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VIRTUAL ENTERPRISE - FIRST STEP TO START USING PLM PLATFORMS

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***Abstract*—**Rapid development of information and communications technologies leads to structural changes at the organizational level. The tendency may be generally described by words cooperation and networking, defining the enterprise in a virtual network, shearing skills and resources. Different types and large variety of networked organizations point to a specific management paradigms like Product Lifecycle Management (PLM), a concept frequently discussed today in research, educational and economical environments, integrating technologies, processes and peoples. Human element is essential, as current PLM applications are working 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. A good start in an educational application is to configure a virtual enterprise dealing with a virtual prototype using dedicated software platform like Teamcenter.

***Keywords*—**PLM, product structure, process workflow Teamcenter, virtual enterprise

I. INTRODUCTION

THE changes at the organizational level are closely related to the rapid development of information and communication technologies, which over the time have shifted the focus from increasing individual skills, team productivity, integrated manufacturing systems, to the *process management* based on *data*, *information* and *knowledge*.

The enterprise in the mentioned global context is a very complex system consisting of a large number of activities, processes, people, resources, often worldwide distributed, which require different and complex systems of communication, in an environment with frequent unpredictable and disruptive events.

These trends have emerged in generic models characterized by structural changes that have led to the occurrence of [1], [10]

1) new types of organizations (business network, enterprise network, cluster, virtual organization etc.);
2) atypical organization (incubators, business centers, consortia, networking etc.).

II. VIRTUAL ENTERPRISES/EXTENDED ENTERPRISES

A virtual organization is a set of independent or autonomous units, placed in different locations, working together, in a distributed environment, in order to achieve a certain objective [1], [5].

The emergence of virtual organizations is a result of:

1) spectacular development of new technologies of information and communication, the direct technical support of their activities;
2) pressure on companies due by rapidly changing of global market conditions.

The idea of virtual and extended organizations with an high dynamism, which is formed in relation to market requirements and remain in operation as long as there are opportunities on which they were formed, suggests a number of benefits, including [2]:

1) agility: fast reacting to unforeseen changes in the business environment, quick responses to opportunities, reduced time to market entry with innovative product or service, superior quality with lower investment than the competitors;
2) complementary: complementary association capability to be competitive and to enter to new markets;
3) critical mass: finding a number of partners that allows them to profit, especially for SMEs to suggest higher apparent size;
4) competitiveness: the ability to reach competitive costs by division of work among cooperating organizations;
5) optimization of resources: the sharing of infrastructure, knowledge and business risks;
6) innovation: the opportunity to get and to exchange inside organization the ideas as the basis of innovation and development of goods and services.

To capitalize the potential of these benefits, especially small and medium enterprises (SMEs) have established in collaborative networks entities, such as virtual and extended enterprises, which are customized entities of virtual organization.

Defining the virtual enterprise as a paradigm that incorporates existing trends in technological and industrial development has been the subject of numerous scientific and multidisciplinary research projects. Trying to combine elements of terminology and different approach aspects that have been imposed in [1] is proposed the following general formulation: *"A virtual*

enterprise is a temporary alliance of enterprises that come together to share skills or core competencies and resources in order to better respond to business opportunities, and whose cooperation is supported by computer networks."

In a particularly way, considering the communication infrastructure, *virtual enterprise (VE)* is a temporary alliance of enterprises that use technology of the Internet (Web Intranet/Extranet) as a means of communication [6].

In most definition proposals the time appears as variable that express lifetime and its length equal to the business length which led to the of virtual enterprise formation. In contrast, the *extended enterprise (EE)* is defined as long-term cooperation, in which the partners share common data, information, knowledge and coordinate manufacturing activities and collaboration with other independent firms and suppliers, in order to ensure a competitive advantage over competitors [2].

The VE and EE are definitions have common features and differences, which are summarized below [7]:

1) EE is based on long-term relationships of trust and interdependence among partners; VE is a temporary association in order to create a new product or service;

2) VE and EE intensive share data, information and knowledge through the information;

3) EE focuses on value-added product throughout the product life cycle; VE is established and rapidly dissolves, based projects;

4) VE and EE are designed to coordinate and integrate product design and manufacture in order to reduce the time to market.

Inside a VE or EE different elements or actors (nodes) may play different roles during the various phases of its life cycle, as shown in Figure 1 [1].

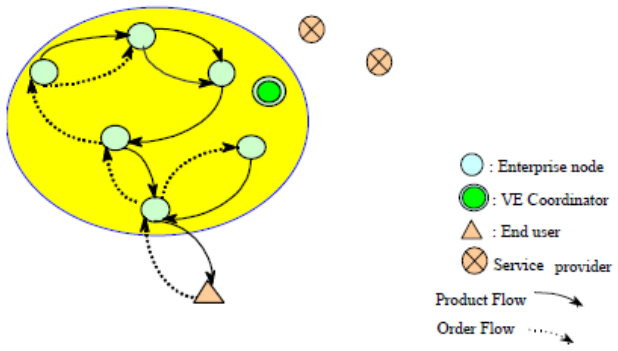

Fig. 1. Rolls in VE and EE
(Source [1]).

The structural elements and the links or flows in Figure 1 suggest the solution used to implement a VE in dedicate PLM software platforms as on will presented in next sections.

III. Base Elements of Product Lifecycle Management

Product Lifecycle Management (PLM) is a concept frequent discussed today in research, educational and economical environments.

There are some definitions proposed for activities under PLM acronym, coming from different actors of economical, business, IT, research or educational environments.

Starting from first formulation, the concept had an increasing complexity and today on agrees, in a very large way, that PLM is all about controlling how people work together to develop ideas or customer requests into finished products or services.

In a more unambiguous definition on agree that PLM "*is an integrated business approach based on information, made up of people, processes/practices and technology that cover all aspects of the life of a product, from design, production, use and maintenance, culminating in decommissioning and recycling in order to increase efficiency and productivity of the company*", Figure 2 [8].

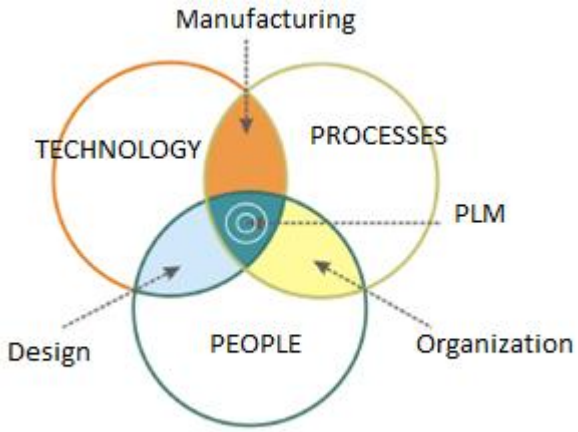

Fig. 2. Base elements of PLM
(Adapted after [8]).

A specific PLM software platform refers centralized product data information, process specific tools, global and particular standards or procedures.

For an enterprise, adoption of a PLM system expects benefits aimed projects, products and processes, but also the people.

Adopting a PLM software system may be a difficult task if the concepts and ways of implementation are confused. Before seeing how PLM can be implemented in a company, it is important to know which the constituent elements of PLM are (Figure 2) and how they are organized (PLM models).

Beyond PLM software capabilities and promises it exists and serious gap between enterprises expectations and implementation results of different solutions. Among others, there are two main sources that helped the development of concept:

1) management's needs to envelop all aspects of product lifecycle and

2) collaborative evolutions of engineering software tools, under general acronym CAx.

In industrial environment, but not only, the needs of

discrete companies may concern Computer Aided Design (CAD), configuration management, parts and product structures and more. The keyword for *discrete enterprises* is to integrate new system with existing structure and that may be same from SME to large manufacturing companies.

An example for adapted and customized PLM software system for SMEs is MESADA [9]. Solution expands standard services CAD/CAM/CAE/PDM/PLM with features for manufacturing operations management and assures links to the other systems of enterprise like Enterprise Resources Planning (ERP), Supplier Chain Management (SCM) and Customer Relationship Management (CRM).

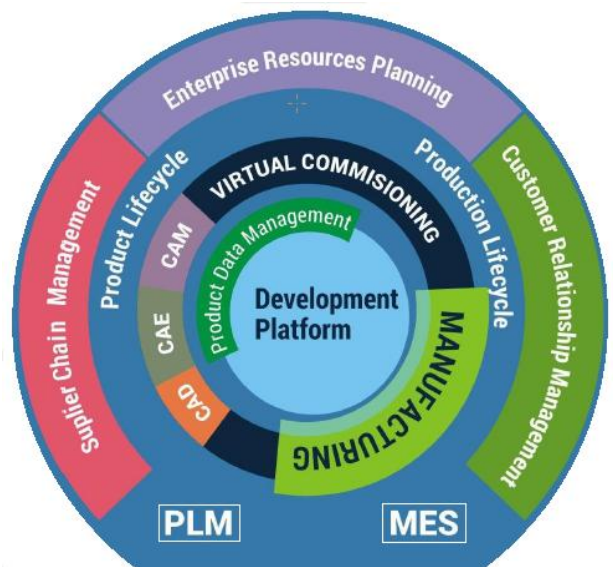

Fig. 3. MESADA customized implementation of PLM for SMEs
(Source [9]).

In Figure 2 the component Technology refers in a significant way also hardware and software platforms for PLM. There exists a difference between PLM as VE system and the hardware equipment and dedicated software. Meanwhile the information along lifecycle of product may is gathered and used several years or decades, the hardware and software support may be updated several times [8].

That reason generates different solutions for acquiring and using PLM software: standalone installations on servers and workstations, in clouds or mobile terminals. The software licenses may be bought, use in leasing or hosting from many *service producers*: UGS Teamcenter, Dassault, Enovia, PTC, SAP, eMatrix, AutoCAD PLM and so on. A more and more interesting alternative is to adopt free or open source solutions for core PLM support, like Aras Innovator, but custom integration of different CAx must be paid.

The people, human element, is essential to successful introduction of a PLM system in an enterprise, considering current PLM applications work through a web-based interface that allows communicating and sharing data on a real-time and collaborative ways.

It is well recognized that the human element is the most resistive to change and the new skills may involve considerable time and resources investments.

Hence the education in PLM must start in initial formation stages. For instance, curricula for students in master level, in many technical specializations should include PLM as a complementary or advanced knowledge discipline.

IV. Start Activities With PLM Teamcenter Software Platform

Teamcenter (TC) from Siemens PLM Software is one of the most widely-used PLM solution suites in the market, with "more than 6,400 customers across about 9,900 operations with 5 million licensed seats" [11].

Starting with version 8.0, TC became an unified architecture, a set of integrated PLM applications that incorporates the latest in technology and business functionality.

A. Creating VE structure

With *Organization* application on can create and maintain a company's virtual organization. An organization is made up of *groups* containing *subgroups*, *users*, and *persons* [12]:

1) a group is formed by users who share data;
2) a role represents specific skills and/or responsibilities; the same roles are typically found in many groups;
3) a user can belong to multiple groups and must be assigned to a default group; each user in the group is assigned a role;
4) a person is a definition containing real-world information user, such as name, address, and telephone number.

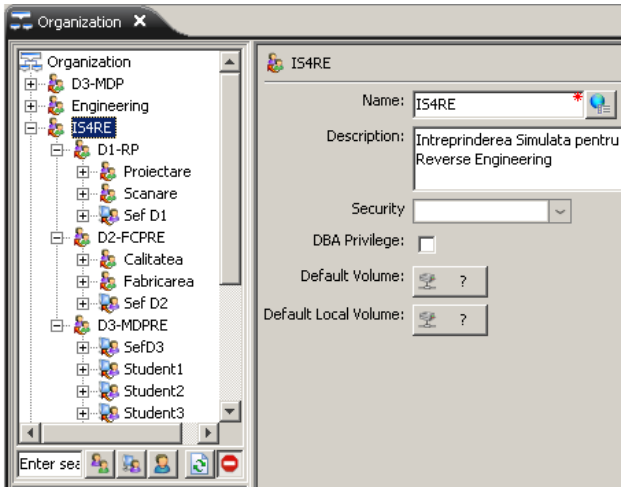

Fig. 4. VE components and structure in TC.

B. Building Product Structure

Product structure is a hierarchy of assembly parts and component parts with a geometric relationship between them. It can be created manually in TC or imported it from CAD systems.

To build a product structure on use a generic objects of TC named items. The item represents a container for the business part and its associated CAD design or other types of files (documents). The items are grouped in folders to reflect the assembly of product [12].

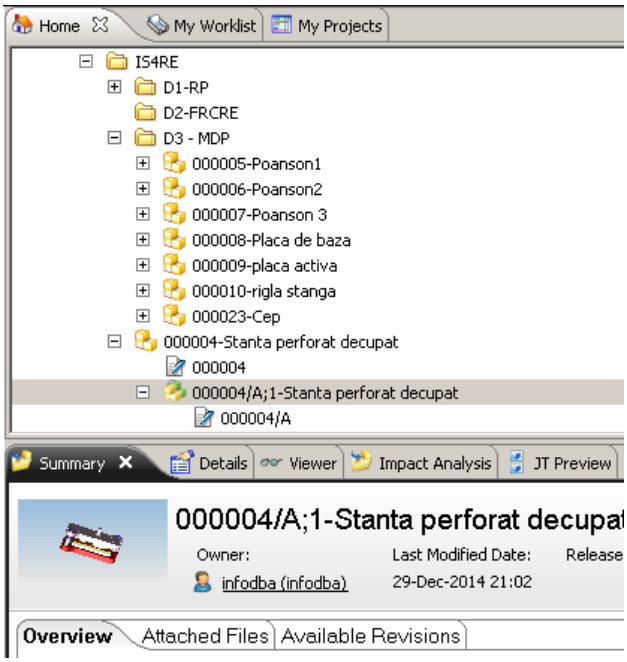

Fig. 5. Product structure created with TC.

C. Process Workflow of a digital prototype project

A workflow process describes the individual tasks and the task sequence required to model the workflow process (WFP). In a WFP tasks have both temporal (time) and hierarchical (structure) relationships, which allows individual tasks to complete sequentially (serially) or asynchronously (in parallel) [12]. An example of WFP is one describing activities to obtain the virtual prototype of a product.

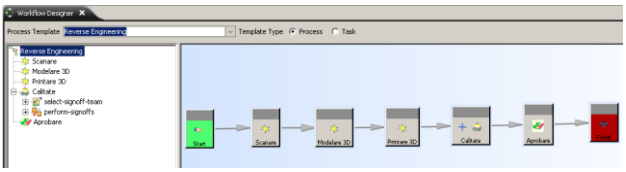

Fig. 5. Process structure workflow.

V. CONCLUSION

One scientific research component is performances demonstration. TC is a PLM platform with a wide range of complex integrated applications for almost all specific processes of product lifecycle. It also open the doors of integration with others systems of virtual enterprise like ERP, SCM, CRM etc. But the essential is to integrate "PLM peoples" and that is possible starting from initial education levels. A suggested start point and experience with students are presented in this paper.

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The experience in PLM, support and licenses for TC shouldn't be possible without following projects: CEEX 243/2006-2008 "*National network in integrated engineering of products and processes"*; POSDRU/60/2.1/S/34217 2018-2013 "*PLM Adaptor*".

TC is also used at this time for students' formation in project POSDRU/161/2.1/G/133930 2014-2015 *"Support for a successful career in reverse engineering"*.

REFERENCES

[1] L. M. Camarinha-Matos, H. Afsarmanesh, "The virtual enterprise concept", in *Infrastructures for Virtual Enterprises – Networking industrial enterprises*, Kluwer Academic Publishers, Sept 1999, ISBN 0-7923-8639-6, pp.3-14.

[2] L. M. Camarinha-Mathos, C. Lima, Al. Osario, "Elements of a VE infrastructure", in *Computer Industry 51*, Elsevier Science, 2003.

[3] M. Guran, G. Dragoi, *Integrated Production Systems aided by computer* (*Sisteme integrate de productie asistate de calculator*), Bucuresti: Editura Tehnică, 1997.

[4] M. Guran, C. Cotet, "A Management Perspective of Industrial and Technological Evolutions", *International Conference on Manufacturing Systems*, Bucuresti: Editura Tehnică, 1999.

[5] M. Guran, C. Cotet, "Manufacturing Paradigm for Virtual Enterprise" in *Digital Economy.Proceedings of the 11-th International DAAAM Symposium*, Viena, Oct. 2000.

[6] O. Szegheo, "Investigating the Extended Enterprise and the Virtual Enterprise", in *Proceedings of International Conference in Industrial and production Management*, vol. 10 no. 4, Glasgow, 1999.

[7] Neaga, Dodun, *The Extended Manufacturing Enterprise. An Approach based on Knowleadge and WEB Technologies*, Iasi: Editura Politehnium, 2005.

[8] L. Nae, *Contributions to the strategic approach of change management in product life cycle*, PhD Thesis, "Politehnica" University of Bucharest, 2013.

[9] ***, http://mesada.ro/en, visited Dec. 2014.

[10] ***, "New enterprises types based on knowledge (Noi tipuri de firme bazate pe cunostinte)", in *tOPBUSINESS ONLINE*, Nr. 695, 10 Ianuarie - 16 Ianuarie, 2008.

[11] http://www.CIMdata.com ., *Teamcenter "unified" "Siemens PLM Software's Next Generation PLM Platform"*, CIMdata, Inc., June 2010.

[12] ***, Teamcenter 8.3 HTML Help Collection, 2012.