In its first five years, the European Strategic Programme for Research in Information Technology has had a direct and profound effect on industrial technology in Europe. ESPRIT, dedicated to preemptive research and development, finishes its first phase this December.

Most of the Phase 1 projects achieved significant results in the form of products, prototypes, or standards. These results are promising for the next generation of complex systems. Many results already have been disseminated in the European Community through workshops, conferences, articles, and exhibitions.

ESPRIT’s second phase, just starting, will build on these results, extending their integration in a real-world industrial context. If this second phase succeeds in its objectives, the ESPRIT Phase 1 results — especially those presented in this special issue — should be supported by tools of industrial quality very soon. A summary of Phase 2 projects begins on p. 54.

**Phase 1.** In all, three separate calls for ESPRIT Phase 1 proposals resulted in 220 projects involving more than 3,000 researchers, all of which included participants from industry, universities, or laboratories. ESPRIT projects are half funded by the Commission of the European Communities and half funded by the partici-
The first-phase budget was 1.5 billion ECUs (roughly $1.6 billion).

Phase 1 had five research domains:
- microelectronics (advanced VLSI design and implementation),
- software technology (software engineering methods and tools),
- advanced information processing (knowledge engineering and expert systems, computer architectures, and signal processing),
- computer-integrated manufacturing (standards for multimedia information processing), and
- office and business systems (hardware and software).

Fully 41 percent (4,900 man-years) of Phase 1 projects were devoted to the two software domains, software technology and advanced information processing.

**Articles.** This special issue highlights four major projects in these two domains.

The first article, by Ian Thomas, describes the Portable Common Tools Environment and its implementation in the Pact software-engineering environment. The PCTE project, begun in 1983, is a key enabling technology.

PCTE is a public tool interface that supports multilanguage applications, easy migration from existing tools, and work in a distributed environment. Its most innovative feature is its data-management system, which provides inheritance properties to objects, and tool execution and communication mechanisms.

This ESPRIT project is one of the most successful. The PCTE functional specifications issued in 1986 are the basis for much work, including efforts to develop a highly secured version of PCTE, called PCTE+, efforts by the European Computer Manufacturers Association to develop a standard based on the PCTE+ definition, and, to some people, efforts by the US Defense Dept. within its Common APSE Interface Set project.

Most of the tools developed in ESPRIT are built on the PCTE standard. The next generation of complex software for European systems such as the Ariane V rocket, the Columbus space station, the Hermes space shuttle, and fighter aircraft will be produced under PCTE. There is no doubt that this advanced technological concept will have a dramatic effect on computer-aided software engineering and computer technology.

The second article, by Michel Diaz and Chris Vissers, describes the Software Environment for the Design of Distributed Open Systems. This project sought to define formal description techniques that could describe Open System Interconnection protocols and services unambiguously.

As we learn to develop the complex distributed systems of tomorrow, formalizing communications protocols and software will become more and more crucial. The two formal description techniques developed within SEDOS — Estelle and LOTOS — help do this.

The third article, by Stefano Mannucci and colleagues, describes Graspin. The Graspin development environment supports incremental graphical specification and formal implementation of nonsequential systems. A complement to PCTE, Graspin is a CASE tool for the front end of the life cycle that adapts to every formalism, imposes methodological constraints, and checks designs.

The Graspin project sprung from the observation that graphical languages are an important — but poorly supported — way to communicate. The project's participants have defined an efficient, graphical interface representation. They used this representation in their prototype, which supports document building, layout, and consistency checking. Graspin's formalism offers good support for problem analysis and formal specification.

Finally, the last article describes the Expert System Builder, a knowledge-acquisition project. Completed in 1988, the Expert System Builder is primarily an artificial-intelligence toolkit that supports rule-based expert-systems implementation.

The knowledge decomposition developed in this project has already been exploited and enhanced by many cognitive scientists in Europe. Its three-level decomposition splits knowledge components into concepts (based on frames), world models (based on behavior of domain entities), and problem solving (based on reasoning).

The explosion of expert-systems research will build on this very powerful work. However, as attractive as they are, the advanced-information-processing (AI-oriented) projects are less directly applicable to industrial problems. The AI approach must still be validated on real applications.

Other important ESPRIT projects not described in this issue explored project management, software metrics, numerical accuracy, and system design. Also, the EC Commission has encouraged much work on formal specifications, especially the development of the Vienna Design Method approach.

Apart from its effect on information-systems development, ESPRIT has provided a wonderful network for technology transfer and exchange throughout Europe. Research teams are now developing agreements with companies to commercialize their results. There is no doubt that this technical climate favors commitments from the managing directorates of many big European groups.

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