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EDITORIAL

Roots, Performance and Future of "Concurrent Engineering"

The increasing role of computers, linked computer systems and electronic data processing systems in all aspects of manufacturing systems including design, marketing, assembly, production planning and control, logistics, sales and distribution, has been an important first step in the development of the philosophy of CIM (computer integrated manufacture). Because of current industrial conditions, and, in particular, strong competition, a second step has been better monitoring of costs, times (time to market), environmental conditions, etc. To make improvements, the proposal for a lean production system has developed quite rapidly, with the objective of achieving lower costs through the reduction of waste of material.

The introduction of factory automation (FA), database technology, computer-aided design (CAD), computer-aided engineering (CAE), computer-aided manufacturing (CAM) and flexible manufacturing systems (FMS) was considered an important step towards CIM. The next step combined CIM with another important emerging philosophy: concurrent engineering (or simultaneous engineering). This philosophy has its roots in the much older concepts of manufacturing as a system (Marchant 1960) and of the computer integration of that system, but it involves additional demands on technologies and human relations beyond those necessary for the above mentioned systems.

The definition of concurrent engineering (CE) is related to the "complex of activities dealing with the design and manufacturing of products in an industrial environment. The basic objective of CE is the installation, organization and control of the manufacturing process as a whole, and in such a way that all decisions to be taken in the course of the product-realization process can be executed in coherence with each other yielding the best possible solutions for design and manufacturing and regarding life-cycle aspects such as maintenance and disposal at the end of product life" (Kals). In other words, CE is a strategic concept, leading to the systematic approach of the integration of design, production and related processes dealing with all aspects of the product life cycle (included manufacturability, assemblability and repairability considered at the earlier phases of the design process).

Concurrent engineering adopts a parallel procedure instead of a sequential one in a concurrent environment: this is an important change from conventional engineering which uses sequential, iterative and distributed steps. Consequently, CE requires a parallel, iterative and cooperative team approach. It seems today that the concept of CE will accelerate simultaneous and parallel development of the entire production process from marketing and design to the product itself, including the manufacturing process and the manufacturing system and sales system, leading to the production of better products with a more efficient production system. With the use of computer models and special tools in addition to parallel running and overlapping of different tasks in the entire process chain, CE allows shorter development times and shorter time-to-market, together with the optimisation of results.

CE represents a teamwork effort to correct the flaws of the functional organisation which often shows its deficiencies and its natural propensity to generate strong local viewpoints in the product realisation process. CE teams draw their members from the functional organisation and try to establish an earlier consensus in the product realisation process about the design, manufacture and marketing of the product. Thus, the conceptual framework of CE is in the role of an additional tool to the functional organisation.

To support the cooperative team for CE it is necessary to consider the types of information and the modes of communication between team members. Future research in this area will be very important in the use of knowledge-processing-technology for the tasks related with: data exchange, data sharing, knowledge exchange and knowledge sharing. The last point represents the highest level of CE: knowledge is interactively communicated and reciprocally shared between persons involved and this is essential when a group of engineers works concurrently on different but interrelated subtasks of a complex design. A proper computer environment is again very important for what is generally called computer-driven concurrent engineering.

The applications of CE have been successful in some types of industry, especially in the automobile industry, because of the particular importance of shortening the time-to-market.

Recently, seminars and conferences have been organised to discuss the problems of CE, among them the CIRP (Institution of Production Engineering Research) planned a seminar in June (1992) in Tokyo; the EUROMOTOR FORCE Programme organised seminars in Paris and Göteborg for the application of CE to the automobile industry. From those seminars, positive results were reported together with a description of the methods applied.

In conclusion, I would like to stress a final point; beyond computer-driven CE is human-driven concurrent engineering in which the role of human designers and engineers in the making of proposals and in decision making is fully present. The design phase requires adequate time for the decisions not only on product functionality, but also in the requirements of all phases of the product life cycle.

Parallel, instead of sequential, integration of the information flow requires more care, and the development of new information technology, organisation and research. It requires flexibility for different types of products and companies, including smaller ones. Multi-company control systems (including suppliers) may be a result. Concurrent engineering involves the global structure of industry to create, design, produce and to conquer the market.

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