworking tool can be seen.

In the red sections the tool wasn't working.

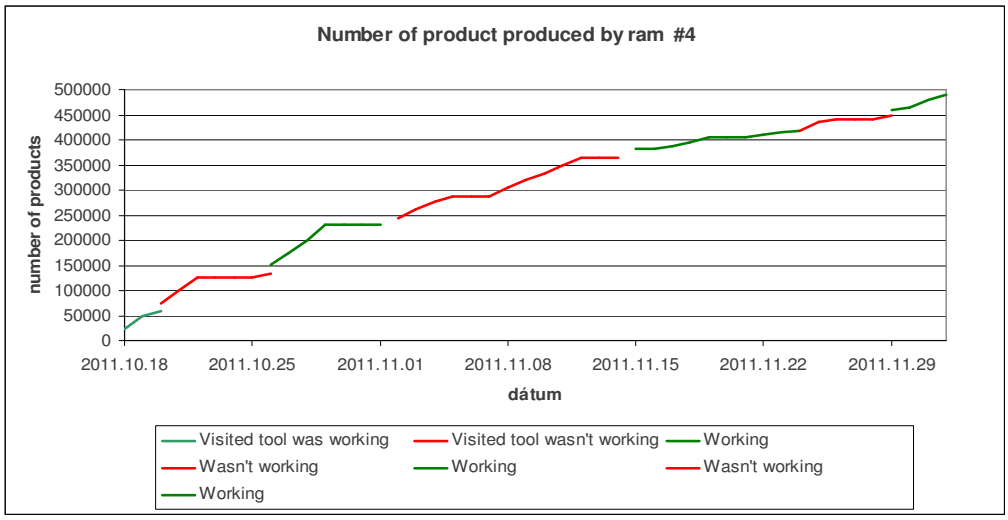

Figure 5. A section of a tool lifecycle

For the elimination of the uncertainty the system has been revised. The new system has got more read-write gate, and the ram data is reached in a central database.

5. FUTURE DATA SYSTEM

In the new solution the tool move triggers updates in the database, and the information-gates actually are RFID read-write heads. The results of the tool repairing gets into the system in the maintenance room.

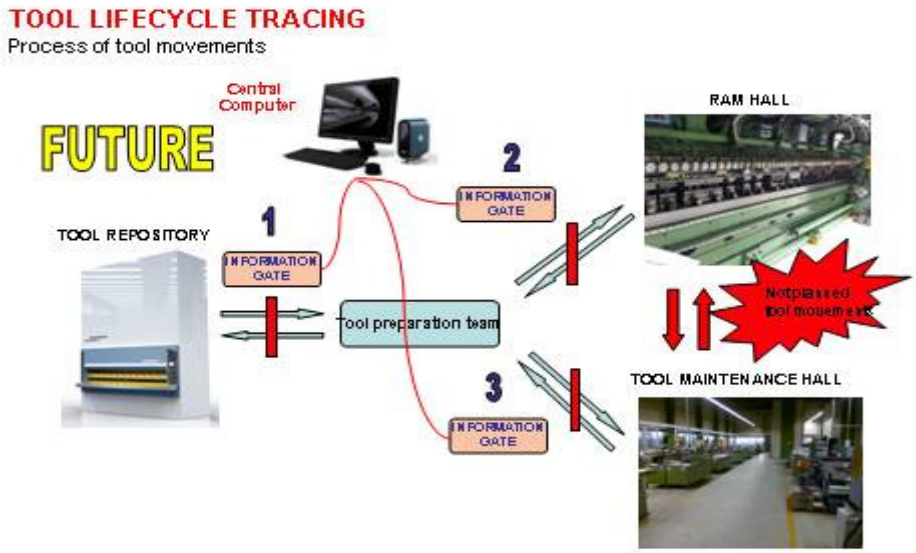

Figure 6. Tool management plan

6. SUMMARY

In the research, we defined the optimal placing parameters of the RFID chip on the tool, according to the machining and technological specialties of metal- and wood-processing. According to this, for the wood-processing industry we have made new tool-fixing bodies

which are differs from the ones used in the metalworking industry and suits for the specialties of the wood industry. On the grounds of our research, dating back for many years, we chose the most suitable RFID system and tested it in industrial circumstances. The woodworking tool lifecycle-management system have been tested among two CNC routers and is still operating with the newly developed RFID tool bodies. This whole system -which is totally new in the wood industry-, with the RFID chip read/write subsystem, the computer interface, and the read/write heads ensures the unlimited storage of tool data. The results collected up to now, show clearly that improvement of competitiveness became available with this system.

The efforts based on our metal- and wood industry research brought completely new results:

1.) We created the "thinking" tool which is differs from those used in the metal industry. We also modified the tool-fixing bodies with the placement of an RFID chip.
2.) The lifecycle-management system filtered out the badly designed tools both in the metal- and in the wood industry and proved superiority of diamond tools against the classic tools.
3.) According to our experiment, we built a widely applicable tool lifecycle-management system that can be used both in small as well as in large wood-processing facilities, and contains both the special software and hardware.
4.) With the help of the tool-lifecycle management system we managed to define a facility-size independent process plan, for applying this workflow both in small and large facilities.
5.) We also designed a smaller version of the tool-lifecycle management system, but outside parties should also be involved in the process to meet the exact needs.

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