Strategies That Worked In Licensing

BY ROBERT F. MUIR*

Today's global competition requires businesses to respond to challenges in innovative ways; author gives case histories

U.S. TRADE IMBALANCES (1986)
Technology-Intensive Industries

($US billion)	Surplus/(Deficit) Industry
Aircraft	10.8
Professional, scientific, control instruments	3.0
Synthetic resins, rubbers, and plastics	2.4
Medical and pharmaceutical products	1.9
Office machine and parts	1.4
Organic chemicals and products	1.4
Metalworking machinery	(1.9)
Miscellaneous industrial machinery and parts	(2.8)
Fibers and textiles	(3.6)
Paper and paperboard	(4.0)
Miscellaneous metal products	(4.5)
Miscellaneous electrical machinery and parts	(5.9)
Nonferrous metals	(6.3)
Nonmetallic mineral products	(6.7)
Iron and steel products	(8.4)
Telecommunications and sound equipment	(16.2)
Motor vehicles and parts	(51.6)

Table 1

We live in a time of rapid change. The U.S. and most industrialized nations are undergoing radical changes that affect their ability to compete both domestically and internationally and are responding to:

• An erosion of their manufacturing industries.

• A shift from basic smokestack and rural economies to service and specialty product industries.

• Rapid global transport. The same technology that created the 747 also created the ability to move large amounts of goods and services anywhere in the world within 24 hours.

• Increasing demands on their education systems to produce more scientists and engineers and to accelerate R&D at universities and colleges and in the public and private sectors.

In a 1988 survey published by Research & Development, two-thirds of the CEOs of America's top 476 industrial companies said that the United States is falling behind other nations in research and development. And the latest comprehensive published figures in 1986 suggest they're right, as shown in Table 1.

According to a Spring 1990 article in the *Benchmarker,* markets in which the U.S. has lost further ground to the Japanese include communications equipment, consumer electronics, business machines, autos and motorcycles, machine tools, scientific instruments, semiconductors, and steel. Promising technologies Japan has targeted for market domination include: fiber optics, biotechnology, optical computing, synthetic fibers, composite materials, superconductor technology, and aerospace.

Technology has become the currency of industry and has created a global economy. In the process, technology has become one of the principal drivers of competition, playing a major role in changing industries as well as in creating new ones. Technology is also the great equalizer, eroding the competitive advantage of even the well-entrenched company and propelling newcomers to the forefront. Sony's use of the transistor to gain market dominance in the sound equipment industry over the U.S. giants: RCA, General Electric, and Zenith, in one example. Technology is continually changing the rules of the game.

Technology transfer is the buzz word of the Nineties, with Japan often quoted as an example of an economic miracle built on technology. For a total cash outlay of about $8 billion, postwar Japan acquired the cream of U.S. and European technology. A united Europe in 1992, a resurgent united Germany, and the opening up of the Communist bloc will accelerate the impact, and the need, for new technologies in the 1990s. The rules of the game will change even faster.

◄ People Solution ►

State and federal governments are trying to get into the technology game both indirectly and directly. The federal government, under its theme of making America more competitive, has passed legislation that allows businesses to acquire intellectual properties (read embryonic technologies) from U.S. government labs and universities. The State of Michigan has poured millions of dollars into its Michigan Modernization Service program for small and medium manufacturers. The problem isn't money — the U.S. outspent Japan 2 to 1 in 1986 on R&D investment. The solution is in the people and the need to be market/customer/demand driven — the Japanese produce no product without a large target consumer market!

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In turn, business has learned that it is often substantially cheaper to license, or buy, a new development than to invest in costly in-house research and development. However, the private sector still views the government sector with suspicion. We have a long way to go to break through the bureaucratic red tape and create the essential partnerships.

Because we live in a time when there are more scientists and engineers alive than ever before, we have a veritable flood of technologies, witness the increase in patent applications worldwide. In fact, there's more technology than the private or public sectors can possible fund for investment purposes to remain competitive globally. (This is not well appreciated by most entrepreneurs when approaching big business and government for support and interest.) The same excess of scientists and engineers further compounds the problem by shortening the technology window.

Witness the exponential increase in the rate of innovation. From the steam age, to the industrial revolution, to World War I, it took, on average, around 100 years for technology to have an impact. In today's society, that window has shortened to some seven years in most industries and 14 months for computer software. Professionals and technicians who were once educated for life now find their skills obsolete within five to 10 years with projections of 50% of our current workforce skills obsolete by the year 2000 — a skills drought.

◄ Technology Impact ►

The influence of technology on the skills drought is best evidenced by an example with the simple average auto mechanic. According to Elizabeth Dole, former Secretary of Labor, in an article published in the *Intercom Journal of the Society of Technical Communication*, in August 1990, Mrs. Dole noted that in 1965 "the average mechanic needed to understand 5,000 pages of service manuals. With this knowledge the mechanic could be reasonably certain of fixing any car on the road. Today, the average mechanic would need to comprehend 465,000 pages of technical text to accomplish the same task."

Good science is good business. A 1989 study by *Business Week* of 897 companies in 19 industries demonstrated that the strongest R&D firms, regardless of size, had average growths of 11% in sales and 18% in profits. In manufacturing, the respective figures were 36% and 31%. The study was based on average R&D funds, per employee to remove bias from major firms.

With the increasing costs and sophistication associated with R&D, how can business and industry respond to the challenges of innovating new products and processes to remain competitive in the world scene? How can smaller nations like Australia with less-developed manufacturing bases and larger nations like the U.S. with a declining manufacturing base remain competitive? How can small business, with significant less resources, gain access to the vital R&D and new products critical to its growth and survival.

In this presentation we'll examine two potential new business initiatives to respond to these challenges. In particular, we'll talk about personal case studies that I'm familiar with showing a trend toward using external R&D and novel business arrangements to make businesses competitive. We'll talk about ants (small business) and elephants (Fortune 500s), high-tech companies, university/industry programs, and we'll conclude with the future role of the not-for-profit research institutes as servants to business, industry, and government.

CERAMIC RESEARCH INC. R&D High Tech Company Case Study

(The Ant and the Elephant)

Ceramic Research, Inc. (CRI) is an example of an R&D startup company funded with seed venture capital to develop and commercialize unique technology. Typically, an R&D startup company is formed to develop and retain intellectual property rights (patents and know-how) relating to a specific technology. Seed venture capital from one or more sources is provided to the owner of the base embryonic technology in return for a significant shareholding in the company. If the R&D is successful, such rights and/or shares may subsequently be sold to third parties, or used to leverage additional rounds of financing to market and sell products from the R&D.

In June 1989, Ceramic Research, Inc. (CRI) signed an agreement with E.I. DuPont (Wilmington, Delaware) to transfer patent rights and technical information on a novel laser-based process that can be used to produce ceramic fibers for various applications. The agreement was the result of a three-year search. The search brought inquiries from more than 100 Fortune 500 and Japanese companies, Boeing, Alcoa and Sohio among them.

The overwhelming response required that we methodically select the right partner, including arranged meetings and presentations tied to secrecy agreements to protect both parties interests. CRI is an example of how research, technology, venture capital, Fortune 500 companies and international business interests were successfully combined. The strategy used to attract the interest of DuPont and some other major companies contains some valuable lessons.

The CRI story is also the story of why and how an ant (CRI) sought and found an elephant for a partner. In dealing with an elephant one is confronted with three major problems: how to attract its attention, how to get the elephant up on its feet, and, critically, how to make sure the elephant goes in the right direction once it is up and running.

Why ceramics? Most people associate ceramics with fine china or clay pottery of brittle, brightly colored materials. However, there is another class of ceramics, known as fine or advanced technical ceramics, which is causing a quiet material revolution in a number of industries. Fine ceramics are lighter, stronger and harder than steel. Fine ceramics are destined for application in everything from aerospace vehicles to automobile engines, from batteries to integrated circuits, from medical diagnostic devices to cutting tools. Not since the advent of plastics has there been such materials with such promise of affecting us all. Dr. Charles Carlson, Research Manager-Fibers Department, DuPont, typically understated corporate interest by commenting that "DuPont's purpose for acquiring CRI's technology was to assess the commercial feasibility of the technology as part of DuPont's commitment to high-temperature materials."

CHARTER: CRI's original charter was to fund the R&D necessary to confirm the feasibility of an idea of a Kansas City scientist, Dr. Paul Nordine, to use a laser to produce fine ceramic materials's idea. As a small business, CRI faced the typical problem of how to investigate the novelty of a new idea without a lot of money or its own R&D capabilities. CRI hired its uncle, Midwest Research Institute, to provide the necessary support and services. It's always cheaper to buy speciality services than to develop such inhouse. Using MRI's staff and facilities, CRI was able to internally demonstrate the feasibility of the CRI Process. The process was named after the company.

◄ Sample Quantities ►

The early R&D work produced sample quantities of carbon, silicon, silicon carbide, silicon nitride and boron fibers with varying degrees of success. Materials produced from single-component materials, such as boron, were pure and strong, but materials produced from multicomponent mixtures, such as silicon nitride, were more fragile. CRI was not convinced that the process was viable since a number of key technical questions relating to chemistry and laser processing remained unanswered. The story could have ended right there on an inconclusive note but fate played her card.

NEW LOOK: About this time, a guy Muir joined MRI Ventures, one of the partners in CRI. Trained as a chemical engineer, I had led a business team for Union Carbide Australia to develop and license a novel separation process worldwide. I was given the job of evaluating the commercial viability of CRI's technology and recommending a course of action to CRI's Board.

I was encouraged by the initial research results, particularly so since CRI had produced ceramic fibers in a simple and crude apparatus without input from the industries who might in the future buy, or use, ceramics produced from the CRI Process. Nordine had just plugged his crude apparatus into the wall, turned on the juice and made fibers. Like many R&D companies, CRI was working in a vacuum, not only unaware of the value of its technology but also, more importantly, the opportunities and business it could create for major companies. I also discovered that CRI was dragging its feet on filing the essential worldwide patent applications to protect the novel intellectual property that it had developed.

I also concluded that CRI needed a partner to help evaluate, develop and commercialize the CRI Process. It was a simple decision not to seek additional venture capital for CRI and to go it alone since the ceramics industry was dominated by major Fortune 500 and overseas companies. Money alone, lots of it, would not buy CRI a ticket to the ceramics game and solve its market entry problems. CRI could not feasibly establish the necessary engineering, marketing and distribution resources to compete with the majors. What did we want in a partner?

◄ Seek Partner ►

THE PARTNER: We decided to seek a partner for CRI with the following characteristics:

- Corporate objectives that included long-term commitment, allocation of resources, and growth through advanced ceramic materials technology.
- Previous history and experience in commercializing new process technologies.
- Availability of, or access to, strong R&D scientific and engineering skills:
  - Ability to specify fiber properties essential to specific industrial applications.
  - Ability to measure and characterize mechanical, chemical, and electro/optical properties of advanced ceramics.
  - Ability to formulate and test composites for industrial applications including life cycle and strength tests.
  - Ability to test material properties of ceramics at elevated temperatures including microstructural, creep, and fracture analyses under load.
  - Strong process design and engineering skills to support R&D efforts, to evaluate scale-up data and to prepare both prototype and commercial plant designs.

People skills were key in commercializing the opportunity. It was essential that CRI's partner not be averse to technology originating from outside the company (the so-called "not-invented-here" factor). It was also essential that the partner's group leaders be experienced in working in joint-venture opportunities. A free interchange of ideas and information is crucial to ensure a successful technology transfer.

THE TARGETS: I thought that the CRI opportunity might appeal to:

- Producers of advanced engineering materials or electronic semiconductor substrate products who wanted to protect or expand their current technology base and markets or who desired to integrate into new markets.
- Companies seeking to acquire or to license an advanced ceramic materials technology to establish or sustain a competitive business opportunity in engineering materials, electronics, optical or semiconductor industries.
- Suppliers of raw materials for advanced ceramic materials who wished to integrate into the actual manufacture of ceramic fibers and/or electronic substrate materials.

I recommended to CRI's Board that CRI might commercialize the technology by one or more of the following business strategies:

- A joint-venture company could be formed to develop, manufacture, or sell products in any one of the following fields: advanced engineering materials, new electronic materials, or new optical/medical fiber products. CRI would contribute proprietary technology rights, inventor access (know-how) rights and full R&D support services through Midwest Research Institute. The partner would contribute R&D capital, resources, and industrial experience to direct joint ventures into profitable markets. Equity would be divided based upon contribution with guaranteed future rights split to protect each partner's business interests.

- An option/license/acquisition agreement could be granted for specific uses under pending patent and proprietary know-how rights with a technical support agreement. Various options could be built in to match the various stages of developments of the technology including an option to joint venture at a later stage.
- A combined technology collaboration, patent and know-how cross licensing agreement could be negotiated with options to future rights to satisfy and protect each party's future business interests. CRI would expect the partner to contribute to the cost of transferring the technology to the partner.

◄ Board Pleased ►

The board seemed pleased (probably relieved) by the plan, installed me as president of the startup, and sent us naively on our way to commercialize the technology.

THE APPROACH: A mini-business plan, which we describe as a "business opportunity," was prepared. This was a document describing the CRI technology, the potential markets, and the R&D status, and suggested business options. It was mailed to a select list of 150 companies worldwide. Press releases announcing the opportunity were also mailed to targeted media. The response was overwhelming. More than 100 companies responded immediately. Among them were Japanese companies clamoring for more information. Feast had overtaken famine. Overnight we had gone from being technology-driven to market-driven.

To process the responses, we designed a simple five-step program aimed at getting to know the respondents and providng the essential information to allow both parties to reach a conclusion within 18 months. The five-step program consisted of:

- Responding to their initial interest.
- Arranging a two-way nonconfidential discussion.
- A confidential technical and economic presentation in Kansas City.
- Agreeing to produce and permit samples to be analyzed to confirm potential applications of interest to the prospective partner.
- Commercial negotiation leading to partnership.

About the same time, late 1986, I visited Japan to meet with several major companies incuding Nippon Steel, Sumitomo Chemicals, Denka, Mitsui, Hitachi, Mitsubishi and Toshiba. They were interested mainly in consumer-related new material opportunities in electronics and components. Many people fail to realize the simple trick of getting the Japanese markets' attention: they are almost solely focused on consumer-related markets.

◄ Hosts Visitors ►

Through 1987, CRI hosted visits from Boeing, Alcoa, BP America (exSohio), PPG, DuPont, Alcan, General Electric, Englehard, Corning and others. Two confidential reports were presented to prospective partners as part of the Kansas City presentation. One report was prepared by Nordine describing the process technology and the other by Muir presenting ballpark investment figures and operating data. The reports were presented under secrecy agreements with each company. The minimum secrecy period was five years. The five-year period was designed to allow CRI sufficient time to process its patent applications and stake out its claims.

SECRECY AS STRATEGY: I also used the long-time secrecy provision to secure a serious commitment from each company. These long-term obligations, coupled with the detailed confidential reports, required the prospective partner to think long and hard, at a reasonably high management level, before accepting this lengthy period of confidentiality. CRI's disclosures would effectively taint each company's inhouse-related R&D efforts. CRI's disclosure thereby created a competitive niche for CRI and for its prospective partner(s).

In early 1987, CRI entered stage four of the program and commenced making samples for certain key companies. CRI's partners clearly defined the properties and specifications that they needed in order to be able to respond to the opportunities within their industries. CRI's role was to meet those challenges, thereby entering the "D" phase of R&D.

CRI also had to respond to another challenge. Dr. Nordine left MRI about this time and Muir had to negotiate a consulting arrangement with him. Technical support for CRI was supplied by Nordine and by staff scientists at MRI. This was a time of rapid development of the technology and confirmation of the often quoted maxim: "In science the credit goes to the man who convinces the world, not to the man to whom the idea first occurred."

THE BREAKTHROUGH: CRI's first major success was to produce continuous, pure boron fibers rated at a strength in excess of one million psi — a mjaor breakthrough. The strength and lightweight properties of this new material made it ideal for several immediate aerospace applications including Reagan's Orient Express, the successor to the Space Shuttle.

This important development also encouraged Boeing Aerospace Company to negotiate an option agreement to secure potential rights for aerospace applications. Under the terms of the agreement (concluded July 10, 1987), Boeing was given the right to duplicate CRI's equipment and to embark on its own aerospace composite R&D.

Boeing fell into a major category on our original opportunity list: "Companies seeking to acquire or to license an advanced ceramic materials technology to establish or sustain a competitive business opportunity in engineering materials, electronics, optical or semiconductor industries."

I knew that it was fundamental in developing technology that a company must also be able to evaluate, or characterize, the materials it produced. Boeing was expert in the composite field and was able to direct CRI's R&D program in this market. CRI agreed to perform additional R&D in Kansas City for Boing, as well as providing technical support. It was clear from the outset, however, that Boeing was in the aircraft and not in the materials business. Boeing never intended to actually manufacture fibers from CRI's process technology. A manufacturing party still had to be found.

COURTING THE ELEPHANT: So Boeing and CRI embarked on the next stage — to find a partner. Through various contacts, CRI developed a list of potential partners that included 3M, DuPont, Morton-Thiokol and Alcan. Meanwhile, CRI continued to produce samples for evaluation by its prospective partners.

Separately, the prospective partners sent business teams to Kansas City and an extensive due-diligence began. CRI and the prospective partners studied:

• CRI's technology, including process, apparatus and future products.

• Potential economies of the CRI Process.

• Market size, niches and characteristics for projected opportunities.

• The fit with existing in-house new business development plans.

• Properties and qualities of the sample materials being produced by CRI.

CRI's patent position and its potential effectiveness in protecting future markets from serious competitors.

• The nature and terms of the proposed arrangement.

While it was clear that each prospective partner sough to "control" the technology, each had differing interests in materials and business strategies.

◄ Produce Scenario ►

Boeing's sponsored partner produced a scenario to develop the technology through boron fibers because of Boeing's unique application in the aerospace and defense industries. The other partners chose silicon carbide and zinc selenide fibers as materials upon which to justify their interests to their respective management. Recognizing that CRI had produced only limited quantities of material for evaluation, the partners had to exhibit large degree of faith before deciding to negotiate for rights to the technology.

Clearly, the fortunes in the technology game belong to those whose vision of the future allows ample opportunity to change direction when the market calls. DuPont's nylon and Kevlar fibers are examples of materials that found markets that weren't in the original vision of the inventors. The territory represented by patents and intellectual property must be staked out with this expanded vision in mind.

The strategies the potential partners proposed to develop the technology included:

• Joint R&D proposals.

• Licensing of CRI's technology and patents.

• Assignment of CRI's technology and patents.

In mid-1987, I traveled extensively, meeting with each of the individual partners to analyze the relative merits of each proposed arrangement. It became increasingly clear that DuPont represented the best choice.

WHY DUPONT? Since the 1930s, DuPont had led the way in developing processes to produce new materials. In each succeeding decade, DuPont had invented the polymer melt spinning, dry spinning, gap spinning, cold drawing, and fiber sintering processes that were necessary to produce polyester, nylon and Kevlar fibers. What's more, certain key people at DuPont recognized that CRI's patent position could become a veritable patent machine — protecting far into the future the materials markets that DuPont/CRI might develop. The other candidates did not appear to be so farsighted in this opportunity. They wanted to focus on known, shorter-term applications and did not seem to grasp the breadth of CRI's technology. I pushed for DuPont as CRI's preferred partner.

THE AGREEMENT: On June 9, 1989, CRI and DuPont executed an assignment agreement under which CRI would assign the basic technology and patents to DuPont for an initial payment involving seven-figures, plus a continuing royalty stream based on a percentage of the sales value for products resulting from CRI's patent. CRI also agreed to put DuPont in business by selling it basic research equipment that would be installed in DuPont's Wilmington facility. In turn, DuPont agreed to assume responsibility for CRI's patents and to embark on a multimillion dollar, multi-year program aimed at the commercialization of CRI's technology.

The success of that program should be evident in the mid 1990s when DuPont is producing and selling new ceramics for industrial uses and applications.

PLASTICS COMPUTER INTEGRATED MANUFACTURING CONSORTIUM (PCIM)

(University-Industry Linked Technology)

Turning now to a future program currently being launched in Michigan, which is indicative of a different approach being taken by my current employer, The Research and Technology Institute of West Michigan (R&TI). The approach is to link the supply side (multi-university) with the demand side (multi-industry) in a consortium driven by industry needs to integrate computers into industry.

The emphasis is on a "try-before-you-buy" plan to integrate computer processing into plastics manufacturing — injected molded plastics in particular. Each consortium member will receive the results of an entire multimillion dollar R&D program for a fraction of the total cost.

ROLE OF RESEARCH INSTITUTES: PCIM is typical of the rationale for investing in research and development capability at R&TI which can be divided into four broad and partially overlapping categories:

• Investing for the future of West Michigan.

• Meeting regional needs.

• Advancing the industrial, business, and manufacturing capabilities.

• Strengthening applied science and engineering education.

R&TI serves as the focal point for the application of science and technology to economic growth in West Michigan. R&TI's prime mission is to perform applied R&D for industry, business and government in conjunction with the staff, capabilities, and resources of its member schools (Ferris State University, Grand Rapids Junior College, Grand Valley State University, Michigan State University, and Western Michigan University).

In addition to its core capabilities, R&TI has adopted a new approach in its support of its business and industry constituents. R&TI is reversing the traditional (technology-driven) process, and is letting problems and industries needs (market-driven, drive its search for technology, being the bridge between science and industry. To meet this objective, R&TI has added two separate, yet related, capabilities: technology and R&D management.

Technology management involves the key elements of strategic planning, forecasting, and technology/industry assessment — in short, define the problem to be solved.

Using its R&D management skills, R&TI then assembles a project team with the required capabilities and disciplines from its core staff, consultants, and faculty from its member schools to define and complete individual tasks for each project. The vast majority of West Michigan businesses lack both inhouse R&D capability, and naturally, the concurrent R&D management capability. Concurrently, many of the challenges facing West Michigan (and the nation) business and industry require more than one discipline. Solving many of today's business problems requires a combination of business, science, and engineering discipliens.

Through its member schools, R&TI can respond to this critical challenge. R&TI has current capabilities in soft and hard sciences. In soft sciences, such capabilities include: technology management (impact of technology on business, markets, economies) and information services.

In hard sciences, R&TI has capabilities in: Manufacturing Systems, Opto-electronics, Sensors, Electronics, Materials, Polymers, Composites, Energy, Environment, Food, Adhesives, Coatings, Wood, Paper, Packaging, Printing and Waste Management.

THE TECHNOLOGY: Computers and related technology are playing an ever-increasing role in manufacturing and the issue of Computer-Integrated Manufacturing (CIM) will be embraced by companies developing strategies for the future. CIM can be one or more systems or techniques that a company applies to their operations. CIM systems include: Just-In-Time, Total Quality Management, Group Technology, Manufacturing Resource Planning, Statistical Process Control, Simultaneous Engineering, Robotics, Computer Aided Design/Computer Aided Manufacturing, and Computer Controls, among others.

Implementing integrated CIM systems can help propel a forward-thinking company past their competitors by allowing them to respond to a rapidly changing and demanding worldwide marketplace. CIM can be used to effect specific components of a company's short- and long-range strategic plans requiring state-of-the-art and breakthrough technologies to maintain and improve quality production and products. The plastics industry, with its rapid growth and many applications, has expressed the need and desire to fully utilize CIM systems as they may be applied to their industry.

Just as important as the development and application of CIM technology is a workforce trained to effectively work with and implement CIM. Previously mentioned, studies forecast that 50% of the skills of the current workforce will be obsolete by the year 2000. This will require substantial training and development of new skills to keep pace with ever-changing industry and marketplace standards.

R&TI has identified three critical areas that contribute to the underutilization of computer-integrated production in plastics injection molding. These areas are:

• Education and training that would enable current employees to use existing computer integrated technology and new technologies as they are developed.

• An understanding of how to efficiently apply computer integration to injection molding at the factory level.

• Determining at which point integration and degree of integration is cost effective.

To respond to these challenges, R&TI in association with its member universities and colleges is inviting companies to join a Plastics Computer Integrated Manufacturing Consortium. The PCIM Consortium will use the individual disciplines from its member schools to target and participate in research, development, training, and application of CIM to the plastics injection molding industry.

The PCIM Consortium is designed to be driven by the needs of industry, to provide the information and tools to improve the productivity, marketability and, thus, profitability plastics injection molding companies, their suppliers, customers, and equipment manufacturers. The PCIM Consortium Research and Development Plan specifically targets:

• The evaluation, application, and deployment of CIM systems, architecture, advanced injection molding equipment, and secondary production processes.

• Investigation of new plastics injection molding materials and composites, equipment configurations and specific operating conditions, throughputs, cycle times, and controls.

• Training in CIM and state-of-the-art plastics injection molding equipment operation and techniques.

UNIQUE FEATURES: The Consortium brings together the resources, faculty, staff, and capability of four educational institutions under the coordination and management ability of the Research & Technology Institute, with the leadership and direction of industry.

The Consortium R&D program is built around a functioning CIM Cell to address the equipment, processing, manufacturing and training issues facing plastics manufacturers. The purchase of the equipment for the Cell was paid for by R&TI under a state grant. This type of cell was never before available in the U.S.; combines the facilities, faculty, equipment and expertise of three educational institutions to form a cohesive, fully-operational, state-of-the-industry unit.

PARTICIPANTS: The consortium is designed to join the supplier, processor, and material base to address the common problems of integrating computers within the plastics industry. Potential plastics industry participants in the PCIM Consortium include:

- Manufacturing/Assembly Companies.
- Raw Material and Resin Suppliers.
- Equipment Machinery Makers and OEMs.
- Peripheral Equipment Manufacturers.
- Software Development Companies.

MEMBER BENEFITS: The consortium is designed to meet the identified needs of industry. Benefits include:

- Appointment of one representative to serve as a member of the PCIM Consortium Advisory Committee formed to review, direct and drive the Research Plan.
- Access to all technical information and data including annually published business and bi-annual research reports for the Consortium.
- Exposure to new ideas, components and state-of-the-technology techniques within an automated environment.
- Access for employees to demonstrations, seminars, and training sessions conducted by the PCIM Consortium research and management teams, addressing CIM for plastics injection molding.
- Consultation with academic experts in Plastics Processing.
- The opportunity to network with other manufacturers, vendors, or suppliers to discuss common applied research needs and to develop strategic relationships.
- A nonexclusive right to license to any patent rights developed during the term of the Consortium.
- The right to separately fund additional research in areas of proprietary interest to a member company. Such additional research would be performed under separate agreement with the member through R&TI and the member school.

DELIVERABLES: What do the consortium members get for their money?

- Reports on research tasks conducted as part of the PCIM Consortium Research Plan.
- Research Newsletter published bi-annually, updating nonproprietary status of the CIM Cell, including:
  - Research task updates.
  - University and college training program offerings.
  - Focus Reports on research conducted on CIm Cell as selected by the PCIM Consortium Advisory Committee.
  - Seminars and demonstrations offered by the PCIM Consortium.
  - Updates on the state-of-the-industry.

Each Member will receive the results of the entire program, estimated to represent an R&D effort of $1 million, but will pay only a fraction of the total cost.

R&TI is planning to initiate the PCIM Consortium on or before September 1, 1991, provided that a minimum of 10 members have joined the Consortium.

Well, that concludes the case studies. What lessons have I learned from these, and other licensing experiences?

LESSONS LEARNED ALONG THE WAY

I have learned (and sometimes relearned) a lot of hard lessons along the way:

- People! The people, on both sides of the table, in the many and varied disciplines, and yes, even the lawyers, is where it's at to be successful in licensing and new business development. To repeat an earlier maxim: "In science the credit goes to the man who convinces the world, not to the man to whom the idea first occurred."
- Translate science and technology into terms easily understood by both business and university. Most business people are trained to place their faith in abstract numbers to fit the annual business plan and to dismiss longer-term visions. Conversely, universities sometimes get hung up in the beauty of technology, failing to realize the time and costs involved in commercializing an embryonic technology. There's too much technology chasing too few dollars!
- To gain industry's interest, demonstrate solid applications for the technology in particular markets of interest. Industry sells products not dreams.
- Given the multi-disciplined approach that is often necessary to commercialize developing technologies, it is necessary to form a multidisciplined team. Your team should comprise strong management and good technical leadership, as well as a legal capability, to be able to perform all the functions necessary to get the job done.
- Identify and encourage strong leadership from industry since industry is in the best position to drive the commercialization effort. Today's economy is market (demand) driven! It is essential to build early and honest relationships with industry and to deliver, deliver, deliver . . .We did.
- It is absolutely essential to seek early involvement, comments, suggestions and concurrence from the government and universities when they are involved. Above all, extreme patience is necessary in working with the university with a plethora of cultures and interests all of which has to be worked through.
- Never work in a vacuum. Someone a lot smarter than you will find a way to overcome a specific technical business or legal problem that will arise if a viable commercial opportunity exists. Our industry colleagues often responded to this challenge.
- It is absolutely essential to know where you want to go, and what outcome you desire, before you start to play the game. You then will not lose sight of the end result as objections and disappointments confront you along the way, as they surely will. Plan your part as necessary lest your emotions sway your judgment and your patience expires. Persevere.

Technology can change the rules of the game, and maybe even the government, the universities, and the research institutes can help you!