OVERVIEW ON PLM CONCEPT AND A SUGGESTION FOR AN EDUCATIONAL APPROACH

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Abstract: There are some definitions proposed for activities under PLM acronym, coming from different actors of economical, business, IT, research or educational environments. A specific PLM platform refers centralized product data information, process specific tools, global and particular standards or procedures. Adoption of a PLM system expects benefits aimed projects, products and processes, but also the people. Human element is essential, current PLM applications work through a web-based interface that allows communicating and sharing data on a real-time and collaborative ways. For instance, curricula for students in master level, in many technical specializations should include PLM as a complementary or advanced knowledge discipline. In this paper a project for a PLM discipline, courses and applications, finally is proposed.

1. PLM DEFINITION IN UNIVERSITIES AND COMPANIES

PLM concept had a dynamic evolution and there are several definitions proposed for activities under PLM acronym, coming from different actors. Today on agrees, in a very large way PLM is an integrated business approach, based on information, made up of people, processes, practices and technology, covering all aspects of the lifecycle of product, from idea, design, production, use, maintenance, removal and recycling, in order to increase efficiency and business productivity.

Even universities are independent contributors to the development of new concepts and technologies, in same time they have peripheral roles in the process of construction and development of new concepts, technologies and theirs acronyms. PLM being tightly linked with Information Technologies, universities have quite limited contribution and participation to develop their own concepts, technologies and acronyms for it.

According different software companies and vendors the concept is too vague and very difficult to be defined, so *PLM is approached without a general consensus* (Purdue University, www.tech.purdue.edu).

Research firms are organizations in constant search and development of new concepts. They evaluate the new technologies, products and manufacturers and generate reports containing descriptions and recommendations. The income research firms typically results from selling their research based on reports that must to be focused, usefully and précised.

CIMdata, a research firm focused on the study of PLM concept from several years, has a definition clearer in the terms of PLM content, referring to information about product, from conception to removal from use. The key to this definition is the words: integrating people, processes, software and information technology. *PLM is more than a software package*, is a strategic business way, integrating people, processes, software and information technology (www.cimdata.com).

Any way, for a company or an organization that exercise their activity in competitive economical environment, human element, named “people PLM”, is critical in implementation of a PLM system. They should be open to use new concepts in a collaborative environment, creating a new system in which the people depends on change. And also they are exposed to very long and continuous adoption cycle.

2. APPROACH OF PLM CONCEPT IN EDUCATION

2.1. PLM AND VIRTUAL ENTRERPRISES

PLM is a vital concern of firms in our days, regardless of their size, in order to have a uniform system of management and control of product portfolio and over the company itself. Hence the training of specialists, at least at master levels, may be subject to advance or complementary disciplines.

Complexity of a PLM system, conceptual and to the implementation level, makes particularly difficult the educational approach even in a master level. A starting point may be considered, if on takes into account the following definition: *"PLM is the integration of business management systems for product life cycle"* [1].

The definition suggests that PLM manages product information wherever it is, and PLM system with all data, information and knowledge on products and processes is not strictly bound like in the classic enterprise, which has all the activities and services integrated (such as design, processing, maintenance and recycling).

As a logically result, the PLM system can be minimally simulated in educational activities through the ***virtual enterprise***.

Virtual enterprise technology is defined as "*a collection of systems and methods for digital modeling of the* **overall process** *of product development and manufacturing in the context of lifecycle management*" [3].

Virtual enterprise with PLM software suite allows to access, update, manipulate and transfer information about a product by using virtual prototype of the product and its associated processes.

This approach is agreed by SME. The keyword for ***discrete enterprises*** is to integrate new system with existing structure and may be from SME to large manufacturing companies. The needs of discrete companies may concern Computer Aided Design (CAD), Product Data Management, configuration management, parts and product structures and more.

2.2. COURSE OBJECTIVES

According to above considerations, the course modules may be divided into several groups:

1) product and their lifecycle (define product, extended product and its features; the lifecycle of a product: definition, stages and their specific activities; management and control of specific activities of the main stages of product life cycle);
2) PLM concept (definition, development, components, software solutions);
3) Virtual prototype (integration of information associated with life cycle stages of a product);
4) Virtual enterprise (types of businesses, organization and their particularities; data management and product documents, searching, modifying, viewing them, in collaborative team; structure of products in virtual enterprise);
5) Manufacturing processes (company resources and the ways of virtualization; connections of PLM system with other departments of the enterprise customers, clients, suppliers etc.).

2.3. APPLIED TEACHING ACTIVITIES

Teaching applications need a PLM software system installed on the local network with Internet access. Also the students may have access to resources for create or use documents linked to virtual prototype or virtual enterprise.

a) PLM platform

PLM software platforms are very expansive. There are two ways to accomplish needs:

- buying software licenses, leasing and hosting are ways to acquire a PLM system from many ***software as a service*** producers: *UGS (Teamcenter)*, *Dassault* (*Enovia*), *PTC*, *SAP*, *eMatrix* and so on;
- more and more interesting alternative is to adopt ***free or open source solutions***, like *Aras Innovator*.

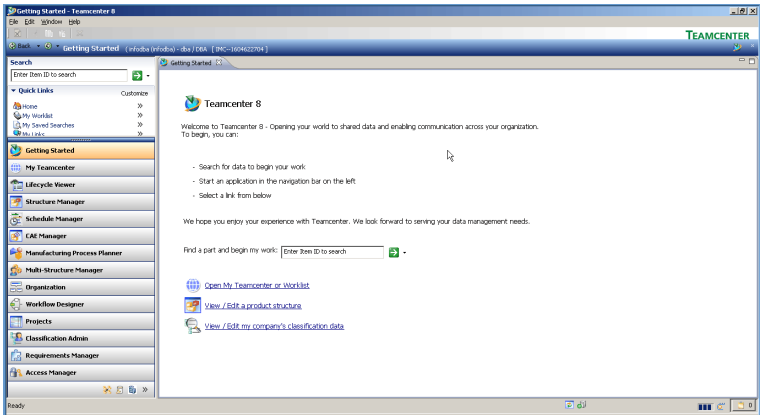

Fig.1 Teamcenter 8 Start Page

b) Create or use documents on virtual prototype (the core PDM)

CAD 3D and 2D Datasets

Provides data (documents) specific to product design, 3D and 2D form. Common CAD formats provide specific documents or in metaformat.

There are many applications like AutoCAD, SolidEdge, NX, Catia, etc. that generate files in .dwg, .par, .prt, .dxf and others.

If is not possible to use full licensed applications, there are alternative solutions using educational, trial or free for students version (Autocad, Solid Edge).

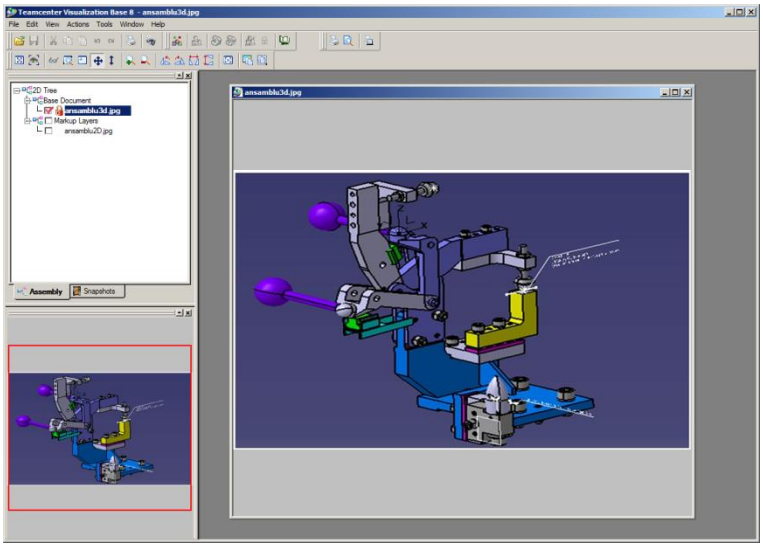

Fig.2 Virtual Prototype 3D Datasets

CAE (Simulation) Datasets

Applications of finite element analysis enable simulation behavior of simple parts or assemblies to demands of resistance, static, dynamic, thermal etc.

One of most accessible FEA environment is Femap, enabling analysis and simulation "to reduce time to market through optimized designs, reduced prototyping and physical testing" (http://www.plm.automation.siemens.com).

Offering free trial full version and many tutorials, it may be a "real word" tools for students and teachers.

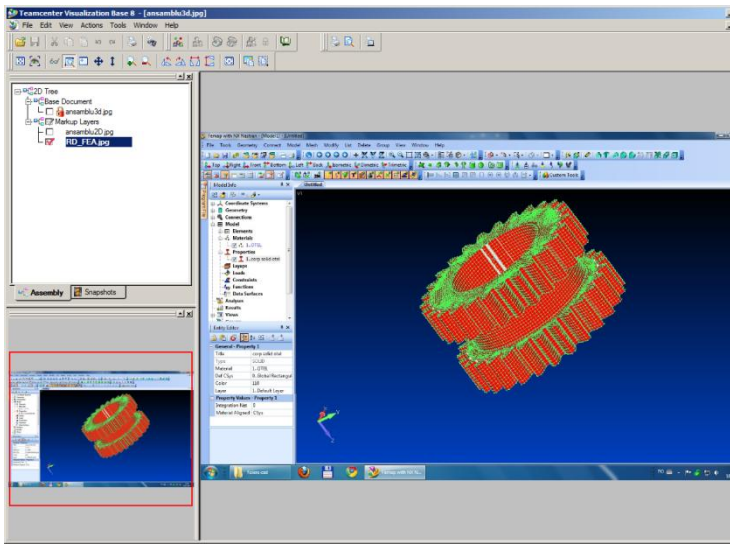

Fig.3 Virtual Prototype simulation with FEA

Virtual Manufacturing Datasets

Common task are regard management of manufacturing documentation, generate and debug NC programs, simulations, processing etc.

Two may be follow to achieve educational purposes:

- using included NC manufacturing sections or facilities of 3D modelers like Catia, NX, Solid Edge, Solid Works;
- trying dedicated applications for generate and simulate NC programs (e.g. Vericut).

Also, the companies specialized in NC machine-tools and components offer a detailed tutorials, interactive courses or e-learning modules, free software for NC educational activities (http://www.heidenhain.de).

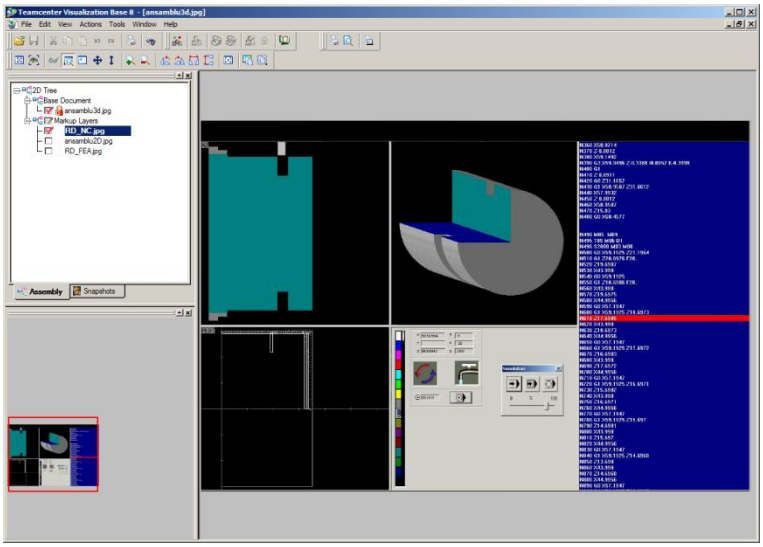

Fig.4 Virtual manufacturing

Business related Datasets

Product related business management, based on integrated PLM system, is an outcome of detailed calculus and data concerning individual or assembled parts of product: bill of materials, operations planning, scheduling time machine, costs and prices calculation etc.

These data are "bricks" needed to estimate product profitability, product performance, cost and revenue allocation etc.

In a simple way, for educational activities, spreadsheet software (e.g. MS Excel) is a useful tool.

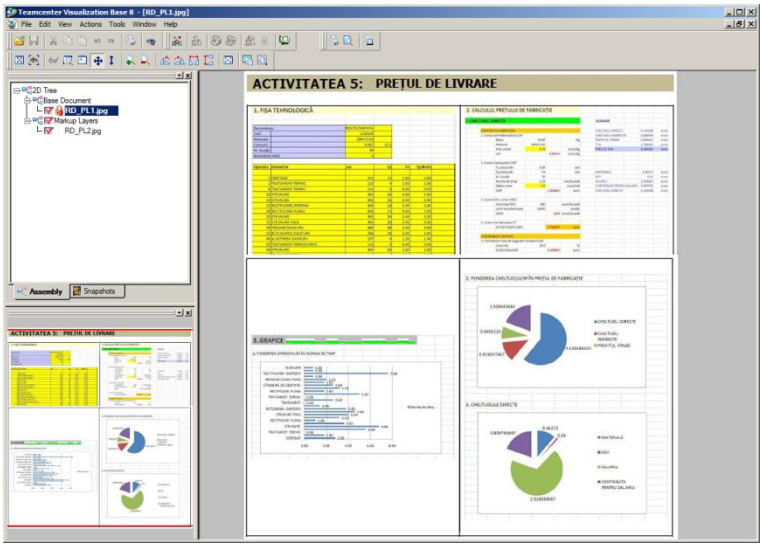

Fig.5 Costs and prices calculus

c) Integrate product and processes in a virtual enterprise

Create virtual company and its structure

Virtual enterprise is structured like real ones, with departments, workshops, functions etc. People access is based on a username and password to virtual enterprise with a hierarchical structure of the members and the rights of access to data and information within it.

For example in TeamCenter PLM environment the an *Organization* means *Groups*, *Sub-Groups*, *Roles* and *Persons*.

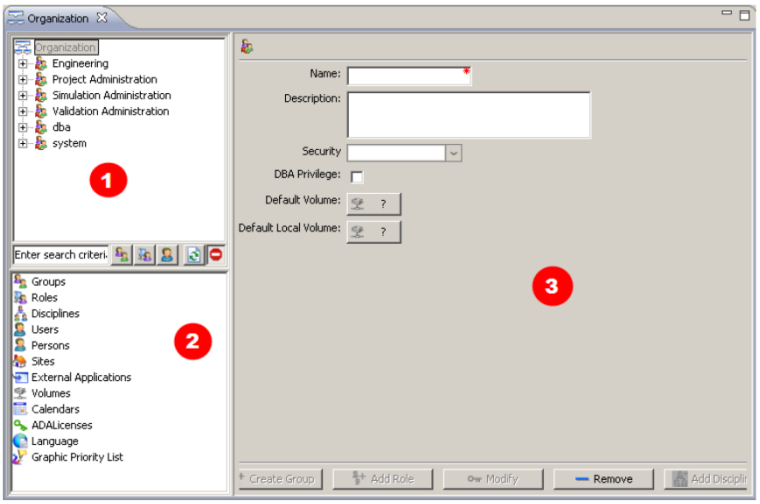

Fig.6 Virtual enterprise structure with TcEng

Object "product"

Object "product" has a folder structure (**datasets**) are organized components and processes all documents associated product [4].

The core PDM (Product Data Management) within the PLM platform (TcEng) has the ability to save documents in databases created with CAD / CAM / CAE applications and other documents created with office applications, accounting etc.

The structure created may be extended with documents needed to link PLM platform with other virtual enterprise systems, like ERP, CRM etc.

Fig.7 Product Object

3. CONCLUSIONS

PLM is an integrated business approach, based on information, made up of people, processes, practices and technology.

Human element is essential in migration to a PLM system in an organization. Forming a teamwork involve to gather the knowledge and capabilities and verify members compatibilities. According with this, the training of specialists, at least at master levels, may be subject to advance or complementary disciplines.

This paper presents a possible frame for courses and applied activities with students or adults in continuous learning forms, in a generally and not very well defined PLM domain.

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