

A REVIEW OF CONCURRENT ENGINEERING

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Abstract— This paper attempts to explain and disaggregate different focuses of concurrent engineering, analyzing their application to product development and highlighting the improvements involved in their enforcement.

Improvements can be observed in projects (quality), in scheduling (reducing the duration) and the cost of implementation (savings), basic achievements of concurrent engineering.

Companies that already apply concurrent engineering are often multinationals, being the majority group in use. Its implementation in medium and small businesses is a very useful and achievable goal, in a field that has not developed the methodology.

The entire organization (human group) is involved in the implementation of concurrent engineering, with an effort aimed at multifunctional integration and development of both product and process concurrently.

Keywords— Engineering, concurrent, management, development, product.

I. INTRODUCTION

Traditional methods of developing a new product are becoming less efficient, so it requires advanced methods, appearing a new work approach known as concurrent engineering.

It aims to make this work a brief review of the integration of concurrent engineering to new forms of work, whose main objective is to obtain a systematic approach to interdisciplinary concurrent design of a product and the processes involved in order to get the product correct reducing costs and time.

Technology and market changes introduce uncertainty in the field of product development, and companies are considering various structural features to help cope with these changes. Concurrent engineering is a mechanism that can reduce uncertainty and improve the competitive capabilities of an organization. Concurrent engineering is usually manifested through simultaneous streams work, product development teams and the early involvement of members.

It allows information to flow through the organization quickly and effectively, thereby reducing uncertainty. At

the same time, allows the discussion, clarification and enactment, which are essential in the fight against uncertainty. The implementation of concurrent engineering practices has significant effects on product innovation, quality and high prices.

Companies that experience a high technological change and product in their environment are using more concurrent engineering practices [1]. Furthermore, the results suggest that concurrent engineering practices have significant direct effects on product innovation. However, only indirect effects of concurrent engineering on quality and high prices are statistically significant. Companies with higher levels of product innovation have higher levels of quality. Companies with higher levels of product innovation capabilities present setting high prices, but only if they have high-quality capabilities.

II. RESULTS AND DISCUSSION

The common approach to product development, being used by many manufacturing companies, is based on the sequential principle and is being replaced by contemporary concurrent approach [2]. For best results of all key cross-functional, such as marketing, product management, purchasing, manufacturing engineering and quality, they must also be concurrent elements (Table I).

TABLE I
KEY CROSS-FUNCTIONAL AREAS

AREA
Marketing
Product Management
Purchasing
Manufacturing Engineering
Quality

Companies that do not adapt to new market conditions cannot survive. However, those companies that can adapt to changing market conditions more easily, achieve permanence [3]. When these companies enter the world market will encounter several difficulties, for example, excessive time for new product development.

These problems can be solved by transforming the

sequential engineering for concurrent engineering. The market forces companies to a transition sequence to concurrent engineering and as a teamwork is the basic element of concurrent engineering, special attention is paid to the working groups that form loops process development of competing products in enterprises.

The papers published in the field of planning teams of the big companies have revealed that recommended in large companies a team structure of three levels. For small businesses, the analysis of three-tier structure leads to the conclusion that one should prefer a team structure on two levels and a matrix organization.

A. Applicability of concurrent engineering

Businesses, whether in manufacturing or services, must be restructured or reorganized to meet the challenges of the XXI century, in which customers are not only satisfied, but also delighted.

In this competitive environment, organizations must use a flexible, adaptable and accountability paradigm [4] system.

Concurrent engineering is a management philosophy and not limited to manufacturing companies. It is a systematic and simultaneous focus on the development of a product or process, educating all people should be involved in the first place.

The pressure of global competition has led many companies to switch to a faster product development, such as concurrent engineering. By running parallel design, improvements occur in many areas such as communication, quality, production processes, cash flows and profitability (Table II).

TABLE II
 IMPROVED AREAS BY PARALLEL DESIGN

AREA
Communication
Quality
Production Processes
Cash Flows
Profitability

The production of current company has become a matter of effective and efficient application of information technology and knowledge engineering. On the one hand, this will increase the competitiveness of a company in terms of quickly meet dynamic changes in the market. Concurrent engineering is performed to enhance the product design process with the intention of improving organizational performance. The model consists of sessions at necessary manufacturing information such as artifact, manufacturing activities, workpiece, equipment manufacturing, cost and estimated time, and sequences of the manufacturing process (Table

III). The document calls for a simultaneous approach instead of the traditional sequence.

TABLE III
 SESSIONS AT NECESSARY MANUFACTURING INFORMATION

NECESSARY MANUFACTURING INFORMATION
Manufacturing Activities
Workpiece
Equipment Manufacturing
Cost
Estimated Time
Sequences of the Manufacturing Process

B. Implementation

The use of concurrent and sequential engineering to develop new products originates shorter development times and better performance [5]. The systematic application of concurrent engineering involves the participation of processes, people, tools and technology, along with metrics and organizational support, contributing to the realization of benefits and removing barriers to success. Among the obstacles that may arise is the lack of business unit and management support, establishing requirements in the concept phase and lack of early involvement of Marketing.

Although there has been considerable interest in concurrent engineering since the late 1980s, and many books and articles have been published in this approach to product innovation, there is still some confusion about the concept, and the problems associated with its successful implementation in large part remain uninvestigated.

The set-based concurrent engineering [6] is seen as a means of improving processes of product design. This can improve the efficiency and effectiveness of the development process. Projects based on sets can be conducted within an existing organization, if given the right support. A set-based approach has positive effects on development performance, especially in the level of innovation, cost and product performance (Fig. 1). Improvements have been made an impact slightly higher development costs and longer standby time. However, the positive effects are predominant and companies involved consider key concurrent engineering for future projects when appropriate.

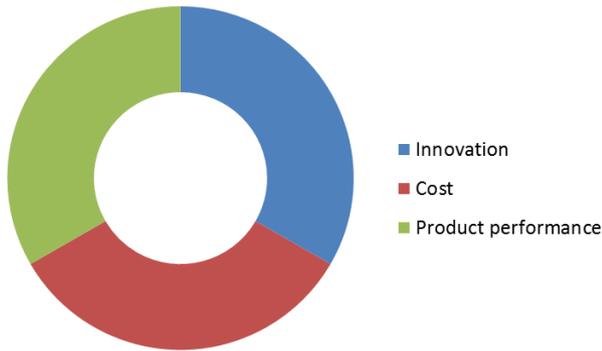


Fig. 1. Positive effects due to set-based approach.

C. Multi-Functional Integration

In the US, concurrent engineering (CI) has been named as the salvation of manufacturing competitiveness, providing the potential for faster development of higher quality or more readily producible products. Unlike traditional approaches, for new product development (NPD: New Product Development) concurrent engineering emphasizes the multifunctional integration and concurrent product development and its associated processes.

As Morgan L. Swink [7] explains, the CI is not a process of plug-and-play. The successful approaches of implementation of concurrent engineering differ depending on factors such as product features, customer needs and technological requirements (Fig. 2).

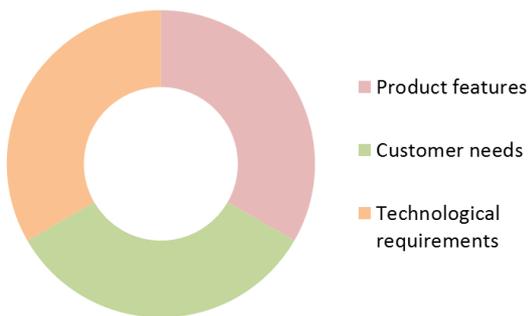


Fig. 2. Factors which determine successful approaches of implementation of concurrent engineering.

Examples of application of concurrent engineering are found in five programs NPD:

Air Boeing 777 project, Cummins Engine Co., olefin thermoplastic coating paint for the automotive industry, air vehicle and night vision infrared system from Texas Instruments and digital satellite system in Thomson Consumer Electronics (Table III).

TABLE III
 EXAMPLES OF APPLICATION OF CONCURRENT ENGINEERING

NPD PROGRAMS
Boeing 777 aircraft
Heavy diesel engine Cummins Engine Co.
Automotive coating thermoplastic olefin Red Spot Paint
Airborne vehicle system Texas Instruments
Digital satellite system Thomson Consumer Electronics

The equipment provides the primary mechanism of integration programs concurrent engineering, and usually appear frequently three types of equipment [8,9] in these projects: a computer program management, technical equipment, and numerous design and development teams (Table IV).

TABLE IV
 MECHANISM OF INTEGRATION PROGRAMS CONCURRENT ENGINEERING

EQUIPMENT
Computer Program Management
Technical Equipment
Numerous Design and Development Teams

Depending on the complexity of the project, a team of integration may be necessary to consolidate the efforts of various design and development teams. The working groups will also be formed to deal with specific issues such as investigating an emerging technology issues.

Some projects include (Table V) collocation and face to face communication. Others resort to telephone conversations, documents and email. Centered design quality projects are based on formal presentations and periodic review meetings. Other projects focused on development speed, require frequent and informal communications.

TABLE V
 ADDITIONAL EQUIPMENT

ADDITIONAL RESOURCES
Face to face communication
Telephone conversations, documents and email
Formal presentations and periodic review meetings
Frequent and informal communications

Programs dealing design quality require extended product and performance testing, with the contribution of design engineering, marketing and customers [10-14]. Efforts to reduce development time require small, informal teams led by design engineers and managers. The aggressive product cost targets require intensive interaction between product designers and manufacturing personnel. The highly innovative products require early supplier involvement and problem-solving concurrent engineering. The formal design reviews and data systems design help in saving information between design groups

inside and outside.

III. CONCLUSIONS

Concurrent Engineering supposed improvements in the product development process. It has the potential to get less fragmented projects, improved project quality, shorten them and their total cost.

Concurrent engineering is a philosophy implemented by various methodologies. Achieving a "concurrent and integrated product" requires a variety of facilitators including tools (software applications in 3D), diagrams, technologies and support structures.

It is a relatively new method. Multinational companies are large users. However, most medium and small companies have not yet launched the development of this methodology.

It involves everyone in the organization, trying a systematic approach and simultaneous development of a product or process, forming all people to be involved in the first place.

Finally, indicate that compared to traditional approaches for the development of new products concurrent engineering emphasizes the multifunctional integration and concurrent product development and its associated processes.

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