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Concurrent Engineering: An Effective Tool for Modern Industries

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Abstract: The organizations are facing tougher challenges in the field of machining where market requirements are increasing. To obtain high production rates with minimum costs effective methods are required to optimize tool geometry. Concurrent engineering is a systematic approach which can be achieved when all design activities are combined and executed in parallel. This paper focuses on various designs process steps for industries for the design and development of complicated products with concept of concurrent engineering..

Key Words: concurrent engineering (CE), complex system, product design and development process.

1. Introduction

Concurrent technology refers to a method used in product development in which the design parameters, manufacturing steps and other factors related for the production are considered simultaneously to provide the improved quality product to the market. Concurrent engineering's basic premise revolves around two principles. The first is the idea that in the early design phases in which all elements of the life cycle of a product which includes its working or functionality, steps involved to manufacturing, assembly of product, testing or verification, maintenance, environmental factor and finally the disposal and recycling should be considered.

The second principle is that all of the previous development processes will take place concurrently, or at the same time. The overall goal is to enhance the simultaneous existence of these processes which increases efficiency and quality of product significantly, which is obviously important in today's fast-paced market. The main reason for the enormous success of concurrent architecture is that it redefines, by default, the basic structure of the design process that has been commonplace for decades. During the process of machining the magnitude of cutting forces, temperature, tool life and surface finish properties of work material are influenced by cutting tool material, geometry of tool, Tool rake angles the design of geometry

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of various cutting edges and its effects on machining performance has been developed through the principles of concurrent engineering. The concept of concurrent engineering is directly connected to the availability at time to all participants in the development of critical design information. All the necessary information or data which is required by a particular development team cannot be available at the beginning of this task for most complex engineering tasks. Therefore, CE demands that such information be maximized and that useful information be exchanged and transmitted on a timely basis. For the better understanding of the mechanism of the formation of chip and exact estimation of efficiency of machining, in terms of force required for cutting, variation in temperature, tool wear rate, surface texture with the integrity of machined surface, it is necessary to consider effects of various edges of cutting tool. Experimental, quantitative and numerical methods are widely used in the systems using the cutting edge geometry of the tool has been observed to have a high impact on different fundamental aspects of production process such as force required for, the occurrence of type of chip formation, variation in temperature, wear rate of cutting tool, life-cycle of cutting tool. It also includes the few characteristics concerned with quality of surface texture such as surface roughness and damage. The variation in major cutting factors i.e. cutting speed, feed and depth of cut can help to achieve the required shape of chip to enhance the production or productivity. The variation in cutting parameters to generate the chip is typically not feasible due to the parameters of machining process and effect of the same on the life of the tool, surface finish and quality measures of the product. The variation in device geometry is therefore one of the essential parameters to be considered for the optimal shape of the chip without hindering the efficiency of turning. The paper's goal is to re-design the machining tools using the principles of simultaneous engineering.

2. Definitions

Concurrent technology is a step towards the integrated, quality product design, process involved for manufacturing and fabrication, including inspection and support. This useful step is highlighted to cause designers to grip all aspects of the product life cycle from its first step of manufacturing to dispose from the outset, including specifications for performance, price, schedule, and consumer.

3. Principles of CE

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The various principles of CE as given accordingly and implemented properly can contribute to reduction in costs and improve product quality and achieve high production rates.

1) Iteration principle
2) Parallelism principle
3) Decomposition principle
4) Stability principle

1) Iteration principle:

The design and development of products are always imagined by the humans. During the design of these products it is very difficult to catch all the various aspects concerned with product. The design process of product, progresses with many factors which include idea generation, required information, availability of technology and feasibility etc. The second major factor is unviability of such design system which can directly convert the set of instruction or requirement into final requirement to fulfil the need. The designer has to always frame the requirements in terms of different specification required for the achievement of final product.

2) *Parallelism principle:*

The complex and scalable and systems should be more parallel to achieve the optimum development times to encounter the wastage of development times and money. According to the rule of Amdahl, the output of a parallel system (i.e. achievable speed-up) can be substantially constrained by the presence of a small fraction of strictly sequential activities that can not be paralleled. Consequently, by exchanging early primary upstream data with downstream, number of design stages should be performed with some overlap or in parallel.

3) *Decomposition principle:*

This concerns with the transformation a complicated system into few sub-systems which should be simple and easy. These sub-systems can put a great influence individually on the on the performance of final complex system. The process of decomposition also breaks the opportunities for parallel execution. The conversion of a complex system into almost different and independent sub-systems is an explored consequence of' reserved rationality;' i.e., restriction on processors ' cognitive and information-processing capabilities (e.g. decision-making by the designer). Processes are generally broken into different tasks and subtasks in from complex product growth. The process involves with assigning tasks to the same team which is expected

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to demand more interaction for problem-solving. Also while assigning tasks to different teams less problem-solving interaction.

4) *Stability principle:*

In context of complex system, this principle represents the coexistence of equivalent multiple ground states or multiple equilibrium. At the initial conditions, if the state of the system transferred to any state of the equilibrium, then the system is called as a stable. If all the design problems which is to be solved remains reserved over the time with the progress of project and drops eventually below the acceptable threshold, then the method is recognised as stable within specific time.

4. Requirements of CE

(1) People*:*

The human resource is the best available resource and is critical and detrimental to development process. This involves aspects like

(a) Team work
(b) Communication
(c) Multidisciplinary team

*(2) P*rocess*:*

The process focus on ultimate goal and the efforts and strategy evolved to achieve it. This is based upon factors like

(a) Strategy involving work
(b) Problem identification

(3) Tools Required*:*

The various tools required are

(i) Organizational tools – TQM, computer network QFD
(ii) Statistical tools – DOE, Taguchi method, statistical process control (SPC)
(iii)Production tools – CAM, CNC, CPI. & JIT

5. Serial or sequential engineering vs concurrent engineering

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Serial or sequential engineering: The following process chart shows the serial or sequential engineering used in manufacturing industries.

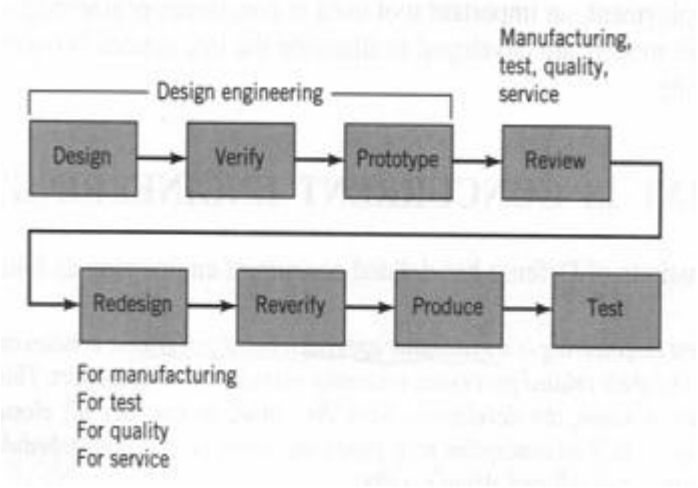

Fig.1 Process Chart

Concurrent Engineering: the following chart showing the chart for concurrent engineering used in the same manufacturing industries.

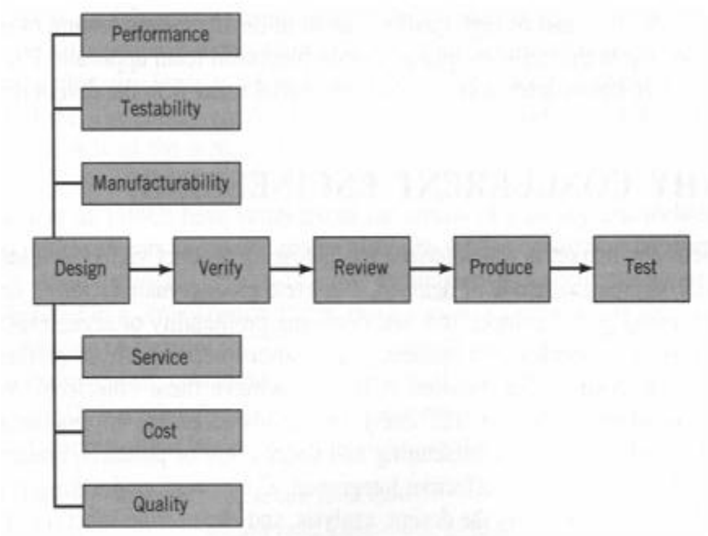

Fig. 2 Concurrent Engineering Chart

TRADITIONAL PRODUCT DEVELOPMENT PROCESS FLOW CHART:

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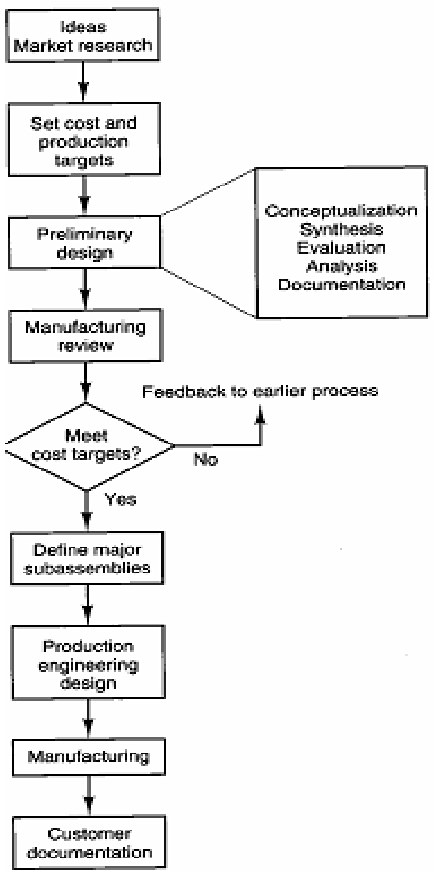

Fig. 3 Traditional Flow Chart

NEW IMPROVED FLOW CHART:

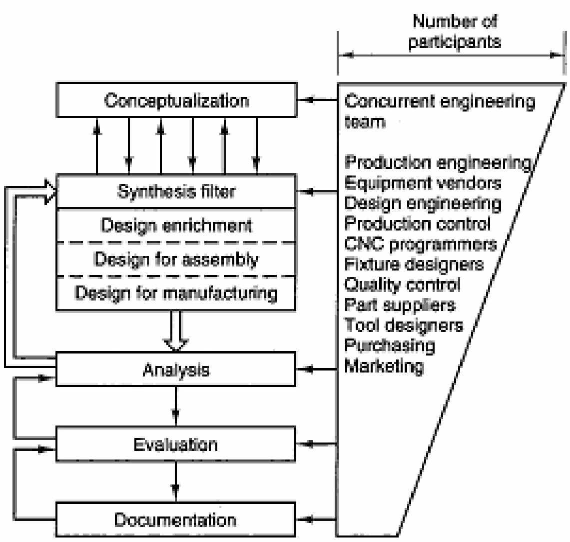

Fig. 4 CE based Flow Chart

6. Why concurrent engineering

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1. The globalisation and completion pushes the concept of engineering to reengineering.
2. The requirement of short product life cycle.
3. By increasing the specifications and variety of product for its improvement, it becomes very difficult to forecast the performance of product during its function.
4. The give a response to the huge demand of customers in market.
5. Innovation and latest technologies is also a major factor for the development of quality product.
6. In industries or organization are making a combined effort for the development of quality product.

By the following highlights, the application of concurrent for the improvement of product in industry can be observed

1. The requirement of time for product development and its production.
- 60% of existing time requirement is reduced for product development.
- Production spans falls by 10%.
2. Highlights of improvement in quality measures.
- Yield improvements are recorded up to four times.
- There is negative variation up to 83 % in field failure.
3. Improvements in engineering processes
- Engineering changes are reduced up to 15 times per drawing
- Inventory is falls up to 60%
- Changes early production engineering is also reduced by 15%.
- Reduction in scrap and rework is recorded up to 87%
- There is reduction in prototype building up to three times.
4. Cost reduction
    - IBM reduced the direct costs of assembly of system by 50%.
    - Boeing reduced mobile missile launcher and realized costs 30 to 40%..

7. Schemes for CE

Concurrent engineering is the combined effort of many techniques to verify the cost, quality, performance and life-cycle of product. It is given as

1. Use of group technology
2. Guidelines for manufacturing process

3. Design techniques
4. Self-evident design of product.
5. Manufacturing process design rules
6. The use Taguchi method for design.
7. DFM for with the aid of Computer
8. Quality function deployment
9. Analysis of failure points with its effects
10. Addition of value engineering
11. Guidelines or path for assembly

8. Benefits of CE

1. Time required for marketing is reduced.
2. Development of quality products
3. Reduction in cost
4. Work in progress is also Less
5. Less Change
6. Rise in Productivity
7. Customer satisfaction (CRM)

8. Conclusions

This research paper supports the facts that the process of concurrent engineering is important in product development process. T his method is constant monitoring process where regular feedback is essential to optimize various cutting parameters to achieve high production rates at minimum costs.

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