HOW EUROPE SWINGS THE COST OF BIG SCIENCE

Its multinational approach lets countries share the tab for—and the benefits of—pricey research

From the air, the doughnut-shaped ring in Grenoble, France, appears to be as frozen as the neighboring Alps. But inside, electrons circle the half-mile tunnel at nearly the speed of light, producing ultrabrilliant X-ray beams that can expose the atomic structures of everything from proteins to crystals for the first time. With a lead of three years or more on similar projects in the U. S. and Japan, Europe hopes to get a jump in developing new materials, identifying viruses, and understanding unexplained chemical reactions.

HAENSEL: "GOVERNMENTS RESPOND TO PRESSURE FROM THEIR SCIENTIFIC COMMUNITIES"

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The European Synchrotron Radiation Facility (ESRF), as the electron accelerator is called, isn't just at the leading edge of science. Around the world, governments are deciding they no longer can single-handedly shoulder the cost of Big Science. Europe, with a 40-year record of multinational collaboration, provides the model for an alternative approach that splits expenses among partners. And the $675 million, 12-nation ESRF is one of its shining successes. "Efforts like ESRF will be what we all look to as a road map" for megaprojects, says David Moncton, associate director of Argonne National Laboratory in Illinois.

The U. S., in particular, has much to learn. Since World War II, it has funded nearly all its own Big Science. But the cold war's end and the runaway budget deficit are forcing a change. "Just as companies have to go multinational, science has to be international collaboration," declares physicist George F. Smoot of Lawrence Berkeley Laboratory in California. Congress underscored this last summer, when it nearly killed two projects—the $8.2 billion Superconducting Supercollider and the $30 billion Space Station. Now, the White House wants to slow down or scale them back. While the debate continues, the U. S. has joined an international effort to coordinate future projects. Says Clinton science adviser John H. Gibbons: "I expect to be pretty engaged in the whole question of international science and technology."

JOINT PRIDE. He could do worse than look for answers in Europe. Its partnerships repeatedly have put aside national pride and resolved disputes over where to build a facility, how to pay for it, and how to share control. "Collaboration means to admit that your country won't be a world leader," says Christian Roche, planning director at the 40-year-old European Laboratory for Particle Physics (CERN) in Geneva. Yet together, the Europeans have authored discoveries that no partner alone could make in particle physics, nuclear fusion, astronomy, and space observation. CERN researchers, for example, have garnered five Nobel prizes in physics.

It's true that Europe isn't perfect. Recession and huge cost overruns forced the European Space Agency (ESA) to stop its premier space station and shuttle projects last fall. And at CERN, financial grievances of Germany, Spain, and others have slowed attempts to fund a new, $1.4 billion particle accelerator. Moreover, some of Europe's collaborative technology projects—as distinct from science efforts—have been flops. Witness the failed effort to develop a high-definition TV standard (page 14).

ESRF itself had a rocky start. It was approved in the late 1970s, after intense lobbying by scientists from 11 countries. "Governments respond to pressure from their scientific communities," says Founding Director Ruprecht Haensel. Then, it marked time while its job-hungry partners dickered over location. In a 1984 compromise, Germany, which funds 23% of ESRF, finally agreed to let France, which contributes 33%, have the machine. In return, a hypersonic wind tunnel funded by both countries was built in Germany. Once that was settled, other nations bought in.

For operating strategies, ESRF took lessons from such projects as CERN. To hold down costs, ESRF, too, awards juicy equipment and services contracts to the low bidder. Although such smaller states

WHAT EUROPE DOES RIGHT

The U.S. can learn from the principles of collaboration used in building the European Synchrotron Radiation Facility

COST CONTROLS Equipment and services contracts go to low bidders—rather than to higher-cost contractors in countries with the biggest investments

PARTICIPATION Small countries that can't afford the minimum 4% share have teamed up to participate

LONG-TERM COMMITMENT Member countries agreed to a 20-year plan and an initial 11-year budget. In the U.S., by contrast, Big Science budgets are vulnerable to infighting in Congress every year

SCIENTIFIC ACCESS Experiments are approved strictly on merit—so countries with the biggest ownership can't force through pet projects

MANAGEMENT Though selections are often balanced by nationality top managers are chosen first on ability. The U.S., by contrast, typically retains management control of joint projects

MODEL MEGAPROJECT: THE ELECTRON ACCELERATOR IN THE FRENCH ALPS HAS GIVEN EUROPE A JUMP ON COMPETITORS

as Spain and Belgium grumble about not getting their share, this approach avoids a trap that snared the space agency, which guarantees contracts in proportion to members' ownership—price notwithstanding. That helped make the Hermes space shuttle too expensive for Europe to afford.

ESRF is well-structured in other ways. It has tapped the brainpower of small countries, which usually can't afford high-stakes science efforts. For instance, it let Scandinavian and Benelux states form consortiums to meet the minimum 4% investment set for partners. Yet ESRF weights the votes on key budget and staff decisions by each country's financial stake. That sidesteps the one-country, one-vote rule that sparked trouble at CERN. Indeed, until Germany won changes last summer, the four largest of CERN's 18 members, which pay 75% of its budget, could be overruled by the rest. "Big countries often feel small countries have too much power," says Robert Comes, research director at France's National Center for Scientific Research. The new deal counts as a majority any group whose contributions total at least 50%.

ENVY OF THE U.S. Not least of all, ESRF's financial structure should provide remarkable stability. Its members signed on for at least 20 years and approved an initial 11-year budget that can be changed only by unanimous vote. The resulting long-range planning ability is the envy of U. S. science administrators, whose budgets are hostage to haggling in Congress every year. "One secret of European collaborations is that countries stick to their agreements," says physicist Michael Riordan, assistant to the director at the Stanford Linear Accelerator Center in California.

The U. S., by contrast, has cut back or pulled out of numerous international ventures with little regard for its partners. "We're not seen as very reliable," says D. Allan Bromley, science adviser to President Bush. In 1990, for example, the U. S. pulled out of a U. S.-French experiment that was scheduled to fly on a Soviet Mars mission. NASA also backed away from a commitment to contribute to the Europeans' Ulysses solar mission. And the U. S. alienated many countries by touting the Texas supercollider as an example of American scientific superiority—then begging hefty foreign contributions when costs soared. So far, less than $200 million has been proffered, mostly in hardware from India, Russia, and China.

> Including such powers as the U.S. and Japan could make truly global collaboration a Herculean task

The next big test of U. S. resolve to live up to its international commitments will be Washington's space station redesign. Under the existing plan, Europe is contributing a $2 billion laboratory module, and Japan and Canada are building major components. The Clinton Administration, which has ordered NASA to come up with a cheaper design, insists the new plan will include the foreign projects. But experts don't see how the space station can be downsized very much without jeopardizing them. "A lot of the designs have no place for the partners' hardware," says John E. Pike, space policy expert at the Federation of American Scientists. There's even a chance that Congress could yet scrap the station—and greatly damage prospects for future collaborations.

It has taken Europe's close-knit states four decades to iron out such issues—often driven by competition with the U. S. Now, adding the U. S. and Japan, among others, may make truly global collaboration a Herculean task. "A new system has to be invented," declares CERN's Roche. To that end, the Organization for Economic Cooperation & Development is taking inventory of the megascience plans of its 24 member nations, including the U. S. and Japan, in hopes of sparking more partnerships. It's a modest first step but a necessary one if Big Science is to thrive in the future.

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