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Reorganizing To Improve The New Product Development Process

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Polaroid Corporation

Polaroid has $2 billion in sales. Nine thousand of its 11,000 employees are based in the U.S., 2000 are overseas in the Netherlands, Scotland, Mexico and Brazil. The company was founded approximately fifty years ago by Edwin Land who stayed with the company until the early 1980s. The company generates approximately one-third of its sales from family/ amateur photography, one-third from industrial users, and one-third from business/amateur users, e.g., real estate agents, police.

Carole discussed a variety of initiatives she has undertaken since becoming Vice President, Corporate Quality three years ago. The new product development process and product quality, in particular, cannot be improved without dealing with the system as a whole. Piece-meal change will not work. Polaroid had to transition from being very internally focused around R&D to becoming more market-focused.

Shamrock's takeover attempt in 1988 was a turning point. Polaroid survived the attempt by establishing an ESOP through which employees bought 15-20% of the stock. Employees acquired shares through an 8% reduction in salary. The new owner-employees are now much more conscious and critical of management decisions and less tolerant of waste and poor quality. Cost cutting and severances led the company to record profits in 1988, but earnings were flat in 1989. This led the company to recognize that future profit growth would not come from cost cutting, but from increased dollar sales from new products and new applications.

Before becoming a VP, Carole had been a director of manufacturing and a plant manager. Her approach to quality improvement was to design products with direct input from customers. This had not been done previously at Polaroid. A key issue after Lands's departure concerned who would make product decisions. Many roles and responsibilities were in need of clarification.

Carole started asking plant management what were their customer's telling them about their products. They were not used to collecting such information. When they did, they discovered that Japanese and American customers differ markedly on what product attributes concerned them. Carole established a Customer Satisfaction Office in 1988. The personnel in this office were technically oriented, but knew how to get functions together to talk about issues.

Also in 1988, Carole introduced a process for clarifying product requirements. She asked marketing and engineering personnel to sit in the same room and agree in writing about what each wants in a new product. Each function used to blame the other for product delays. Quality Function Deployment has eliminated a lot of these difficulties. Carole hired a Director of Quality Technologies in 1989 to develop a cadre of QFD facilitators. The products that have been developed using QFD have had very few design changes during the development process.

A corporate quality steering committee was established two years ago to guide the total quality commitment. This senior level commitment has produced a number of local initiatives to improve quality in various parts of the company. Carole also initiated some corporate retreats during which current organizational structures and practices were examined and changes made where appropriate.

Carole is currently spending about 75%-85% of her time on the "Product Delivery Process" which takes a product from development to market introduction. She has asked the relevant functional managers to agree on the stages of product development and the activities within each stage. She also has been working on a process by which to prioritize new product development projects. No particular prioritization process is best, but agreement on a process is critical.

Virtually every manager must take a course in statistical process control. The course is taken one full day every week for twelve weeks. New types of predictive tools are being developed (via sensitometry) which will take some of the guesswork out of determining what customer reactions are to changes in the light, color, etc. of photographs.

Polaroid was organized around functions until 1990. In April, the company was reorganized into business sectors. The business sectors are family, business, industrial. There also is an electronic imaging group which works with each of the business sectors. Separate groups for research, product development and manufacturing remain, but each assigns a staff representative to work within each sector. These sectors do not have independent capital structures; so many economies are possible from sharing equipment, nor does each sector have profit and loss responsibility. The purpose of the reorganization is to facilitate customer focus.

Carole has been working recently on clarifying cross-functional relationships between research, product development and manufacturing. This is being done by bringing together all the relevant people and having them discuss cross-functional barriers and how to deal with them. They are required to develop a statement of mission, procedures for allocating funding, defining teams, etc.

Supplemental Comments Made in Discussion Groups

Polaroid is encouraging personnel in Research to follow their products into Product Development, although such movement is voluntary. Management encourages product teams to focus on the total project budget, rather than on the budget for each function.

Carole commented on a visit she made to Konica about two years ago. Konica spent a great deal of money on redundant quality systems, the sole purpose of which was to avoid customer complaints. Such investments did not have to be justified by the usual return on investment criteria.

Polaroid devotes as much effort to developing self-directed work teams among salaried employees as it does among hourly employees. Employees of either type can bid for placement in such teams at their discretion.

Assessing Product Life Cycle Performance Using Cash Flow Techniques

Bob Wurtzelbacher
Procter and Gamble

In October 1987, Procter and Gamble changed its business units from brands to product categories. Brands like Pampers previously competed with Love, Dash with Tide, Ivory with Camay, etc. Now all similar brands were assigned to a category general manager to whom R&D, marketing, advertisement, and finance reported. A new unit called Product Supply was created also. It had responsibility for purchasing, engineering, manufacturing, and customer services; in other words, for the entire chain from supplier to customer. Functions were subordinate to product categories and to Product Supply. P&G has thirty-nine product categories in 140 countries and annual sales of $24 billion.

In April 1988, all managers within product categories began to be evaluated on overall category profitability instead of on function-based criteria. Marketing had been rewarded previously on market share, sales on number of shipments, manufacturing on efficiency, etc. Bob would have preferred the new common measure to have been cash flow instead of profitability. Aside from senior management preferences for profitability, there was the issue of whether P&G's information system could have provided the data to track performance or to determine compensation. The accounting people did not collect data which could be used for tracking performance or determining compensation. Also, decisions based on cash flow treat depreciation differently than decisions based on GAAP (generally accepted accounting principles), e.g., GAAP specifies 20 years on plant depreciation, but the life cycle of a product produced in a plant built exclusively for the product might be only four years.

Bob presented a case study which he and his staff had written (see enclosed case or write CMTOC for a copy). The case study involved a new product introduction that required a $116 million investment. Assumptions about potential market size and market share led to a $36 million net present value (NPV), assuming a product life cycle of ten years and a discount rate of 10%. However, the potential market size was underestimated. Nevertheless, the product team could make up for the shortfall in volume by achieving a market share beyond that originally projected. This would require an additional $20 million investment and delay the product introduction by one year in order to launch a more aggressive advertising campaign. The case was written so that all function-based objectives were met or exceeded as was the target for after-tax profits per year; however, the NPV within the original ten year time-frame was a negative $3 million on a $136 million investment. All function-based team members would "win" under this scenario, but the company would lose.

The case highlights the conflicts that exist between assessing project performance on function-based criteria, short-term profitability or NPV over the product life cycle. The case also was designed to elicit answers to three questions. (1) Should projects be tracked on the same basis as that used to make initial investment decisions, i.e., if cash flow is used to make initial investment decisions, then why not use it to monitor and evaluate investment performance? (2) What project-related data are incorporated into the managerial accounting system? (3) Does the data collected affect compensation?

A general discussion followed the case presentation during which the following points were raised. (a) DCF is better for comparing projects to each other than for making absolute judgments about their merit. (b) The actual plan almost always differs significantly from the original plan so modifications in DCF calculations are frequent. (c) New products can be introduced that complement an existing product line even if the DCF is negative. (d) Was risk mitigation considered as part of the investment plan? (f) Rewards that are too far removed in time from actual behavior will not reinforce that behavior. This could happen with decisions made on a life cycle basis. (f) Rewarding managers on function-based criteria can lead to promotions before any meaningful profitability or NPV results can be assessed. Brand managers at P&G (marketing function was previously dominant) used to get paid for ideas, not profitability. (g) The current reward system encourages managers to be risk averse and support product extensions rather than new product launches. One highly successful new product may be worth twenty failures, but can the reward system tolerate that? (h) Can the person who makes the initial product launch decision be objective enough to make an abandonment decision, if results warrant it? Does the reward system provide sufficient incentives to make abandonment decisions when it is the correct decision?

Bob pointed out that adding new features to an existing product at P&G is a capital initiative which must be justified by DCF. However, the calculation wouldn't be burdened with the costs of the existing plant. Such costs are viewed as sunk. Plant investments to meet capacity increases for an existing product do not require payout justifications as they are viewed as part of normal market growth. On the other hand, abandonment decisions do require payout justifications.

The concept of value options was introduced as a basis for assessing projects. That is, an investment can give rise to a "call option" which assesses opportunities that wouldn't exist for a firm unless the investment were made. An investment could have a negative payout, but its call option could have a high value. Apparently, McKinsey has done some work on this concept.

Since CEOs are assessed according to GAAP-based profitability criteria, they are inclined to assess others using the same criteria. Although GAAP does not prohibit the use of internally generated performance measures to assess and reward managers, no publicly held companies appear to use them.

There was consensus that multi-functional teams were a necessary prerequisite to successful use of profitability or cash flow as a basis for rewards. If we track the right data, then we can show function-based team members what the implications of their decisions are for profitability. Any team member then might be willing to take a hit from their function's perspective in the long-term interest of profitability.

Supplemental Comments Made in Discussion Groups

Broad product lines can be good for P&G when competing for shelf space in supermarkets. P&G can cut distribution costs by delivering a larger variety of products (from different product categories) to the same supermarket.

Since R&D is expensed at the corporate level, it tends to make category managers look good. GAAP tends to be kind to them.

Category-based profitability raises a question about who benefits and who is hurt when plant consolidations take place. Consolidations mean lower profits, but higher cash flow. What usually benefits cash flow tends to hurt profits. Why would a manager write-off a plant if he or she were rewarded on short-term profitability? Bob suggests that the corporate level take the write-off, rather than operations so as not to penalize them. Sometimes more plants can mean more flexibility. However, Bob says that managers at P&G almost always opt for consolidation because of lower total burden per case and higher efficiency. From an overall company perspective, responsiveness may offer more competitive advantage than does efficiency. New developments in flexible technology may change these managers' preferences.

Unquantifiable criteria are increasing relative to the quantifiable. Bob recommends a higher hurdle rate for the unquantifiable. Also, it is possible to speak of ranges for the unquantifiable rather than specific numbers. The senior levels tend to want a specific number. Why not 90% accuracy for a range rather than a 75% accuracy for a specific number?

Bob believes that any operation can be adequately described with no more than five measures (non-financial measures), e.g., number of cases produced per day, number of crew members, percent yield, number of customers called, square feet of warehouse space used. These measures could be easily compiled, but they are not.

Applying Activity-Based Cost Accounting

Howard Kutcher
ALCOA

Howard introduced a methodology by which cross-functional teams can achieve clarity and consensus on a common task. The methodology also can help the team and higher management achieve consensus on customer needs. Functional representatives tend to wear filters when they try to retrieve information relative to a common task. They collect information and solve problems independently, then present solutions to other team members that reflect only their own functional perspective. It is no wonder that conflict and wasted effort occur.

Perspective Understanding of Multifunctional Perspectives or "PUMP" was developed to help teams undertake an inquiry together so that they can reach consensus on any number of organizational or manufacturing processes and their cost, e.g., facilities, equipment, quality specifications, etc. PUMP was developed a few years ago and, in fact, Howard had made a presentation on it at an Advanced Manufacturing Forum meeting in October 1987. However, PUMP has been updated as PUMP II. The update allows users to identify and assign costs to the processes they identify.

Pump I and II can serve as a foundation for gathering information that can be used in conjunction with other tools such as QFD, FIX (a software package for collecting and documenting information on processes), Structured Analysis Design Technology (SADT), IDEF, and various types of process modeling and graphical simulation tools.

PUMP has six perspectives which Howard represented as sides of a cube: (1) the business or strategic plan, (2) a written description of the process tasks needed to accomplish the plan, (3) a process flow chart, (4) resources needed to accomplish the tasks, (5) integration of the layout with

task requirements, (6) information needed to accomplish the task. PUMP II adds a seventh perspective which is a costing system that is based on the foundations built by the first six perspectives.

Howard concentrated on perspective 3, the process flow chart. He listed a set of manufacturing processes and asked what was required to support these processes (plant facilities, materials, process support), as well as whether buffers or scrap existed. He used a framework called SIPOC (Supplier, Input, Process, Output, Customer) to identify the requirements to move from one process to another. Every process can be subdivided into smaller processes. This level of detail is ideal for allocating time and cost to processes and movements between processes as well as for assigning the cost of commodities to products. Howard called the cost information generated as "truth in engineering." A manager can now see the true cost of maintaining a buffer. Costs for labor, supplies, materials, etc. that were spread across many products can now be assigned directly to the products that use them. Costs that often were overlooked can be tracked.

Howard said that some clients resist learning what PUMP can surface about their organization and practices, i.e., "they don't want to find out what they don't know." However, accounting more readily accepts cost estimates generated by PUMP because they better understand how they were derived.

Market and Technological Change as Determinants of Productive Capacity Decisions

Rocki-Lee DeWitt
Penn State University

Productive capacity decisions e.g., plant size, location and product mix, are typically analyzed using standard capital budgeting techniques that equate up-front expenditures with an expected stream of inflow, discounting the inflow with the value of money over time. Limited attention has been given to the underlying assumptions that are made about the expected life of the project and the returns associated with it. As a consequence, managers have made investments in productive capacity that: (1) were insufficient to meet demand, (2) were never operated because demand never materialized, and/or (3) never realized the operating efficiencies they sought.

Rocki outlined a strategic framework for productive capacity decisions that explicitly incorporates market and technological changes into an industry life cycle model. An industry life cycle aggregates separate product life cycles that are related by a common product, market and/or technological characteristics. The industry life cycle model is a useful tool for understanding productive capacity decisions because: (1) it provides insight into the types of market and technological changes that productive capacity choices must address, and (2) it offers creative alternatives for productive capacity investment when similarities in market and technological changes between the various industry life cycle stages are used as a guideline to productive capacity investment.

Similar to a product life cycle, the industry life cycle has four stages: introduction, growth, maturity and decline. The determination of which stage the industry is in is made by observation of the aggregated rate of growth of products associated with the industry. Similar to the product life cycle, rapid increases in market demand occur in the introduction and growth stages. During maturity, the

market becomes saturated and demand plateaus. In decline, demand for the industry's products, even on a replacement basis, drops.

The productive capacity requirements of a business depend upon the market and technological characteristics that are present in each stage of the industry life cycle. During the introduction stage, the market and technologies used to serve those markets are first being defined. There are a few products produced by few competitors for a few customers. Productive capacity investments are tentative; small, typically leased, production facilities are located proximate to either material resources or customer locations. For example, Steven Jobs used a garage to assemble the first Apple computers.

During the growth stage, the market expands rapidly and new technologies are developed. More products are created (both initial products by new entrants and second-generation products by existing competitors) and customer acceptance increases. During growth, managers are less tentative as investments are warranted by demand and the technology becomes more standardized. Managers' expectations about how large the industry will get and their business' position in that industry are used to form projections about the productive capacity that is needed. Owned facilities are constructed to meet these expectations. Whether these facilities are located close to the previous facilities depends upon managers' improved knowledge of where customers are located and the availability of resources. Families of products are likely to be constructed under the same roof where common components or input skills are required.

During maturity and decline, market growth plateaus, then declines. Technologies are relatively well-defined and productive capacity decisions focus on replacement of existing, antiquated manufacturing locations and/or limited construction of facilities for new products. There is a hesitancy to build new facilities as projection of how long maturity will persist and what the rate of decline in growth will be is uncertain. Under these circumstances, which are similar to the market and technological characteristics of the growth stage, except in reverse, managers must seek creative solutions to productive capacity decisions because there is a ceiling on the technological efficiencies realized from process improvements in existing facilities. Furthermore, improvement of existing facilities usually requires interruption of production, which may be detrimental to the company's market position. Productive capacity decisions in this stage require a reversible decision.

Reversible productive capacity decisions provide a flow of required product that can be stopped with minimal occurrence of continued outlay for maintenance of facilities and personnel. Alternatives include sub-contracting production, leasing a previously mothballed facility, and/or utilization of excess capacity at other manufacturing locations within the corporation. In each of the aforementioned alternatives, the ownership of the facility reverts to the original owner upon termination of a contracted period of operation. In addition, responsibility for the pension obligations of the workers associated with those facilities is limited. The major downside of these alternatives is that if demand rebounds, the company may be limited in its ability to add these facilities. But, since the likelihood of rebound is smaller than the likelihood of continued stagnation of decline, this risk is minimal.

In summary, while productive capacity decisions during introduction and growth stages are designed to establish a market position for a company, productive capacity decisions during maturity and decline should be designed to allow the company to gracefully withdraw from the market. Reversible productive capacity decisions provide an alternative to managers who are faced with a situation that requires additional productive capacity, either as a replacement of existing facilities or as support for a product that is introduced during the mature or decline stages of the industry life cycle. These

alternatives minimize the responsibilities of ownership while allowing the company to continue to serve the marketplace.

Computer Simulation as an Aid to Decision Making Over the Product Life Cycle

Dave Christy
Penn State

Many manufacturing managers have complained that the justification procedure for investment in advanced manufacturing technology and plant reconfiguration is a major block to innovation in product and process technologies. For the past several years, the professional business press has been filled with articles regarding the lack of compatibility between measures of performance in finance and manufacturing. While some firms have found solutions that avoid this incompatibility, Dave believes that modeling tools that are currently available can be used to address this problem. He proposes combining financial data with alternative manufacturing system configurations to build "cost models." These cost models should be useful in strategic deployment of manufacturing resources, justification of investment in manufacturing, and product/process planning.

Sample Scenario: A facility currently produces three products, and is committed to introducing two more some time in the future. The configuration of equipment is a traditional job shop. Several alternative situations are under consideration by management, including:

- The timing of introduction of the new products
- Should any existing products be discarded, or assigned to another facility?
- What is the reliability of the manufacturing technology?
- If products follow a traditional product life cycle model, what is the rate of increase/decrease in demand? What is the steady state demand, and how long will it last? How do these possibilities affect capacity utilization and cash flow?
- What are the routing and scheduling procedures on the shop floor?
- What is the effect of learning of our production efficiency and cash flow?
- What procedures does our accounting system use to allocate costs? How sensitive is the cash flow outcome to this procedure?
- What alternative configurations can be used to manufacture the products? What is the effect of allocating machines to cells on cash flow? What is the impact of introducing a dedicated machining center? Which products should be assigned to it? Should we salvage old equipment, or maintain excess capacity?

Notice that the system that he describes is flexible enough to evaluate product mix changes, volume changes, technology changes, and assumptions about the product life cycle for each product. A network model of a project can be incorporated into the events that occur in the simulation.

Computer simulation software has been advancing in the sophistication of both what can be modeled and how the results of simulation experiments can be displayed. Concurrent with added manufacturing and material handling phenomena to simulation software, the 1980s witnessed the development of sophisticated animation software that could be employed to illustrate the movement of material in the system, including queue lengths, elapsed time, and many other features. Animation made simulation experimentation more easy to understand for non-technical managers. More recently, these modeling languages made export of data from simulation experiments possible, in formats acceptable for financial planning, such as 1-2-3 spreadsheet.

Using the comprehensive data collection and activity tracking capabilities of simulation, Dave and his colleagues can conduct manufacturing experiments with sample scenarios and with various parameter values. Counters can accumulate transaction data. Time weighted variables can accumulate the value of products as they progress through the system. Project management milestones, with their associated cash flow implications, can be included in this single model, and a period by period cash flow outcome can be computed and plotted.

Using R&D for Competitive Advantage

Fred Honnold
Carrier Corporation

Carrier faces tough competition both from the low cost "copy-cat" producers who spend little money on R&D and from the Japanese who compete quite vigorously with R&D. Five of the six top worldwide air conditioning suppliers are Japanese (Matsushita, Hitachi, Mitsubishi, Toshiba, and Daikin). Carrier is still number one in total sales and is 75% larger than its closest competitor.

Carrier offers 23,000 models and 320 product lines worldwide. Their products range from 1/2 - 10,000 tons capacity. Annual sales in 1989 were $4 billion, having risen from $1.5 billion in 1980 and $2.5 billion in 1985. They have 34 plants worldwide. Much of the recent growth has been through foreign acquisition. They have 50% market share in Italy and Spain and 60% market share in Brazil. The total market is $24 billion and is divided equally among American, Japanese, and all other markets. Carrier has a wholly-owned company in Japan, but has only about 1% total market share. As Carrier's market share in the U.S. is 25%, they are unlikely to make any domestic acquisitions because of possible FTC reaction. However, they will continue to make foreign acquisitions.

Fred acknowledged that Carrier had taken its eye off the Japanese in the late 1970s and early 1980s. During this time, the Japanese focused on developing rotary compressors and reducing sound levels. However, Carrier undertook a major re-engineering program in 1985 which has resulted in 90 new products which now account for 90% of sales. The company focuses on five core technologies (compressors, air management, heat transfer, electronics, and refrigerants). The last one is new due to increasing concern about chloroflurocarbons and their impact on the ozone layer, global warming, etc. Each core technology is headed by a director, except for compressors which have separate directors for hermetic (rotary and scroll) and commercial compressors (semi-hermetic reciprocating and screw).

Compressors make up 25 - 50% of direct product cost and are the major contributor to product reliability, sound, and efficiency. Carrier used 2.9 million compressors last year. Most were reciprocating. There is a big opportunity to reduce costs and improve product features by switching to rotating compressors. The objective in 1985 was to establish a leadership position in rotating compressors. They wanted rotating compressors eventually to cover the range from 1/2 - 350 tons. Currently, types of compressors cover the following ranges: rotaries (1/2 - 2.5 tons); scroll (2 - 15 tons); reciprocating (7.5 - 40 tons); screw compressors (30 - 350 tons); and centrifugal (100 - 10,000 tons).

Carrier also has a major initiative in simultaneous engineering. They have used project teams since the 1960s, but they realized that more was needed. Simultaneous engineering has helped them reduce lead-times by 33 - 50%. Project team members interface very early in the project. This is reducing the number of changes required following final drawing release. The entire team (engineering, marketing, manufacturing, finance, etc.) has focused sessions with customers so that product specifications can be established up-front. Suppliers are becoming members of their project teams also. Management tracks the number of engineering changes after drawing release and holds engineering responsible for this number. They also are looking at total design time, turnaround time for reliability qualification and for materials analysis, how well specifications are met, and number of field failures. Teams also assess internal, as well as external, customer requirements.

Carrier does extensive benchmarking through its Engineering Council, made up of 25 directors of engineering and numerous program managers from all over the world. They meet twice a year and review the status of the competition. Development engineers buy their competitors' products and analyze them.

Carrier is trying to reduce the number of models it offers, but recognizes that the Japanese are increasing their range of models. The only way to deal with this and manage costs is to standardize as many parts as possible, and increase factory flexibility.

Carrier sourced its first rotary compressors from the Japanese and began producing its own compressors in December 1988 when they opened a factory in Kwangju, South Korea. Engineering headed the project team and carried the project through plant start-up. Full capacity was achieved before there was a hand-off to regular plant operating personnel. The engineering manager who headed the team for the Korean factory had a good manufacturing background, as did other engineers on the team.

There is no separate program office. Development projects are managed by engineering, with responsibility for design engineering and manufacturing processes. They are evolving toward a single job classification of product design-process engineer, as the Japanese have done already. They also are moving the proportion of R&D dollars towards more process engineering. The current U.S. distribution of R&D is 60% product design and 40% process. The Japanese have the reverse proportion. Carrier is training their manufacturing engineers in finite element analysis, strain gauge measurement, etc. They have a single worldwide engineering/manufacturing CAD system, to which suppliers are now being linked.

Carrier has a ten-year technology plan. It is based on expected advances in core technologies over the next ten years. R&D was 2% of sales and is now approaching 3%. Research is conducted both at Carrier in Syracuse and at the United Technologies Research Center in East Hartford. The

Carrier plan is global in content. While efficiency is the key competitive issues in the U.S., sound is more important elsewhere.

Carrier uses three other brand names in the U.S. in order to differentiate its product line; e.g., Bryant, Day & Night, and Payne, but the Carrier name always will be associated with the most advanced technology. Most of Carrier's domestic competitors are not technology leaders nor major exporters.

The rotary compressor team was able to develop a family of three rotary compressors within three years. All three compressors are produced on the same line. The tolerances are extremely tight (3 - 4 microns on the cylinder roller). The Korean plant is partially automated, at least where it makes sense; e.g., for assembling parts with very tight tolerances. The classified parts for the new compressor have been reduced from 142 to 26. A new compressor can be assembled in 20 seconds. The team searched the world for machine tools that could machine the entire family of compressors. Carrier does not develop their own machine tools, but seeks state-of-the-art equipment. Carrier is now the leader in reliability and efficiency.

They are now able to manufacture scroll compressors at a lower cost than reciprocating compressors. Special high-speed production machines are necessary to achieve this. The goal is to reduce machining time for the scroll by a factor of 10.

The Arkadelphia, Arkansas plant is Carrier's largest capital investment ever for a single new product. The project began in 1987 and will be completed in 1992 when the plant opens. Engineering is responsible for everything. The team consists of 60 - 70 persons. Its membership includes a patent attorney, product designers, evaluation engineers, manufacturing engineers, research, and engineers from suppliers. More recently purchasing, quality assurance, finance, materials engineering, human resources, and production people were added. The screening process for employees and managers is rigorous. An average of 20 people are interviewed for each hourly job. They are selected on attitude as well as on technical skills. The state of Arkansas is providing substantial training support.