

# TERMÉKFEJLESZTÉSI FOLYAMAT ELEMZÉSE ÉS ÉRTÉKELÉSE

## ANALYSIS AND ASSESSMENT OF THE PRODUCT DEVELOPMENT PROCESS

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### KIVONAT

Új termék kifejlesztése az innovációval foglalkozó vállalatok egyik legnehezebb folyamata, ám ez a versenyképesség legfontosabb forrása. Számos megközelítés és módszer létezik innovatív tartalommal ellátott projektek végrehajtására. Ez a cikk elemzi a termékfejlesztési folyamatot a multinacionális ipari környezetben. A kutatás célja a termékfejlesztési folyamat kritikus pontjainak meghatározása a hatékonyság javításának érdekében, a várt eredmények elérése vagy túlteljesítése. Fontos továbbá a termékfejlesztés siker-tényezőinek azonosítása, mivel ez lehetővé teszi a fejlesztési tevékenységek hatásának fokozását. A cikk a termékfejlesztés feltételezhető sikerének és akadályozó tényezőinek feltérképezésére összpontosít.

### ABSTRACT

Developing a new product is one of the most challenging processes of companies dealing with innovation. However, it is a major source of competitiveness. There are several approaches and methods for delivering innovative content of the projects. This paper analyzes the product development process in a multinational industrial environment. The purpose of the research is to find the critical movements of the product development process with regard to the efforts to improve its efficiency and deliver or over-deliver results that are expected. Moreover, it is also essential to identify the success factors of product development since it allows enhancing the impact of the development actions. The paper focuses on mapping the presumable success and hindering factors of product development.

### 1. INTRODUCTION

Product innovation and competence of innovation are the key success factors for every modern industrial company. McKinsey Corporation found a clear relationship between innovation activities and business success [1]. Companies must con-

tinuously find new and newest ways for creative and cost-efficient solutions to keep their competitiveness. Usually, purchasing and product development departments are working together to manage the changes and to implement cost-savings in running production. Beyond these efforts, a big challenge is maintaining or improving the quality of products. Several perspectives are considered during this process to be successful. This paper presents the interrelation between the departments for managing an environmentally friendly, effective product development project in the sustaining engineering phase to deliver benefits to the company by cooperation.

### 2. OVERVIEW OF PRODUCT DEVELOPMENT PROCESS

The mainstream approaches to product development come from VDI 2221 and 2222 structure of product development during the analysis of the product development process. In a broader approach, checking the concept of process in a more traditional way, the definition of Deák [2] is applicable (Figure 1), which states that product development delivers an idea to customers.

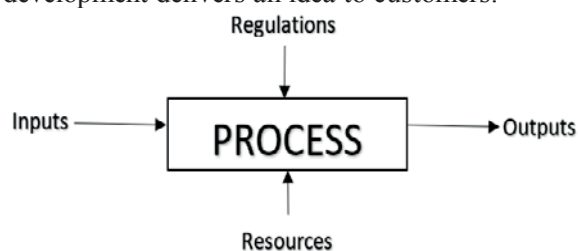


Figure 1. Process and connections [2]

Otherwise, delivering time, cost, quality ‘magic triangle’ (Figure 2) is usually outweighed in product development departments [3]. Measurement of the performance of product development teams is usually built up for the cost, quality, time triangle. During the regular review of the related indicators, and the introduction of PDCA according to the lean approach, it continuously

will provide a performance increase at the delivery of projects. However, this performance can be presented by delightful and satisfying figures in business overview dashboards, and the line management cannot see a real evaluation of the innovation level of the products.

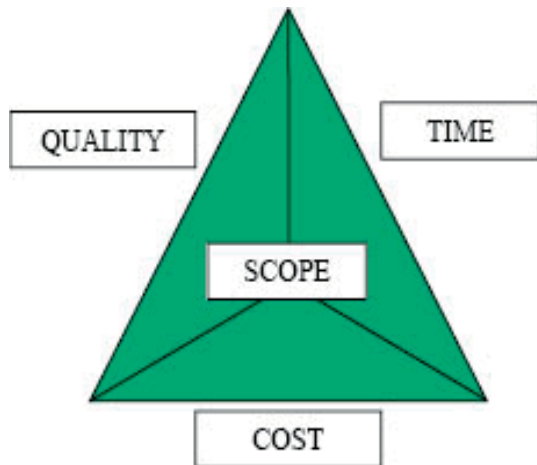


Figure 2. Product development triangle [5]

### 3. EMPIRICAL ANALYSIS OF PRODUCT DEVELOPMENT PROJECTS

The next sessions of the paper give an empirical overview of the product development projects based on the experience of the authors.

This analysis emphasizes how industrial companies can handle the cost, quality, and time triangle in practice (Figure 2). A general approach to the process shows that critical points awake in the progress when the importance of these three elements are in focus, but parallel, there are rooms for changes at all three elements.

#### 3.1. Product development triangle: Cost

The most important goal of companies with industrial products is to support their customers to increase their performance [4]. Cost planning is a key element of product development projects already from the start. After accepting the design concept, a predictive cost calculation is prepared by the project manager (with or without the involvement of designers and other interested parties).

During the project acceptance meetings, the cost and payback calculations are in the focus of management. The match of costs, business case calculation, and payback with each other is an essential topic of these meetings. If accepted, the figures are built into budgeted investment plans for the timeline of projects.

A great challenge for the managers of product development projects is keeping the cost plan, and changing it during milestone meetings

if necessary. However, the cost calculation in this project phase is only a preliminary one. Most of the management teams of industrial companies want to keep this ‘promised’ cost plan until the end of the project.

Otherwise, in the finish of the project planning, a time plan must be saved, but different difficulties during the development project with an effect on cost. The planned and achieved figures can become irrelevant to compare with each other, especially in the case of possible turnover losing due to the late step into the market with a new product or technical changes of the product.

#### 3.2. Product development triangle: Time

To introduce a newly developed, innovative product into the market is a necessary condition for successful companies as McKinsey proves that via researches [1]. The success of a company is measured by both the management and the investors/stock market through various financial indicators. If we predict that a product will be successful on the market – according to previous market researches and tests –, the product development schedule becomes a key factor of the product development triangle. In other words, the late of the project (not keeping the original time plan) leads to a delay in the market introduction and causes lost profit.

During the project planning phase, the project manager should focus on administrative details, including time plan and cost calculation. The task of the design engineering team is to deliver verified technical solutions that we can see in Figure 2 as the scope.

Finally, during project planning, the project manager should find a great balance between cost (resource use) and timing. In the right case, product strategy and profitability together can define perfectly or at least the best deliverable and the project timing plan, considering the available resources by the company. Within a product development project, attention, and influence of management to project timing are varying. This attention is quite intensive at the beginning of the project, and it becomes lower during the execution phase. The next peak of attention comes during the verification and implementation phases [6]. In these phases, delays due to non-predicted issues during verification or further necessary design changes cost, especially if a timing dual leads to an extra resource need.

### 3.3. Product development triangle: Quality

Product scope is specified first, followed by milestones and market research phases. In front-loaded product development projects, the scope and customer requirements are well-defined and carefully researched, as well as verified by different control groups. The main objective of the product design engineers is to fulfill this specification for satisfying future consumers. Parallel delivery of technical specifications and special capability of the company must be considered, like production capabilities, available technologies, raw materials, or cost-effective solutions. Product quality strictly belongs to product specification, but it is a different topic. Several years ago, high-level quality (according to consumer requirements) was a remarkable advantage in the market and supported the companies to improve their market share, turnover, and profit [8].

Nowadays, market situations with a large number of competitors raise different problems. A high level of quality is just a 'must' but not an advantage. During the execution of the project, there is no way to make any concession of quality, the only way to change timing or cost if any fine-tuning is necessary even lightening of quality level can be an easier way to deliver product development project.

## 4. INTRODUCTION OF A PRODUCT

### DEVELOPMENT PROJECT IN PRACTICE

This study shows an industrial product development process. The reason for product development, specification, and requirements of market and company management for the project will be understood in detail. An accurate description of the product and its specifications is not recognizable in this paper due to privacy and disclosure reasons.

#### 4.1 Project definition

Product development targets were in this analyzed project to solve three topics against available product via redesign and modernize product:

- solving delivery disturbances;
- cost-saving;
- reducing dependence from external conditions.

The subject is a new product family of an industrial product that makes regulation, control, and operation function in automation assemblies. The products are combined with electrical and mechanical components converting the electric controller signal to mechanical signals. Two versions of the products were designed with different

voltage and power level versions. In both cases, speed is highly important since it influences the working speed of the total system. These are measured in the test laboratory within the company.

## 4.2 Project targets, specification

The most important goal of companies producing industrial products is to help their customers to increase their performance [4]. That is why the main properties of the new product family were defined at the start of the development process as key factors for customer's performance increase:

- speed;
- environmental efficiency;
- energy efficiency;
- stable operation;
- usage of less packaging (replacing supplier import);
- design for assembly/automation;
- cost-savings.

The product operates on a medium scale of input mechanical driving input; however, it is able to operate and control the higher limit value of mechanical input. This means that the product can work on lower level input that is not the same as the input level in the executing system.

The most important market advantage of the product compared to similar products is the short working time, operation speed (Table 1).

Table 1. Speed comparison

Version	Working speed new product [ms]	Working speed average competitors [ms]
Version 1	15	25
Version 2	20	35

#### 4.2 Product design details

The goal of the company is to serve the customers with the required quality and innovative solutions created with the optimal extent of energy investment. Besides, to set an example with the quality of the work on the domestic and national market with our intention to help the Hungarian industry and economy. Therefore, European industrial and automotive standards were satisfied by involving and develop a product. In the year of product development, the company reacted to the actual customer needs high speed, robust design, high level of reliability since the products were popular and were requested in a large quantity by the heavy industries.

In both cases (Version 1 and Version 2),

the manufacturing process happens in our Hungarian factory, and no external supplier is needed anymore. As a result, the manufacturing cost of the products got significantly lower as well as the material flow got more simple. In the case of Version 1 product, the material of the house is black surface treatment metal. Internal parts are also made from light metals, which guarantees the resistance and the long lifetime of the parts against corrosion and the extreme temperature intervals.

The house of Version 2 product is made of glass-fiber reinforced plastic, and the parts are produced of light metals. The lifetime of products is measured in actuating cycles. The guaranteed value is several million cycles for both versions.

Considering the stress tests, a triple safety factor is applied in both versions, which means that for a short period of time, they can bare three times the maximal operating load. As a result of the Version 1 valve development, on maximum operating load, it grants a more stable and more reliable function than before. The usage of the product is relevant because it is used as a control actuator in the high flow-rate systems in heavy industry. A high level of usage comes from the ship and train industry.

#### *4.3. Verification*

During the design of the construction and the functional structure of the product, consumer interest was a primary aspect. The product has a wide range of consumers, i.e., the usage has various locations, temperature ranges, and functioning mediums. The product has to stand against climate impacts and disturbing factors, including high temperature, low temperature, vibration, salt-saturated medium.

From a design point, these outer impacts during the functioning of the product have to be considered. Product Version1 and Version 2 also have a lower function range of  $-50^{\circ}\text{C}$ , and the higher function range is  $+85^{\circ}\text{C}$ . In the case when products work on this low or high temperature, we cannot neglect the importance of the testing phase. In order to guarantee the customers the functioning of these extreme temperature ranges, in the company, there is an officially developed and investigated testing laboratory is in service, where testing engineers are working to create a product with better quality. Even satisfying special non-series needs, they are testing the half-done products, in a simulated, close to real-life circumstances. Therefore, eliminating the errors occurring during function and raising safety. It is to confirm that different tests with one test plan

template and one test record sheet example. The record sheet displays the function speed of the running system, using a Product developed.

#### *4.4. Market situation*

Regularly, the product is produced for the domestic market in the normal product life-cycle in the ramp-up phase, and after sufficient marketing and manufacturing knowledge is built up, the international market introduction is targeted [7]. Because the predecessor product was available in Europe at the beginning of developing Product, the product family of Product has shown the potential to improve, based on former functions and inner customer feedback. Therefore, we took a commitment to improving them further, as well as to create new ones. The results are the current Version 1 and Version 2 products. The new Product shows improvement in several features (e.g., reliability, speed) contrary to its predecessor. Therefore, the expansion of the market segment is expected by the company both in internal and foreign areas, even where former products were not in a competitive position.

## 5. RESULTS OF PRODUCT DEVELOPMENT PROJECT

By the analysis of this special Product Development project following weak points of the process were found.

### *5.1 Database of product design lessons*

At every product development case, a mandatory session is to analyze the design of similar products to see design solutions. This requirement also managed by the ISO 9001 standard too. In practice, both the own products and competitors are regularly revised by the designer. All companies are focusing on building up design lesions or best practice databases to provide available design information from the past for new product development projects and especially for design engineers.

However, in every case, these databases are available and available to designers; they usually find it difficult to search in. Design issues are not always clear because past designers are not interested in supporting future research in the database. Another problem comes up if the author of learning in the database is not available for discussion anymore.

These points establish an uncertainty of usage of lessons from previous design works to avoid similar design-related failures in the future.

## 5.2 IT environment for product development

IT systems for product development are inevitable for successful, efficient delivery of projects. From project management tools, during Product Lifecycle Management (PLM) systems until design lesson databases. Via analysis of projects, some bottlenecks were popping up.

### 5.2.1. Change management systems

Change Management System is an important tool to provide enough information for production about technical changes in product development. This tool can be combined with the PLM system and MRP (Material Requirements Planning) systems on a professional level. Change management mandatory to use by Sustaining Engineering after product introduction into production when any undocumented changes can cause difficulties in operation systems and/or quality issues. Between milestones of production start and ramp-up phase before design ownership handover by Sustaining Engineering necessity of Engineering Change management is questionable. Product Development project members (product designers) are not entirely familiar with the Engineering Change Management system because, in routine work, they do not have to use. Otherwise, in the case of products already in mass production, the Bill Of Material and other technical documents are released as mandatory to documentation.

## 6. SUMMARY

Critical points awake in the progress when the importance of these three elements are in focus, but parallel, there are rooms for changes at all three elements. In the right case, product strategy and profitability will define perfect or at least the best deliverable project time plan considering available resources by the company. Introduced Product development study has shown that new products took over the position of the predecessor. In several aspects like producibility, economy, energy efficiency, and environmentally friendly solution can overdeliver original product to fulfill the requirement of company management. Customers will be satisfied with stable working in a hard environment in a heavy industry area parallel high speed and quick reaction time. Especially excellent achievement to execute this design work with the focus for manufacturing. This project, according to the required specification, quality, business case, timing point of view, is successful. During the analysis of the project, two critical points were defined, as the efficiency of the lesson database and change management system just before design handover to

sustaining engineering from new product development engineers.

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