Product Lifecycle Management (PLM) contributions to product development and innovation

LUMINITA POPA
Department of Automation and Information Technology
Transylvania University of Brasov
Mihai Viteazu 5
ROMANIA
mluminita2001@yahoo.com

BADEA LEPADATESCU
Department of Engineering Technology
Transylvania University of Brasov
Mihai Viteazu 5
ROMANIA
lepadatescu@unitbv.ro

Abstract: - In this paper the authors point out that PLM solutions enable collaborative processes across geographical or organizational boundaries, enhancing business process efficiency and innovation capacity. In order to maintain the market any product needs innovation. Beyond developing new products, a company is investing significant resources in prolonging the life of existing products by adding novelty in design and functionality. Implementation of PLM in the virtual enterprise is becoming an essential requirement for the design, development and manufacture of new products in optimal conditions, according with market requirements. By using PLM technologies, the enterprises become innovative, flexible and have a greater ability to develop complementary skills based on agile and flexible organizational structures. These solutions manage the collaborative creation by simulating products, processes and resources. Where market and consumer pressures require product innovation is applied PLM mode. Thus, the new products on the market can differentiate only by tracking efficiency of a product life cycle from conception to obsolescence. PLM incorporates concepts of PDM, ERP, CRM, CAD, CAE and CAM systems.

Key-Words: - PLM, product innovation, product life cycle, design

1 Introduction
The ability to consistently hit the market with the right products at the right time is no longer a competitive advantage but a necessary condition for survival.

"Innovation is a highly complex process involving multiple participants and processes, and huge volumes of data and initiatives. For a successful innovation solution, it must provide value to all levels of an organization, from end users and IT managers to executive management" said John Kelley, Vice President, Product Manager at Oracle.

Innovation, new product development and sustainability are considered imminent trends for companies which are wishing to remain competitive in the global market. In the current manufacturing environment, incomplete communication within the production flow leads to a high rate of errors, products versions control issues, increased costs, poor quality and a long time for product completion. The business development through innovation is presented in the form of actions that an organization carries out in order to create and deliver new products to market, performance and streamline processes by innovative technologies capitalizing and innovation promoting.

2 Theoretical aspects related to PLM
Product Lifecycle Management (PLM) is an integrated business approach based on information, made up of people, processes/practices and technology, that covers all product life aspects, from design to production, use and maintenance, culminating in product out of service and recycling in order to increase efficiency and productivity.
Product Lifecycle Management is an approach focusing on all aspects of the product life cycle. PLM allows you to make decisions, based on information in each stage of the product life cycle. Product Lifecycle Management (PLM) is a solution that allows manufacturers to gather ideas from customers, engineers and scientists and turn them into products and services that dominate the market. The PLM is integration of enterprise data flow with other systems such as CAD, CAM, CAE, ERP, CRM, in real time as shown in the figure below (Fig.1).

Fig.1 PLM interaction Universe [1]

2.1 The PLM stages
First stage - Within the first stage there are collected customer requirements which are sent to the design department. The product life cycle stages and the applications that enable those steps are crucial for understanding the PLM model.

The planning stage - At this stage, based on marketing analysis, there are established functional requirements of a new product. Product development is done by the creative department.

The conception stage (styling) - At this stage, based on the product functional requirements, is carried out the performing of virtual prototype that incorporates the shape and aspect of the new product. The applications that make this possible are CAD applications that allow complex surfaces modeling.

The design stage - This stage involves 3D modeling, based on appearance and using the same CAD applications with specific modules for achieving each milestone component of the product. Also in this stage is achieved the virtual prototype that respects both the functional form and technical requirements. With virtual prototype at this stage, we can get technical documentation: 2D drawings. All the same CAD applications, taking into account the 3D model; we can generate 2D drawings in compliance with drafting standards.

The virtual prototype analysis, simulation and validation stage - To ensure that the product will withstand all stresses during operation, we can make a finite element analysis in order to verify resistance to certain requests. Thus, using specific CAE applications we can optimize the product to function according to technical specifications.

The processing devices stage of (Tooling) - This stage involves devices design for processing components.

Preparation for the manufacture in CNC stage (Machining) - Using CAM applications, and having as a starting point the 3D model, is obtained processing software for CNC machines.

Manufacturing parts preparation phase - production line (Part) - In this stage is organized the parts production line.

Manufacturing assemblies preparation phase - Assembly line (Assembly) - In this stage is organized the assembly line of previously machined parts.

Resources manufacturing management stage (Resource) - To achieve low price product, it is necessary that manufacturing resources (machine tools, tooling, raw materials, etc.) to be well managed in order to achieve continuous and optimal production. Resource management is done by the designers of manufacturing processes.

Plant design stage - The product information is known since the design phase. This information is, as follows: parts, quality and technical characteristics, manufacturing processes and methods. Therefore, to optimize the production of a product, in this stage is done the location of machine tools in the factory (or in the workshops) and establishes the flows (routes) movement of parts within manufacturing cell (depending on plug technology - or operations). Finally, after establishing these parameters, the production simulation for optimization can be made.

Human Resources Management Stage (Human) - Project managers within design department have the ability to manage both projects and human resources that make the design. In the case of manufacturing processes design, technology designers have at their disposal a number of plant resources, including human operators of machines or those who are assembling or painting.

Quality Check Stage (Quality) - This stage occurs after making manufacture and involves comparing the specifications of the produced products. Through PLM applications, manufacturing defects are recorded in the system and forwarded to the design / manufacturing department to correct mistakes.
The life cycle of the materials production is shown in Fig. 2, in its ideal form, closing the materials cycle by reverse flow, and with implementation strategies including end of life, recycling, remanufacturing and reuse.

Product life cycle management requires meeting high sustainability and innovation through new knowledge and solutions that take into account the impact of various processes on the environment. Collaboration between different fields, knowledge and contributions from the complementary knowledge can help increase organizational performance. PLM supports collaborative innovation, centralizing tools to capture ideas, manages data and disseminates information at the right time in heterogeneous environments. Key business processes involved in product life cycle management are shown in Fig. 3.

4 The strategic role of PLM in the innovation process

The interest in innovation, research and development is generated by the multitude of changes in the economy and social sphere. The companies innovate due to current market demand. Innovation process starts with reviewing and combining all existing information and knowledge, which requires dialing the innovations user experience and their use as a source of innovation. For innovation to succeed, it is necessary to create a favorable climate for innovation and creativity in organizations. Innovation can occur in all areas of an organization along the value chain and in all stages of the life cycle of the product or service. Continuous development in accelerated products innovation requires the use of complex and innovative software technologies at every product life cycle stages.
Only in this way can streamline and automate all processes within the company, thus leading to increased productivity. Innovation may be the result of a long process involving multiple innovation processes which are in closed interrelation (Fig. 4).

The most important innovations go through radical changes over the life cycle. In the context of innovation and new product development throughout the product life cycle management we must take into account the limitation of natural resources, environmental conservation and social responsibility. Gaining knowledge of theoretical and experimental research in fundamental aspects plan or applied phenomena, and the use of assimilated knowledge as a result of practical experience, is the first stage of the innovation process, followed by the translation of knowledge into production artifacts. Openness to new ideas and solutions is essential to innovation, especially in the early stages of the process, allowing the adoption of decisions by the combination of ideas, knowledge and skills, and combining them in different ways leading to more complex innovations. Run innovation process depends of external conditions. In this sense, innovation through broadcasting is a creative process in which innovation becomes input to other innovation activities without being a passive process, but an adaptive. In time, however, products are affected by obsolescence, leading to the company's orientation to the process innovation as a result of market competition to reduce costs.

In Fig. 5 there are shown three reasons of PLM power.

At the same time, the enterprises consider eco-innovation as a potential source of competitive advantage in the goods and industrial services.

5 Conclusion

We believe that PLM technology and innovation are key drivers of production and prosperity. PLM brings the next short-term benefits: reduce the time needed to complete the technical bids, the smooth transfer of information from the bidding stage to the design and production and better quality projects through communication between departments. At the business level, PLM becomes an essential tool for increasing productivity and profitability of the firm. In its Project-Management Approach in relationship with each client, PLM enables strict control of costs through proper planning of human, material and financial. Shortening product life cycle is the biggest advantage of implementing PLM because it can achieve better products at significantly reduced costs and explore numerous variants in a shorter time. PLM deployment of the innovation process depends essentially on the external activities of the new CAD/ CAM technology and are the results of interaction with customers, suppliers, competitors and various other public and private organizations.

References:
[2] https://tech.purdue.edu/