HIGHLIGHTS

of the

Thirty-First

Advanced Manufacturing Forum

November 10-12, 1993

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

The Pennsylvania State University
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Managing Technology And Product Platforms Across The Product Life Cycle

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Eastman Kodak Company

The Kodak Imaging Group (KIG) recently reorganized its research, development and manufacturing functions into a new centralized and highly leveraged structure which serves multiple business units. Previously, these functions were decentralized and located within the business units. The intent was to develop "platforms" or sets of technologies, product subsystems and/or manufacturing processes which can evolve and be used to enable multiple generations of products. A successful platform can give a company a sustainable competitive advantage over a substantial period of time. The Sony Walkman, Canon's Xerographic printing "engine," and Kodacolor technology are examples of the successful use of platforms.

Eastman-Kodak had approximately $20 billion dollars in sales in 1992. KIG represented about 60% of total corporate sales. Health and chemicals generated the remaining 40%. There are four business units within KIG; Consumer (film, cameras, processing, prints, photo CD), Professional and Publishing (film, systems, electronic cameras), Office Imaging (copiers, printers, microfilm), and Motion Picture Film.

KIG invests $800 million a year in R&D, commercialization and new manufacturing processes. About 70% is invested in photography and 30% in electronic imaging. The business units are its customers. Bion provided an overview of four management tools that help KIG manage technology.

The first tool was the Technology Management Tree, which provides a way to trace links between technology programs and platforms, products, business units and markets. For example, the Technology Tree can show how many platforms and product systems (commercialization programs, product categories, and product systems) a specific technology project is linked to. In turn, how many products, etc. are linked to business units and market segments that they serve. Revenue projections can be determined by moving backward from market segments, while cost projections can be determined by moving forward from technology projects, commercialization, etc. The Technology Programs seek business unit funding for promising technologies. The business units will fund the commercialization of projects that show promising revenue projections.

The second and third tools concern the Program Business Plan and the Commercialization Process, as well as the link between them. The commercialization process consists of seven phases. A small product planning and business development team determines the attractiveness of a concept and its link to the business strategy (Phase 0). Elements of the business strategy are linked to ideas received from the labs, customers, employees, etc. A cross-functional Core Program Team is formed if the concept is judged to represent a good business opportunity. This team develops a twelve item business plan, which includes a marketing plan, manufacturing plan, financial calculation, etc. The remaining phases of the commercialization process are carried out once a commitment is made to develop a product.

The fourth tool is the Sourcing Decision Tree which helps in deciding what to buy outside versus make internally. If the decision is to make internally, then subsequent decision branches concern whether to make or outsource assemblies, subassemblies, and components. These decisions are aided by use of a cost/performance matrix. For example, if a component, etc. has high impact on performance and is high cost, then consideration should be given to outsourcing the component (unless it represents a core competence or proprietary technology). Low performance, low cost components generally should be outsourced. The company produces high impact, low cost components in-house. Complex imaging systems have numerous components and assemblies, each of which can be plotted on the matrix. A cross-functional team decides on the in-house/outsource mix.

KIG's centralized research, development, and manufacturing structure has been in place about eighteen months. The processes and tools described above have facilitated communication among cross-functional stakeholders. They have been helpful particularly on making strategic sourcing decisions. They stimulate behavioral change as well as indicate what kind of behavioral change is required to make these processes and tools effective.

The Research and Development and Technology Management Philosophy of the Fanuc Company

Inyong Ham
Penn State University

The success of the Fanuc Company and, in fact, of most Japanese companies is based on how technology is managed and on a complex system of supplier relationships. Their success has little to do with just-in-time systems or quality circles. Japan also has a competitive edge which is based on the high literacy rate of its workers and the large percentage of engineers that graduate each year from its universities. Sixty-eight percent of Japan's college graduates are engineers compared to 28% in the United States. Furthermore, 85% of Japan's engineers read English scientific journals, while only 4% of Americans read Japanese journals and 9% read Japanese journals translated into English. Japan is now first in the world in numerical control machinery, Germany is second and the United States is third. Japan and the United States have reversed their positions since 1980. In 1987, Japan was first in machine tools, West Germany was second, and the United States was fifth. The health of a country's machine tool industry is an important indicator of its manufacturing capability.

Fanuc has 50% of the United States market in numerical control machines and robots, 60% of the world-wide market and 80% of the Japanese market. It has formed 50-50 joint ventures with General Motors and General Electric. In each partnership, Fanuc develops the hardware and the American partner develops the software. It expects to rely heavily on partnering as a means of future global growth. In 1990, Fanuc ranked second among all Japanese companies on a financial performance index developed by Nippon Keizi, and ranked first in 1989 among companies in the electrical industry.

The company has two research labs. Its product development lab employs 600 engineers and focuses on short term commercialization objectives. The basic research lab has a five to ten year time horizon and can be accessed only by Dr. Inaba, who is founder, CEO and president, and by a small number of senior research staff. Dr. Inaba tells his engineers that technology is an accumulation of the past; engineers have no past, the future is the only basis for creativity. Fanuc's culture includes

large clocks that run at ten times normal speed to remind everyone that time is too precious to waste. When Dr. Inaba convenes a management meeting, section managers (80% are engineers) take assigned seats that are based on their recent performance. The successor to Dr. Inaba was designated four years ago. Several managerial levels were by-passed in making this selection.

Fanuc does not have quality circles. The company's philosophy is that if a shop-floor worker can identify a problem, then the source of the problem is a flaw in the design of the manufacturing system. Design engineers are expected to live on the shop-floor and design the manufacturing system right the first time or redesign the system if flaws are detected. The company never strays from its core competence, which is to produce numerical control machinery and control motors. It develops products which have a cost structure of 70% electronics and 30% mechanics. This applies to NC, robots and recently to plastic injection molding equipment.

Fanuc's sales force consists of engineers. Their sales slogan is "first friendship, then sales." Customers are never given discounts, however. Prices are lowered if the competition is cheaper, but if this were to occur, the equipment would be returned to the designers to find ways to lower its cost. Before a product development project begins, a thorough study of the world market is made so that prices can be set low enough to be invincible for five years. A certain amount of profit is subtracted from the price, leaving a cost target for designers to meet.

Customer-Focused Design: Designing for Ease of Installation and Maintenance

Dave Harroun
Johnson Controls

The Commercial Building Systems Division is one of the oldest within Johnson Controls (JCI). Its core competence resides primarily in pneumatic controls, which are a key component of building control systems. JCI customers are primarily general contractors, service and building maintenance companies that are more concerned with total installed costs rather with the cost of the equipment itself. Dave used the expression "inside/out factory" to describe JCI's manufacturing process because a system is not operational until it is installed at the customer's site.

JCI had been making a "me-too" product for over twenty years by letting its competition be the design leaders. It was viewed as slow to market and technologically backward. One of the companies most senior managers started to change that by issuing a directive not to design another incrementally improved product, but to design a "great new product" that could be installed at considerably lower cost. There clearly was potential to design such a product because materials costs accounted for only 20% of product cost, while labor costs accounted for 80%. The company had appropriate engineering skills to design product components, but did not have the in-house skills to design a radically new product. Consequently, it hired GVO, an industrial design consulting firm, to help them design a new product.

JCI recognized early that their current line of control boxes had a safety problem because line voltage (very dangerous) and low voltage were very close together. Several different power sources fed into the same control box. The division of labor allowed workers who worked only on low voltage

to work very close to line voltage. The same problems occurred for workers who worked on pneumatic controls. A typical installation involved five unions at a given site.

An early lesson was that QFD led to data overload. The amount of data drawn from user's statements from management and staff was overwhelming. GVO recommended that QFD be replaced with the Product Value Matrix, which offered a set of guiding principles for a product redesign. The principles concerned the purpose of the design, as well as physical, cognitive, aesthetic and evaluative dimensions. Input on these dimensions were sought from corporate planning, marketing, development, first use training, customer service, repair, refurbishing and reselling. The goal was to look for fits on these dimensions by these personnel. Their inputs and concerns tended to vary by phases of the product life cycle. Eighty percent of their inputs could be designed in at the front end.

The design goals included lower installed cost, flexibility for future growth, repair by untrained staff, 50% of cost in installed labor. The product was designed so that components could be replaced easily. Line and low voltage were separated by color-coded "troughs" which were easily identifiable. Frequently replaced parts were made from high impact injection molded plastic, which could be replaced with parts from any manufacturer in the industry, most of whose components are not plastic. (Over forty American cities have now approved of the use of plastics parts in control boxes.) The "plug and play" modules had integrated pneumatics and electronics.

The front-end process took more than a year to complete, but has shortened the overall development cycle which previously was four years. Although the front-end process was thorough, the product still required three major redesigns. More than a million dollars has been saved by learning from customer focus groups what not to include in the product.

The success of the new "Metasys" product line has allowed JCI to make inroads into the market share of their primary competitor, Honeywell. The front-end effort has paid off both in the design of an attractive product, and in the satisfaction in collaboration that has been expressed by design team members.

Conceiving and Designing Products for a Cost Conscious and Capital Constrained Market

Roy Armstrong
Du Pont Medical Products

Du Pont Medical Products (DMP) develops and manufactures medical products that analyze body fluids for diagnosis and treatment of diseases, therapeutic drug monitoring, drug abuse, and substance toxicity. Its products are used in hospitals, clinics and commercial laboratories. DMP's focuses primarily on automating existing lab analytic techniques. Its products are becoming increasing software intensive. The product also needs to be able to handle reagents effectively during analysis as well as to package and dispose of them safely. Integration of their information with that from other hospital systems is a challenge and a competence which DMP believes it has. Their equipment automates data generation and retrieval; the physician still does the diagnosis, however.

The market for DMP's products focuses primarily on cost reduction. In addition to automating data generation and retrieval, productivity may be enhanced by reducing the amount of reagents used, and by reducing the need to reanalyze samples. It performs tests primarily as physicians want them even though some innovation in methods could cut costs further. Physicians are conservative because of the risks of malpractice. Hospital and lab administrators are more cost conscious and are DMP's basic customer. Product evolution has responded to and helped accelerate the reduction in staff employed in labs as well as in staff skill levels. Work once performed by skilled lab technicians can now be performed by a person with a high school degree.

Customers have been demanding greater product performance and breadth of offering as well as raising their expectations for product support and response to inquiries. Food and Drug Administration (FDA) regulations are becoming more demanding, which affects how the product is to function in the lab as well as how it is to be manufactured. Some of the implications for product performance include twenty-four hour operation, readily available support, more sensitive analyses for fluids with low concentration substances, capability for integration with other lab information systems, and ability to generate data for use for FDA reviews.

DMP's product development process consists of five phases. Business opportunities and financial returns are assessed during the Business Analysis Phase. A Core Team is formed if senior management approves the project. The team is responsible for Feasibility, Development, Preparation, Launch & Scale-up. All major functions are members of the core team from the team's inception until the product has been introduced to the market. Core team leaders generally come from R&D, and members are usually assigned full-time to a specific project. A Business Leadership Team consisting of senior function and product managers oversees DMP's entire product development process. A subset of this top-level team, the Product Approval Committee, monitors the progress of Core Teams and allocates resources to them as they are needed.

Roy showed some diagrams that DMP has found useful for understanding the relationship between complexity and project outcomes. These diagrams have led DMP to divide a complex project into a series of less complex, but successful projects and raise the probability of overall business success. The diagrams also have encouraged DMP to appreciate the impact that front-end work on product definition has on cycle time reduction and reduced engineering effort. Some of the front-end work consists of the use of focus groups, QFD, etc. The core team remains intact during field trials to get feedback from customers. After the core teams are disbanded, feedback is received from service personnel and from their Customer Response Center.

DMP has been in the medical products business for twenty-five years. Its product line is based on two basic platforms. Product evolution will come mainly from further efforts to automate processes and add features. Growth prospects arise from new test requirements in the U.S. and elsewhere. Such requirements arise from the discovery of new indicators or "markers" of diseases and the development of new drugs that need to be monitored in the body. DMP responds to such opportunities primarily with its existing product development capability or by licensing needed technologies rather than by acquisition of other companies.

Technology Choice: Linking Product Development To Core Competencies

Amitava Datta
EG&G

EG&G is a $3 billion dollar company with six business groups. Amit is Vice President for Research of the $220 million Fluid Components Technology Group (FCTG) which has seven divisions world-wide. He presented examples of products produced in some of the divisions. Noteworthy were aeroengine dynamic seals (Engineered Products Division) which use hot air to separate air from oil, solenoid valves (Wright Components Division) for space shuttle thrusters, and metallic bellows pump seals (Industrial Division) for the fast growing world-wide petrochemical industry. The last product is produced in Ireland and is the company's highest volume product. The Irish facility is concentrating on cost reduction. It already has achieved levels of quality that are superior to the Japanese. Aerospace is a major customer for EG&G products, e.g., a Boeing 737 has approximately $100,000 of EG&G equipment. Products for the petrochemicals industry is growing quickly due to rising environmental demands.

Amit reviewed the concept of core competence which has been popularized by Prahalad and Hamel in a widely cited article in the *Harvard Business Review* in 1991. Companies usually have a limited number (two to four) of core competencies that enter into core products, which, in turn, are sold by businesses that use the core products in their respective end products. For example, laser printer technology is a core competence of Canon. This competence includes precision mechanics, fine optics, and micro-electronics. Canon uses its printer heads in its own end products, but also sells them to its competitors, giving it 84% of the world market for such printer heads. Having its competitors as customers gives Canon competitive intelligence about competitors' products as well as ideas for new products. The CEO and Chief Technology Officer of a company are responsible for the vision that leads to recognizing and harnessing the core competencies that will lead to competitive advantage. Core competencies can take years to develop, and are nonobvious and difficult for competitors to imitate.

FCTG views its core competencies to be (1) tribology and fluid sealing technology, (2) thin metallic shell technology, (3) thin film/fluid mechanics, and (4) magnetic and hydraulic circuit design. Amit gave examples of the technologies, the divisions in which they reside in FCTG, and some of the products that incorporate these technologies. He showed a $40,000 noncontacting gas seal for compressors and steam engines that has been taking market share from its chief competitor, John Crane of the UK. Gas is used to create a gap between a stationary and rotating interface that is 1/20 the width of a human hair. One of FCTG's core competencies is its computer simulation capability. He showed brush seals for turbine engines and turbocompressors, and metal bellows noncontact seals for pumps and steam turbines. The latter are for low RPM pumps that are used in dirty environments. The company has developed a prototype that is working better than the product of its leading competitor.

Companies need to leverage their core competence with product development capability. Amit has borrowed concepts from 3M, particularly how to develop ideas and accelerate the new product commercialization process. He also has looked at Hewlett-Packard's break-even time (BET) concept and DuPont's PACE process. With the help of A.D. Little, EG&G has articulated a seven stage product development process that emphasizes the front-end of the process, i.e., opportunity identification and

evaluation, feasibility assessment. Premature focus on later stages, e.g., net present value, can kill a project.

EG&G also has given a lot of thought to how to allocate research dollars. Amit showed a 3 X 3 matrix which plotted technology uncertainty and market uncertainty. The rows consist of a continuum of technology from basic research leading to major technology breakthroughs to incremental change in existing technology. The columns consist of a continuum of markets from extensions of existing markets to new emerging markets. EG&G's current thinking is to invest approximately 80% on incremental change in existing markets (at the division level), and 20% in basic research (corporate level). The technologists and the marketeers tend to favor more risky projects, however. FCTG is inclined to grow by investing in incremental change, but moving into new markets such as medical, semiconductors, etc. (same technology row, but across market columns). Time could be considered a third dimensions because conditions that lead to current conclusions about investments can change.

The last topic concerned new ways to do market research that go beyond customer satisfaction. In addition to identifying the right customer is the issue of how well the customer can articulate needs and the uses to which the product can be put. Amit discussed some A.D. Little concepts as well as those associated with Kano, a Japanese approach to market research. The idea is to identify the threshold for customer satisfaction. The company's product performance should be higher than the threshold, of course, but the real objective should be to excite the customer by offering something beyond what was expected. A company's product eventually may establish the new threshold which competitors will have to meet if they are going to remain in the market. Some of the ways to find out what will excite the customer go beyond focus groups and surveys and include in-depth observation and use of lead adopters. The latter is more than being a lead-user. It includes asking customers to become members of an EG&G product development team or putting EG&G personnel on the customer's product development teams.