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DIGITAL MANUFACTURING – THE MAIN COMPONENTS FOR DEVELOPING A PLM STRATEGY (PRODUCT LIFECYCLE MANAGEMENT)

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¶A***bstract: :*** *PLM (Product Lifecycling Managenent) is an IT system with all data files saved that are used in inovating new products. The PLM (Product Lifecycling Managenent) system is not extemelly complex. The basis for an PLM (Product Lifecycling Managenent) system is a representativ system for implementing ERP (Enterprise Resource Planning)and PDM (Product Data Management). Often used with success the PLM will continuue to be aplyed in the future.*
Key words: *Digital Manufacturing, Product Lifecycling Management, Digital technique and product development*

1. INTRODUCTION

The very short time for developing a new product and short time for developing a new manufacturing technology are important factors for de competitive ability or medium of small companies on the European or world market. Besides this development, the development of the market, the increasing of the products complexity, the increasing of the products quality, the increasing of the working safety, the reducing of the manufacturing time in close relation with the manufacturing process as well as with the production surface, become characteristic features. As a support of this development of the increasing process, in every company there is a very varied Information System , as a support for making, developing, testing and presenting (CAD, CAE, CAT, CAM, etc.) of each product or process of manufacturing. Each of these systems are well defined and structured on a field of development. Besides the documents management, the functionality of the product, the correct and efficient development process belong to this data base.

The project management, the manufacturing management and the collaboration management support the organization principles of the product lifecycle.

Product Lifecycle Management PLM is based firstly on the promptness that becomes possible between the partners inside, as well as outside of a manufacturing company. These are realized through the improved team working and communicating techniques

The IT systems represent only the technological base that makes possible this new way of working together and communicating.

2. DIGITAL MANUFACTURING

An accepted definition of the digital manufacturing is: „ the most important models, methods, tools network which are integrated into a permanent data management.” The aim of digital manufacturing is the designing as a whole, evaluation, and the permanent improvement of all the main processes and of „ manufacturing resources related to the product”.

This becomes possible by introducing all the relevant data into a PPR (Product, Process and Resource) commonly integrated model. The significant changes while working as well as organizational adjustments are necessary. The virtual models 3D developed with modern and competitive systems 3D-CAD decreases a lot the verbal, written communication waste and helps to overcome place, language and time limits.

Specialized development teams are modelling with this CAD technology the most complex products, with thousands of components and they communicate not only among themselves but also with other engineers, with supplier clients and the last but not least with the manufacturing fellow-workers. An important role, related to this, is played by the so called DMU (Digital Mock-Up) which permits the examination and the proving of the collision freedom and the possibility of the 3D models. Nowadays DMU tools belong to the standard equipment of any manufacturing, designing and building company.

To realise modern and sophisticated products more and more complex manufacturing medium are installed, as well as manufacturing processes very detailed designed and implemented in the production shared into different locations, as the complex products are very difficult to describe in details. It’s also difficult to describe the manufacturing lines needed to realise a product, like the necessary tool machines, the material flow, the order of performing the operations and the technological phases so that the quick check of the manufacturing equipment can be possible. According to a research made by General Motors, the quantity of information needed to realise a product is about 1000 times bigger than the quantity of information given by the product design. This overwhelming data quantity necessary for the complete description or a product must be worked out and evidenced in a way or another [1].

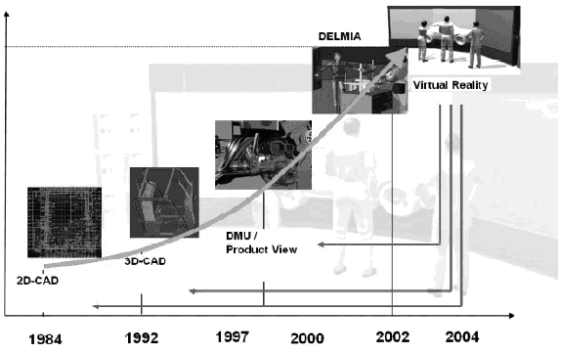

Fig.1. *Manufacturing Engineering on a change [4]*

with the technical equipments of the designing section you can understand very well the bigger and bigger importance the virtual factory has for the integration of the industrial manufacturing. More and more companies let at the engineers disposal performing solutions for designing the processes and process 3D simulation so that the product is influenced by time and the process of manufacturing is assured on time.

Comparing the using of the modern working medium with the factory flow and

The aim is SOP (Start of Production), real products realised digitally in virtual factories. The manufacturing processes are simulated and perfected before the first investments in the means of real manufacturing are made. Data model PPR is the determining premise for a totally digital manufacturing model success.

Different models of processes, installations and factories can be conceived with this type of simulation of the manufacturing in a digital factory, before a single tool or mean of manufacturing should be made. This way, the best alternative can be transposed at the end of the designing. The result is a quicker, cheaper and more efficient development with less error of the manufacturing equipment and the manufacturing processes. By simulation in advance the realization of digital manufacturing in the virtual factory it is succeeded especially an improvement of the product configuration even in the incipient phase of the real manufacturing so that the manufacturing and the assembly can be brought to the desired form more economically. The design and manufacturing cost economy obtained by this method have proved very important.

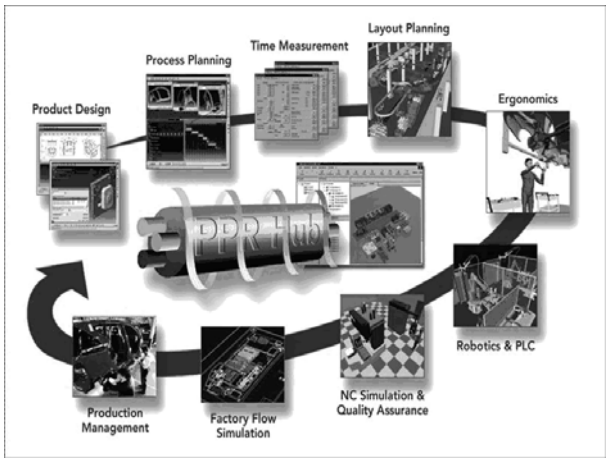

Fig.2. *The integration of the PPR product as a main principle in digital manufacturing [5]*

3. PHASES OF PRODUCT LIFECYCLE MANAGEMENT AND CORRESPONDING TECHNOLOGIES

Many software solutions have been developed to organize and integrate the different phases of a product's lifecycle. PLM should not be seen as a single software product but a collection of software tools and working methods integrated together to address either single stages of the lifecycle or connect different tasks or manage the whole process. Some software providers cover the whole PLM range while others a single niche application. Some applications can span many fields of PLM with different modules within the same data model.

An overview of the fields within PLM is concept here. It should be noted however that the simple classifications do not always fit exactly, many areas overlap and many software products cover more that one area or do not fit easily into one category. It should also not be forgotten that one of the main goals of PLM is to collect knowledge that can be reused for other projects and to coordinate simultaneous concurrent development of many products. It is about business processes, people and methods as much as software application solutions. Although PLM is mainly associated with engineering tasks it also involves marketing activities such as PPM (Product Portfolio Management), particularly with regards to NPI (New Product Introduction).

3.1. CONCEPT

The first stage in the development of a product idea is the definition of its requirements based on customer, company, market and regulatory bodies' viewpoints. From this a specification of the products major technical parameters can be defined. Although often this task is carried out using standard office software packages there are for the field of Requirements Management a number of specialized software tools available. Parallel to the requirements specification the initial concept design work is carried out defining the visual aesthetics of the product together with its main functional aspects. For the Industrial Design, Styling, work many different medias are used from pencil and paper, clay models to 3D CAID (Computer Aided Industrial Design) software (ProE, SolidWorks, SolidEdge etc.).

3.2. DESIGN

This is where the detailed design and development of the products form starts, progressing to prototype testing, through pilot release to full product launch. It can also involve redesign and ramp for improvement to existing products. The main tool used for design and development is CAD (Computer Aided Design). This can be simple 2D Drawing /

Drafting or 3D Parametric Feature Based Solid/Surface Modelling, Such software includes technology such as Hybrid Modelling, Reverse Engineering, KBE (Knowledge-Based Engineering), Assembly construction. It covers many engineering disciplines including: Mechanical; Electrical; Electronic and Architectural. Along with the actual creation of geometry there is the analysis of the components and product assemblies. Simulation, validation and optimization tasks are carried out using CAE (Computer Aided Engineering) software either integrated in the CAD package or stand-alone. These are used to perform tasks such as:Stress analysis, FEA (Finite Element Analysis); Kinematics; CFD (Computational fluid dynamics); and MES (Mechanical Event Simulation. CAQ (Computer Aided Quality) is used for tasks such as Dimensional Tolerance (engineering) Analysis. Another task performed at this stage is the sourcing of bought out components, possibly with the aid of Procurement systems.

3.3. REALIZE

Once the design of the product's components is complete the method of manufacturing is defined. This includes CAD tasks such as tool design; creation of CNC Machining instructions for the product's parts as well as tools to manufacture those parts, using integrated or separate CAM (Computer-aided manufacturing) software. This will also involve analysis tools for process simulation for operations such as casting, moulding, and die press forming. Once the manufacturing method has been identified MPM (Manufacturing Process Management) comes into play. This involves CAPE (Computer Aided Production Engineering) or CAP/CAPP – (Production Planning) tools for carrying out Factory, Plant and Facility Layout and Production Simulation. For example: Press-Line Simulation; and Industrial Ergonomics; as well as tool selection management. Once components are manufactured their geometrical form and size can be check against the original CAD data with the use of CAI (Computer Aided Inspection) equipment and software. Parallel to the engineering tasks, sales product configuration and marketing documentation work will be taking place. This could include transferring engineering data (geometry and part list data) to a web based sales configuration and other Desktop Publishing systems.

3.4. SERVICE

The final phase of the lifecycle involves managing of in service information. Providing customers and service engineers with support information for repair and

maintenance, as well as waste management/recycling information. This involves using such tools as MRO (Maintenance, Repair and Overhaul Management) software.

4. THE ADVANTAGES OF USING THE DIGITAL MANUFACTURING AND THE PLM

The aim of a simple manufacturing which has spread in many companies for many years is not associated immediately with the PLM or with the digital manufacturing, even though no other aim is hidden behind the digital manufacturing except the systematic decrease of any waste till the complete elimination, mentioning that not only the manufacturing equipment is prepared in advance but also the entire manufacturing and designing process is decomposed. The digital manufacturing provides for the designer, the proper working medium and the necessary information for reaching alone the aim of a simple manufacturing system.

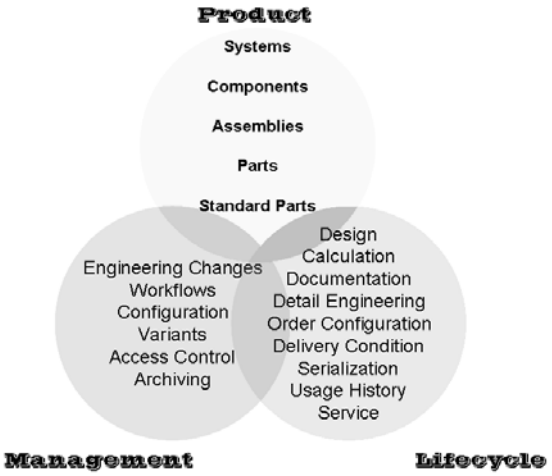

Fig.3. Phases of Product Lifecycle Management

The results already obtained by the users of the digital manufacturing are convincing:

- the production costs more reduced by the improved quality of the product;
- the launching on the market earlier, with reduced costs of the product;
- time for beginning the series manufacturing reduced;
- a better profitableness of the investment.

To obtain all these advantages there are usually necessary considerable changes of the factory flow and of the conditions given to the organisational adaptation.

We should also mention that the implementing of the digital manufacturing depends essentially on the following premises:

- top management is responsible for the central innovation theme;

- a project organisation with a capable and multilateral central team for the realization of the project;
- a preliminary working plan with a clear device and certain resources;
- a software partner with strong performances who can deliver tools really necessary in a proper offer;
- the acceptance of the new working code and of the new tools is guaranteed at all the levels of the company by the specific level of preparation and of knowledge;

4.1. THE ADVANTAGES OF PLM FROM THE POINT OF VIEW OF ORGANIZATION AND LEARDING THE COMPANIES

- Time to Market, quick on the trade market;
- High quality;
- Standard manufacturing process;
- Reducing the costs by means of digital assurance of the manufacturing process by reusing the data and the economical Know –how for the prototype;
- The increasing of the innovation power;
- The transparency of the project control all along the manufacturing process through the relationship between all the manufacturers from a certain field of activity including the supplier;
- Harmonizing and beginning the entire manufacturing process;
- The link between the supplier at any point of the product development;
- The safety increasing for all the relevant resources in the process.

4.2. THE ADVANTAGES OF THE PLM FROM THE POINT OF VIEW OF THE INFORMATION TECHNOLOGY

- new technology;
- reducing the administrative field;
- the integration of the individual manufacturing cells in the manufacturing process;
- easy communication between partners and supplier.

4.3. THE ADVANTAGES OF PLM FROM THE USER'S POINT OF VIEW

- easy using;
- new technology introduced;
- the increasing of the Know – how technology;

- easy access to the data;
- passing through standard working processes;
- working in collaboration with all the people involved in the project (mates, partners, supplier).

5. CONCLUSION

Digital manufacturing as a fusion element of the general results between PLM (Product Lifecycle Management) makes the companies more innovative, efficient and competitive. The digital manufacturing comes to support the profitable developments of the product by optimising the product development by means of an early influence in the development, as well as influences in planning, designing, developing and efficient implementation in the manufacturing and establishing the manufacturing process.

To implement the digital manufacturing it is compulsory that a project becomes applicable, the project must be clear defined, have real aims and points of modulation, based on the allocated budget, and the installations used to realize it should be step by step positive, so that the new product brings a success for the producer in a short time.

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