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Product Lifecycle Management in Stamping and Moulding Tool Manufacturing for the Automotive Industry

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Abstract: - At present, the principal objective in the automotive industry are the costs that must be as low as possible, in the circumstances of client satisfaction growth. From this reason, in the automotive manufacturing the preparing time of manufacturing, i.e. the design and the execution of the stamping and moulding tools, must be as much as short. The researches from this paper referred to the implementation of the Product Lifecycle Management - PLM concept in the manufacturing of stamping and moulding tools for the automotive industry, using the principles concerning the product lifecycle as well the methods and means of the computer aided design. The paper present the way by which the PP&C, CAD, CAE, CAM and ERP activities were integrated with the help of different soft. E-business solutions were applicated in the information and material flow as well a consistent set of principles concerning the product design and manufacturing. The results of these researches were tested and then implemented in an automotive company from Sibiu.

Key-Words: - PLM, CAD, CAE, CAM, PP&C

1 Product Lifecycle Management - general considerations

All the undertakers wish to satisfy their customers as good as they can. The working analysis is an effectual way of defining the products that answer customers' expectations. So, it has to consent to the definition of "the good product", the one expected by the final customer, but it has to integrate the intermediary users that will interfere in order to give life to the product as well-starting with the conception. Organising a company (factory) depends essentially on its importance and on the types of the manufactured products. It is believed that the resources of a factory are organised on a structure determined by its functions. The main four elements of the factory are, fig.1:

- The ***product*** - end result of the manufacturing process can be a tangible good or service;
- The ***costumers*** - a person, company, or other entity which buys goods and services produced by another person, company, or other entity;
- The ***supply*** - total amount of a good or service available for purchase;
- The ***resources*** - a person, asset, material, or capital which can be used to accomplish a goal, equipment, people, assets (money).

The necessity of phase analysing and developing has great importance in the lifecycle of a product, having consequences on costs, quality and the delivery terms.

From the point of view of the expenses, reporting to the sequential approach, the curve of the simultaneous approach is getting considerably close to the expected costs which allows the pursuit in real time of the financial consequences for the decisions made during the project.

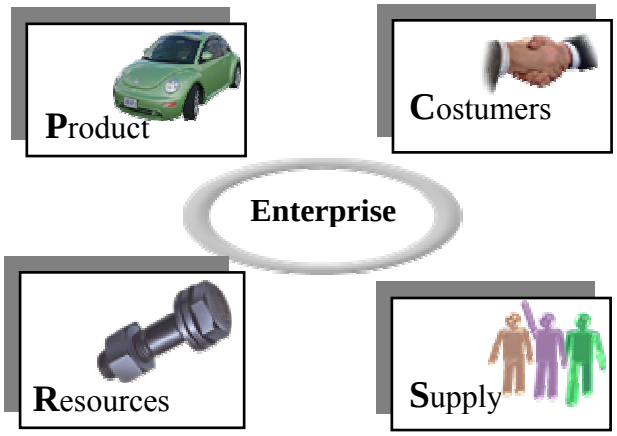

Fig.1

Using a parallel structure of work doesn't solve all the possible aspects. One of the difficulties that may appear is related with human issues. In order to ease this reorganisation, a physical regrouping of

the participants in the project, being in the same room, might be a solution, even though is not easy to accomplish because of the communication problems between the different professions. So, an automobile wing will be seen:

- depending on the way the light reflects; by the designer;
- from the point of view of the maximum plastic deformation endured by the sheet during the deformation, by the mechanic;
- from the point of view of the trajectory made by the tool in order to get the shape of the mould, at the recommended tolerances, by the processor. But all these cases are about the same figure, which can be geometrically defined by Bezier's squares. Finding a common language to allow everyone to pursue the evolution of the project in real time represents an impossible bet.

Product Lifecycle Management - PLM is a strategic business approach that applies a consistent set of business solutions to manage product definition data for a product throughout its lifecycle, fig.2. Through PLM, automotive industries can: improve the product, support the customer, reduce the cost, minimize the downtime, beat the competition, increase the profit, etc. and know how and when to pull the plug of a product.

In our research we focused on the following activities:

Planning - configuring, scheduling;
Design - conceptualizing, detailing, analyzing, prototyping, testing, solid modeling, simulation;
Manufacturing - process planning, part producing, CNC machining, virtual NC.

2 Product Design

The conception process is considered as an activity based on induction, deduction, intuition, experience and creativity. Through information technology systems, we can progressively transfer the experience, deduction and induction from the conception engineer to the CAD system, thus the latter becoming an intelligent system. A CAD system requires a permanent dialogue, between the technical data basis and the general data basis on one side and the algorithms basis on the other side, through a conception monitor. Taking into consideration that the conception process has to offer optimal solutions to the problem, there is no general methodology, which can guarantee the global optimization of the conception. That is why CAD system has to allow the user to make a product with cost and time reduction and also with a high degree of flexibility. In CAD stamping and moulds tools for automotive company use CATIA v5. CATIA comes in aid of the users with structure editing facilities, inspection, cinematic simulations, databases, modules and possibilities of definition, storing and reusing of engineering knowledge. CATIA offers an unique technological environment of design and preparation for manufacturing using the PLM concept (Product Lifecycle Management).

The premises on creating a stamping and mould tools in the CAD module are:

- its integration in the integrated system of production
- connection with the other two modules through: informational system, the definition of the types of information used and the compatibility of information

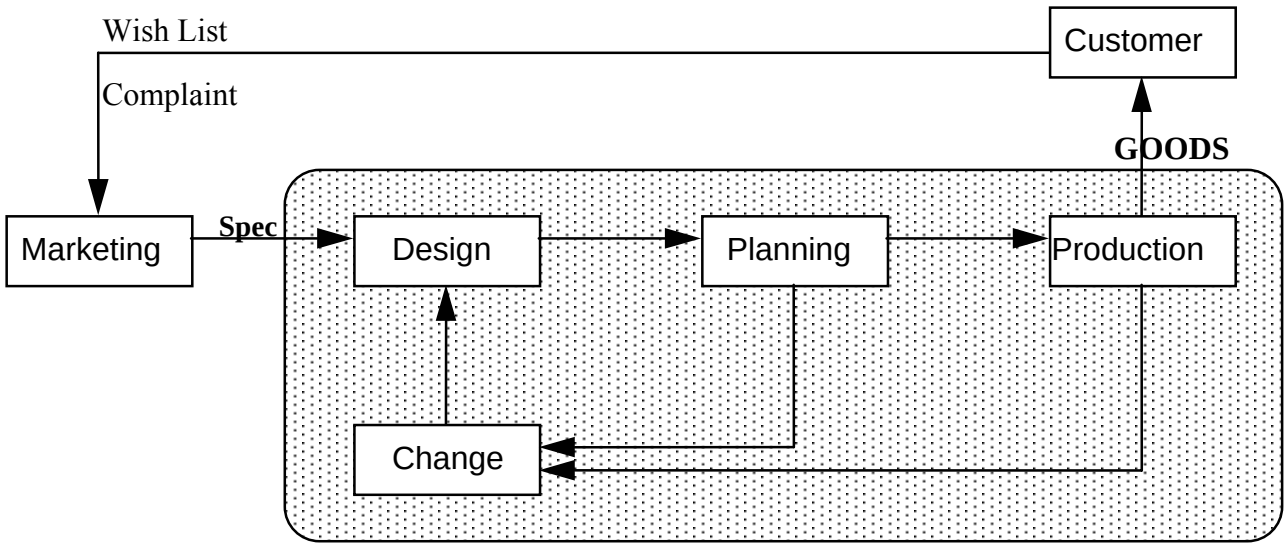

Fig.2

- the possibility of recognition of geometrical data (the geometric attributes of the product) by the CAPP module (the module which uses the data from CAD as in-data. Punctual attempts have shown particular interest on form features in the preparation for manufacturing stage. In stead of using a product molding starting from conceivement, at the end of this stage form characteristics extraction algorithms can be applied to the supplied model. With the help of calculated data this model can be expanded so it would come close to a product molding, to a high level structure, containing not only the structural description of the piece but also complementary data regarding certain areas, profitable especially for manufacturing.

is, the more possibilities of automatism, faster production, so more advantageously is. In our specific case, form characteristics that, in particularly, must be detected before the manufacturing stage, lead to:

- reducing, even canceling human intervention, till absolute necessity, to interpret the conceptual models and plates provided, and so decreasing the risk of errors;
- automatic selection of the tool;
- calculation of the trajectory of the tool;
- feature based parameterization of the manufacturing process;
- analysis of the possibility of manufacturing;
- classification of tools and comparison of objects.

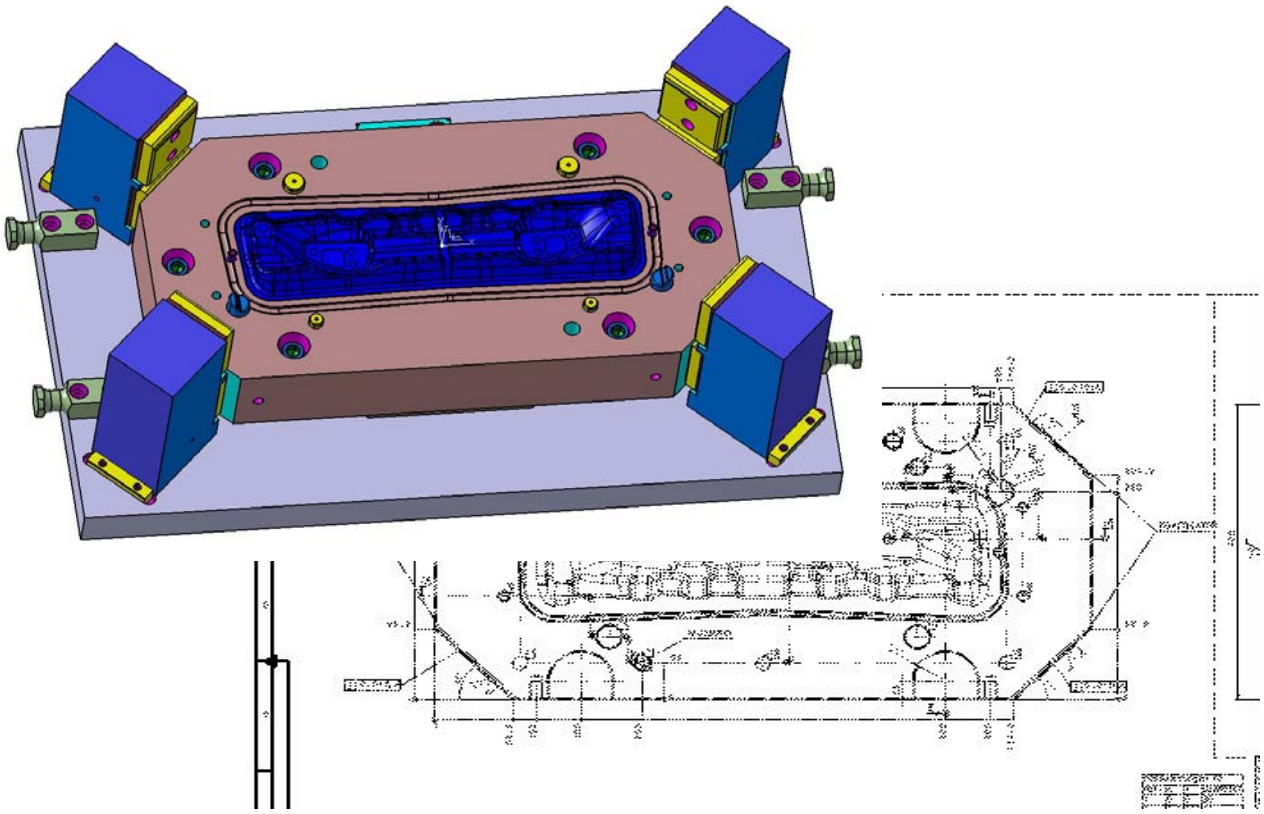

Fig.3

The description of a form characteristic is tied to two aspects:

- its form (geometry, typology, category)
- complementary data on its meaning or functioning, even if these last do not intervene in algorithms yet

The study of form characteristic extracting subscribes to a larger picture of automatic understanding of a piece. The interest is so immediately, because the better this understanding

The graphic databases of standardized and normalized products which communicate through CATIA v5, in the stages of design of moulds, is an important facility which leads to an increase of productivity and of design precision. Parameterized design of stamping and moulding tools that is possible thanks to some facilities of CATIA v5 program, leads to the increase of the design productivity and its quality too.

Data bases with normalized and standardized marks are used in the design stage; these have as support "xls" files with numerical values of the parameters used in design. Figure 3 shows 3D and 2D for a stamping tool. During the design stage, the technological engineer team realizes simultaneous the computer aided design of the technological process, so that the overlapping of the design times reduces the preparing total time of the manufacturing and consequently the reduction of costs. Once the 3D and 2D drawings are realized, the technological data necessarily for the manufacturing process are realized too through the Bill of Material are established the work pieces of component elements, materials, costs etc.

3 Analysis and simulation

The product consists in the description of an object, not just geometrically, but also depending on a certain number of features, functional features, manufacturing features etc. So the model of product contains:

- geometrical information, which can correspond to that which is being manipulated in solid models
- technological data, for example manufacturing operations(drilling, threading, milling, lathering) which give more explicit data regarding the whole geometrical feature or just a part of it;
- precise data, which explain the manufacturing tolerances in order with the ideal feature;
- material data, which specify the type of material and its properties;
- administrative data, which make the maintenance of the material easier (references, providers, supply).

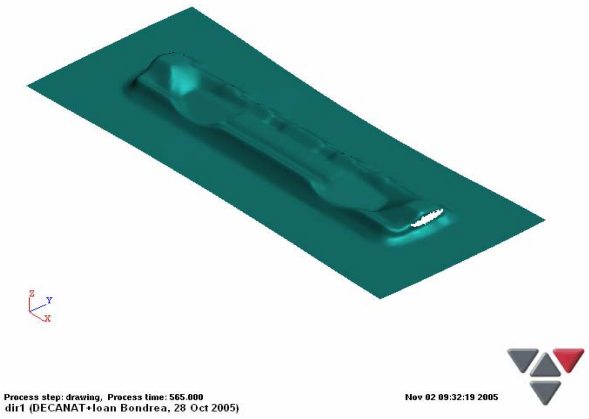

Fig.4

After the model was realized, one passes on the engineering calculations using methods and means of Computer Aided Engineering – CAE. The constructive-functional optimization of the product allows its verification from the point of view of the dynamical solicitations during the working, but also the simulation of the stamping-moulding operation. By this simulation (fig. 4), the product is subjected to the real working conditions and the obtained results (fig. 5) offer the necessary data through which the product and technology designer can decide on the correctness of the project.

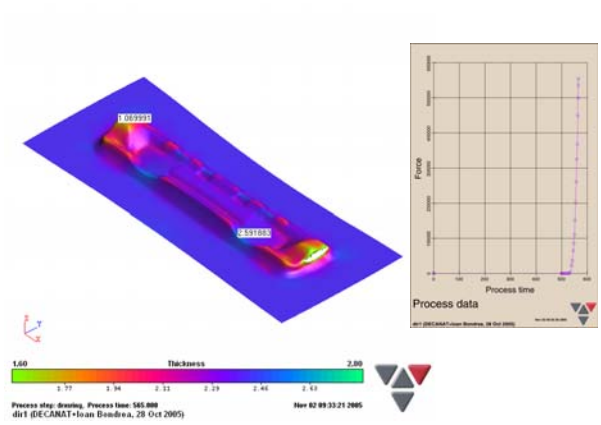

Fig.5.

After the finish of the analysis and optimization operations the geometrical data of the model (product) are transferred to the manufacturing department for the physical realization of the product.

4 Manufacturing

Computer Aided Process Planning (CAPP) makes the connection between constructive computer aided conception and aided manufacturing. In this module, the technological processes of manufacturing are conceived, and than, the data is transmitted to be processed with the purpose of product manufacturing. Computer aided manufacturing (CAM), is the most complex module of the production system, its integration directly affecting the quality and manufacturing flexibility. The CAM module includes procedures of automatic generation of numeric commanded machines-tools running instructions, based on the geometrical model of the executed piece. CATIA v5 is the program that allows the making of NC manufacturing programs necessary to the numeric command machines-tools, using the NC Manufacturing module, fig.6. The results of CAM department, the NC program in APT or NC-Code

language is being transmitted to the CNC machines equipment and the mark of the product is being manufactured.

5 Production Planning & Control

Production Planning & Control - PPC&C is a classical area of application for the electronically processing data about the entire production process. The term PP&C is used to describe the way the informational systems are used for planning, supervising and controlling the life cycle processes of the product, starting with the collection of the data (the order) and ending with the products delivery, considering in the mean time the quality aspects given by the placement and the capacity.

Using the PLM concept it was possible to realize stamping and moulding tools, under the circumstances of high quality and low costs.

The design and manufacturing teams, the technological and quality engineers worked linked at the Internet overlapping the activities and so reducing the preparing time of the manufacturing and the delivery terms. All of these leaded to on increases of the company profit.

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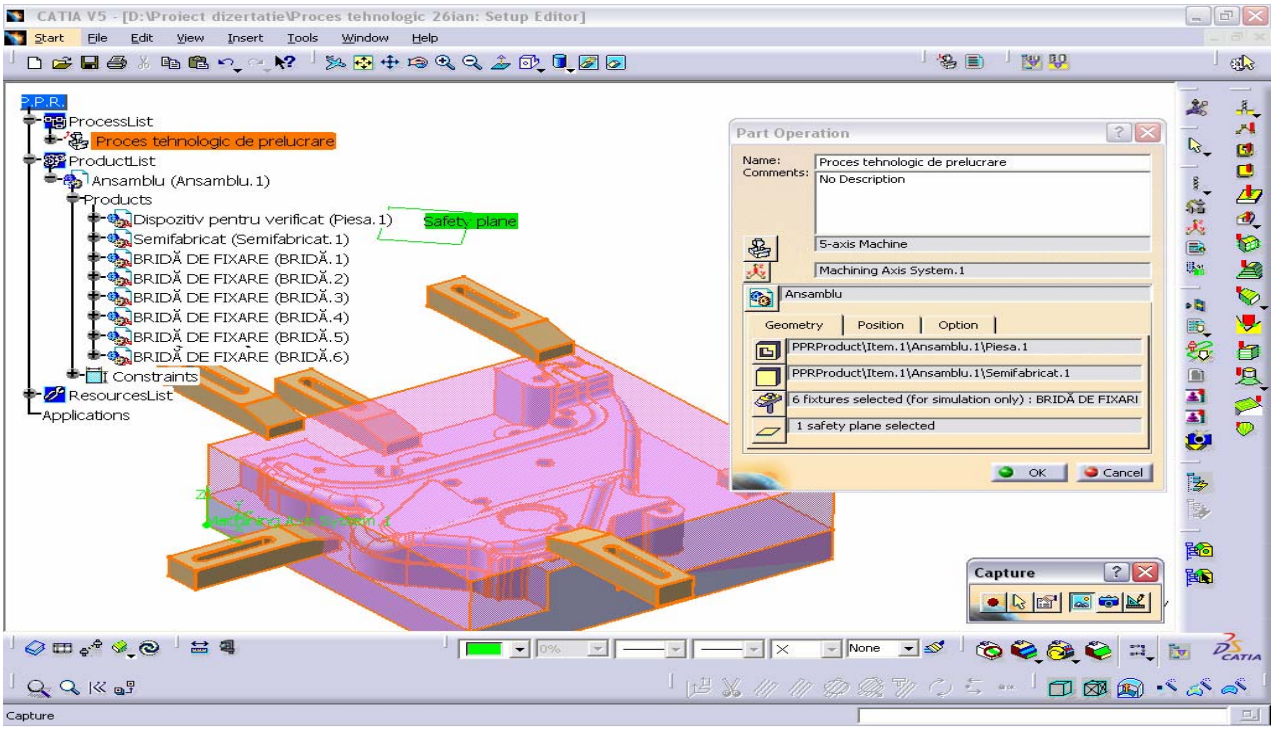

Fig.6

The link among the graphic databases, the technological databases, customers and delivery terms are realized through the use of the SAP/R3 program.

6 Conclusions

The paper presents a part of the research and preoccupation of the collective of the "Manufacturing Science" regarding the design and manufacturing of stamping and mould tools in the auto field in the context of a modern production system.

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