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HIGHLIGHTS

of the

Twenty-Fifth

Advanced Manufacturing Forum

October 23-25, 1991

Center for the Management of Technological and Organizational Change (CMTOC)

The Pennsylvania State University
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Organizing to Shorten the Development Time of Customized Products

Mike Monachino
IBM

IBM developed a new philosophy regarding customization as it became clearer that their customers were looking for tailor-made products and some of their niche-oriented competitors were able to offer such products to them. The challenge for IBM was to develop new products frequently and deliver them to customers quickly.

IBM analyzed its basic processes, starting with working more closely with customers to develop the right requirements to meet their needs. They traced all steps backwards to initial idea generation and eliminated all non-value added steps or developed new processes to meet their customers' needs better. This analysis alone can save billions of dollars and add to the bottom line without searching for new revenue sources.

IBM also revised its organization structure and performance measurement system to assure balance between new product development and manufacturing efficiency. Early manufacturing involvement was a start in the right direction toward cycle time reduction; but it did not go far enough because the performance measures and rewards remained the same. Thus, manufacturing was merged with development under a single manager. Engineering management now owns product engineering as well as the manufacturing floor. This new arrangement makes it easier for one manager to consider trade-offs between cycle time, cost and quality. Sometimes all three goals can be improved simultaneously, but tough trade-offs can remain that require that cycle-time be balanced against other considerations.

Time to market can be reduced in other ways. For example, product changes can be prohibited beyond a certain point in time. Changes not introduced in time for the current product are saved for introduction in the next product, perhaps, within six months of the current product release. Also, successive members of product families can be developed in parallel so that product variants based on the same platform can be introduced to customers at more frequent intervals.

IBM also needed to reconsider ways to match the business cycle and the product development cycle better. The business cycle refers to the company's business and investment strategy, which is related to the technology and product life cycles and to the actions taken by IBM and its competitors that may accelerate or prolong these cycles. Manufacturing and development now share responsibility for developing derivative products for niche markets, while manufacturing has primary responsibility for refreshed products, that is, products that are redesigned to lower costs. Responsibilities for both types of products used to belong exclusively to development.

IBM also took a closer look at its core competencies by studying what it does best. Unless the company were investing in a product in which no competition is likely for many years, it prefers to form partnerships with companies that have complementary core competencies so that each can reach a new market segment in a relatively short time. IBM formed its recent partnership with Apple with this in mind. Apple has superior graphics and human interface capability, while IBM has a

superior RISC engine and semiconductor manufacturing capability. Motorola is a player too because of its excellent capability in designing customized chips.

IBM views its organization as consisting of three types of teams. The red team is corporate management, which is mainly concerned about investment justification and financial return. Blue teams are headed by technical managers who try to develop and maintain the competencies of particular types of technical specialists. Green teams consist of product managers who form product teams made up of selected personnel from the blue teams.

Using sandlot baseball as a metaphor, Mike described how product managers from green teams pick technicians from the blue team "benches". The technicians who develop reputations for skill and competence are picked often, while other technicians warm the bench. This selection process provides an incentive for technicians to stay up-to-date in their field. Technicians want to avoid the embarrassment of not being picked, and the more teams on which a technician works, the more money he or she makes. Also, working on teams is one of the best ways to hone technical skills and stay current with a field.

Mike described how major platform managers work with component product teams to develop customized products in a timely manner. He described the relationship between platform managers and product component teams as similar to that between railroad cars and a train. Components such as video tubes or input/output devices are completed and ready for market at different times. The platform manager may want to introduce a new product to the market at a specific time. Components or "railroad cars" that are ready when the product or "train" leaves the station are added to the product in a modular fashion. Components that are not ready when the current product is introduced are added to the next appropriate product when its train leaves the station.

Project management is now simpler. For example, there are few managerial levels, and less frequent and detailed project phase reviews. Boundaries between functions have been reduced or eliminated as in the case of merging manufacturing with development.

Lead-Time Reduction As A Competitive Weapon

Ron Steinkamp
Thomasville Furniture

Thomasville Furniture is an eighty-seven year old company that is based in North Carolina. It was acquired by Armstrong World Industries in 1968. It consists of three business units that generated $436 million dollars in 1990. Five thousand people are employed in wood operations ($300 million), 1100 people in furniture ($90 million), and 600 people in upholstery ($50 million). The company is highly vertically integrated. They have eleven plants that are focused by products (bedroom, chairs, dining room, etc), seven support plants (lumber processing, veneer), two upholstery plants, and two Armstrong furniture plants (low end, ready-to-assemble).

The furniture industry has been characterized by low concentration and low brand recognition among customers. There has been significant turnover among the top 25 companies, many of which were acquired recently by outsiders at high cost. This has saddled their parent companies

with high debt and lack of funds for investment in new technology. Retailers have shrunk from 29,500 in 1970 to 16,000 today. Furniture dealers traditionally have purchased goods at the International Furniture Market held twice a year in High Point, North Carolina. These dealers have no particular loyalty to any manufacturer. Goods that were manufactured in anticipation of sales at these shows often had to be heavily discounted if they were not sold immediately. The manufacturers often gave exclusive sales to a dealer in a particular geographical area or the prime choice of available stock.

Factory showrooms began to emerge in the 1970s. In response to anticipated demand, Thomasville built a new plant in Appomattox, Virginia in 1974. Armstrong headquarters staff were instrumental in introducing advanced technology and manufacturing methods, e.g., MRP II system (class A), computerized setups, and automatic storage and retrieval devices. They also introduced composite materials, embossing and foil technology. Factory capacity exceeded demand for quite some time, but the major problems were related to coping with the industry's existing marketing and distribution system. This system began to change in the early 1980s. K-Mart and Wal-Mart stimulated the growth of the ready-to-assemble furniture market, which led to single orders of 20,000 pieces of furniture. The Appomattox plant and another Virginia plant were producing products valued at $100 million annually by the early 1980s and achieving a satisfactory return on assets.

The majority of sales come from the wood or high value-added side of the business. As suggested earlier, the marketing and distribution system had to change if sales and profits were to increase. An analysis of inventory and delays found that inventory (1) was waiting in the warehouse for the right mix of pieces to be produced before shipment, (2) included heavily discounted furniture that was not sold at the show or before models changed, (3) waiting for pickup by trucks that were hired by the retailers, (4) held as work-in-process because of administrative delays, (5) held as options to buy by retailers, (6) held until a weak retailer's credit was cleared or was sold due to bankruptcy. A very small amount of inventory remained that could be characterized as "service inventory," that is, inventory to meet immediate customer demand.

The rise of the gallery system began to eliminate some of the serious inventory and delay problems discussed above. In this system, one dealer is assigned an entire line, which is displayed in natural settings. Forty-two galleries in the United States now show Thomasville furniture exclusively. Furniture is shipped often enough and in adequate time to meet customer requests, so discounting is no longer necessary. A gallery dealer must use a truck line that is endorsed by Thomasville and can make deliveries within a week. Retailers are no longer allowed to buy furniture on option. With such changes, Thomasville now produces and delivers products 85% in conformance with a thirty-day delivery schedule and is aiming toward 95% conformance. They can provide the same service to customers by producing 50% fewer units.

Ron believes that achievement of the next 10% improvement will be based on studying the processes that lead to customer satisfaction, from order receipt to delivery of the product. They are using nonfinancial measures that relate to customer satisfaction to help them achieve this, e.g., yield, late parts, in-stock service. Teams of hourly workers are analyzing processes to eliminate delays and improve cycle-time.

Thomasville believes that market presence and customer service are the ways to differentiate themselves from their competitors. Improvement in these dimensions has originated thus far from

efforts to transform the marketing and distribution system. Further improvement will come from encouraging manufacturing to produce to customer order rather than to meet volume or dollar targets and by reducing administrative lead-time.

Cash-Flow Implications of Reductions in Inventory and Lead-Time

Jim Ridings
Westinghouse Corporation

Jim provided an overview of Westinghouse's cost-time management concept that has led to significant reductions in lead-times, improved quality, and lowered costs. The analysis begins with the selection of individual operations for study. A cost-time profile can be developed for each individual operation, in which cost/time is measured on the Y axis and time is measured on the X axis (see accompanying handout). A curve is developed by designating the costs of materials and outside services as vertical movement of the curve, wait time as horizontal movement, and work as a diagonal with a slope that varies by dollars of pay per hour and time to complete the work. These profiles are studied — usually by cross-functional teams — to develop ideas for reducing either time or cost. The impact of actions taken on such ideas is to reduce the area under the curve.

These cost-time curves were studied first within manufacturing operations where cycle-times were reduced by as much as 50%. A 50% reduction in cycle time can translate into a 25% reduction in cost. Jim initiated such studies at Westinghouse's plant in Lima, Ohio. The focus included vendor selection, floor layout, rework, quick changeover of dies, machine up-time, JIT, satisfaction of internal and external customers, etc. By eliminating, reducing, and combining operations, the Lima plant reduced the number of indirect labor persons to ten. Non-value-added activities were taken out of the cycle wherever feasible. Jim also cited work done at a Westinghouse plant in Asheville, North Carolina that manufacturers circuit breakers. The reduction in cycle-time has left the plant half empty, and the plant is looking for new products to utilize its newly discovered excess capacity.

The concept has since spread to white collar work where the inventory is "invisible." This inventory includes all the knowledge and information needed before and after production, from the time an order is received until it is delivered to the customer. An early application in the Commercial Nuclear Fuel Division led to reduction of the time needed to design the refuel load that is required whenever a nuclear plant has to be refueled. This process, which involves hundreds of people and costs millions of dollars, used to take three years to complete. By analyzing the process, drawing the profile and finding leverage points, the division reduced the cycle to eighteen months. Since people were available to do other work, plant output went up. This division was one of the winners of the first Malcolm Baldridge Award for Quality in 1988.

More recent studies have focused on product redesign in order to reduce the amount of rework, that is, doing the work right the first time. Existing processes can be improved or new processes developed to do the work better. All of the studies undertaken so far indicate that reduced cycle time leads to improved quality and lower cost.

Jim then focused on the macro implications of cost-time management, in particular, on cash conversion analysis that is done primarily at the business unit level. Improvements in micro profiles at the operations, department or plant level reduce the cash requirements of a business, mainly by reducing requirements for inventory. Cash requirements also can be reduced by reducing the time between a customer order and receiving payment, i.e., reducing accounts receivable. Westinghouse reduced such cash requirements — mainly inventory reduction — by $920 million between 1982 and 1990. They also reduced compensation as a percent of sales from 41.7 in 1986 to 32.2 in 1990.

Jim showed plots of operating profit/sales and cash requirements/sales that permits businesses to be assessed on cash flow relative to profit generation (see handouts). Decisions regarding acquisition, divestiture and candidates for improvement can be made from such analyses. Forecasts of cash requirements also can be made for businesses with the same ratio of cash requirements to operating profits, that is, the same cash conversion efficiency.

Justifying and Tracking New Product Development Projects

Gerry Susman
Penn State

A common problem with measures for justifying new product investments is that they are not used consistently throughout the product life cycle. The measures used to justify new products are often different from those used to track the product's sales and profitability. This limits the opportunity for feedback on the merits of the original product justification. Gerry reviewed some of the most common financial performance criteria used to evaluate new products, e.g., net present value, revenue and profit contribution, return on investment, payback period, gross margin and return on net assets. Each one is useful, but also has drawbacks.

The ideal measure for both justifying and tracking new product development projects should be product-based to maintain continuity in assessing products before and after market introduction. It should take into account the type of product, e.g., "new to the world," "new to the company," product line extensions, cost reductions, etc., so that risk can be appropriately assessed. It should be cumulative so that the total return over the life of the product is assessed rather than only over specific short-term periods. It should compare the original capital investment to the revenue and profits generated, and, finally, it should approximate cash flow, that is, take account of depreciation, accounts receivable and inventory. Current accounting practice can lead to divergence between operating profit and cash flow, because money was spent (inventory) or not received (accounts receivable) during the accounting period for which operating profits are calculated.

Gerry interviewed twenty managers in nine companies for CAM-I to learn what methods companies were using to justify investments in new products, how they tracked product performance and rewarded people who were responsible for the product. He found that few companies used a "text-book" discounted cash flow analysis for projects. They were more likely to use such an analysis for large, new product's projects, but not for extensions or improvements of products with long lives. The calculations were seldom discounted or modified for risk and often were overridden for strategic reasons, such as maintaining customer loyalty. Most companies tracked product performance by

operating profits, without correcting for cash flow, and not tracking profits cumulatively. Few assessed the original product separately after market introduction or as a member of a product family. Most managers were rewarded on the basis of operating profits. Some supplemented this with nonfinancial measures or corrected for changes in net assets. Hewlett-Packard uses "break-even time" as a basis to reward all team members involved in developing, producing and selling a new product. Break-even time is the time required to recover all product development costs incurred from product conception.

Gerry reviewed some of the problems that companies faced in assessing product performance, e.g., assessing depreciation for capital that lasted for more or less time than permitted by current depreciation schedules, defining a product when it is a member of a product family that shares common parts, allocating R&D and marketing costs to the first or subsequent generations of a product family or to other products that may benefit from the R&D investment.

Some barriers to assessing products on a life cycle basis are organizational in nature, e.g., rewards for performance, career paths and strong functional orientations. Other barriers relate to unclear product definitions. Some facilitators include shorter product life cycles. Also, as products and family extensions proliferate, performance is more likely to be tracked on a product basis. Finally, the divergence between cash flow and operating profits may shrink as companies reduce cycle-time and inventory. Divergence due to depreciation may shrink also as less capital is invested in "brick and mortar" and more is invested that can be expensed in three to five years.

Developing and Implementing A Strategic Technology Plan

Dave Rea
DuPont Automotive Products

DuPont had $40 billion in sales last year; about 40% came from energy (Conoco) and 60% from chemicals and specialties, e.g., insecticides, polymers, fibers, chemicals. R & D expenditures were $1.3 billion and profits were $2.5 billion. The Automotive Products business had $3 billion in sales, e.g., parts, plastics, freon, and paint; paints alone had $1 billion in sales. Paint is becoming increasingly complex technologically. It has to be electrostatically applied and capable of being switched from one color to another within two seconds without overspray. There are two main segments to the automobile paint business; OEM and aftermarket. The product also is being driven increasingly by environmental issues, such as reduction of solvents and becoming water-based. Their domestic customers (the big three) are weakening relative to the Japanese and, finally, the fragmentation of the automobile market is creating a demand for a greater variety of paint colors.

Developing the technology to keep up with all of these changes is very expensive for a business in which profit margins are small. Thus, it was important that the technical function have a clear agenda of its role in the strategy of the business. Dave formed a technology council made up of middle level managers from the technical, market and manufacturing functions. They wanted to work on what was the proper goal for the technical function within the business. A technology planner and a consultant were hired also.

The council used a quality function deployment approach to technology planning. They tried to understand the customer's attributes and match products and technologies to these attributes. They got ideas about what to work on even though some of the products wouldn't be developed for several years. A common dilemma in trying to match customer attributes with company capabilities is that customers may not know the company's capabilities nor can they see much beyond three years into the future. They tend to suggest incremental improvements in existing products. Dave mentioned the distinction between delighting the customer and satisfying the customer. The former requires taking more than incremental steps in product improvement.

The council discussed whether viable new market segments could be created by combining existing market segments or breaking apart existing segments. The latter was judged more likely to be fruitful. Teams also were formed to discuss process innovation, which is particularly important given the trend toward water-based paints, increased throughput, and reduced cycle-time.

Two-by-two tables were used by the council teams to characterize DuPont's position in the market (as leader or follower) on customer attributes and products (high or low impact). The most desirable combination is to be the leader on attributes and products that have high impact on customers' preferences. This combination did not always characterize DuPont's position in the market. Also, it is difficult to generate the data to assess segments for leaders and followers and for high and low impact. The two-by-two tables can be developed for each segment, then combined to evaluate all segments. "Vintage charts" that show a comprehensive product plan and assumptions about the life-cycle of products within given segments can be used also.

Dave emphasized how important the process of joint inquiry and discovery was for developing conviction and consensus concerning the role of technology in strategy formulation and in understanding which product concepts will best match the customer attributes. A successful process will help the team sell its conclusions to all levels of management. The first iteration of the process took a year to complete and helped DuPont Automotive validate its understanding of its current core technologies, clarify its patent strategies, e.g., exclusivity, and take some steps toward implementing a technology commercialization process. The planning process is never complete nor perfect and the team expects soon to begin a second iteration of the process that is broader in scope.