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PRODUCT LIFECYCLE IN SMALL AND MEDIUM-SIZED ENTERPRISES

Julia LITVIKOVA[1], Milan RAFAJ[2], Stefan VALCUHA[3]
[1] Faculty of Mechanical Engineering, Slovak University of Technology in Bratislava, julia.litvikova@gmail.com
[2] Faculty of Mechanical Engineering, Slovak University of Technology in Bratislava, milan.rafaj@stuba.sk
[3] Faculty of Mechanical Engineering, Slovak University of Technology in Bratislava, stefan.valcuha@stuba.sk

***Abstract*—** Generally product lifecycle management (PLM) is characterized as an integrated management process of product information and related processes across the product lifecycle. PLM affects development time of product and optimize the cooperation of all components of the development process of products. Therefore attention has to be paid to this fact in production and research. Currently, still only a few small and medium-sized enterprises (SMEs) uses real benefits that PLM offers. It is caused by several factors that may have information, technical and financial character. Purpose of this article is aimed to refer to the problems mentioned above and highlight the benefits that PLM brings. It also describes the major barriers to the implementation of PLM in SME and propose possible solutions.

***Keywords*—**Lifecycle, product lifecycle management, medium-sized enterprises

I. INTRODUCTION

PROGRES in the area of information technologies have opened possibilities for the support of current needs of the industry, such as the acceleration of innovation cycles and reduction of costs. First EDM (Engineering Data Management) and PDM (Product Data Management) systems emerged in the late 1980s as engineers recognized a need to keep track of the growing volumes of design files generated by CAD (Computer Aided Design) systems. Links between the PLM (Product Lifecycle Management) systems and other software, such as Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), Enterprise Resource Planning (ERP) and Supply Chain Management (SCM) etc. ensure diffusion, traceability, archiving and reuse of information. PLM is a holistic business concept including not only items, documents, and BOM's, but also analysis results, test specifications, environmental component information, quality standards, engineering requirements, change orders, manufacturing procedures, product performance information, component suppliers and so forth. Modern PLM system capabilities include workflow, program management and project control features that standardize, automate, and accelerate operations. PLM is a collaborative backbone allowing people throughout all extended enterprises to work together more effectively. Operational efficiencies are improved with PLM because groups all across the value chain can work faster through advanced information retrieval, electronic information sharing, data reuse and numerous automated capabilities, with greater information traceability and data security. This way, PLM can result in impressive cost savings and better overview of the lifecycle which gives opportunities for companies to boost revenue streams by accelerating the pace at which innovative products are brought to the market. The return on investment for PLM is based on a broader corporate business value, specifically the greater market share and increased profitability achieved by streamlining the business processes [1].

II. TECHNOLOGY SOLUTION FOR PRODUCT LIFECYCLE MANAGEMENT

In general, PLM systems must ensure two elementary functions:

1. Enterprise knowledge management
2. Exploit enterprise knowledge

PLM systems are usually developed as an integrated set of user applications. Architecture of comprehensive solution includes three components: central infrastructure, system for development and integration application and enterprise applications. Central infrastructure is core on which other applications of the PLM system are based. Basic functions of product lifecycle management are using following tools: debugging tools for data flow, data vault, database management system, administrator tools, standard tools for cooperation, visualization tools, data flow management tools, etc. PLM systems usually support 15 and more CAD formats, XML and many industry standards such as VRML, IGES, STEP, JT and others. Enterprise applications automate working operations and completely cover all phases of the lifecycle [7].

Processes across the entire product lifecycle management are complex and it is difficult to support various levels of cooperation. It is necessary to identify technological solutions to facilitate the implementation of

PLM systems into processes of product life cycle. Deviation of technology layers presents Fig. 1 Derivation of technology solutions for PLM (product lifecycle information modeling and management, product lifecycle knowledge management, design chain management, product lifecycle process management, product trade exchange, collaborative product service and product lifecycle portal for stakeholder, developer, customer, manufacturer and supplier) and applications of advanced information technologies for implementation of PLM [6].

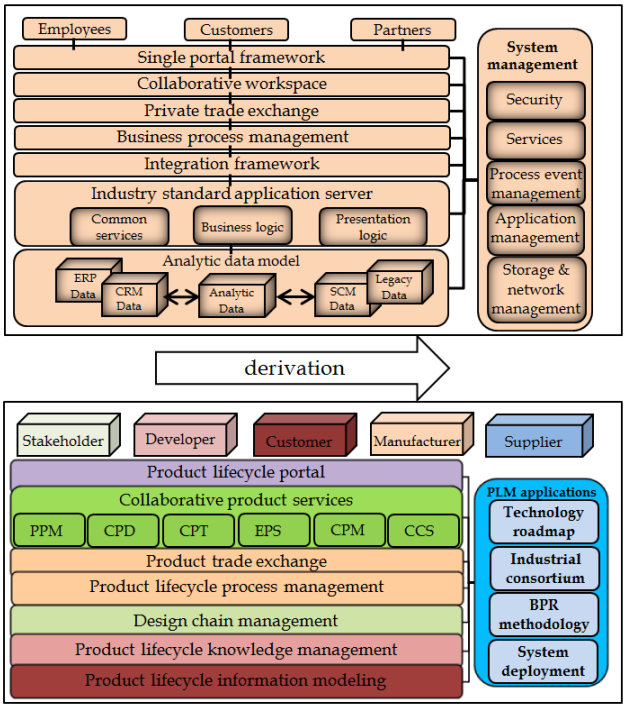

Fig. 1. Derivation of technology solutions for PLM

With the application of PLM systems in industry, potencial advantages are expected as follows:

- PLM systems bring customer into the design chain, which can lead to shorter product lifecycles and higher levels of customer satisfaction.
- As nearly 70% of product´s cost is formed in during design and development phase, consequently, the best opportunity to impact costs and profit margins is during the crucial design process. PLM systems provide capability for designer, customer, manufacturer and supplier to work closely in order to leverage intellectual capital and facilitate collaborative innovation for new and effective product design and development.
- Suppliers can add significant intellectual capital to the design process. PLM systems link designer and supplier together to get competitive advantages such as increased use of alternative technologies, more design reuse, better manufacturability, shorter cycle times and lower production costs.

Technological solution (Fig. 2 Technology solutions to meet industrial requiremets) was developed to meet industrial requirements and obtain long term sustainability in today´s highly competitive market.

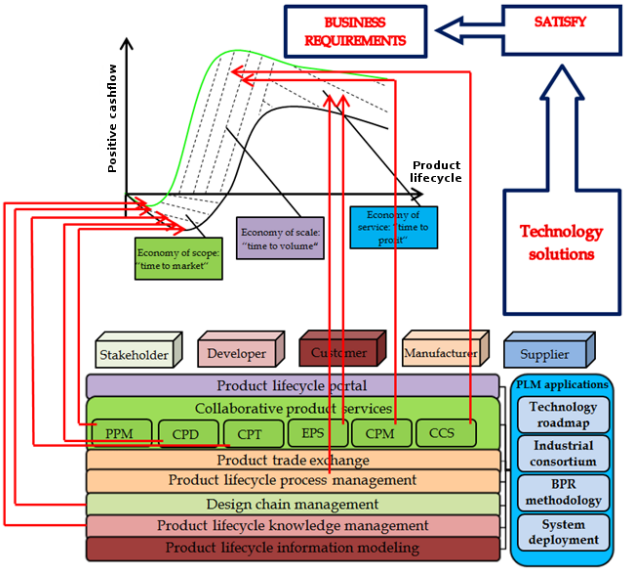

Fig. 2. Technology solutions to meet industrial requirements

PPM - product portfolio management
CPD - collaborative product development
CPT - collaborative product customization
EPS - extended product service
CPM - collaborative product manufacturing
CCS - collaborative component supply

III. PRODUCT LIFECYCLE MANAGEMENT IN NETWORKED ENTERPRISES

In product design, CAD tools may fail when operating in a collaborative environment. The reason of this problem is the lack of interoperability features. One way to gain operational excellence is to reduce the waste both in the value chain activities as well as in the linkages among them. Research indicates that wasted time comprises about 60 percent of total operational time in most businesses. The major portion of this waste can be attributed to the absence of an efficient knowledge management system. Searching and waiting for data, data translation, working with wrong data and reinvention of the existing knowledge are very common problems in the value chain. For reducing waste in the value chain, is necessary to create an environment characterized by systematic capture, management and dissemination of knowledge and to eliminate the deficiencies that time, distance and differing professional disciplines introduce into the value chain [4]. To effectively tackle the above challenges in a modern collaborative enterprise environment, new industrial capabilities are required in order to obtain business success in today´s internet

economy [6]:

1. Geographically scattered design teams and supply chain partners need to collaboratively design products on a virtual basis.
2. Static designs need to be replaced by mass customization – often using predefined modules or building blocks to rapidly configure new product platforms that can be flexibly managed through their lifecycle.
3. A new approach needs to be created to leverage netcentric technology to liberate the inherent value in today´s extended business model.
4. Such a new approach should enable business to use and leverage information needed by each partner to accelerate and enhance product development predictability.
5. To exchange and control product information and to perform real-time project management.
6. A system needs to emerge as the dominant technology for managing inter-enterprise data, information and knowledge, and providing design teams with a virtual design space.

To meet these requirements, a new system is imperatively required [6]:

1. to provide an information continuum in order to deliver pervasive, real-time analytics, querying and reporting throughout the entire product lifecycle,
2. to provide a collaborative environment bringing together multiple roles, constituents and stakeholders in threaded discussions beyond four walls of enterprise,
3. to enable interactive viewing and commentary upon product development through multiple devices, channels and systems involved with the product lifecycle,
4. to be an open but integrated solution supporting key enterprise value disciplines of product leadership, customer intimacy and operational excellence.

IV. APPLICATION IN SMALL AND MEDIUM-SIZED ENTERPRISES

Due to globalisation, enterprises have to work in networks which are increasingly diversified and geographically dispersed. To reach cost, quality and delay optimisation, enterprises implement new information and communication technologies.

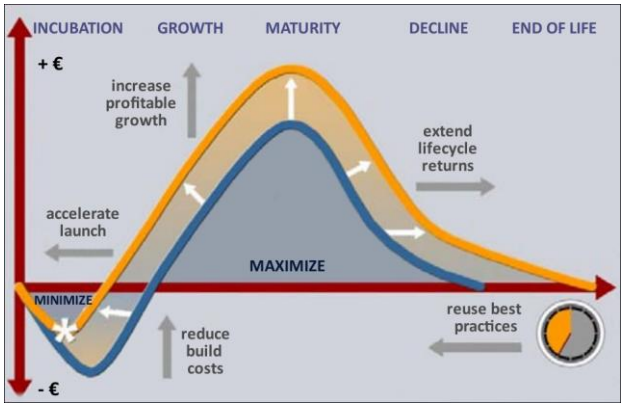

Fig. 3. Business value of PLM [2]

The small and medium-sized enterprises also try to implement those technologies but, despite their flexibility, they have difficulties in structuring and exchanging information. Enterprises also have problems in creating data models for structuring and sharing product information, especially in the context of extended enterprises [5].

One main difficulty lies in the implementation of the product meta-model, due to the fact that small and medium-sized enterprises have to integrate different information structures of their customers.
Different surveys show that the main difficulties that arise for the implementation of PLM systems for SMEs are [3]:

- The lack of interoperability between different information systems inside (PLM, CAD, ERP) and outside the enterprise (PLM of partner companies)
- The difficulty of modeling. There are not enough modeling skills in SMEs due to the critical size of the information system´s internal service
- The match between the functionalities proposed by the actual software and the needs of some kind of enterprise, especially the raw part makers

Another problem of manufacturing companies is currently long time which passes from receipt of order after the equipment and product delivery to the user. This time is proportionally longer with more partners involved in the business relationship. Communication channels between workers at the enterprise level and also between trading partners are mainly for small and medium-sized enterprises often on the manual form of obtaining data. Because of that, there is a problem with out-of-date information and errors in realisation of contracts, orders, etc.

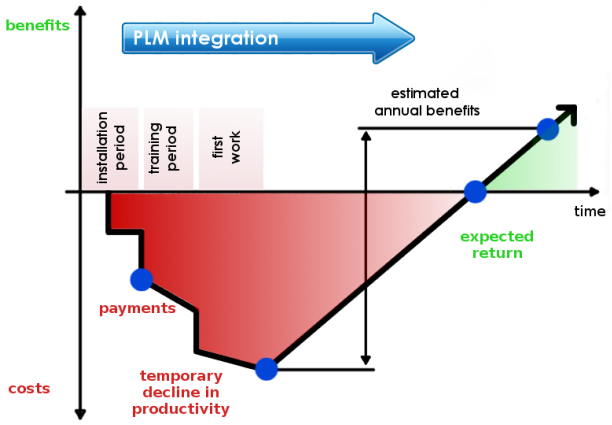

Fig. 4. Estimat payback period

V. Cost of Product Lifecycle Management

The high cost of obtaining PLM solution is the main reason why SMEs have problem to start using it. Cost can be divided into financial and time. Under financial costs belong licenses for all necessary applications, payment of the renewal fee for software, paying consulting company that perform the analysis, paying programming adjustments, training on system and salaries for the employees who will take care of the technical administration of the system. It is also important to count of earnings due to the transition to the new system and distractibility for current business contracts. Time costs include time when managers dealt with the tender, time when the necessary data were being and consultation period with an implementation company. It is necessary to include training and testing period into the time costs too [8], [9].

VI. Return on Investment in PLM System

If an enterprise is able to implement PLM system properly according to the predefined project, it can expect payback usually within several months to years. Return on investment is determined primarily by revealing errors in product design in the early stages of its development. The latter error is detected, the higher the price for elimination is. Price increase of errors in these cases have exponential character and is necessary to include salaries of employees for time when they were working on faulty design, consumed time, energy, rental of premises and production equipment, raw material and loss of earning because of late product launch. In the worst case, is necessary to download the product from the market after few months and even compensate dissatisfied customers [8].

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