EUREKA CATALYZES MANY PROJECTS, TRANSFORMS EUROPEAN RESEARCH

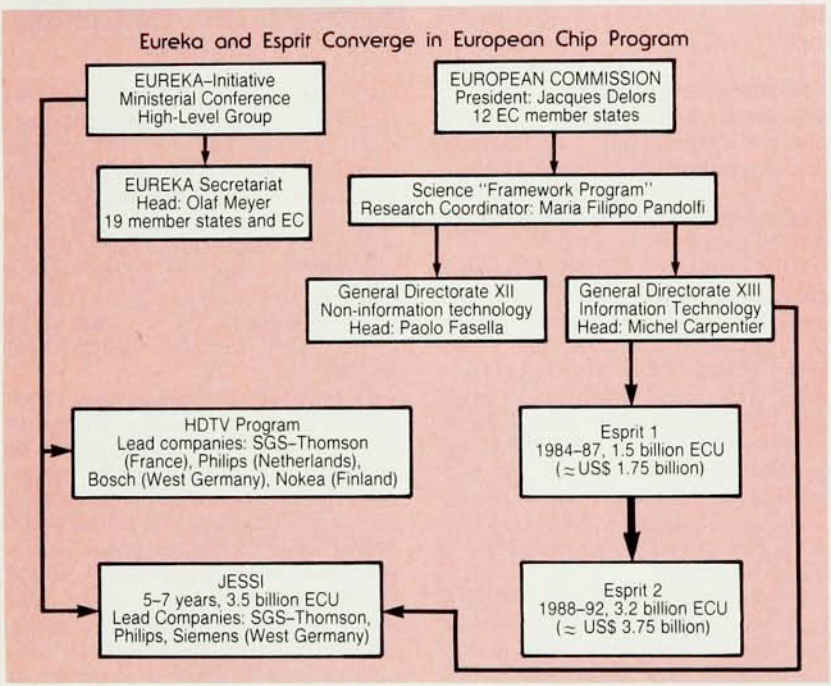
Seven years ago this month, when President Reagan surprised the world with what came to be known as the Strategic Defense Initiative or Star Wars, boosters of the program promised that it would have wonderful spinoffs in commercial technology. Unfortunately, from the US point of view, some of the most dramatic spinoffs have been turning up in western Europe. Luckily, from Europe's perspective, the net effect is to bolster the competitive position of European countries vis-à-vis the United States and Japan.

Our story begins in April 1985, when Reagan made a trip to Europe on the 40th anniversary of the Allied victory over the Axis with the intention—among other things—of enlisting NATO allies in the SDI research program. On the eve of Reagan's arrival, French President François Mitterrand delivered a speech proposing that the Europeans join together in a "European Research Coordinating Agency," or EUREKA, to pool resources in industry-relevant research. Implicit in Mitterrand's suggestion was the idea that the Europeans would do better to concentrate their research ECUs—European currency units—in maturing commercial technologies, rather than squander them on what many considered the chimera of a leakproof missile defense.

What began as an apparent political ploy soon turned into a smashing success. At a meeting in Paris in July 1985, 17 members of the European Community plus the EC Commission agreed to establish EUREKA, and at a second meeting in Hanover, West Germany, in November of that year, agreement was reached on 10 joint research projects. Largely at the behest of West Germany and Great Britain, initially skeptics in the planning for EUREKA, the Europeans decided to focus their joint efforts on product-oriented projects, rather than generic programs.

By mid-1986, when EUREKA representatives met in London, the number of projects had grown to 72, representing a total commitment of 2 billion ECUs ($2.35 billion, at the present exchange rate). The representatives decided in London to situate EUREKA's secretariat in Brussels, the seat of the European Community's fast-growing bureaucracy, rather than Strasbourg, the home of Europe's nascent parliament. Xavier Fels, a French diplomat previously in charge of international affairs for France's telecommunications agency, was put in charge of staffing the new EUREKA office.

By mid-1988 the number of EUREKA projects had reached 165, representing a total commitment of 5 billion ECUs, and the number of participating companies and research organizations had grown to 600. At this juncture the biggest single project by far was the high-definition television program, in which the initial lead participants were Thomson, Philips and Bosch (see chart above). But in June 1989 agreement was reached on a second major EUREKA program called JESSI—the Joint European Submicron Silicon Initiative—and it promised to soon eclipse the sprawling HDTV project.



By mid-1989 EUREKA had 19 member states plus the EC, and the first head of the secretariat was completing his three-year term. Fels was succeeded by Olaf Meyer, an industrial and academic engineer who had served as head of Sweden's industrial development fund. The French, now ready to give the idea of cooperative research another twist, proposed a joint defense research organization. Meeting in Lisbon on 28 June last year, 13 European nations agreed to establish EUCLID, short for European Cooperation for the Long Term in Defense.

By late 1989, when a PHYSICS TODAY reporter visited the EUREKA secretariat for the first time, the number of EUREKA projects had grown to 297, the total commitment of funds to 6.4

billion ECUs and the number of participants to 1600.

In a letter following up on the PHYSICS TODAY visit, Meyer emphasized to the magazine that the national component of each EUREKA project is funded independently, country by country, and that the total commitment of funds to EUREKA projects represents the total amount of money that all participants have agreed to spend over the lifetime of the projects. "EUREKA is *not* just another financing scheme," Meyer said. "On the contrary, the EUREKA label is only given to a project if the participants can make clear that the project indeed is totally financed."

Bottom-up organization

The usual refrain about EUREKA is that it's a "bottom-up" organization, in which initiatives for market-oriented R&D projects come from the private sector or public research organizations, and so it is.

Each EUREKA project originates as a proposal from at least two separate organizations in two member states. If the proposal seems suitable to the national authorities in charge of EUREKA, the small staff in Brussels circulates information about it to prospective partners, provides advice concerning matters such as information sharing and protection of proprietary inventions, and facilitates contacts with member governments and public agencies.

The EUREKA secretariat consists of just seven professional employees, and "the intention is to keep it very small," says Paul Caluwaerts, a Belgian staffer who previously was in charge of energy policy in Belgium's science-policy office. Caluwaerts says it is the secretariat's job to "oil the machine and tend to the memory."

The directorship of the EUREKA secretariat alternates every three years between a representative of an EC country and one from a non-EC state, and there is one deputy director (currently from Portugal). A high-level group implements policy, and there is a national project coordinator in each participating country. The first national coordinator for France, for example, was Yves Sillard, who appears to a great extent to have been the brains behind both EUREKA and EUCLID. Sillard currently is the general director for defense research, engineering and manufacturing in France's Ministry of Defense, and a deputy, Jean-Paul Chauvot de Beauchêne, is France's national coordinator for EUCLID.

Major policy decisions in EUREKA are made at the ministerial conference, which includes industry or research ministers from the participating countries and the EC science commissioner, Maria Filippo Pandolfi. The ministerial conference decides, for example, on actions in support of major programs such as the HDTV effort or JESSI. Asked whether the ministerial conference would be consulted if, say, IBM asked to join JESSI, Caluwaerts smiled and nodded.

Olaf Meyer

Even before the Berlin Wall came tumbling down, eastern European governments were seeking entrée to EUREKA projects. Since then, "developments in eastern Europe have been so great, nothing is left untouched," Meyer says. Although EUREKA projects always have been open to single participants from any country, provided the other participants agree, the number of applications from entities in East Europe is expected to increase. Beyond that, Meyer says, EUREKA has to think about "what Europe will look like five years from now, and what EUREKA should do to prepare."

Esprit 1 & 2

In contrast to EUREKA, the European Commission's science secretariat is a very large bureaucracy with perhaps 1000 professional staff members. But bureaucratic stereotypes do not necessarily apply. "I really like those guys," said Dieter Pohl, the vice president for HDTV at Bosch, during an interview conducted in Eindhoven, headquarters of the Philips research laboratories. "They have a sense of mission, and they work really hard," Pohl said of the EC science staff.

The EC science programs are organized top-down. That is to say, the member states agree periodically on a total budget and a framework program, and within that program, the Brussels bureaucracy solicits proposals, has them peer-reviewed and makes grants.

Easily the largest and most important EC research program is ESPRIT, the European Strategic Program for Research in Information Technology, which was launched in 1984 and now accounts for roughly 40% of spending in the framework program. The first phase of ESPRIT ran from 1984 to 1987 and involved expenditures of 1.5 billion ECUs, half of which came from the member states, half from industrial and academic partners. ESPRIT 1 ended up funding 220 projects in microelectronics, peripherals, information processing and information-technology applications (such as computer-integrated manufacturing and integrated office systems).

The second phase of ESPRIT is running from 1988 to 1992 and involves expenditures of 3.2 billion ECUs. By April 1988 the European Commission had received 700 proposals, of which 100 were accepted. A second call for proposals went out late last year.

An article in the October issue of *Physics World*, the monthly magazine published by Britain's Institute of Physics, provides tips to ESPRIT applicants and sheds considerable light on the European Commission's working procedures. E. W. Williams, the electronics engineer who wrote the article, says, for example, that ESPRIT aspirants should be sure to attend the ESPRIT annual conferences. These are open to anybody who has asked Brussels for information about ESPRIT. Williams suggests employing a consulting firm that specializes in EC funding support. Following preparation of an ESPRIT work plan, attendance at Brussels workshops to become acquainted with possible partners also is recommended. "It so happens that a French partner is particularly desirable since French scientists often hold key positions in the EC," Williams observes. "A partner from Ireland, Greece or Spain can also yield a distinct political advantage, given that these are perceived as 'poor' countries deserving a share of this particular cake."

Despite the extremely arduous procedures that must be followed, Williams strongly encourages fellow Europeans to apply. "The EC advisory experts are of a very high standard, and one or two of these will attend the key progress meetings every six months. Finally, EC officials are—in my experience, at least—very easy to deal with and constructive in their approach."

Jessi

During the past year, the EC bureaucracy responsible for ESPRIT and the

Transpacific and Transatlantic Alliances Emerge in Chip Industry

The American approach to competition in the semiconductor industry has taken some interesting turns in recent months. What would have been the largest cooperative effort of US semiconductor and computer companies to manufacture memory chips was laid to rest in January. Shortly thereafter, two companies that were to have participated in the venture announced that they had entered into chip-producing arrangements with Japanese and European partners.

What these and other recent events suggest is that the leading US computer and semiconductor companies are rethinking how best to maintain their own competitiveness. Despite the general perception of an industry-wide "us-versus-them" attitude, US firms are finding alliances with Japanese and European concerns much more palatable and even desirable these days, leaving the future of exclusively American ventures in question.

Death of a consortium

The now-defunct consortium, called US Memories, was intended to reduce American dependence on Japanese memory-chip suppliers. The idea to form an all-American consortium to make memory chips first arose in 1988, at a time when memory chips were scarce and prices were high. Most US semiconductor companies had dropped out of the memory-chip business in the mid-1980s. A joint task force was set up by the Semiconductor Industry Association and the American Electronics Association to explore the possibility. Last March, Sanford Kane, a vice president in IBM's general technology division, told several American chip makers that IBM would license its technology for making dynamic random access memory chips to a group of US companies to create another independent US source.

In June 1989 US Memories was announced with great enthusiasm by Kane, who had left IBM after 27 years to head the venture. The plan called for construction of four state-of-the-art plants to manufacture the latest-generation memory chips, 4-megabit DRAMs. The first of them would come off the line in 1991. Member companies, at first restricted to semiconductor and computer makers, were to invest a total of $500 million, with an equal amount to be borrowed; in addition, members were to purchase an agreed-upon percentage of their chips from US Memories.

Seven companies initially agreed to back US Memories: IBM, Digital Equipment and Hewlett-Packard—the first-, second- and fourth-largest US computer companies, respectively—and semiconductor firms Intel, LSI Logic, Advanced Micro Devices and National Semiconductor. But the idea never spread further than that. Unable to attract enough investors, Kane declared the venture dead on 15 January.

What happened? For one thing, even before Kane went looking for partners, the memory-chip market had completely turned around—the price of a one-megabit DRAM had plummeted in the one year from June 1988 to June 1989 from $40 to $14. Some companies criticized the US Memories plan, which was devised by a 35-member team of managers—from the seven founding companies, Goldman, Sachs & Co and Price Waterhouse—for being too ambitious and constraining. Though the original plan was eventually scaled back and non-electronics companies were invited to join, some of the largest American computer companies—notably Apple Computer and Sun Microsystems—refused to join.

"The problem that companies had with US Memories was that they would have been committed to a certain source for their DRAMs, which may or may not have been the best quality or the cheapest," Herbert I. Fusfeld told PHYSICS TODAY. Fusfeld, who is director of the Center for Science and Technology Policy at Rensselaer Polytechnic Institute, added, "That's a very risky strategic move." He pointed out that there was talk of creating a common manufacturing facility when the semiconductor research consortium Sematech was first being put together. That idea was subsequently dropped. "Every company has its own objectives, its own strategy to maintain a profitable business, and there are lots of options. US Memories was just one of those options," Fusfeld said.

Other options

On 22 January Intel Corp of Santa Clara, California, announced that it will join forces with NMB Semiconductor, a subsidiary of the Japanese conglomerate Minebea, to produce and sell memory chips. Two days later IBM said that it will cooperate with West German electronics giant Siemens AG to develop the 64-megabit DRAM. Both companies were quick to say that the new agreements were independent of the US Memories failure and would have gone through even if it had succeeded. "The demise of US Memories was a disappointment to IBM," says Paul Bergevin, an IBM spokesperson. "But it was only one piece in an overall strategy. Other pieces are still in place."

On the same day as, but independent of, the IBM–Siemens deal, IBM's European group was invited to participate in JESSI, the European semiconductor consortium overseen by EUREKA (see page 70).

The Intel–NMBS arrangement calls for Intel to put its name on NMBS-produced chips, which Intel would then market worldwide. The venture is scheduled to be operating by the third quarter of this year. Intel will gain access to NMBS's state-of-the-art manufacturing technologies, but there will be no technology transfer by Intel, which stopped making DRAMs in 1985. NMBS currently has two chip-making plants operating in Japan, with another scheduled to open by mid-year. A fourth plant is to be built in the US, thereby creating another American source of memory chips.

The IBM–Siemens agreement provides for the two companies to jointly develop a memory chip capable of storing 64 million bits of information, with commercial production to begin as early as 1995. The cost of the development project, estimated to be in "the hundreds of millions of dollars range," is to be shared equally. The work itself will focus on chip design and processing techniques, but will not include work on x-ray lithography, on which IBM has spent a half billion dollars over the past decade (see PHYSICS TODAY, January, page 67).

Though Siemens entered the semiconductor business fairly late and is still the lesser of the two companies in terms of technological know-how, the agreement positions the West German firm to become a major player in the European chip market in the 1990s. The agreement is also the next logical step for both companies in heightening their already strong presences in the European computer market. At present IBM leads the field, accounting for $20.2 billion of computer sales revenues in 1988; Siemens was second with $5.4 billion. Siemens recently fortified its position by acquiring Nixdorf AG, a German pioneer in personal computers and workstations, which had been the sixth largest European computer maker.

—JEAN KUMAGAI

members of EUREKA joined forces to launch the Joint European Submicron Silicon Initiative.

JESSI originated in discussions held among French, Dutch and German industrial leaders over a period of years. Its implementation phase was launched at the EUREKA ministerial conference in Vienna in June 1989. JESSI's mission "is to put Europe back in the running in the world microelectronics market, by giving it the means to negotiate successfully the major change in the development direction of chips expected before the end of the century," according to a EUREKA publication. The main objective is the competitive manufacture of chips with features of 0.3 micron compared with 1 micron at present. The definition-phase budget for JESSI was set at 555 million ECUs ($650 million), and Pandolfi has indicated that the EC may contribute as much as 25% via the same bureaucratic network that manages ESPRIT.

JESSI is managed by a board that includes representatives of Thomson, Siemens, Philips, Bosch, Alcatel (a firm headquartered in Holland that is mainly a Belgian–French concern), Olivetti (Italy) and Electrotech (Great Britain), plus an academic representative, P. Balk, a professor at Delft and Aachen. An operating group consists of representatives of the same organizations, with each member spending about 20%–30% of his time on the operating group and the rest at the parent company. The small headquarters of JESSI is in Munich.

The chairman of the JESSI board, Cees Krijgsman, says that the big difference between JESSI and Sematech is that all the work at JESSI is done by the participating companies and research organizations. "The advantage is that the commitment [to JESSI] by the companies is 100%," Krijgsman says. "The disadvantage is that everybody has to travel a lot."

The general objective of JESSI often is described as the development of the 64-megabit memory chip, but this is an oversimplification, Krijgsman says. "That's just the last step—the 64 M." He says JESSI encompasses development of every kind of advanced chip with 0.5- or 0.3-micron features. Management of the program is divided among four subprogram boards for long-term research; semiconductor manufacturing equipment and materials; CMOS technology; and applications, that is, application-specific integrated circuits or ASICs.

Noting that Esprit has been "extremely successful," Krijgsman emphasizes that Esprit is devoted to specified research areas. JESSI, on the other hand, is a "comprehensive program with a lot of vertical and horizontal integration."

World market in perspective

While Europe appears to be moving rapidly and effectively to build a position in the global chip and computer markets, its general position remains disadvantageous by comparison not only with Japan but also with the United States.

According to statistics prepared by Dataquest, a firm in San Jose, California, that specializes in collecting data on the semiconductor industry, the United States and Japan each supplied about 30% of the world semiconductor market in 1988. The data were reproduced last November in "Strategic Industry at Risk," a report prepared by the President's National Advisory Committee on Semiconductors. They show that Japan's market share increased from less than 30% to about 35% between 1981 and 1988, while the US share dropped from 60% to 30%.

Statistics quoted regularly in the business pages of major newspapers say that roughly two-thirds of the chips currently manufactured for the world market are made by Japanese companies. But it is important to note that the standard statistics have some important flaws. Charles Ferguson, an expert at MIT on the computer and chip industries, says that data for Japanese companies are reported differently than those for US companies, so that Japan's share of the chip market is systematically overstated. The Japanese statistics typically include both "merchant" manufacturers, firms that produce mainly for external customers, and "captive" manufacturers, firms that produce chips primarily for themselves, whereas the US statistics usually include only the merchant manufacturers. Thus the statistics for the United States often exclude IBM, for example, and Hewlett–Packard—not minor players in the chip game.

Ferguson says that IBM produces about $4 billion worth of semiconductors each year. If that output were sold externally, he says, the statistics would show that IBM accounts for between 5% and 10% of the world chip market, and maybe 20% of the world market for dynamic random access memories or DRAMs.

Other statistics suggest that IBM produces about $5 billion in semiconductor products annually, that Japan's NEC runs a very close second with about $4.8 billion, and that Toshiba is a distant third.

IBM–Europe relationship

Last year, when IBM appeared to be spearheading a drive to establish a US manufacturing consortium called US Memories (see box, page 69), three major blocs seemed to be emerging in the world chip market: Japan, Fortress Europe and Fortress America. Sematech, the US research consortium, often was characterized as a response to Japan's cartel-like practices in the chip market, and JESSI typically was described as Europe's answer to Sematech. Early this year, in evident imitation of an anti-dumping agreement the US government reached with Japan four years ago (PHYSICS TODAY, October 1986, page 69), the European Commission reached an agreement with 11 Japanese manufacturers regulating their sales of semiconductor products in the European market and setting minimum prices for Japanese semiconductors.

But with the demise of US Memories, and the closely coupled announcement of manufacturing and marketing agreements between IBM and Siemens and Intel and NMBS, it may be that we are seeing the emergence of two rather than three major industrial systems: a European–American grouping, in which IBM and Siemens are the biggest partners, and a Japanese–American group, in which NEC, Intel, Texas Instruments, Toshiba or Hitachi will be the heavyweights.

IBM for decades has been the symbol of US economic and technological supremacy in western Europe. As such, it is the object of suspicion and resentment, and it remains a touchy issue for EUREKA. At the ministerial conference last June in Vienna, IBM's European units werre invited to participate in EUREKA projects, provided they used only their own resources. More recently, the JESSI board announced that IBM's European units would be welcome to submit proposals for JESSI projects. But IBM as a whole continues to be barred from EUREKA, though EUREKA's governing bodies repeatedly have discussed letting it in. —WILLIAM SWEET

IN BRIEF

Optics: A Career Spectrum, a brochure describing careers in optics, is available from the Optical Society of America, 1816 Jefferson Place NW, Washington DC 20036. ■