SWP 28/91 **HOW TO ACHIEVE COMPETITIVE EDGE BY SIMULTANEOUS PROCESS ENGINEERING**

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HOW TO ACHIEVE COMPETITIVE EDGE BY SIMULTANEOUS PROCESS ENGINEERING

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Abstract

The search for competitive edge continues unabated and simultaneous engineering is considered by many to be a solution to this problem. Its recent prominence is exemplified by the holding of the first international conference on this management issue in 1990.

Most of the publications on simultaneous engineering have examined the benefits of this approach to product engineering. This paper examines the process of simultaneous process engineering and details a recommended approach. The methodology was developed from the preparation of a manufacturing system design for a simultaneous engineering project carried out in a UK manufacturing company.

Introduction

Exposure to increased international competition, which the single European Market will bring, has provided an added impetus to the search for an international competitive edge. It is clear that UK manufacturing organizations must be both quick and flexible in their response to the changing needs of their customers and to the actions of their competitors if they are to survive [1]. A continuation of the lowering of international trade restrictions and the accelerating rate of technological change will exacerbate the problem of competitive strategy management. However, these changes do also create opportunities for establishing competitive edge. For example, a technological change to a product could provide competitive edge in a wide variety of industries.

An examination of the application of technological change in manufacturing industry in general may provide a guide to how it is being used to gain competitive edge. Recent studies of the strategic management of manufacturing, by Roth and Miller [2], De Meyer [3] and Sweeney [4] have shown that a large number of companies have adopted a competitive strategy which consists of supplying better products faster than the competition. This is, of course, a long established competitive strategy, i.e. to be the first to the market with improvements to meeting customer needs, but it is the pace of change that appears to be becoming the focal point of competition. Gomory and Schmitt [5] have observed "that a firm able to quickly introduce new products will appear to have newer products with newer technologies. This gives the firm a reputation for technical innovation and leadership, thus enhancing the company's image. It only takes a few new product introductions to build up a significant product lead, which of course enhances the firm's market share".

Is such a strategy appropriate only to a select group of firms within an industry? Riedel and Pawar [6] suggest that "if a firm needs to maintain its competitive edge by being first to market them the implication is to value the time benefit over the cost risk and choose simultaneous engineering". This recommendation correctly links simultaneous engineering as the means of reducing the design-to-manufacture lead time which is ideal for a first to market competitive strategy. However, it is just as appropriate to a company adopting the fast followers product strategy.

The application of simultaneous engineering has therefore become more prominent of late. The capability to put simultaneous engineering into practice appears to have become increasingly important because of its potential to provide differentiated products and to achieve competitive edge. However, although Abernathy [7] discussed the differences between sequential and parallel product development strategies, approximately twenty years ago, simultaneous engineering has been rediscovered by a much larger audience through Imai et al. [8] on five cases in the Japanese industry, Hayes et al. [9] and the studies carried out by Clark and Fujimoto [10] on the world-wide motor industry.

Much of the recently published research has concentrated on the development and use of tools to ensure an integrated approach to product design by the marketing, development and manufacturing specialists. (For details refer to Hartley and Mortimer [11] and the proceedings of the first international conference on simultaneous engineering [12]).

However, very little research has concentrated on the management of the simultaneous process engineering activity. This is the subject of this paper. The paper consists of three parts. In the first part a conceptual model of simultaneous engineering is presented with a discussion of the critical problems of simultaneous process engineering. The second part of the paper consists of a description of a methodology recommended to aid the design of the production system. This methodology has been developed to ensure that the voice of the customer (marketing) is used for the design of the production process, which is essential to achieving competitive edge. Its purpose is to improve the quality of process design and to increase design efficiency.

The final section of the paper provides an illustration of how this approach was employed for a case-based research project, which was carried out recently in a UK manufacturing company, with the conclusions drawn from the experience.

Simultaneous Engineering

The Rolls-Royce definition of simultaneous engineering [13], which really defines the objective rather than the process, is as follows:

"Simultaneous engineering attempts to optimise the design of the product and manufacturing process to achieve reduced lead times and improved quality and cost by the integration of design and manufacturing activities and by maximising parallelism in working practices".

Hartley and Mortimer provide a clearer description of the process [14]:

"Simultaneous Engineering is not just project management by Task Force under another name. Vital elements include:

Multi-disciplinary Task Force;
Product defined in customer's terms, then translated into engineering terms in considerable detail;
Parameter design to ensure that product is optimised for use and quality;
Design for Manufacture and Assembly (DFMA)
Simultaneous development of the product, the manufacturing equipment and processes, quality control and marketing".

This process is shown in figure 1. The use of the quality function deployment technique (QFD) and DFMA are essential for an appropriate definition of the product concept. The quality function deployment technique is carried out to ensure that the customer's requirements, or the customer's voice, is heard when decisions are taken which define the quality and performance characteristics of the product. In addition, the QFD approach also includes a comparison of the firm's product quality with those of competitors' products which helps establish how competitive edge can be achieved.

The application of these methods is beginning to be better understood in the UK although the extent of their use in British firms is still unclear and does not seem to have been researched. However, in Japan, QFD and DFMA have been used for many years, apparently to good effect [15]. It is their method of gaining, in a systematic way, a consensus on the product concept. This is a crucial strategic decision. The value of QFD is well recognised now because it has proved that its use can induce a disciplined approach to designing the product to customer needs. Its use therefore should eliminate the tendency to design to what is believed, usually by the uninformed, to be what the customer wants.

Figure 1 has been produced to illustrate an equally important need, which is the preparation and evaluation of a concept for the manufacturing system design. It is essential that this design should also satisfy the customer's needs, i.e. the marketing and sales functions of the firm. Consequently, the same discipline and

Competitive Capabilities	PROCESS CHARACTERISTICS: SPC Product	SPC Process	CAD	CAM	JIT	MPR	Importance Rating (%)	Competitor Evaluation (HI – LO)
Low Price							10	
Design Flexibility							15	
Volume Flexibility							0	
Quality Conformance							30	
Product Performance							10	
Delivery Speed							20	
Delivery Reliability							10	
Product Variety							5	
After Sales Service							0	
Percentage In - House Application	50	50	10	0	5	100		
Competitor	100	100	0	0	50	100		
Importance Rating (%)	30	20	15	10	25	0		

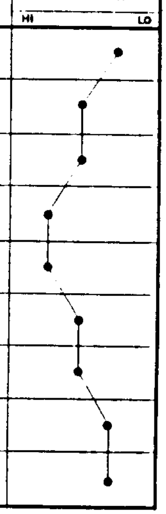


Figure 2. Manufacturing capability deployment

The competitive capabilities listed are the same as those used by Roth and Miller and De Meyer in their studies of manufacturing strategies. They are to be interpreted as follows:

Low Price	The capability to compete on price
Design Flexibility	The capability to make rapid design changes and/or introduce new products quickly
Volume Flexibility	The capability to respond to swings in volume
Quality Conformance	The capability to offer consistent quality
Product Performance	The capability to provide high performance products
Delivery Speed	The capability to deliver products quickly
Delivery reliability	The capability to deliver on time (as promised)
Product Variety	The capability to deliver a broad product line
After Sales Service	The capability to service parts, support etc.

For each of these capabilities the management should compare their capability with competitors and rank the significance of this capability to the needs of the market. Examples of the range of process characteristics that could be used for this analysis are as follows:

Process Characteristics List

Manufacturing Process Design

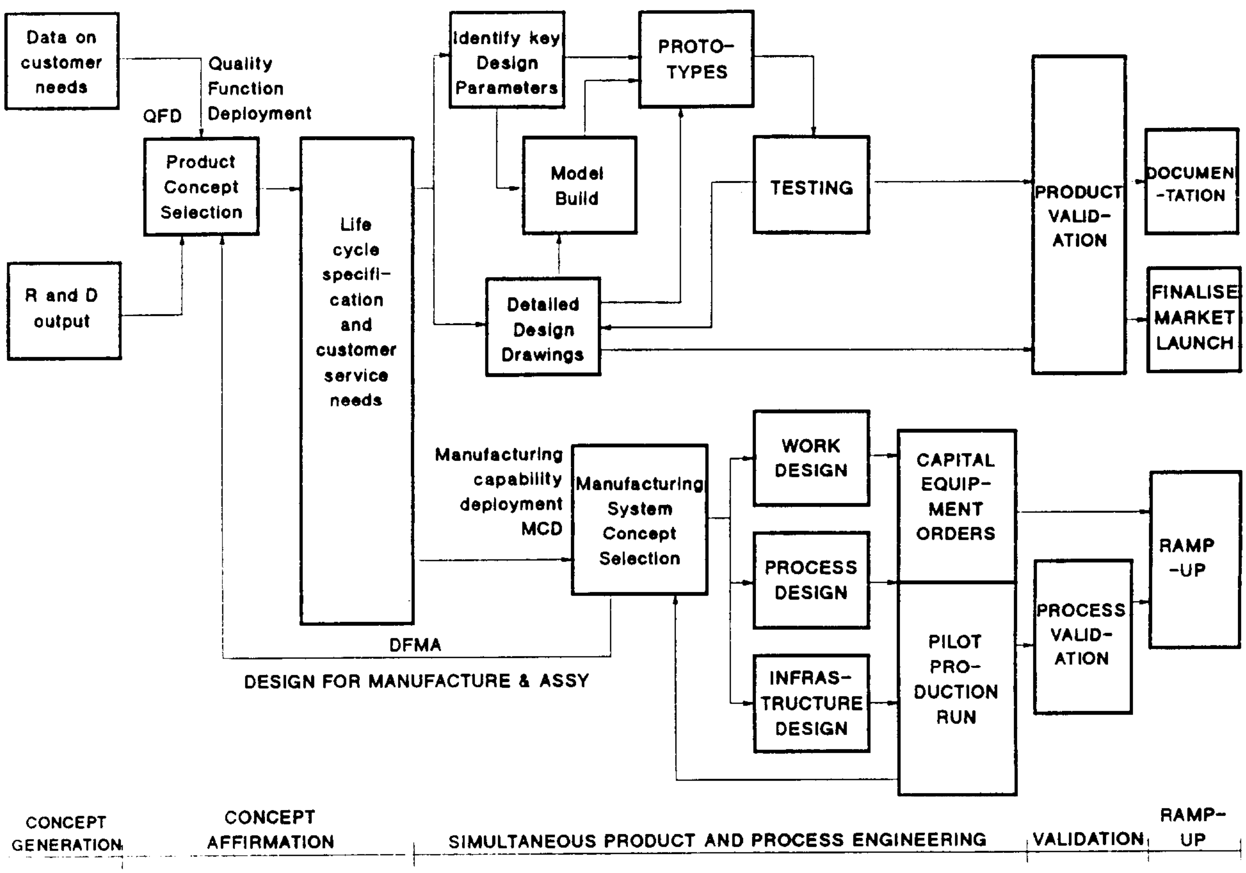
Cellular Production - Product based
Cellular Production - Process based
Assembly Line production
Flexible Manufacturing system - FMS
Robot Production - Welding, assy, etc
Computer Aided Manufacture - CNC, DNC
Just in Time Production control
Strategic Stock holding - RM, WIP, FGS

Organisational and Information Infrastructure

Computer Aided Design
Statistical Process Control - Product
Statistical Process Control - Process
Materials Requirements Planning
Manufacturing Resource Planning (MRPII)
Electronic Data Interchange (EDI)
EDI with suppliers
Shop Floor Data Capture (SFDC)
Specialist Skill workforce
Multiskill workforce
Group Working
Total Quality Management (TQM)

rigour should be used for process engineering as that for product engineering. Such a logical proposition leads to the adoption of a technique similar to QFD for the selection of a concept for the manufacture of the product. To achieve competitive edge it will also be necessary to compare the manufacturing capabilities of the firm with those of its competitors. Such a comparison will help determine how the firm should deploy its manufacturing resources to provide a customer service with competitive edge.

Figure 1. Product development lead time with simultaneous engineering



Manufacturing Capability Deployment (MCD)

Figure 1 shows the progressive development of a product concept into a tested and approved/validated product design. The diagrams show that QFD and DFMA are tools used to aid the design of the product concept.

Figure 1 also shows the simultaneous development of the manufacturing process. For simplicity, this is shown to consist of three major elements, i.e. the manufacturing process design, the design of the allocation of work and the manufacturing management information system design. However, all three elements of the manufacturing system cannot be designed until a manufacturing capability concept has been defined. Just as the product concept defines how the specified customer requirements are to be satisfied and how it will outperform the competitors' product, so the manufacturing system concept converts customer service requirements, i.e. the manufacturing capabilities desired by the marketing and sales functions, into process characteristics. These, in turn, signify how the manufacturing resources need to be deployed. The process is a similar one to QFD and the tool developed to aid the process of selecting a manufacturing system concept, which has been entitled manufacturing capability deployment (MCD), has been designed on similar lines to that used for QFD. This is shown in figure 2.

Manufacturing capability deployment (MCD) requires the matching of the most appropriate process characteristics with the capabilities which will achieve competitive edge. In this case - research project the desired competitive manufacturing capabilities were quality conformance, product variety, after sales service and delivery speed. This was also the order of importance rating that resulted from a comparison with competitors.

CONCLUSIONS

The manufacturing capability deployment (MCD) analysis proved to be a useful tool to discipline and to give direction to the design of the manufacturing system. It was also helpful as a aid for the comprehensive evaluation of the process design options. As with QFD, its integrative value was to require the marketing personnel to prepare and present to manufacturing management their competitor evaluations and to lead the discussion on the most critical manufacturing capabilities required in the coming two to five years.

Figure 3 shows the resulting plan for the factory design. This included determining the Just in Time (JIT) batch size by carrying out a Computer Aided Design (CAD) analysis of the nesting of component profiles by major sub-assembly. It also included using simulation to evaluate the impact of batch size differences on throughput efficiency.

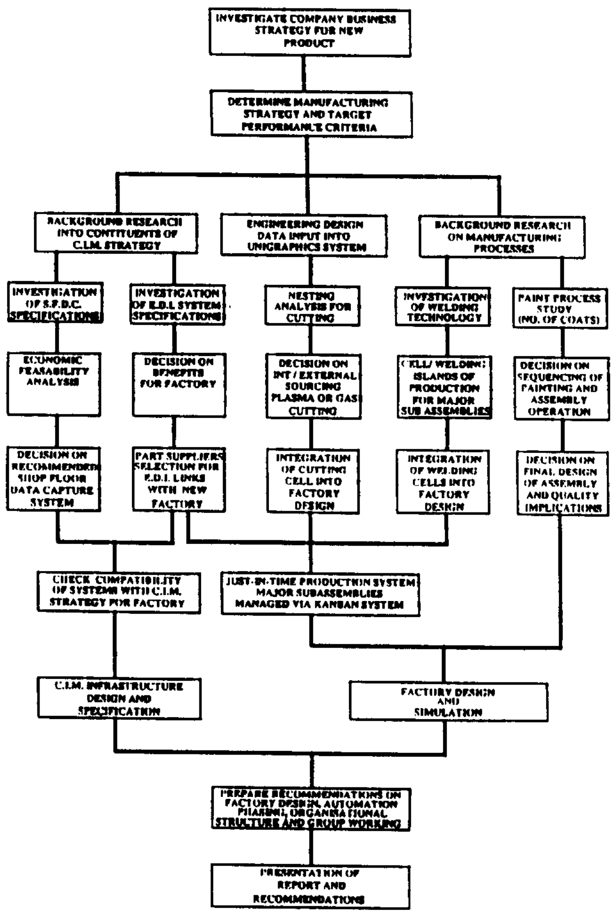


Figure 3

The collaborating company has stated that the efficiency of simultaneous process engineering was improved. It is still too early to assess the impact of the use of MCD upon the quality of the process design. Research is continuing on the contribution of MCD to simultaneous process engineering. However, competitive edge has been achieved from the innovative manufacturing system which resulted from using MCD on this project and the application of simultaneous engineering principles has played a major part in that achievement.

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