

# **A holistic Product Lifecycle Management framework facing the challenges of 21st century**

Dr. Julius D. Golovatchev  
Managing Consultant for Enterprise Effectiveness & PLM  
Detecon International GmbH  
Oberkasseler Str. 2  
D-53227 Bonn  
julius.golovatchev@detecon.com

Oliver Budde  
Research Institute for Rationalization and Operations Management  
at Aachen University  
Pontdriesch 14/16  
D-52062 Aachen  
oliver.budde@fir.rwth-aachen.de

**Keywords:** Product Lifecycle Management, Integrated PLM, Extended Product, Integrative Approach, Lifecycle Value Management

## **ABSTRACT**

Consistent definition, categorization and operationalization of products (e.g. extended products, bundles, etc) delivered to global markets and customized for different buyer segments is one of the major challenges for the Lifecycle Management. Each lifecycle encompasses the processes, information, support systems and people involved in delivering the related business functions. It can be argued that process supporting technologies/solutions like WFMS, PDM-System etc exist today for the creation of a seamless environment for accessing, manipulating and reasoning about product information that is being produced in fragmented and distributed environment. A holistic approach that is suitable for aligning the Product Lifecycle Management (PLM) business requirements (like process flexibility, shorter time to market etc) to the potentials of new technology driven concepts in the information management like SOA is nevertheless still missing. The authors give reasons why the holistic view on the product lifecycle management as well as the link between an inter-company wide information management is critical for an efficient PLM and present an integrated approach taking these aspects into account. In this paper four building blocks of Next Generation PLM are introduced. The PLM Meta Model makes up the first building block. It defines the constraints and rules for decomposing the product functionality into meaningful modules. The PLM IT-Architecture represents the second part and describes the IT-components and their interrelation utilized for the purpose of PLM. A PLM-Process methodology as a basis for describing the relevant activities is attached in the third building block. The final building block is constituted by the Lifecycle Value Management concept for steering the PLM- process on a strategic level like, among other things, by considering portfolio effects. The paper closes with the presentation of a short case study validating the proposed concept for a company in the service industry.

## 1 Motivation

As Shark (2004) postulates, Product Lifecycle Management (PLM) is the activity of managing a company's products across the complete lifecycle, from the early stages of conception to the final disposal or recycling of a product. From this definition, a strong interrelation between the value creation process and the PLM of the company can be deduced. Taking the current globally changing business environment into account the PLM can be considered as a strategic weapon for enabling the company to provide an additional value to customers and thereby gain a competitive advantage over their competitors.

### 1.1 Business Drivers

#### *Business Driver One: Management of the Extended Product*

The dichotomy between tangible goods and immaterial services is subject to change according to Saaksvuori (2004). In the service industry as well as in the traditional industries like manufacturing this development towards a hybrid or extended product can be observed. (Figure 1) Following the argumentation of Mateika (2005) a critical success factor in the manufacturing industry is the ability to provide more profitable services in addition to the tangible good. But this combination of tangible and intangible attributes in terms of the extended product increases the complexity in managing the Product Lifecycle (Saaksvuori, 2004). Especially in the service sector (eg. telecommunication) products typically consist of several modules that in sum create the customer benefit (e.g. Multi-Play products). Each module embodies its own lifecycle, which implies an additional product complexity in terms of module design, module management and module removal from the product.

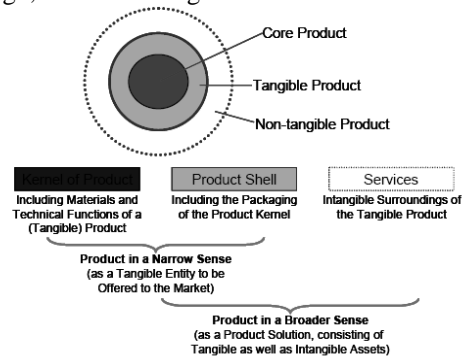


Figure 1: Extended Product according to Thoben et al., 2001

#### *Business Driver Two: Globalization*

Global and deregulated markets result in global competition that every company is confronted with. For the service industries this results into the shift from the suppliers' market to a buyers' market, where the customer is in the focal point. Because by their very nature services are easy to copy, companies in the service industry actually face more pressure to innovate and develop new products than manufacturers. This business driver forces companies to follow either a cost-leadership strategy or a differentiation strategy on a global scale according to Porter (1985). In order to perform in the cost-leadership role, companies have to implement efficient processes regarding the development of complex products and to handle the order management process. Simultaneously companies have to cooperate with numerous business partners, which results in a high effort for coordination. A product/service differentiation strategy implies processes that ensure short time-to-market on one hand and an effective degree of freedom in the process definition for staying innovative on the other hand.

#### *Business Driver Three: Legal Frameworks*

Increasing regulations such as safety, environmental and product reliability will influence company's PLM-process. Especially the resulting effort for ensuring traceability will have an impact. Traceability has two dimensions in the PLM-context. First of all it is related to the PLM process itself. Effective measures have to be in place in order to ensure the flow of transactions to identify where material misstatements due to error or fraud could occur (Sarbanes Oxley Act). Further, traceability in the order-delivery process is about tracking of an

individual product units or even components. Legal frameworks like TREAD Act for the automotive industry in the USA or REACH for the chemical industry in EU can be subsumed under this dimension. Companies that need to respond to this kind of regulation must ensure that the implementation and the integration in the existing processes happen to be simple and at the least possible lifecycle costs.

## 2 Integrated PLM-Approach

The integrated PLM- Approach consists of four components depicted in figure 2.

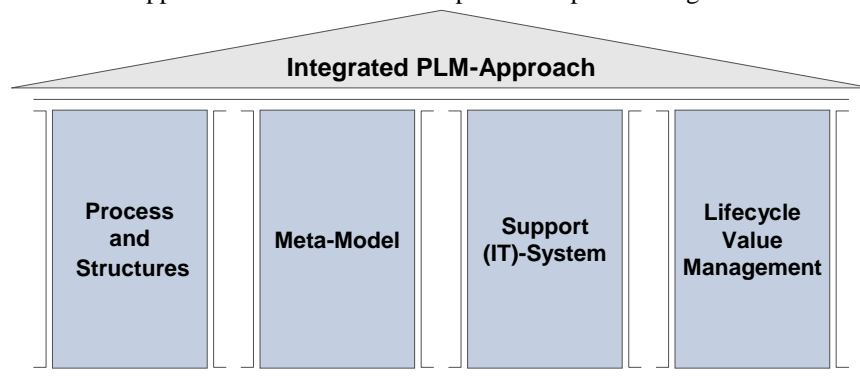


Figure 2: Four components constituting the integrated PLM-approach

### 2.1 PLM Meta-Model

Many quality deficiencies in the product development (esp. in the service industry) originate nowadays from a diffuse definition of products as well as from the inconsistent view on the object "product". Studies show that 80% of the total cost structure over a product's lifecycle is pre-determined during the concept and design phase. Especially in the service industry, the product (or service) should be clearly and precisely defined to be developed, commercialized and to be understood from the customer. There should be a constant product definition with the overall product lifecycle and for all business processes. The product as the main subject of the process needs to be defined and this definition should be taken from the customers' perspective. A product is an entity the customer perceives in its entirety and is characterized by being offered to a market place. It includes physical products, services and information (compare figure 1). The precise definition of the complete product range and their categorization still remain a problem especially in the service industry (eg. telecommunication, energy, finance industry etc.). Product definition is not simply a reflection of the engineering design. It also includes the entire set of information that defines how the product is designed, manufactured, operated and managed on the market and finally withdrawn from the market.

Product definition should be furthermore detailed by the company-wide specific PLM Meta-Model to decrease complexity costs. Such a Meta-Model defines the product on an even more detailed level for the optimization of the time to market and for the purpose of decreasing the effort of resembling components.

PLM Meta-Model is the basis for standardization and modularization of products. Modular product data structure as a core element of PLM Meta-Model ensures the linking of the sales perspective to the internal (production) perspective in relation to the offered products and services. The main aim of introducing a modular product structure is the optimization of the product development.

The unique PLM Meta-Model and the corresponding processes should be implemented by considering the existing processes, company structures, and cultures. Requirements from the affected functional areas flow into the definition of the product data structure (see fig.3). One master product data management fits all needs of the main processes and its interfaces.

Using PLM Meta-Model leads to simplification and cost optimisation of "product and service engineering" through the re-use of the production and service modules, shorten "time-to-market", avoiding overlaps in development and reduce technical variance, availability of the product modules range of all service lines (factories) for all division of the company.

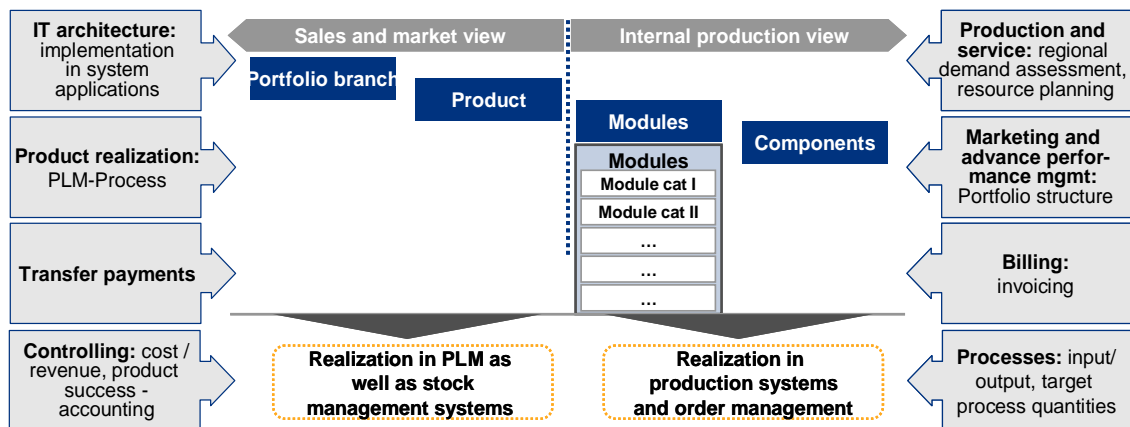


Figure 3: Definition and requirements on product data structure

## 2.2 PLM IT-Architecture

The foundation for moving a product through its complete lifecycle beginning with the product idea and ending with the product removal from the market is a solid PLM IT-Architecture, that is customized for the company-specific PLM- requirements. In our perspective, such a PLM IT- Architecture must support the PLM- process in the dimensions: (1) Decision support, (2) Operational support and (3) integration of supplemental business applications. A standardized off-the-shelf PLM-System is therefore not the tool of choice as Ausura and Deck (2007) point out. Instead we suggest to rely on a PLM IT- Architecture that re-uses, respectively customizes existing IT- components as far as possible:

### *Decision Support System (DSS):*

The main purpose of a DSS is to gather and consolidate data from operative systems in order to provide the senior management with aggregated information regarding the product lifecycle. The Computer Aided Selling (CAS) module provides functionality for the product configuration and product pricing. The component Strategic Resource Management focuses on the long-term resource capacity planning on a strategic level. Product portfolio management aspects are covered with the last Value Management component.

### *Operational Support System (OSS)*

On the operational level the PLM- process execution is supported by the OSS. The Workflow Management Systems (WFMS) enables a higher degree of process automatization. Especially in the context of distributing and releasing unstructured content like a product specification in cross-functional teams, the WFMS plays an essential role through a strong link to the Product Data Management System (PDM). The Product Modeling System and the PDM are closely coupled. The former defines the product structure, in which types of modules the product is decomposed into. In the database context this functionality is similar to the schema definition. The PDM-systems stores all product relevant data according to this definition and provides different views for each stakeholder e.g. marketing and engineering. The Multi-Project Management System as well as the Collaboration Tools are instruments for managing the product in different phases in a collaborative environment.

### *Integration of supplemental business applications:*

A PLM IT- Architecture is supposed to hold the promise of seamlessly integrating and presenting all information produced throughout all phases of a product's life cycle to everyone in an organization, along with external business partners. For ensuring this functionality, an EAI-approach has to be implemented. According to recent research activities a Service Oriented Architecture (SOA) is most suitable to integrate the business applications from external partner e.g. suppliers as well as integrating the own business applications like ERP, CRM etc. in order to fulfil the promise of seamless integration for becoming a real-time enterprise (Abramovici, 2002).

### 2.3 PLM-Process

Companies should take a disciplined, analytical approach to developing new products (services), relying on targeted customer input. The main design goals of this approach is to facilitate the execution of this collaborative process (efficiency goal) and equally important to align the activities with the strategic goals of the company (effectiveness goal). Our PLM-Process approach is based on three principles: Stage Gate Approach, Multi-Perspective, Metrics based Management.

#### *Principle One: Stage-Gate Approach*

The Stage-Gate Approach is both a conceptual and an operational model for the development, marketing and removal of a product during its life cycle. This structure is oriented on the life cycle of the product and has been validated in several projects by Detecon Inc. primarily in the Telco-Industry. Every stage consists of a distinct number of activities (organized in perspectives, refer to the next section), which have to be accomplished by specific process stakeholders at the given phase. The entrance to each stage is a gate; these gates control the process much like quality control checkpoints. Each gate is characterized by a set of deliverables as input, a set of exit criteria and an output. Gates are manned by senior managers that form the so-called Product Board. The Product Board acts as a gate-keeper that evaluates the results from one stage by a given set of criteria. Based on this evaluation, the product board can either decide whether the product idea proceeds to the next stage, re-starts at the previous stage or is archived.

#### *Principle Two: Multi- Perspective*

PLM has always to cope with the conflict of objectives between the product marketing and the technical side. Several case studies have documented that this conflict often results in product failure in the market. Either because the product specification is too much technical driven and therefore far from the market demand or the product marketing has defined product specifications without collaborating with the technical department about technical feasibility beforehand. For solving that conflict of objectives three perspectives on the process have to be taken into account in order to ensure an efficient coordination and collaboration of the relevant departments or business partners.

In the market perspective all activities are assigned to that relate to the product marketing. Referring to the service industry, typical tasks like the definition of product specifications and the management of the product on the market-place belong into this category. By contrast the technical perspective subsumes all technical or production- oriented activities. Additionally the financial implications of moving the product through the life cycle are grouped in the financial perspective.

#### *Principle Three: Metrics based Management*

In addition to the process definition the organisational component must not be neglected. Since products, and consequently the PLM-process, become more complex and involves internal as well as external partners along the value chain, there is a greater need to balance top- management control with the empowerment of self-managed, cross functional teams. As a prerequisite for achieving this balance, the company has to implement a metrics-based management approach in which teams are measured on strategic performance indicators such as development cost, time to market and customer satisfaction. The definition and selection of the indicators is critical for the successful implementation of the PLM-concept. By setting the weights properly the teams will self-steer to the greatest short- and long-term profit, which results in less coordination effort and efficiency gains especially in the context of for cross- departmental teams.

### 2.4 Lifecycle Value Management

Life cycle oriented product planning is a basic necessity for companies on a global market and requires a robust and systematic process combined with the right organizational environment. Enterprises use Lifecycle Value Management to support the management of the product after launch through the growth, maturity, and decline stages of the product life cycle. In the overall value chain, Lifecycle Value Management ensures that the products and services which are developed and implemented fulfill the market requirements and reflect the market demand. Lifecycle Value Management requires permanent attendance for analysing and planning for ensuring the customer benefits and the alignment to all company functions.

There are three different but supplementary building blocks of Lifecycle Value Management:

#### *Value oriented portfolio management (incl. IT-supported portfolio database)*

Increased complexity of product marketing in the service company without an appropriate and efficient data foundation results in a lack of business transparency and low synergies in the value network. The modular

structure of the portfolio promotes the use of common parts in the production processes, increasing the ratio mass production to overall production. Strategic alignment and value based product portfolio management enable an effective product lifecycle management. Focusing on clearly defined products makes a significant contribution to effective portfolio management. The products can be positioned without overlaps and in accordance with the market demand. Value oriented portfolio management helps to prioritize product investments. Sales and marketing departments benefit from the increased transparency of the product range and the improved comprehensibility for the customers.

#### *Customer Needs Management*

Customer Needs Management incl. Requirement Management builds interfaces between PLM and Customer Relationship Management (CRM) and gives input for the collaborative product design. The effective Customer Need Management ensures that the product content matches customer requirements and it allows delivering more personalized products by facilitating mass customization.

#### *Reporting and controlling process regarding the product lifecycle management process*

By adhering and referencing to a standard product definition (compare section 2.1) across all company divisions (sales, production planning, accounting etc) the basis for introducing important controlling instruments like the product success accounting is created. The unambiguous correlation of the basic data to business management indicators along the lines of a standard product structure provides staff and management with precise and timely information about all of the critical success factors that supports the management to make the right decisions at the right time.

Implementation of these three building blocks combined with a modular product data structure ensures the “state-of-the art” Lifecycle Value Management.

### **3 Case Study**

A renowned company in the telecommunications industry carried out an extensive restructuring program which would enable it to maintain its position in a deregulated market environment. Implementation of integrated PLM at this company showed the valuable benefits for solid product development, marketing and strategy:

- Product portfolios across all of the company were reduced by 50% and integrated into a modular structure.
- Acceleration time-to-market up to 25%.
- Efficient cost savings ca.20% along the PLM process by using standard support system and re-using of modules and components in product realization phase.

### **References**

- [1] Abramovici, M.; Sieg, O. C. (2002): Status and Development Trends of Product Lifecycle Management Systems. In: Proceeding of International Conference on Integrated Product and Process Development, Wroclaw, Poland, p. 2122.
- [2] Ausura, B; Deck, M (2007): The new product lifecycle management systems: whar are these PLM systems? and how can they help your company do NPD better? Visions Magazine. Online available at <http://www.pdma.org/visions/jan03/plm.html>, last visit 26.01.2007.
- [3] Mateika, M. (2005): Unterstützung der lebenszyklusorientierten Produktplanung am Beispiel des Maschinen- und Anlagenbaus. Essen: Vulkan-Verl.
- [4] Porter, M. E. (1985): Competitive advantage: Free Press New York.
- [5] Saaksvuori, A.; Immonen, A. (2004): Product Lifecycle Management: Springer.
- [6] Stark, J. (2004): Product Lifecycle Management: 21st Century Paradigm for Product Realisation: Springer.
- [7] Teresko, J. (2004): Auto Report: Information Technology The PLM Revolution. In: Industry Week-CLEVELAND OHIO-, Vol. 253, Nr. 2, p. 32–38.
- [8] Thoben, K. D.; Jagdev, H.; Eschenbaecher, J.(2001): Extended Products: Evolving Traditional Product Concepts. In: Proceedings of the 7 th International Conference on Concurrent Enterprising: Engineering the Knowledge Economy through Co-operation, Bremen, Germany, p. 27–29.