Using Teamcenter engineering software for a successive punching tool lifecycle management

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Abstract. The paper presents studies and researches results of the implementation of Teamcenter (TC) integrated management of a product lifecycle, in a virtual enterprise. The results are able to be implemented also in a real enterprise. The product was considered a successive punching and cutting tool, designed to materialize a metal sheet part. The paper defines the technical documentation flow (flow of information) in the process of constructive computer aided design of the tool. After the design phase is completed a list of parts is generated containing standard or manufactured components (BOM, Bill of Materials). The BOM may be exported to MS Excel (.xls) format and can be transferred to other departments of the company in order to supply the necessary materials and resources to achieve the final product. This paper describes the procedure to modify or change certain dimensions of sheet metal part obtained by punching. After 3D and 2D design, the digital prototype of punching tool moves to following lifecycle phase of the manufacturing process. For each operation of the technological process the corresponding phases are described in detail. Teamcenter enables to describe manufacturing company structure, underlying workstations that carry out various operations of manufacturing process. The paper revealed that the implementation of Teamcenter PDM in a company, improves efficiency of managing product information, eliminating time working with search, verification and correction of documentation, while ensuring the uniqueness and completeness of the product data.

1. Introduction
In last decade, there were a lot of references to Product Lifecycle Management (PLM) and their development. The general idea is the PLM systems implied “a single source strategy for gathering and managing product data in a single system” [1]. This objective is hard to be realized “due to the distributed nature of engineering work and systems” [1] and it seems to be impossible to develop a system which supports this way of working.

The paper [2] defines a framework for modelling the product system in the early development, which accompanies system design considering sustainability aspects in a prospective view. Also, the paper focuses on expanding modelling constructs by relevant behaviour elements capturing semantic links and information. In [3] it presents how PLM systems represent a very important foundation for achieving a more sustainable paradigm for life, a more sustainable development, engineering, manufacturing, use and disposal of products.

The paper [4] deal with the urgent problem to create integrated PLM solutions in today’s European automotive industry. The different author’s points of view using focus groups, blogs, and face-to-face meetings in a university community of practice are analyses and integrates in [5].
2. Program and method

2.1. Assigning tasks

The term "technical data" of a product includes all data, both of the product and of the processes, used to design, manufacture, utilize, maintenance and dispose of it. The technical data are created and used throughout the product lifecycle. Some technical data, such as part geometry and NC programs, are created according to the technical conditions, some are created elsewhere, such as coming from the client, as a result of feedback obtained from the product testing.

Some of the data resulting from the material strength analysis of are used in the design study and others such as welding instructions in manufacturing, others such as installation instructions to customers or disassembly instructions at the end of the product lifecycle. Technical data are available in many places, on various storage supports and in large volumes.

Workflow is the sequence of technological operations, consisting of activities that creates or uses technical data. They intersect with the life cycle of the product. Flow can start the marketing department traditionally defined and can continue with design departments, manufacturing, services and so on. There is also a flow through other organizations that use technical data. Some of these activities take place outside the company.

Depending on the specific of company and the types of products designed, a flow of technical documentation can be initiated by different people, from design department, marketing department (where they settle and product requirements) to the high level management board of the company. If the product is a punching tool with successive punching and cutting operations the tasks circuit and flow may be defined in the Teamcenter Process Manager like in figure 1.

![Figure 1. Documents workflow in design process.](image)

After establishing the circuit of documents in design process on go to the allocation of tasks within the departments. Thus, on assign peoples to design the various components of the punch (figure 2). Also, on assign tasks to verify and check the documentation and for the approval of the whole process (figure 3).

![Figure 2. Assigning the design task.](image)  ![Figure 3. Assigning the approval task.](image)

After assigning tasks on verify the start of the workflow. On can observe two tabs with two types of tasks: Task to Perform - where are listed the tasks and activities to be performed (figure 4) and to Task Track - where are listed the tasks to be pursued.
3. Design
Experiments Design activities will be performed by the team of specialists called Designers. In this team, the person named designer1 will find in the section Quick Links -> My Worklist the task of designing successive punching and cutting device (figure 4), as instructed by the Project Manager person. He has access to the available information, such as the drawings item, containing technical data about the product, other additional files and so on.

In the design activity are created items containing three-dimensional models of punching. In figure 5 is shown the window in which the item Upper package of punch is started to be created.

![Figure 4. Task to do- Punch design.](image)

![Figure 3. New item created for Upper package.](image)

After defining items, in the Attached File will add files and import 3D model of the Upper package of the punching. When all parts are attached, the items form the tree structure of the product, a three-dimensional assembly with all parts included (figure 6).

![Figure 6. Product structure of punching.](image)

3.1. Checking
Verification activity was attributed to user Designer2. It can access all the files associated with the project. The person appointed to verify will check the project according to the specification of the Project Manager. Depending on how the project meets the requirements imposed by, the verifier has three options: validates the project, reject the project, or takes no decision.
3.2. Approval
The state of the project seen in terms of the approving person Project Manager is shown in figure 7. The marked activities have been made. The Project Manager has three options: approve, reject, or decide anything. In the case of rejection (Reject), the project returns to the previous stage (Checking) for making changes.

![Figure 7. Workflow state, after Chavking task.](image)

4. Creating product structure BOM (Bill of Materials)
BOM View Revision option defines constructive structure of the product design. After this operation, all standard and nonstandard components are inserted into the assembly of successive perforating and cut punching.

![Figure 8. 3D visualization of product structure and BOM.](image)

List of components in .xls format can be transferred to other departments of the company and used, for example, in order to supply the necessary materials to achieve the product.

5. Change Management in Teamcenter
If changes occur in the piece obtained by punching, these will cause changes in the components of the punch. Thus, if the initial piece (figure 9) has had a 20 mm hole, the modified piece will have a 25 mm hole (figure 10). This change will determine the 2D drawing item to have two revisions, A and B (figure 11).

This change must occur in Workflow Process module. Change must be described and approved). Also, the process of changing determines specific documentation flow.
This workflow involves several people: the person making the request for change (Change Admin), the person who make up technical report and recommendations regarding changes (Author Recommendation), the person that analyze the impact of change (Check Change Type), the person who analyzes change impact in terms of the customer (Custom Preliminary Comments) and the person who approves the change in the company (Author Business Decision).

After the analysis of required change, Designer1 person will make all necessary and needed recommendations and will prepare documentation in this regard. This will create new revisions of modified items: 100070-successive processing punch item, item 10020-upper package, item 10030-lower package (with item 100250-guide plate, and item 100230-active plate).

6. Manufacturing Management in Teamcenter

Creating manufacturing processes is performed Manufacturing Process Planner application from the main menu. Defining a new manufacturing process of the punch is possible in the New Process window. In figure 12 is shown the process of "assembly of the successive perforating and cutting punch". Considering the assembly processes of components of lower and upper package, the configuration in figure 13 is resulted, corresponding to the manufacturing process of assembling the punch.

The next level is to establish operations necessary to manufacture of parts that go into the punch assembly. Thus, for the manufacture the part 100230/B-active plate is assigned unique code 100350/A-board manufacturing assets. Operations to manufacture active board part are: cutting, planar milling, contour milling, drilling (4xpinhole), drilling (4xscrew hole), drilling of punch hole (25 mm diameter hole punch), milling (2 x rectangular punch hole), milling (shape of the exterior).

In figure 14 is shown how to define the cutting operation. Setting the sequence of operations (technology) in the manufacturing process of the active board of successive perforating and cutting punch is shown in figure 15. Also, Teamcenter enables the design of manufacturing department's
After the design of manufacturing layout, the links among resources \textit{product-process-manufacturing department} are created.

\begin{figure}[h]
\centering
\includegraphics[width=0.3\textwidth]{figure14.png}
\caption{Defining cutting operation.}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=0.3\textwidth]{figure15.png}
\caption{Technological workflow of active board manufacturing.}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=0.3\textwidth]{figure16.png}
\caption{Layout of the manufacturing process}
\end{figure}

\section{6. Generate reports and documentation production}

If the information in digital format is not enough, the program provides users the option to convert digital information into the printed information on paper. After designing the processes, operations and activities, they should be described and detailed. The documentation that is generated is specific to each operation and activities for each manufactured or processed product.

\section{7. Conclusions}

The implementation of a PDM application, like Teamcenter, in a company, improves manufacturing capacity by managing product information, eliminating long time working with search, verification and correction of information, while ensuring the uniqueness and completeness of the data.

Teamcenter includes all processes and activities of the product life cycle and can create and generate reports at any stage thereof. The application significantly improves relations between different departments of the company through its interactive modules. Makes available a clear traceability of the product lifecycle management, helping to track changes that occur during the project development and also enables to reuse data.

Teamcenter manages projects and resources enabling the enterprise team selection. Provides the enterprise virtualization, enables the design and simulation of manufacturing errors and eliminates the waste of materials and resources.

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