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Implementation of concurrent engineering: a survey in Italy and Belgium

A. Portioli-Staudacher[a,*], H. Van Landeghem[b], M. Mappelli[c], C.E. Redaelli[d]

[a] *Department of Management, Economics and Industrial Engineering, Politecnico di Milano, Piazza L. da Vinci 32, I-20133 Milan, Italy*
[b] *Department of Industrial Management, Ghent University, Belgium*
[c] *SMART Laboratory, Politecnico di Milano, Italy*
[d] *FIAT auto S.p.A., Italy*

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Abstract

The concept of concurrent engineering (CE) has been known for quite a while now, and it has been widely recognized as a major enabler of fast and efficient product development. This paper examines the extent to which CE best practices, as obtained from a broad literature review, are being used effectively in companies. Companies both in Belgium and in Italy were investigated using a CE compliance checklist. The paper comments on usage patterns in both countries and compares them. Specific information per sector is also included. Finally, the positive impact of formal CE programs is proven by the data.

Keywords: Concurrent engineering; International survey

1. Concurrent engineering

During the past two decades companies in almost all markets have been facing an increasing level of competition. There are many reasons for this, but most of them can be tracked to some dominant trends: shortening product life cycles, globalization of the market, rapid technological changes, environmental issues, higher complexity of products, customers demanding products with more features, higher quality, lower cost, and demand for more and more customized products.

As an example, in the mid-1960s the Chevrolet Impala was the best selling car in the USA, and the platform on which it was based was selling 1.5 million units a year; in 1991 the best selling car was the Honda Accord, and the platform on which it was based was selling 400,000 units a year. Despite the increase in the market size the number of units per model has decreased by a factor of 4 [1]. Companies are required to produce more and more new products, and at the same time reduce the time to market these products [2,3].

The first attempt made by Western companies to respond to this faster changing environment was to shorten their response time, pushing their development processes to move faster, but kept on doing the same things. Product design was asked to reduce the time to deliver the blueprints, and so was process engineering to design the process and manufacturing to produce. Strong efforts were made to help each function to meet the goal of shortening its lead time, particularly where Western companies felt to be stronger on new technologies; and particularly on computer technologies: CAD, CAE, CAM and CIM. Sophisticated automation has been introduced, but in most cases results were disappointing. The main reason is that these technologies have been utilized just to speed up the process, not to change it. The need for a new development process then became clear and concurrent engineering (CE) has emerged as an effective answer to this need.

1.1. Concurrent engineering vs. sequential engineering

Sequential engineering, also known as serial engineering, is characterized by downstream departments

*Corresponding author.
E-mail address: alberto.portioli@polimi.it (A. Portioli-Staudacher).

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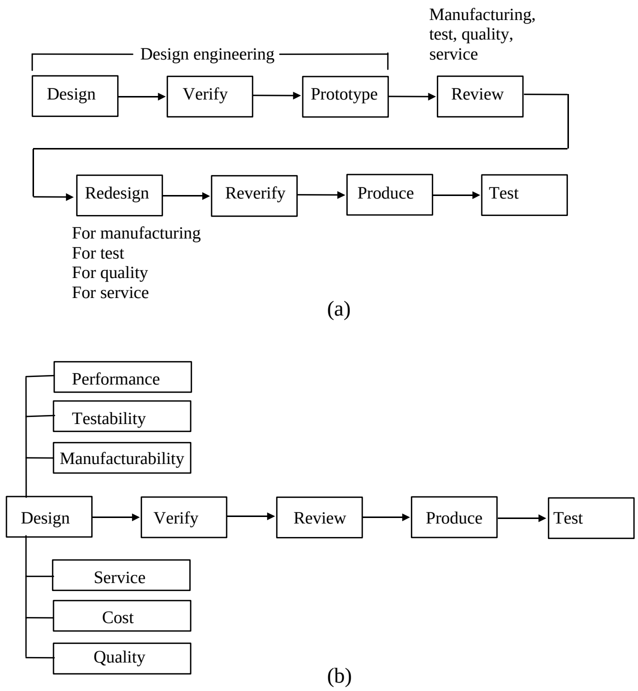

Fig. 1. (a) Flow diagram of the serial engineering organization and (b) flow diagram of the CE organization (from [4]).

supplying information to design only after a product has already been designed, verified and prototyped [4], in order to change what design engineering did wrong, or what could have been improved. A flow diagram of the serial engineering organization is shown in Fig. 1a. In serial engineering, the various functions such as design, manufacturing, and customer service are separated.

The information in serial engineering flows in succession from phase to phase. For example, the prototype model, verified by either simulation or prototyping or both, is reviewed for manufacturing, quality and service. Usually, some changes are suggested after the review. If the suggested changes in the design are made, there are increases in the cost and time to develop the product, resulting in delays in marketing the product. If the changes cannot be made because of market pressure to launch the product quickly, or the fact that the design is already behind schedule, then specialists in other functional areas or managers from manufacturing, quality, and service, among others, are informed of the impending problems. In sequential engineering a department starts working only when the preceding one has finished, and, once a department has finished working on a project, or part of a project, this is not planned to come back: information flow is one way only.

On the contrary, in CE all functional areas are integrated within the design process. In this case information continuously flows back and forth among all functions. During the design process CE draws on various disciplines to trade-off parameters such as manufacturability, testability and serviceability, along with customer performance, size, weight, and cost [4–6]. A flow diagram of CE is shown in Fig. 1b. The decision-making process in a CE environment differs from sequential engineering in that at every stage decisions are taken considering the constraints and the objectives of all stages of the product life cycle, thus taking at the product design level issues that are usually addressed much later, thus giving the possibility to achieve a better overall solution [5,6]. The integration of other functional areas within the design process helps to discover hard-to-solve problems at the design stage. Thus, when the final design is verified, it is already manufacturable, testable, serviceable, and of high quality. The most distinguishing feature of CE is the multidisciplinary, cross-functional team approach.

Product development costs range between 5% and 15% of total costs, but decisions taken at this stage affect 60–95% of total costs [7]. Therefore it is at the product development stage that the most relevant savings can be achieved [8].

Examples of successful CE implementations are reported from all over the world:

- Suppliers involvement, a careful selection of team members, a hands-off management, a progressive development and the adoption of CE (through “design for …” methods) within ZETA and MTX75 programmes lead Ford Motor Company to dramatically decrease time to market, whilst increasing quality and decreasing costs [7].
- The support of management and the use of QFD, design for manufacture and assembly, a top–down approach and cross-functional teams were the keys to the success of the Hewlett Packard’s 34401A multimeter [9].
- In 1990 Bull Worldwide Information Systems Inc. improved manufacturers’ distributor performance using QFD; the key factors were maintaining employees’ motivation and involvement, continuing education for the work force, correctly anticipate and interpret customers’ expectations and emphasize prevention [9].
- An extreme example of fast product development, integrating customers, is the eBay company. Its product, a consumer auctioning website, evolves through suggestions from its customers. They are constantly monitored and their suggestions are turned into product upgrades in a matter of days. The cross-functional design teams include all of top management, who is required to auction items themselves in order to share the customer’s experience [10].

Although results of CE can be impressive, the adoption rate and the completeness of implementation differ markedly between different companies and different countries. Moreover, CE is an integrated