Introduction to Product Engineering

Topic Outline: General introduction of Product Engineering in general and defines the essentials of new product development and innovation.

1 What is Product Engineering?

Defined as “the discipline of driving and managing product development efforts following a predefined methodology” and that “it considers the whole realization-cycle of a product from its idea over the various development stage to a marketable product.” Besides this generic definition there are more, slightly different, definitions for various disciplines (manufacturing, software development,etc.) .Product Engineering is a task that drives product innovation from the product idea through the whole product life cycle (design, development, manufacturing, usage, and recycling or disposal).

To understand the boundary constraints of new products and to get a clearer picture, it needs to be defined what characterizes product innovation. Drivers for innovation and for new products are technology advances, changing customer needs, etc. Another area to be investigated are the key ingredients for successful new product developments and innovation in general. As documented by Cooper et al. their analysis revealed that there are several key ingredients:

• to embrace a long-term commitment to new product innovation

• to develop a vision, objectives, and strategy for new product development efforts driven by and linked to the business’s corporate objectives and strategy,

• to install a systematic, high quality new product process.

Several of the success factors are non-systematic and depend on company politics and management decisions. Such an approach is referred to as a Product Engineering methodology.

The next question to answer is about the necessary ingredients for a high quality product engineering process. The first major ingredient is to have a methodology to coordinate the life cycle of a product. This mostly consists of processes for the development, the improvements, and the phase-out of a product. Because a pure methodology only sets the processes how to perform the tasks, the second necessary ingredient consists of a framework of tools supporting the different activities. Both, the methodology as well as the tool framework, require a laser sharp on quality.

This means the quality of business process execution and the metrics/KPIs (Key Performance Indicators) thereof as well as a tool framework assuring the quality execution of the work and the product. All these aspects require high attention to develop high quality products.

The major challenge to be addressed for setting up product engineering activities

is to select or define a product development methodology. This is a key activity and depends on the market, the business model, and the history of the company.

To define a product development methodology and to set up the necessary method framework, it is essential to recap the essentials for product development / innovation.

2. Drivers for Innovation

Innovation is driven by several different factors which need to be reflected in the product creation process. These factors can be roughly categorized into technology advances, changing customer needs, shortening product life cycles, and increased world competition. Additionally a new product can be new to the company developing it or even new to the market. In detail new products can be split into the categories of new to the world products, new product lines, additions to existing product lines, improvements and revisions to existing products, repositionings (products developed for one area but afterwards used in a different area, (e.g.,Aspirin) and new products due to cost reductions. Because these categories have a major impact on the business case of a potential new product, an idea for a product needs to be carefully analyzed and categorized during the initial assessments.

An additional aspect of innovation is that the best inventor is not necessarily the one who solves a problem best, it is often about seeing and understanding aproblem. The detection and understanding of the customers’ problems is key for an innovative company. Therefore the early involvement of customers in product ideas and a constant contact with the customers to detect problems is the key for future innovation. These points are supported by Davidsen et al. [7].

3. Success Factors for New Product Developments

Cooper and his colleagues have analyzed several different product development efforts and approaches. They report, in the widely accepted and supported book “Product Leadership” the following key ingredients for new product success:

• Embracement of a long-term commitment to product development.

• Development of a vision, objectives, and strategy for the new product effort driven by and linked to the business’s corporate objectives and strategy.

• Installation of a systematic, high quality new product process in the business and to practice discipline, following the principles of the process.

• Making available necessary resources.

• Fostering the innovation in the organization.

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Cornerstones of new product performance

(based on [6])

These findings can be summarized into the cornerstones of new product performance shown in Fig. 2.2. It presents that the resource commitment, a new product strategy, and a new product process are the major contributors to a businesses innovation performance. The cornerstones business strategy and resource commitment are beyond the scope of this book and highly depend on the business itself. The third cornerstone of a systematic, high quality new product process is addressed by the Product Engineering Methodology described

4.Success Factors for a New Product Process

Before going into the details of the methodology, the key success factors for a new product process or product development methodology should be summarized as they are reported in literature. Cooper’s book presents several primary and secondary success factors for a new product development methodology. From their point of view a new product process needs to address the following goals:

• Exemplary Quality of Execution

• Sharper focus, better project prioritization

• Strong market orientation

• Better up-front homework and sharp, early, and stable product definition

• Fast-paced parallel processing by different disciplines

• A true cross-functional team approach

• Products with competitive advantage

• A fast-paced and flexible process

For an Exemplary Quality of Execution the parameters focusing on completeness, quality, and importance should be continuously watched. This can be achieved by establishing quality-control checkpoints, by designating the leadership team to become quality controllers, by clear and consistent metrics at intermediate checkpoints, by defining activities, tasks, methods, and best practices into the development phases, by specifying visible deliverables for each phase.

Often the product engineering performance of a business suffers from too many projects with not enough resources. Therefore sharper focus and better project prioritization is essential for innovation to strive. The product engineering process needs to allow to have project funnels rather than project tunnels. So there need to be tough (Go/Hold/Recycle/Kill) decisions.

To achieve a strong market orientation of the innovation efforts, marketing tasks need to be designed into the product engineering process. This includes to perform preliminary market assessments. Market research is to determine user needs and wants, competitive analysis, value-in-use analysis, concept testing, customer reaction and feedback during development, user test and field trials, test market or trial sell and market launch based on a solid marketing plan. Additionally the project executives and leadership team needs to ensure the execution of marketing tasks and provides the necessary marketing resource.

For commercially successful innovation high quality up-front homework and sharp, early and stable product definitions are essential. The up-front homework needs to define the product and its business case in a stable manner. It lays the baseline for a successful or non-successful innovation. Therefore the new product process needs to ensure the proper execution of the early development phases and stages.

Another essential feature of the methodology is a true cross-functional team approach. Such an approach needs the ingredients: A cross-functional team with committed team players; defined team captain or leader, accountable for the entire project; a leader with formal authority (co-opting authority from the functional heads); fluid team structure, with new members added or dropped as work demands; a small core group responsible, committed, and accountable from beginning to end.

Reference:

D. Ortloff et al., MEMS Product Engineering, DOI 10.1007/978-3-7091-0706-5\_\_2,

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