CHANGE MANAGEMENT IN PRODUCT LIFECYCLE MANAGEMENT

Laurenţiu NAE, George DRĂGHICI, Ion UDEANU

Abstract: Many companies are continually challenged to reduce development costs and improve productivity. At the same time, companies are forced to quickly adapt to ever changing global markets. To strike a balance, companies distribute engineering, design and manufacturing, as well as marketing, sales and service activities all over the world, to where they are most cost effective. Change Management is one of the most important issues to be considered for any strategy in PLM. This paper brings a significant number of best practices to help managers to be more effective in their decisions regarding change management.

Key words: change management, PLM, PDM, ECO.

1. INTRODUCTION

The companies consistently strived to provide the market with leading edge products. Over the years, it sharpened its focus on efficient management of its core processes of innovation, product development, and market exploitation. Being a critical element of product development, the process for product change management was highly established and extended across multiple functional units like Engineering, Manufacturing, Spares, Engine Services and product control board. A few partner organizations also participated in this process.

However, lack of digitization had an adverse impact on the process run-time. Moreover, each functional unit had its own stand-alone system to manage its core operations. The data required for introducing product changes was dispersed across different departments, which affected the process efficiency. The paper-based manual procedures for the approval of product changes further aggravated the process lag. It was evident that the companies needed a solution that digitized the process of product change management and facilitated the collaboration among the various departments and partner firms involved in introducing product changes.

2. THE CHALANGE

In industry, ECM (Engineering Change Management) is recognized as a problem that receives too little attention relative to its importance. This means that it is necessary to develop methodologies and techniques to improve the ECM practices. Current tools dominating in new product development and introduction process are low-cost, low-function personal productivity tools like spreadsheets, project management and word processing according to AMR Research.

3. GENERALISED MODEL OF ENGINEERING CHANGE PROCESS

Generalised model of engineering change process helps us understand and compare procedures in different types of production and consequently find the most appropriate methods for a specific enterprise. Each change begins with an idea (Fig. 1). It is important to stimulate the employees to creativity as well as to ensure an easy collection of ideas and their tracking.

Collecting of proposals for changes must be possible and accessible in a simple manner, throughout the company and also from the outside, servicing personnel and salesmen being the most important participants. It is necessary to ensure that proposals are collected centrally and that they are properly documented.

In the next step, the idea itself should be transformed into a proposal for a change. The information system plays and important role in arrangement and collection of the required data. Arranging also includes analysing and testing, if applicable. It needs to be ensured that each proposal is subject to appropriate professional discussion, which, due to economic reasons, can be conducted in several stages.

Each change must go through the process of approval, where the consequences of the change are calculated from all perspectives, e.g. in terms of costs and technical feasibility.
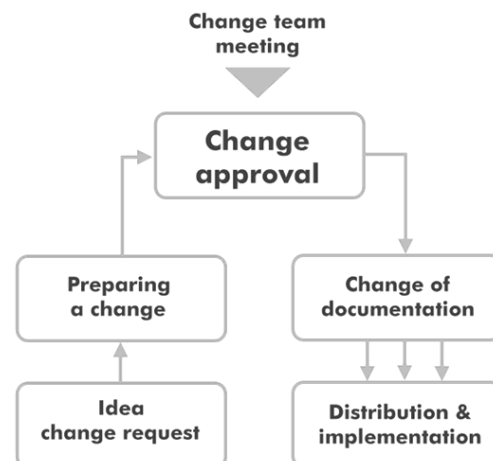

Fig. 1. Change Management Process.

Once the change has been approved, it should first be provided for changes in documents and their distribution, following which the change needs to be implemented in the production process, servicing, etc.

4. IMPLICATION

Change Orders are a necessity of manufacturing, whether they are used as a strategy for keeping competitors at bay, for setting the pace of innovation, for satisfying customers, or simply for fixing product flaws. Fixing flaws, especially those that could lead to litigation, demands speed *and* thoroughness. In today's internationally competitive market, setting the pace of innovation for the entire industry means huge benefits: higher margins, increased quality, reduced costs by replacing less cost effective models more quickly, recognition for innovative leadership, increased market share, and overall lower risk. On the other hand, companies that fall behind the leader end up with two choices: proceed as scheduled and eventually offer products that are one to two years behind the competition, or stop and start over, which causes even more delays and represents more risk because of constantly changing market conditions and competitive offers.

If you are not a leader, then the only way to combat these conditions is by dramatically reducing the time it takes to plan, design, develop, manufacture, and offer new and improved products. One way to accomplish this is by using change orders as a tactic for keeping products fresh while new major product innovations are under development.

Change Orders effectively become a low cost method of responding to new competitive product introductions by enabling the company to offer regular and timely updates. Like any other core process, ECO (Engineering Change Orders) require the coordinated decisions of participants from many different suppliers and departments, such as sales, marketing, engineering, procurement, finance, legal, QA, and manufacturing. In truck manufacturing for example, developing new products and enhancing existing ones covers changes to, or new designs of, engines, chasses, mirrors, heating, electronics, seats, axles, fuel fills, gauges, transmission, controls, welding, fenders, grilles, paint, and many, many other components. These cannot be handled in isolation. Even a small change may affect other areas of design, production, sourcing of parts, and production, not to mention cost. Tying all of these disparate groups together so the process can flow seamlessly across departments and corporate boundaries to customers and suppliers, requires a business process management system that is designed around the way people interact.

5. GLOBAL PRODUCT DEVELOPMENT

As manufacturers expand globally, they need to manage a distributed design team and a broader cross-functional team, not just design and development. With this global expansion, issues such as intellectual property (IP) management, enterprise security, HCM (Human Capital Management), and regulatory compliance need to be managed proactively. These risk factors have always held importance, but GPD (Global Product Development) brings them closer to the forefront.

The primary areas of opportunity in Global Product Development that define the future of PLM (Product Lifecycle Management) fall under the umbrella of decision support and change management:

Connecting disparate data sources. Each group sees product information through the lens of its own role: CAD geometry, formula development, manufacturing processes, spare parts data, or pricing and packaging. It's critical to enable role-based views inside and outside the company for faster decision support.

Single user interface. Most companies don't have a single product knowledge interface that contains the relevant information for engineering, development, manufacturing, service, marketing, sales, partners, and customers. Creating a single UI with personalized product portals for each constituency would alleviate this challenge.

Customer needs management. This is an important aspect to be considered in any PLM approach. As companies reach new levels of PLM maturity with PDM (Product Data Management) and process management, they begin to think about linking customer data with the front end of design.

Product, process, and people performance and analytics. PPM solutions provide a view of a company's products, but most applications don't have deep analytics capability to look holistically at the performance of product, process, and people from an opportunity, sales, quality, and execution standpoint.

Integrated product and process design. Manufacturers need to be able to design, simulate, and execute the product, process, and production definitions to verify they have the capability and capacity to make the products they want to produce.

6. USE CASE SCENARIO FOR CHANGE MANAGEMENT

Users initiate a rapid product change by creating a change request that incorporates the business case for adopting the product change along with a proposed implementation plan.

To expedite the change process, the change request identifies the impacts of the proposed product change. These impacts describe what documents and designs have to be changed to support the improvement in question.

Approval of the change request authorizes work to begin on the execution of specific product changes.

Fast-track review/approval is supported as an option. This enables change "owners" (empowered change analysts) to approve the change request without going through a change review board.

Once the change request is approved, the change request is forwarded - along with its approved implementation plan – to appropriate change implementers. Change analysts can monitor the progress of given product changes by examining the status of individual tasks and determining whether or not they have been closed. During the execution of a given product change, the PLM/CM (Change Management) solution can update

appropriate incorporation dates or units of change without disrupting the integrity of your change package or imposing a further review.

7. KEY FACTORS OF SUCCESS

7.1. Communication

As we can see in Fig. 2, communication is number one factor for success. Regular and effective communication is the necessary prerequisite for the functioning of virtual teams. Virtual team members need specific skills to communicate and work well. In addition to technical knowledge required to use the communications equipment, special features of work in a virtual team also need to be taken into account, e.g. regular responses, which are important for building trust. Each virtual team member must be independent and must show initiative:

- willingness to cooperate and work in EC team,
- effective communication in a virtual team (trust building),
- initiative and ability to find information and make decisions,
- mastery of a common spoken and written technical language (similar background is an advantage in communication),
- working with the communications software,
- ability to access and work with product data,
- specialized knowledge (compatible with other team members).

To support developmental-design activities, it is important to be able to identify the relevant communication channels, as well as the frequencies and contents of communication. The predominant type of communication varies considerably with the design level. In new product development, the world outside the core development team serves as an important source of information, and creative dialogue will predominate. At the level of variants, designers are considerably more limited and dependent on the information that has been organized within the information system; this is even truer in the case of product changes. Poor communication is the most frequent reason for problems in ECM. Creativity requires an optimum level of communication. Overly intense or overly limited communication reduces creativity. Communication is the driving force of development teams.
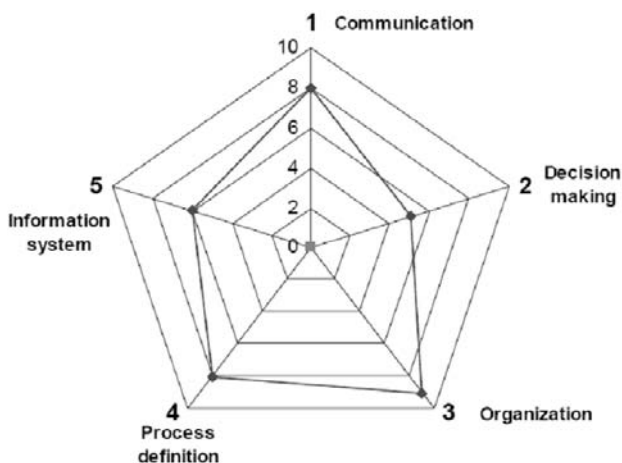

Fig. 2. Key factors of success.

7.2. Organisation

Best-in-Class performers are committed to creating an environment that supports improved decision-making. They are twice as likely to utilize a cross-functional CRB (Change Review Board) in order to fully understand and evaluate the impact of change across all aspects of the product lifecycle, in addition to holding separate meetings to make decisions on whether to enact a change, and how to develop change implementation plans.

7.3. Knowledge Capture and Management

To support better decisions on change, companies must be able to act on the right information in a timely manner. This provides centralised access to the change history which creates more accountability on the decisions made. Metrics allow companies to track what works and what doesn't work, and to make more informed decisions in the future, thus ensuring smarter and better change orders.

7.4. Process Definition

Quick and reliable implementation of EC's requires a detailed process definition, which should be well understood by all participants. The EC process has characteristic milestones, but the execution should be in line with the company's special features and goals.

A common mistake in practice is to use the same process for small changes and for new products. This causes a great deal of waiting and long lead times during change implementation. A clear division of processes and people who are in charge of them has been proved to be successful.

Workflow in an information system significantly contributes to tractability and transfer rates between individual workplaces. It should be taken into account that changes always involve a large degree of unpredictability. It also often turns out that additional research is necessary, as well as cooperation with external suppliers, customer approvals etc.

An effective ECM system ensures reliable operation, especially in such exceptional cases.

7.5. Technology

Having the right information at hand is critical to making better business decisions. Many from the most successful companies are keeping centralised data in the Product Data Management system.

8. LEVELS OF MATURITY

To determine the maturity of an ECO process we need to measure the metrics that drive product profitability in any manufacturing company:

- Meet change deadline targets.
- Meet design product budgets.
- Achieve product cost targets.
- Achieve product lifecycle cost targets.
- Achieve product performance objectives.
- Achieve product quality goals.

According to Abeerden Group, there are key capabilities that are helping Best-in-Class companies achieve their superior levels of performance, allowing them to hit the metrics that drive product profitability:

Step 1: Centralize Product Data. Data must be captured and managed in the first place in order to get the right information to the right people. Laggards lack the ability to integrate the right data into their process because they do not have the fundamental product data management capabilities required to easily capture and share product information. Developing this capability is a fundamental requirement to success.

Step 2: Extend Change Impact Analysis. Laggards should look at a broader spectrum of product information to ensure that decisions on proposed changes are not having unintended impacts on downstream departments and the supply chain. These companies take a limited view on the impact of change, and should extend their view to beyond the technical impact of change to consider commercial impacts such as changes to requirements or current supply and demand.

Step 3: Leverage Collaboration and Collaboration Technology. Put in place capabilities to better collaborate on change requests. Organizationally, develop a cross-functional CRB. Enable the CRB and other impacted parties to participate more fully in evaluating the change by making it accessible, through visualization technology so non-engineers can interpret and discuss the change to arrive at a better business decision.

Step 4: Formalize Change Management Processes. Develop formal change management processes, including a formal split between change analysis and change implementation planning. Formal processes provide consistency in decision-making and continuous improvement. This process should follow the best practices identified in Best-in-Class companies, including formal change implementation plans and separate functions for review and approval versus implementation of change.

9. CONCLUSIONS

Good change management has always been a crucial process, but in today's fast-paced market it has elevated in importance - it is now being viewed as a competitive tool to increase product profitability through improved market responsiveness in addition to improving efficiency.

An automated change management process, incorporating customer needs and requirements into the development process, can help any company to increase quality and meet time-to-market objectives by keeping unwanted or unauthorized changes out of the product lifecycle.

Traditional engineering change process is based on teams that work together at the same location and on physical prototyping. Therefore, a move to a virtual environment is difficult. Communication technology is getting better, cheaper and more widely available. Effective work and communication in a virtual team require special skills. The best way to acquire such skills is via personal experience. ECM processes require intense communication, which is possible via videoconferencing.

Companies are focused on improving their change management processes in order to get to market faster. A rapid and efficient change process allows a company to resolve issues more quickly. This, in turn, reduces the impact a change has on the product launch date or the date that a product change can be implemented in manufacturing.

Increasing efficiency also limits non-value added work, enabling engineers to focus on delivering a solution more quickly. Even though many companies focus on efficiency, improving efficiency only is not a differentiating initiative. In fact, Industry Average and Laggard companies demonstrate heavily focus on improving efficiency than the Best-in-Class

While companies of all classifications are removing inefficiencies and increasing coordination internally, the Best-in-Class stand apart by improving change management decision-making processes. These companies recognize the fact that even a small change can have a large *ripple effect* on downstream processes and even the supply chain at large.

As industry leaders, the Best-in-Class are analysing the impact of change across the product lifecycle and the supply chain, and are involving a broader perspective from different departments in the change process.

After a successful implementation for Change Management in PLM a company should be able to:

• evaluate the impact of individual product changes,

• create streamlined work breakdown structures that can be injected into your implementation plan,

• audit the execution and completion of assigned work tasks,

• notify users when assigned change tasks need to be expedited,

• maintain a complete history of product changes executed during the product lifecycle,

• verify conformance to documented requirements,

• track both planned and actual impacts to the product information associated with your proposed changes.

REFERENCES

[1] O'Marah K., (2004). *Trends in New Product Development and Introduction Processes*, AMR Research, Boston, USA.
[2] Ramachandra Walvekar, Subbanarasaiah Akshintala, *Managing Uncertainties in PLM deployment*, TATA Consulting.
[3] Rajesh Jha, Robins Mathew, (2002). *Cultural and Social changes from PDM Introduction*, Paper presented at Product Data Technology Europe.
[4] Michael Burkett (2003). *Eliminate Waste Before it Begins – Design for lean*, AMR Research.
[5] Joze Tavcar, Joze Duhovnik, *Manufacturing the Future: Concepts, Technologies & Visions*, ISBN 3-86611-198-3.

Authors:

Eng., Laurențiu NAE, PhD Student University, "Politehnica" of Bucharest, Machines and Production Systems Department,
E-mail: laurentiu.nae@adacomputers.ro
PhD. Eng., George DRĂGHICI, Professor, University "Politehnica" of Timisoara, Director of National Research Network for Integrated Product and Process Engineering, E-mail: gdraghici@eng.utt.ro
Eng., Ion UDEANU, PhD Student University, "Politehnica" of Bucharest, Machines and Production Systems Department, E-mail: leo.udeanu@gmail.com