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Implementation of concurrent engineering in the suppliers to the automotive industry

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Abstract

In the past the main processes in the introduction of a new vehicle into the market were developed by large manufacturers, or original equipment manufacturers (OEMs), and the vast majority of concurrent engineering (CE) research work was based on issues relevant to them. Today the situation has changed world-wide. Large companies outsource a great deal of high level engineering work to suppliers. This outsourcing is justified by lower costs and higher quality, and at the same time every company can use its resources in the areas it has technical expertise. However, most suppliers still follow the 'build and break' approach. The cost of introducing new approach such as CE, and adopting new technologies such as computer aided engineering (CAE) is substantial, as this cost adds to the operating costs and is only justifiable if it enables the development of higher quality products in less time with fewer people. The authors have examined a number of available CE frameworks and noted that these frameworks dealt with different aspects of CE in different degrees of detail. But they did not differentiate between the introduction of CE in large manufacturers on one hand and their suppliers on the other. This project is based on the recognition that a different approach to CE implementation is needed at the suppliers' level. A three level framework has been proposed, i.e., (i) the environment in which the suppliers operate, (ii) a five stage implementation approach, and (iii) a CE tool portfolio. Implementation of the three level framework has started successfully at Tickford Engineering Ltd., which is a typical and fast growing supplier to the automotive industry.

Keywords: Concurrent engineering; Automotive suppliers; CAD/CAM/CAE

1. Introduction

In the automotive industry, the traditional product development had as its main characteristic the partition of the organisations into departments and the specialisation of the employees [1]. All the procedures were sequential and the trend was to complete 100% of each stage before performing the next. In this approach a large number of modifications had to be made in the later stages of the product development cycle, which proved very time consuming, expensive and difficult. The automotive industry now faces greater market pressure to develop high quality products more quickly, at lower costs and to satisfy more sophisticated and demanding customers. To overcome the above problems a concurrent engineering (CE) approach has been introduced and implemented by large companies or original equipment manufacturers (OEMs). CE is a philosophy, not a technology, and as a concept is not new [2]. The new element resides in the systematic way of implementing the concept. CE tries to knock down the departmental barriers and make people communicate during the whole product development cycle. It encourages specialists in every department to contribute their knowledge and experience to the project in order to *prevent* problems. CE ensures that all activities start as soon as possible, work in parallel and effectively shorten the overall product development processes [3]. The actual design process tends to take longer with CE than with traditional methods because additional issues are evaluated in more detail, but this will result in an overall improved quality, better product definition and an time reduction [4]. It should be noted that to date the vast majority of CE research work was devoted to issues relevant to OEMs as traditionally they carry out most tasks of new vehicle development. Today large companies outsource a great deal of high level engineering work to suppliers so that every company can use its resources in the areas it has technical expertise. This has created a new problem as smaller suppliers are left behind in terms of introducing new approach such as CE, and adopting new technologies such as computer aided engineering (CAE). The costs are substantial to smaller suppliers, especially when they have contracts with different OEMs who use different approaches and CAE tools. This project aims to propose and implement a CE framework specifically for automotive suppliers.

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2. Approaches to CE

There are basically two approaches to the implementation of CE, i.e., the *team-based* and the *computer-based approach* [5]. In the first approach, team members are selected from different functional areas such as design, manufacturing, production and marketing. They contribute to the product design and identify early difficulties and problems that the design may have. In this way the multidisciplinary team prevents a series of changes from occurring at the final stages of product development. The second approach focuses on computer-based systems, which can provide an integrated design environment in which the tools can interact, transfer data and co-operate with each other. As a result, the product can be optimised according to different criteria following a virtual product development cycle. A number of existing frameworks based on the two basic approaches are discussed below.

2.1. Cranfield CIM Institute's framework

The Computer Integrated Manufacturing (CIM) Institute of Cranfield University has developed a framework focusing on multidisciplinary product development teams as the main vehicle for successful CE implementation [6,7]. The framework consists of three stages as shown in Fig. 1. Stage one is mainly a preparation phase during which the senior management is introduced to the CE philosophy. They will identify what actions to take in order to create a supportive and effective multidisciplinary team environment. Then a pilot project and team members are selected. In stage two, the senior management and the team together define the strategy and execute the pilot project. All the members of the team have a clear understanding of their working environment and every source of future conflict is eliminated. During the third stage, the team reviews the pilot project and, based on the experience acquired, proposes process changes and structural improvements. Training needs are also identified and CE expands to the rest of the organisation. The framework suggests continuous improvement within the company. The team will look for ways to improve the whole product development process, while the senior management will change the organisational infrastructure to support these new processes. This framework is based completely on teams, but there is no comment on tools and practical techniques to be used. It does not provide details as to the actual steps necessary to progress using this particular approach.

2.2. The product complexity based framework

This framework is based on the complexity of products a company develops, which can be divided into *internal* complexity (from the manufacturing point of view) and *external* complexity (from the end users/customer point of view) [8]. Four main categories are used to represent the product complexity, i.e., (a) component driven products (high internal complexity, low external complexity), (b) simple products (low internal and external complexity), (c) customer driven products (high external complexity, low internal complexity), and (d) complex product (high internal and external complexity). The framework also

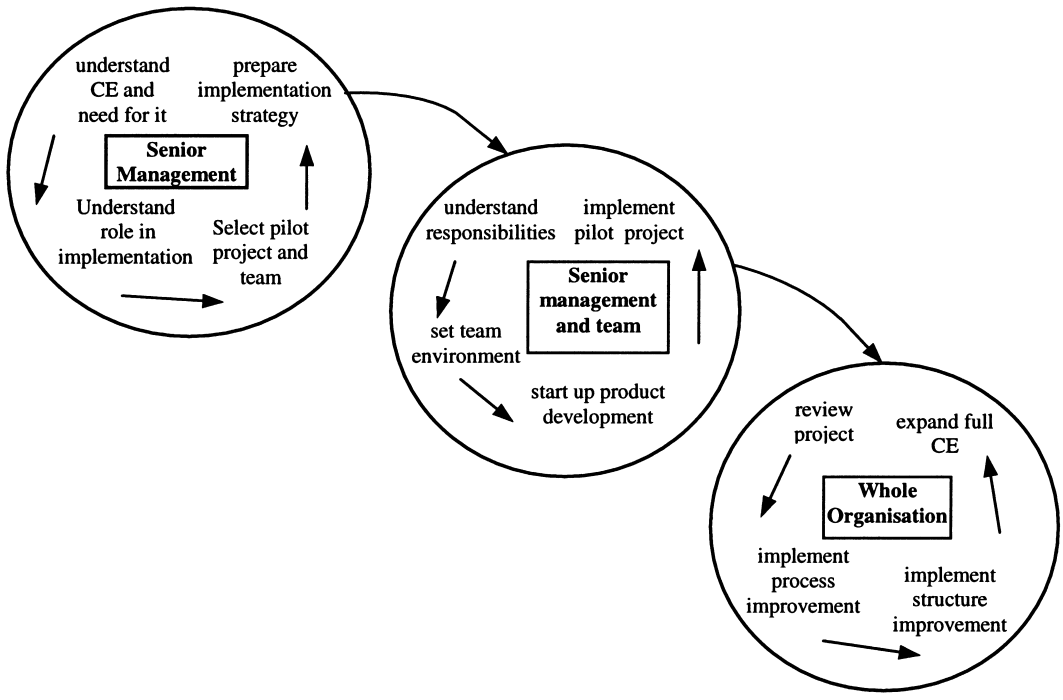

Fig. 1. The CIM Institute's CE framework.