Title: Are the walls coming down: A look at simultaneous Engineering

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Introduction

What is Simultaneous Engineering (SE)?

Simultaneous engineering combines and coordinates the functional areas within a company at an early stage and helps to eliminate problems that may arise later in production and/or marketing. Each stage of the product development cycle takes into account the needs and desires of the customer as well as the design for manufacturability. Simultaneous engineering uses such tools and techniques as quality function deployment, computer-aided design, statistical process control and design for manufacturability. [1] The old way of developing a product in the automotive industry began with a new product being requested by Product Planning. The Design department would then create a detailed drawing and a clay model of the product. The approved model would then be given to engineering and they would attempt to create a functional car within the artistic shell they had received. Next, Manufacturing tries to develop a cost effect way to produce the product. The "over the wall" approach to product development took four and half to five years to complete in the automotive industry. As a result the end product could be quite different from the initial conceived idea of the product or a luxury car conceived in an economic boom could be delivered during a recession. [2]

The Beginning of Simultaneous Engineering

"Henry Ford and later Walter Chrysler individually performed or directed all the major functions attributed to the simultaneous engineering concept now being touted by some as a new approach." [2] When Chrysler started his automotive company he remained involved in all major areas of the automotive design and integrated the functions of all the

divisions. Chrysler became a leader in product innovation and built more cars than Ford in the 1930's.

Case Study
"Implementing Simultaneous Engineering at Cadillac"

Cadillac was founded in 1902 and is now a division of General Motors Corporation. The Cadillac division encompasses 10,000 people, four manufacturing plants in Michigan and administrative/engineering offices in the Detroit area. In the mid-1980's Cadillac faced declining market share and needed to turn this trend around. To do this, Cadillac began the implementation of a vigorous simultaneous engineering program that was fully supported by management and included a complete company culture change. [3]

Cadillac began by creating a vision that required input from the people who would implement the vision. This resulted in a shared vision that was supported by its developers. From here a Simultaneous Engineering Steering Committee (SESC) was formed to study and plan for the implementation of SE. This was the beginning of the teamwork culture that would later permeate the company. [3] A champion was chosen to act on the behalf of the team full-time. He coordinated information from the different staffs and teams and acted as chair at the SESC meetings.

Next, Cadillac began benchmarking other companies and learning from them the important issues that should be highlighted when implementing SE The issues identified are as follows: cultural issues, organization structure, physical location, education and training and business objectives.

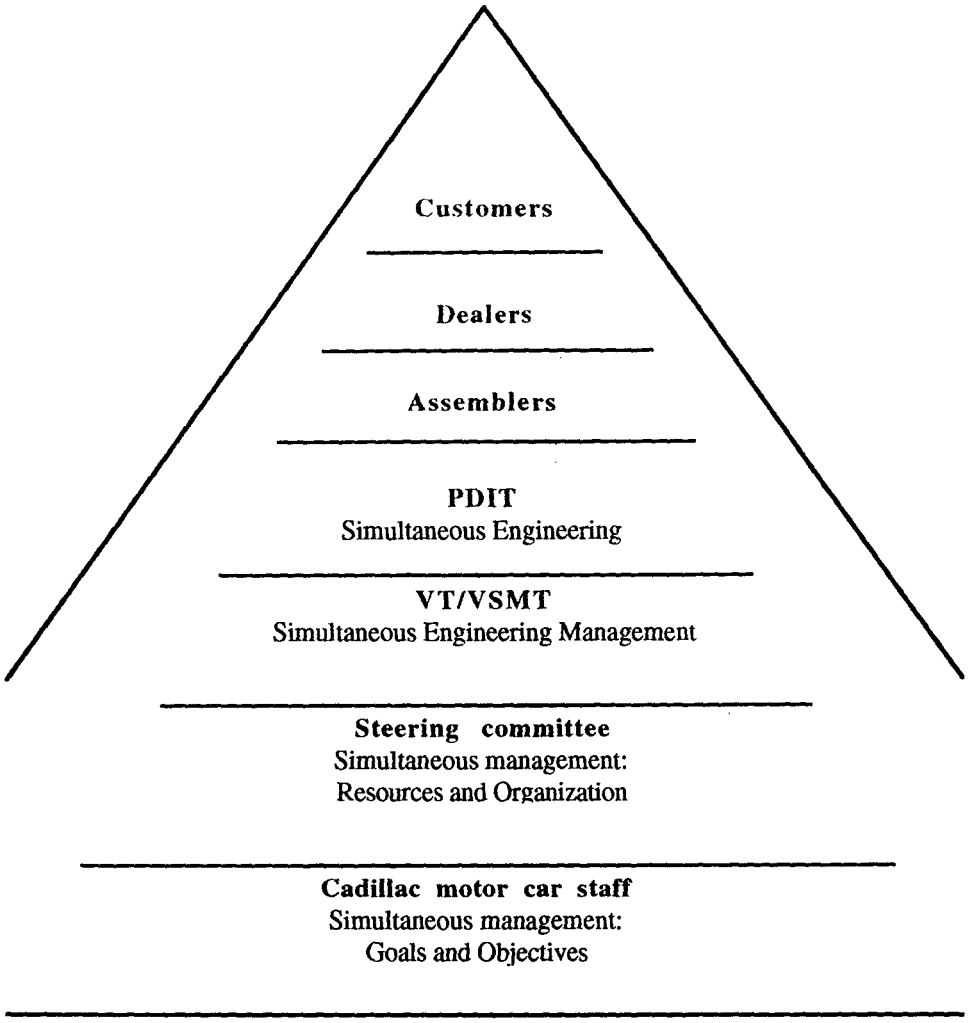

Figure 1. Cadillac simultaneous engineering pyramid.

The steering committee's purpose was to plan and implement SE, allocate resources, monitor the process and serve as SE process liaison to the company. Next on the pyramid are the vehicle teams, and they establish vehicle goals, assure customer needs are met and manage continuous improvement of vehicle's quality. [3] From here the vehicle was sectioned into specific vehicle systems and teams called product development and improvement teams (PIDTs) were assigned to each system. One hundred percent of the vehicle is covered

by the SE teams. The PIDTs have cradle to grave responsibility for quality improvement of the product. These teams focus on all aspects of their portion of the vehicle, including quality, cost, timing, technology, reliability, and profitability. [3]

Each level of teams has business decision-making responsibilities. This required team members to learn about other parts of the organization and develop cross-functional teamwork and decision making skills. A large need for education and training was identified.

To implement the plan and educate the employees, a series of work shops were develop for the teams. The Vehicle system Management Teams (VSMT) were part of a four day workshop that included background information, cultural change, business and systems information, planning and Esprit de Corps. In contrast, the PIDTs went to workshops that were conducted in three phases:

Phase 1: Simultaneous engineering, business, and systems information
Phase 2: Team building and planning
Phase 3: Problem Solving

Each of the SE teams left with a plan and goals to accomplish. But, more importantly they had the tools and support to accomplish their missions.

Tools for Implementing Simultaneous Engineering

Cadillac's use of benchmarking was beneficial in identifying potential problem areas and a tool that doesn't seem to be as widely used as it could be by industry. John Deere as well

as Cadillac have instituted a cradle to grave concept for product development that seems to have increased their product quality and reliability. [3,4]

Collocation is often the most difficult part of SE to implement. Many companies have went the extra mile to collocate their teams. These companies have recognized the importance of communication in the new product development cycle. If your cross-functional teams are not communicating the you might as well go back to throwing the design over the wall. Communication also plays a large role in quality functional deployment and design for manufacturability. The whole basis for SE is to create an environment where people within the company can communicate their ideas and create a better product.

Why are Companies Implementing Simultaneous Engineering?

In today's business environment with increasing competition, the desire to develop products quickly and inexpensively without sacrificing quality has brought simultaneous engineering to the forefront of business. Businesses must continually scrutinize all aspects of the organization to remain competitive. [5] "According to Huthwaite, factory floor "fixes" cost too much and do to little. Indeed, it has been documented by Ford and others that product design accounts for only 5% of total costs, but can influence up to 85% of the products total life cycle costs." [6] The conclusion that can be drawn from Huthwaite is that cost and process design simplification should be addressed early in the design stage.

After researching the Japanese cost advantage an automotive manufacture discovered that the door panels alone were

costing twice as much as his Japanese rivals. The engineering differences between designs accounted for three-quarters of the extra cost and were locked in at the design stage. This resulted in a 50% material wastage during manufacturing. [1] Another example would be a defense contractor that experienced between 20,000 and 30,000 engineering changes at a cost of $2,000 per engineering change for a total of $50 million over the life of the program. If SE had been applied early in the design phase a considerable amount of money could been saved. John Deere implemented SE because, their products either performed poorly, lacked customer acceptance in the market place or were poorly designed for manufacturing.

The result of the traditional wall-blocking approach to communication between engineering and manufacturing results in 90% of engineering documents being inappropriate for manufacturing. In addition, it is estimated that $40 billion was lost due to rework, scrap, manufacturing schedule delays, administrative costs and loss of market share due to the functionally oriented approach to manufacturing in the US.

Goals and Design Guidelines for Simultaneous Engineering

The purpose of SE is to link the departments through out the design process and into the production phase. The goals are as follows:

* Provide more effective product designs to meet customer needs and quality expectations.
* Design products and the manufacturing process simultaneously.
* Improve time to market.

* Simultaneously link producible designs to high-productivity processes

In order to support the goals of simultaneous engineering, organizations should implement company-wide data bases and information systems and incorporate management's practices that concentrate on the needs of the customer.

The following are design guidelines for simultaneous engineering:

* Reduce and simplify the number of active parts.
* Design alternatives - balance effort and cost.
* Producibility - use design for manufacturability.
* Make sure the assembly process is unambiguous.
* Design in verifiability.
* Tolerances must meet product and process design requirements without exceeding the natural limitations of the production processes.
* Part handling and orientation should be factored in at the design stage
* Ease of assembly should be incorporated into the design by reducing fastening steps and part movement.
* Common parts should be used in new designs.
* Design for modularity of both the product and the manufacturing process.
* Design maintenance and servicing considerations in the product. [1]

The SE process can employ a number of tools and techniques that when used effectively can reduce cost and time to market and ensure quality products.

Problems Implementing and Maintaining Simultaneous Engineering

Cultural barriers are often the most difficult obstacles to overcome. The mortar that holds the walls together between functional groups is often very strong. There can be no half hearted attempt to chip away at it. The organization needs to use a jack hammer to bring the walls down. All people experience anxiety or fear when presented with the unknown. This fear could manifest itself as a possibility that some peoples career paths could be changed and/or damaged. Once people realize that change is inevitable they are more willing to adapt to the plan and adopt their career goals to meet the proposed SE criteria. And in order to speed this process up, good communication is needed. Because, once people understand that their jobs will not be in jeopardy and this a move to increase productivity and quality in order to strengthen the company in the work place.

The problems of implementing SE in a large organization can be quite different from those in a small organization due to the business strategy. One inherent problem in large corporations is departmentalization and this seems to be necessary as the corporation grows. People in a department develop a mindset and communication begins to break down and walls go up. People are by nature territorial. [7]

Compensation seems to be a large issue in the SE philosophy. The American culture has long admired individual achievement and rewards are based on this philosophy. This mindset does not promote teamwork, the foundation of SE. There has yet to be a system developed that can adequately evaluate a persons performance based on team interaction and contribution. [7]

It seems to be the American way to look for the quick fix rather than find a real solution to the problem. There are more quick fix books and theories on the market than you can count, but the bottom line is that you usually can not fix the problem in one minute or from behind your desk. You have to get out there and change the organization and provide an environment for SE to flourish. [7]

Suppliers and Simultaneous Engineering

Suppliers are often overlooked as a resource for technology in developing a new product. The main reason being that many companies fear that they will lose a trade secret and compromise their market position. Fortunately, this has begun to change. The reason for this being that technology is changing so rapidly that many companies cannot afford to develop all of the technology on their own. [6] Xerox led the way in the early 80's to include suppliers in the product develop cycle. They formed cross-functional teams that worked with suppliers to become familiar with the suppliers processes. The suppliers were encourage to make suggestions to reduce cost and lead-times while improving quality. The result was a 75% reduction in material costs and a reduction in manufacturing lead-time for new products from nine months to two months. [6] Lockheed included the supplier in the development of the C-130 and was able to identify in the design stage that a special titanium metal would be needed to construct the wing of the plane. Had this been discovered in the manufacturing stage it could have cost millions.

The SESC participated in two SE vision and implementation strategy workshops. As a result the vision was put into words:

> simultaneous engineering is a process in which appropriate disciplines are committed to work interactively to conceive, approve, develop, and implement product programs that meet pre-determined Cadillac objectives. [3]

Another development was the pyramid structure. Management was placed at the bottom so as to be viewed as a support and a nurturing force for the process that would eventually satisfy the customer.

Successful Results of Simultaneous Engineering

As a result of SE, John Deere's product development teams have reduced product development cycle time by 30%, machines are now built on schedule and scrap and rework are at the lowest levels ever. [4]

After Milacron developed an innovative solution to their collocation problem and implemented SE, their project had a 40% production cost reduction, product assembly time was greatly reduced, reduction in number of product parts, reduction in lead times and a 45% reduction in design-to-prototype. [4]

Northrop's introduction of SE in the B-2 project reduced the misfitting and misalignment of parts six to one and 97% of the hydraulic tubing was produced successfully the first time.

For Cadillac the main case study, SE meant redesigning the El Dorado in a industry record of 125 weeks and once again becoming the leader in the luxury car market.

Conclusions

One major problem that SE can not conquer is that decades of de-emphasis of the importance of innovation in the auto industry has resulted in a policy or mindset that makes it difficult to get the latest internally developed technology into the current crop of new automobile models. There have been no significant innovations in domestic automobile design in over two decades. This is largely a problem of corporate policy and is not always cured by simultaneous engineering; even using simultaneous engineering , it still requires five

years to produce the current 'non-innovative' US car models. [2] Is product development new? No, it is very similar to the approach used by car manufacturers Henry Ford and Walter Chrysler 35 to 80 years ago. Many feel SE is failing to meet expectations of reduced product cycle time. Some attribute this to the fact that product development projects are not headed by technical 'gurus', but by MBA's. The bottom line is if automakers do not take risks to become the technical leader, they will not be able to match the Japanese and European cars in quality. People want the latest technology and if you want to hold onto the market edge you have to provide it.

If properly used simultaneous engineering can be an effective media to deploy a melange of tools and techniques that will ensure a quality product at a lower cost and a shorter time to market. In order to be effective, the cross-functional teams need to have a constant flow of communication. Without the inter-departmental communication there is not point in trying to implement simultaneous engineering. Cadillac took a no nonsense approach and with full management support systematically implemented a well thought out SE program that worked well for them. There is no cookies guide to SE. Each company must evaluate their needs and resources in order to develop a program to fit their company culture.

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