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TOOL MANAGEMENT IN CIM SYSTEMS

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ABSTRACT
Tools and their management are very important parts of each manufacturing system and with an increasing impact of information technologies on manufacturing we get the possibility to effectively manage their use and to obtain an important influence on the increase of productivity and reduction of manufacturing costs. In CIM systems, the tool management must fill functions as optimization of used types and numbers of tools and their components, connection of the tools to the planned processes, operations and NC programs, the assembly of tools from components and its adjustment, measuring of assembled tool dimensions, transfer of information about tool dimensions to NC system for determination of the corrections, watching of the cutting time for tool life estimation and control of tool flow within the manufacturing system. These all functions require the use of an information system, which will collect and handle all the information necessary for the tool management. This information system must be integrated into a complex control system for the whole manufacturing system – the interface to all relevant subsystems must be defined and implemented. This paper describes proposal and implementation of such information system, which was developed in the Institute of Information Technologies of Faculty of Technology, Tomas Bata University in Zlin, Czech Republic in cooperation with the Faculty of Mechanical Engineering, Technical University Brno, Czech Republic, and used in practice in a machine tool manufacturing system.
Keywords: tool management, information system, CIM

1. INTRODUCTION
The importance of the use of tools in manufacturing today is higher than in the past. The major reasons are increasing prices of new, special tools for an efficient, accurate and complicated form machining and a demand for lower production costs. The costs of tools make about 2-4 % of total material costs. Therefore it is necessary to use new methods of effective tool management and to optimize the use of tools in manufacturing processes. To achieve that, it is necessary to get exact information about the location and state of tools. The application of such methods is possible with the use of information technologies – it is effective to form an information system for tool management (ISTM).

2. TOOL MANAGEMENT AS SUBSYSTEM OF CIM
Manufacturing system can be divided into more subsystems - tool management is one of them. Within the CIM concept it is necessary to integrate all the subsystems into one universal control system for the manufacturing system. This brings many interactions (data exchange) between individual subsystems and for every interaction both subsystems must have functions for data exchange

handling. Tool management subsystem interactions with subsystems as represented in Fig. 1. The functions for every subsystem are the following:

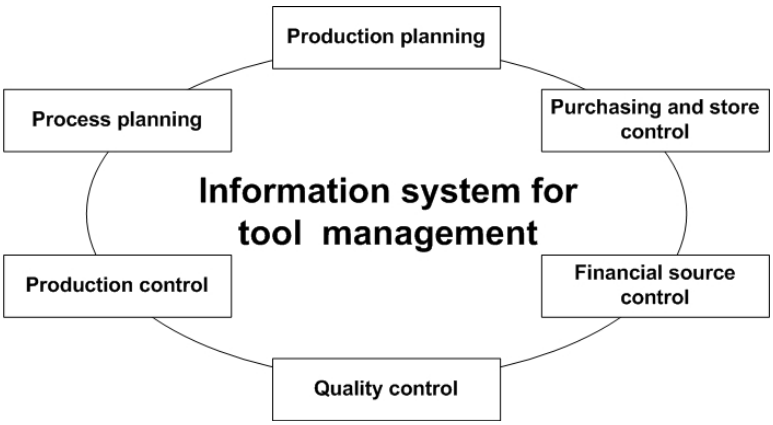

Figure 1: Elements of a company system, which exploit information from information systems for tool data management

Subsystem for process planning
Finds the useful tools and their technological parameters for every operation. Gets information about location and quantity of useful tools in manufacturing system – it helps to reduce assortment of the used tool types. Attaches selected tools to NC program, to part and to adequate operation.

Subsystem for production planning
Prepares the requirements for tool types and the quantities necessary for planned production on the basis of the production plans. Prepares the basis for tool orders from these requirements and according to information about the state of tools in system. If the requirements for tools are not possible to be satisfied on time (including orders), the subsystem for production planning has to modify the prepared plans.

Subsystem for manufacturing control
Prepares, assembles and adjusts tools for manufacturing. Transfers dimension information from tool-measuring device to NC system for tools used in the given NC machine, where this information will be used to correct the tool path. Controls and registers tool flow in the manufacturing system. Controls and registers tool flow between tool grindery and the manufacturing system. Watches the tool states and their cutting lives.

Subsystem for purchasing and storage control
Purchases tools according to the requirements for tools from subsystem production planning including the request and supply process. Registers of tool usage and tool purchasing. Gives information about the amount of individual tool types in storage.

Subsystem for financial resources
Obtains financial resources for tool purchasing. Registers of tool usage from financial point of view and its division into individual parts, individual departments etc.

Subsystem for quality assurance
Watches the quality of manufactured parts, identifies tools with negative influence upon the manufacturing quality and gives suggestions for tool changes. Watches the usage time for individual tools and calculates statistical parameters for specific tool groups (tools from individual producers, tools using individual materials for cutting edge, etc.). Gives specific kind of reports.

With regard to the watching and registration tool information in a production system it is suitable to classify tools into several groups. One group comprises usual tools – tools with relatively low first

price. For these tools it is not necessary to register information for each individual tool; it is sufficient to register the first price, the amount of tools, their location in production system and their consumption. All pieces of one type of tool from this group are equivalent. Other groups include some special tools – the tools with a high first price or tools with specific information for each one, for example gauge, where there is important the information about calibration. It is necessary to handle these tools individually and to save for each physical tool such information as its accuracy (i.e. important dimensions), working time, number of sharpening, cutting life etc. For this purpose the system has to identify each tool with the help of some identification facility (identification chip, bar code etc.).

3. INFORMATION SYSTEM FOR TOOL MANAGEMENT

The basis for the ISTM NAHOS design is created by inputs from selected divisions of the manufacturing plant. A team of employees of Tajmac – ZPS a.s. company gave us information and recommendations for the design of the system.

Client/server architecture was chosen with respect to the planned utilization of the IS, the reasons for this architecture being a higher number of client workstations and "up-to-dateness" of the data on the particular work-station. Selection of such architecture reduces hard-ware demands for client workstations (and their price). Optionally, it is possible to use older workstations. A single central database located on the server is another advantage of the system. This guarantees a simple access to the up-to-date data for all users and simplifies the control and maintenance of the system.
NAHOS application was programmed in Java (Sun Microsystems). The programming language was selected with respect to the compatibility of created applications with particular operating systems. This allows us to use client workstations with Windows operating system and a server with UNIX operating system (or Linux, etc.).

It is also possible to create different applications in a single programming environment and to distribute these applications by a simple transfer of the database. Another possibility is to run multiple user interfaces on a single workstation (with no need of significant changes within the application). Obviously, it is possible to use the application environment also for different branches out of the Information Systems for Tool Management branch.
The user interface is based on the forms used for data presentation and for inputs. The forms are created in the Form Editor (a part of the NAHOS). Creation of the forms has two steps. The first step is creation of the form structure; the second one is "activation of the form" with the use of predefined operations and SQL requests.
All the information about the user interface is saved to a separate database. The database has tables with a description of the user interface – names of the databases with inputs, users and their passwords, user groups, etc. One of the most important tables is the table with a description of particular forms (for user interface). These forms are saved in XML code (eXtensible Markup Language) – this guarantees compatibility.

Information system for tool management is build as a modular system - see Fig. 2. The system has not been completed yet; there are some basic modules, missing modules will be added soon. The description of functions of implemented modules follows:

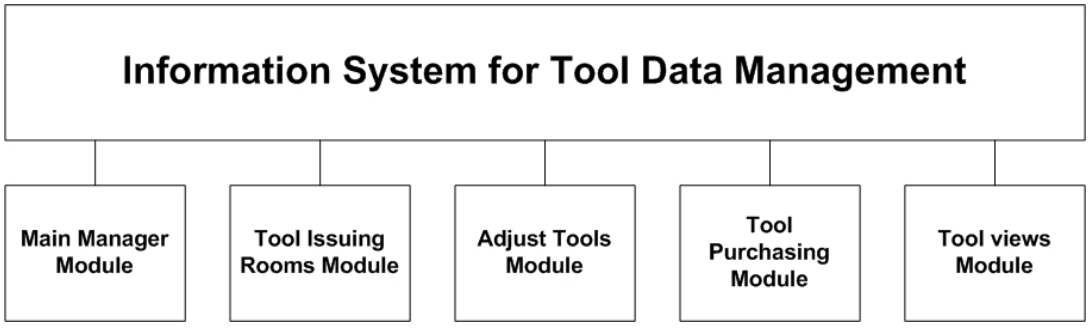

Figure 2: Structure of Information system for tool management

Module for tool issuing rooms
This module implements the functions attached to the physical tool flow within the manufacturing system – i.e. tool distribution to machines, registration and handling of worn-out tools, transfer of tools to and from the tool grinding, to and from another issuing room etc. Further, there is a storage handled for a given tool issuing room including creation of different summary reports. Within the storage, the amount of individual tool types is checked, compared with the minimal and optimal amount for the given tool type and, if necessary, requirements for tools purchasing are generated.

Module for tool assembling and adjusting rooms
The functions in this module are divided into two groups. In the first one there are functions for tool assembly. Some tools used in manufacturing (above all the special tools) are necessary to be assembled from components (clamping or chucking element, extension element, cutting elements etc.). For this reason, the NAHOS system gives information on the composition of elements and handles the amount of the components in the storage for the tool assembly and disassembly. In the second group there are functions attached to tool adjustment and measuring including creation of correction tables for NC machines.

Tool purchasing module
This module gives the information necessary for tools purchasing. The cumulated requirements from the tool manager are requested from possible suppliers and after their offers the required tools are ordered and purchased. All these steps are registered in the database and it is possible to get necessary views and reports.

Tool views module
This module serves for workers, which make the process planning. They may find here the technical parameters of single tools, their appearance on separate tool issuing rooms or machines, possibilities of the substitution of unavailable tools for alternative types of tools etc.

The access to different modules is limited to selected users (with the use of a predefined user's access rights). User's access rights are further dividend into two groups, a reading only access and a reading/writing access. These rights are used not only for the definition of the access to different modules, but also for access restrictions to particular tasks inside the modules (for particular users).

The described modules have been accomplished and at present the information system is being implemented and tested at the Tajmac-ZPS,a.s. company during a trial run.

4. ACKNOWLEDGMENT
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