Topic 2: Product Development Process

Introduction to the Topic

While it is important to stress that Lean Manufacturing principles must be diligently applied to remain competitive in today’s manufacturing arena, these efforts are directed primarily towards production line (‘on-line’) activities. More recent advances in the quest to improve productivity have been targeted at the early design or ‘off-line’ activities, through the application of Simultaneous or Concurrent Engineering practices.

Learning Outcomes

Upon successful completion of this topic, you will be able to:

- discuss why design affects manufacturability
- define the basic ingredients of Simultaneous Engineering (SE)
- identify the advantages of SE
- identify the factors that prevent successful application of SE
- define Product Design Teams, their composition and operational guidelines
- explain how to implement SE into an existing Product Development structure.

Session 2.1: Product Development and the Organization

An essential ingredient for the successful manufacture of a product lies in the ability to improve the product design process. This is the core process which dictates more than 70% of the total costs, quality and manufacturing characteristics exhibited by a product to its end of life cycle.
Ironically it has also been estimated that, only about 5 -10% of the overall product development budget is normally allocated to the early part of the product development cycle.

It has not taken long for organizations to realize that major improvements in productivity could be achieved by focusing on the concept design stages, through the application of what is now known as Simultaneous Engineering (SE) or Concurrent Engineering (CE) practices.

The practice of deploying cross functional teams responsible for the design and development of products from concept to production (and beyond), is synonymous with Simultaneous/Concurrent Engineering practices.

While the application of SE principles may vary from company to company and from project to project, the following organizational guidelines are widely accepted as ‘best practices’, namely:

- deploy engineers with the experience, knowledge and ability to support the program
- involve all the key elements of the manufacturing process (including suppliers) early in the program to provide ‘up front’ support
manufacturing and product engineering agreed to support design reviews and sign-off procedures throughout the PD process.

Achieving these objectives requires re-alignment of the organization, focusing particularly on the product development process to:

- establish clear company and product guidelines (with no surprises)
- facilitate earlier involvement by all facets of the company
- encourage early sharing of vital design information with suppliers
- establish ownership of the product for the entire life cycle (e.g. service).

Today it is also well known that it is easier and less expensive to make changes to designs at the early design stages and it becomes increasingly more difficult and expensive to make changes as the design progresses towards completion.

In this approach management must recognize the importance of allocating adequate effort and resources to the early stages of the design cycle in an effort to get the design ‘right’ from the start.

The comparison above reflects the difference in the product development process for a similar product made at two different sites within the same organization. One product was developed at a factory using the traditional linear (sequential) approach while the latter used simultaneous engineering approach.

In this example it can be clearly seen that although the SE approach requires more time and effort at the conceptual design stages, the long term impact is to significantly reduce the total product development
time and associated costs. Releasing the product earlier into market not only increases Return-On- Investment (ROI), but also has the potential to capture and retain new customers.

Further studies have reflected the following overall advantages:

<table>
<thead>
<tr>
<th>Concurrent Engineering Pays Big Dividends</th>
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<tbody>
<tr>
<td>Development time</td>
</tr>
<tr>
<td>Engineering changes</td>
</tr>
<tr>
<td>Time to market</td>
</tr>
<tr>
<td>Quality</td>
</tr>
<tr>
<td>Dollar sales</td>
</tr>
<tr>
<td>Return on assets</td>
</tr>
</tbody>
</table>

Figure 2.3 Some of the benefits commonly realized through the application of Simultaneous Engineering practices (based on data from Business Week, 30 April 1990).

**Session 2.2: Communication Challenges**

The growing sophistication and complexity of today’s products coupled with intense global competition, have stretched the boundaries of the product development cycle. An understanding of market trends, customer response and competitive advantages are now essential ingredients to the success of the core product development process. At the same time a thorough understanding of the most current and accessible technology will often provide a competitive edge and must also be integrated into the PD cycle at unprecedented speed. Further challenges arise as the various functions traditionally associated with PD are brought together to interact with those which have traditionally been left to the end (e.g. purchasing of equipment, fixtures, tooling, quality etc.).

In this scenario good communication becomes increasingly more important, with the timely and accurate exchange of information still remaining the greatest on-going challenge to the successful launch of new products into the marketplace. The organizational structure will have a large bearing on this.
In the sequential (“over-the-wall”) organizational model shown above, the organization is divided into separate divisions based on functional expertise. Here communication and feedback is normally limited and departments at the end of the development cycle typically have limited understanding of the initial marketing directives or expectations of the customer and vice versa.

In situations like this poor communication often leads to:

- hidden knowledge being overlooked (or assumed as being unimportant)
- assumptions that information has been received – but has not
- people unaware of existing knowledge and resources
- lack of agreement on the most appropriate action
- progressive deterioration of traditional inter departmental procedures.

Problems of miscommunication and misinformation grow proportionately as companies expand and hierarchical structures lead to the development of specialized departments and the spreading of facilities. The concept of ‘self directing’ teams has been successfully deployed to overcome some of these obstacles. Careful implementation of Product Development Teams (PDTs) has lead to improved integration of responsibilities and allowed for greater flexibility and faster response to changing market trends.
Session 2.3: Product Design Teams (PDTs)

Product Design Teams (PDTs) with clearly defined responsibilities and authority levels, are seen as a way of enhancing communication through better information exchange at informal meetings, coupled with fewer structured meetings and design reviews.

Properly structured PDTs can:

- promote timely and accurate exchange of information
- enhance multi-functional ownership
- facilitate improved decision making.
Figure 2.6: PDT process: the design team may need to undergo a number of iterations before achieving the best result, copyright RMIT University, 2007 (Lou Travella)

While the size and composition of PDTs will vary depending on the nature of the product, best results have been achieved when a fixed nucleus is given total responsibility for the product/process from concept to production (including service). Other responsibilities can support the teams on a part time basis.

Most PDTs should have representation from at least the following disciplines:

- Product Planning/Marketing
- Design Engineering
- Manufacturing Engineering
- Purchasing /Suppliers
- Sales/Service/Quality.
Session 2.4: Integrating Simultaneous Engineering into Existing PD Structures

The success of Simultaneous Engineering is determined by the ability of the organization to make the PD process more efficient through improved communication between the various divisions. Apart from the difficulties inherently encountered in the normal operation of teams, the very organizational structure itself can prohibit the successful formation and operation of the PDTs.

While it is recognized that smaller companies may operate in a SE approach without even being aware of it, as organizations grow larger, the need to formalize the process within the constraints of the existing product development cycle becomes more essential. It becomes increasingly important for management to endorse and promote a team approach, to attempt to remove divisional barriers and to focus more effort in getting the design ‘right from the start’.

The transition from a sequential (linear) structure to a cross functional team structure can be difficult and may take some time for established organizations to successfully achieve, but the significant advantages that it presents cannot be ignored in today’s highly competitive marketplace.
This illustration shows how the SE sub-process fits into the normal PD process.

Because the size and complexity of the design teams can vary from company to company and from project to project within the same organization, it is not practical to make simultaneous engineering too prescriptive. The scope of simultaneous engineering will depend on the type of organization and degree of complexity of the project. Further the size, composition and operation of the PDTs will also be determined by the complexity of each project.

In this scenario, it is important to remember that not all the work that is performed by team members is conducted in a team mode. The team approach is best utilized for brainstorming and decision making after
the relevant information has been successfully gathered by individuals for further processing by the team. A stylized representation of the general operation of a PDT is shown below. This approach can be applied throughout the various stages of the product development process and can be successfully applied within the established organizational structure.

![Diagram of PDT operation]

Figure 2.7 Team interaction is used for decision making and generating commitment, but there is a need for individual inputs for data gathering etc. copyright RMIT University, 2007 (Lou Travella)

Different types of PDT structures have been identified ranging from the Autonomous/Tiger team structures to the Lightweight Project Managed teams - each exhibiting relative advantages and disadvantages. These aspects should be seriously considered for the successful application of Sim Eng into an organization.

Several topics that relate to the successful operation of the team must be addressed early in the PD process, including:

- roles and responsibilities
- team charter - contract
- support structure
- training
- performance measures
- team selection.
This illustration depicts the functioning of PDTs within the SE sub-process.

Many organizations have mistakenly assumed that it is enough to simply nominate the appropriate personnel to participate in a PDT and expect the team to operate successfully. Or to procure the latest developments in technical developments (e.g. CAD, Rapid prototyping, FEA etc.) in the hope that in themselves these technologies will enhance teamwork. But more often than not the reverse will be the case as personnel quickly privatize their use in an effort to become specialists. While diligent use of the latest digital technologies is mandatory, extra effort is needed to enhance cross functional involvement at the early design stages – well before the end product is in sight. In other words the successful application of simultaneous engineering relies on the successful resolution of many people related issues as well as organizational issues.

Having identified the importance of teamwork etc., it becomes equally important to apply the correct procedures at the correct time to help expedite the performance of the teams and to ensure that the correct
information is available for accurate decision making. A number of simple yet pertinent methodologies have been devised to help PDT’s acquire this information in an attempt to improve decision making at the design stage.

Activity 2 A

Simultaneous/Concurrent Engineering

Reading:
Please refer to the bibliography at the start of the programme. Many texts will make reference to various types of organizational structures that foster cross functional integration across the full spectrum of the PD cycle. In particular please read:


Activity:
1. What are the differences between the conventional Linear organizational structure over the cross functional Design Team structure for PD?
2. Why do organizations only allocate a very low proportion of the total PD budget to the early design phase?
3. There are a variety of recognised product design team structures, be prepared to discuss the following:
   - why you would select one type of design team structure over the others?
   - what obstacles might be encountered in a conventional PD structure from successfully applying a design team approach and how would you manage to overcome these?

Discussion:
- Participate in groupwork during lectures and online discussions
  You can obtain feedback from your online tutor/and or course coordinator
Summary and Outcome Checklist

This Topic introduced you to simultaneous/concurrent engineering. Tick the box for each statement with which you agree:

☑ I can discuss why design affects manufacturability.
☑ I can define the basic ingredients of Simultaneous Engineering (SE).
☑ I can identify the advantages of SE.
☑ I can identify the factors that prevent successful application of SE.
☑ I can define Product Design Teams, their composition and operational guidelines.
☑ I can explain how to implement SE into an existing Product Development structure.

Assessment

Assessment for this Topic will be included in Assignment 1.