"Concurrent Engineering"

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Abstract— Concurrent engineering has also been identified by business organization as a simultaneous engineering, life cycle engineering, parallel engineering, integrated product and process development. Concurrent engineering practices have considerably matured over the last decade. However many companies still face enormous challenges while implementing and managing practices of C.E. This is due to the increased complexity of engineering products process on one hand and lack of concurrent engineering tools on the other hand. So in this paper important tools of concurrent engineering are discussed. Also in this paper main focus is given on how to implement concurrent engineering in industry with its major benefits and obstacles.

Keywords: concurrent engineering, traditional engineering, three Ts of C.E, implementation methodology, advantage and drawbacks of C.E.

I. INTRODUCTION

Concurrent engineering, also known as simultaneous engineering, is a non-linear product or project design approach during which all phases of manufacturing operate at the same time - simultaneously. Both product and process design run in parallel and occur in the same time frame. Product and process are closely coordinated to achieve optimal matching of requirements for effective cost, quality, and delivery. Decision making involves full team participation and involvement. The team often consists of product design engineers, manufacturing engineers, marketing personnel, purchasing, finance, and suppliers. Team of engineers looks at the problem at the same time.

Concurrent engineering techniques can be used to compress time in the product development cycle, and business cycles in general. Every business has basic cycles that govern the way that paper is processed, parts are manufactured, and decisions are made.

They may be documented in the form of procedures or routings. Examples of business cycles are customer order, product development, production, and procurement

II. TRADITIONAL ENGINEERING AND CONCURRENT ENGINEERING.

A. Traditional engineering

Traditional engineering approach also known as serial engineering towards development is largely sequential in nature. i.e. each discipline performance separately its own functions. Typically there is not so much interaction between various departments .thus this leads to problems in later stages. Once a new product design is verified it is passed to the manufacturing, test, quality, service engineers to review. Continuous changes usually must be made as problems are discovered later in process. So this affects on overall product cost and time to market. In terms of product quality emphasis is on correction rather than prevention. Design errors are detected during manufacturing stage only and so this leads to rework, and manufacturing becomes costly. Information is also one way and it is restricted mostly because it is stored on many media in many locations. As a result insufficient information is exchanged among various groups.

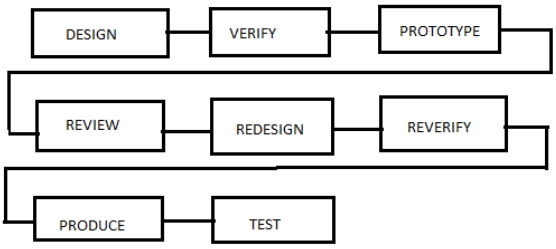

Fig. 1: Traditional Engineering.

B. Concurrent engineering:

Concurrent engineering encourages team work and it harnesses expertise from all disciplines and are involved to work together closely in parallel right from early stage of product design and development.

Trades off regarding ease of production, testing and servicing are made along with product performance, quality, weight, cost. When a design is reverified it is already manufacturable, testable, of high quality.

Hence multiple iterations on product changes commonly found in sequential process are eliminated.

This will minimize the time from concept to release of product. With C.E. working in parallel allows multidisciplinary team to rectify problems at earlier stage. This prevents any design problem to occur later in process and help to reduce the no. of checks and tests required at later process.

Information shearing is vital for implementation of C.E. organization should be unified with mechanism for storage, control of any information and data relevant to product.

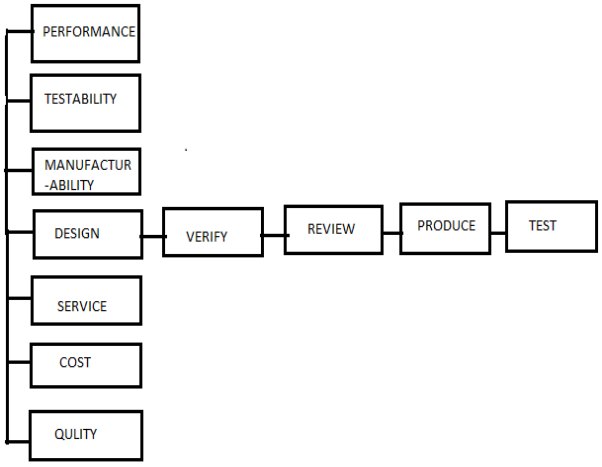

Fig. 2: Concurrent Engineering.

III. THREE T'S OF CONCURRENT ENGINEERING

Concurrent engineering preaches the simultaneous progress of activities required in getting new products out to paying customer as quickly as possible.

For successful transformation of C.E require three basic elements known as three T s of concurrent engineering.

Tools: involves material infrastructure.

Training: relates to the human aspects and includes educating personnel on the basis of appropriate tools.

Time: consider realistic expectation in terms of setting targets

A. Tool:

More impotent tool is a communication tool. The complexity and wide range of specialized disciplinary area s involved in modern manufacturing makes it interdependent activity often involving hundreds of people. So in this situation communication tool is most important tool. As an example blue print from the design department has been the agent for production planning and subsequently actual production. Today's concurrent engineering requires blue print be replaced with 3D solid models using any one of the computer aided design package. This provides flexibility and easiness in defining geometry. Also designer can use 3Dmodel for taking feedback from customers and to make improvement.

B. Training:

one of the greatest challenges in managing the simultaneous operation of interrelated task is to figure out ways that get people to work together as a team. Typically the business failure of production based enterprises have been attributed to controversies between people within or/and external to firm.

For manufacturing competitiveness members of concurrent engineering team need to recognize the following.

1) it is not possible to create optimal design by an accident. It must happen collaboratively among people making the best of resources.

2) As a team member they should feel free to raise genuine questions concerns.

A personnel training is the key factor in maintaining the bottom line goals of companies. Concept of establishing training consortiums maintained by a group of companies deserves attention. The mission of this consortium is to create a competitive advantage for their employees through innovative practices and expertise. Companies now willing to provide infrastructure such as computers and internet access so that their employees may receive as needed and pursue the goal of never ending continuous improvement which in many cases has become the integral part of C.E.

C. Time:

As companies find that it is imperative to reduce the cycle time for new product development the begin to think in terms of parallel activities. Reduced cycle time is most important for profit equation. The quality of the product and cost to the customers are major factors to success in market. If company only focuses on reduction in cycle time the end product could be the poor quality produced at premium cost in a shorter cycle time. This can be very dangerous for company. Clearly considerable amount of time should be devoted towards establishing some level of understandings between all of the employees for effective production of the final product

IV. IMPLEMENTATION METHODOLOGY:

The generic framework described below is especially aimed at showing how to implement CE in an ordinary company i.e. not using a 'super-motivated' project team which can produce misleading results. It is based on the steps of change management in the specific context of CE.

It is intended that the framework could be used as part of the guided tour for (say) the Project Manager or simply as an overview of what implementation of CE typically involves. The seven steps and the related measurements are discussed below.

A. STEP 1 Develop a Strategy

Informal ideas for implementing CE may already exist but a top level strategy must be formulated before proceeding. Exactly why the company must change needs to be identified, together with a thorough implementation plan. The kick-off activity would be to analyze long and short term business objectives - e.g. a computer manufacturer may have reducing time to markets the primary objective, whereas a luxury boat maker may consider quality to be critical with time being a lesser factor. Followed by:

1) Define motivation for change

Assess the need for change in the organization and obtain buying from all concerned. Without this any change will fail. Working processes have to be reengineered at all levels of the business encompassing everything from marketing, engineering and development through to manufacturing.

2) Appoint a CE team

People committed to the change need to be assigned at an early stage. Acores team of top and middle managers from across the organization could initially be assigned as a think tank or an individual CE champion could be appointed.

3) Write the strategic plan

Top management strategic plan outlining the reasons for change and involving all parts of the organization needs to be formulated at this stage.

The exact nature of the plan must be decided by the individual organization - according to their policies and procedures, the main point being the involvement of everyone.

Plan needs to concentration core aspects such as clarifying the problem and reason for change, discussing the implications of the chosen solution, etc. Once this is completed, set timescales and move onto assessment .

B. STEP 2 Assessments

Analyze current situation both quantitatively and qualitatively by assessing available resources, tools and techniques.

Measurements could include benchmarking, assessment tools, questionnaires and performance metrics. Specifically:

1) Define
Company targets by carrying out a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis.

2) Analyze
Core business aspects including people (determine skills, experiences and capabilities in the company), technology (and its role in the company), processes (count, record interactions and who is involved) and data management.

3) Bottleneck analysis
Identify weaknesses in the existing system by tracking the workflow, focusing on all the aspects mentioned above. A huge variety of methods and techniques (both software and paper-based) are available to do this.

4) Assign people
From the core team to initially be responsible for these changes.

- An assessment system must be put in place and maintained by the CE champion.

C. STEP 3 Create the Culture

Without support and understanding, implementation will fail. Creating a welcoming atmosphere very important. This will have both tangible benefits (results) and intangible benefits(willingness to succeed). A number of measures need to be taken in order to elicit full support. These could typically include:

1) Raising awareness
Communicates the reasons for change and outline what will happen to help Create an organization where learning and change is the normal situation.

2) Encouraging involvement
Ask for opinions and ideas on the proposed changes from *all* levels of the organization.

3) Holding initial training sessions
Introduce the practicalities of the changes.

This can be philosophy training to give an appreciation of the big picture; and specific training on tools and techniques CAD,QFD.

4) Debriefing
After the initial stages should involve top management to discuss problems and opinions and to ensure buy-in from all-concerned.

5) Applying the training
Into a real job situation while it is still fresh and before enthusiasm is lost. The purpose of these measures is to encourage openness, ease of expression of ideas and a common ethos amongst employees.

D. STEP 4 Priorities Improvements

Constraints (either financial or otherwise) reduce change options open to most businesses.

Ascertain path may look ideal at first glance but without backing in terms of available team members, equipment and time, it would be doomed to fail. Identify suitable tools – considering product development, manufacturing and support tools, to help achieve the proposed plan. Investigate what is already available in-house and what would need to be purchased. Consider the cost-benefit decision - analyze the results from the assessment performed in step 2 to identify the weakest areas in the organization that are in urgent need of attention. Priorities bottlenecks in order of importance.

Perform a cost benefit analysis and match highest returns with business objectives, bearing in mind budget and other resource constraints. Optimal allocations can then be made.

E. STEP 5 Plan the Change

Careful and appropriate planning is essential for success. The CE champion and team representatives use results from step 4 to draw up an action plan. This plan should:

1) Involve all people
Affected by the change

2) Include operational planning at a detailed level
I.e. all tasks & sub-tasks and a full reporting structure

- establish milestones/targets and anticipated interim results
- consider rate of change, resource allocation and include a Gantt chart to clearly represent activities, timescales and targets.

There should be provision in the plan for more in-depth training on the chosen tools and techniques as the project develops.

Ensure that there is constant feedback from the assessment/measurement tools (see step 2). This needs to enable constant up-to-date flow of information - at the activity level - to allow adaptation to changing circumstances and to keep the plan on target.

F. STEP 6 Implement Improved Situation

This step is the centre of activity and will be used to put the new system into practice. For example if a company successfully trains its engineers in QFD and prepares them to use the technique on future projects, but then decides not to go ahead for financial or other reasons, this could result in disillusionment with training and a lack of enthusiasm for future 'management fads'. Specific stages include carrying out the plan, monitoring deviations, adapting as necessary(according to changes in circumstances e.g. loss of key personnel, new technology, etc.) and installing a feedback loop. An ongoing feedback loop, to ensure that there are no weak links in the chain, is of utmost importance at this stage.

This should be linked into the activities of the CE champion and the teams. Feedback information also needs also to be easily accessible by senior management - perhaps electronically via a computer network.

G. STEP 7 Support Implementation

This step requires a major effort to avoid reverting to previous behavior. It is mainly concerned with making sure that; the change process is stable, the benefits are visible and that change is common practice. The loop is made continuous by identifying the next improvement opportunity. Once the first solution has been operationalised, it has to be constantly reviewed and improved upon. Specific steps could include; on-going commitment of top management in a visible way; contingency funding in the budget to cater for any unexpected changes in technology, market, personnel, etc.;

clear support and communication network; track progress to ensure that what you are doing does not become sub-optimal; and continuous training involving new staff and updates/review.

V. ADVANTAGES OF C.E:

Concurrent engineering also known as iterative development method requires continual review of team's progress. The rationale behind this creative, forward looking is that earlier those errors can be discovered the easier and less costly they are to correct. C.E approach provides increased quality for the end users, faster product development time, and lower cost for both the manufacturer and consumer.

VI. DRAWBACKS OF C.E:

There are some drawbacks associated with the initial implementation of C.E., including the need for considerable organizational restructuring and extensive retraining of workers. There may be resistance from employee of the organization for changes. Also there may be considerable difficulties in transferring the data among various departments. it requires the additional tracking software to install.

VII. CONCLUSION

The basic premise for concurrent engineering revolves around two concepts. The first is the idea that all elements of a product's life-cycle, from functionality, producibility, assembly, testability, maintenance issues, environmental impact and finally disposal and recycling, should be taken into careful consideration in the early design phases. The second concept is that the preceding design activities should all be occurring at the same time, or concurrently. The overall goal being that the concurrent nature of these processes significantly increases productivity and product quality, aspects that are obviously important in today's fast-paced market. This philosophy is key to the success of concurrent engineering because it allows for errors and redesigns to be discovered early in the design process when the project is still in a more abstract. By locating and fixing these issues early, the design team can avoid what often become costly errors as the project moves to more complicated models. Though it seems to be very difficult and lengthy process to implement C.E. in an organization it is essential to get benefits like high quality product, happy customers, low cost etc. C.E in future will utilize tools which will enable team work to be performed in organizations where the various functional expertise is often geographically dispersed. All activities should be supported by fast and cheap networking system, multimedia communications and integration enabling tools in real time.

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