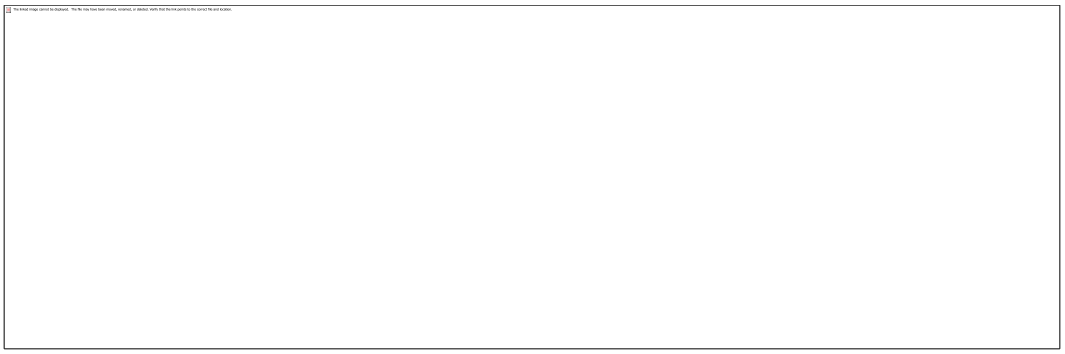

JTEC Panel on

KNOWLEDGE-BASED SYSTEMS IN JAPAN

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May 1993

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WTEC Welcome Page

Published: May 1993; *WTEC Hyper-Librarian*

EXECUTIVE SUMMARY

Expert Systems (ES), also called Knowledge-Based Systems (KBS) or simply Knowledge Systems (KS), are computer programs that use expertise to assist people in performing a wide variety of functions, including diagnosis, planning, scheduling and design. ESs are distinguished from conventional computer programs in two essential ways (Barr, Cohen et al. 1989):

1. Expert systems reason with domain-specific knowledge that is symbolic as well as numerical;
2. Expert systems use domain-specific methods that are heuristic (i.e., plausible) as well as algorithmic (i.e., certain).

Expert systems have become the most successful commercial applications of Artificial Intelligence (AI) research, first in the United States, and then in Europe and Asia. Thousands of systems are now in routine use world-wide, and span the full spectrum of activities in business, industry and government. Economic gain has been realized along many dimensions: speed-up of professional (and semi-professional) work; internal cost savings on operations; improved quality and consistency of decision making; increased revenue from new products and services; captured organizational know-how; improvements in the way a company does its business; crisis management; and stimulation of innovation.

From a business perspective, the expert systems industry in the U.S. consists of many small companies, or divisions of larger companies, which are selling both expert system development software and support services for assisting users in using that software or developing expert systems. Typical annual revenues for a small ES company or division of a larger company are in the range of $5 to $20 million a year per company. The aggregate total of such sales worldwide is in the range of several hundred million dollars per year.

The technology of expert systems has had a far greater impact than even the expert systems business. Expert system technology has become widespread and deeply embedded. As expert system techniques have matured into a standard information technology, the most important recent trend is the increasing integration of this technology with conventional information processing, such as data processing or management information systems.

Study Objectives

The primary objectives of this JTEC panel were to investigate Japanese expert systems development from both technological and business perspectives and to compare progress and trends with similar developments in the United States. More specifically, there were five dimensions to the study, namely, to investigate:

1. Business sector applications of expert systems
2. Infrastructure and tools for expert system development
3. Advanced knowledge-based systems in industry
4. Advanced knowledge-based systems research in universities
5. National projects, including:
    - COT - the laboratory of the Japanese Fifth Generation Computer Project
    - EDR - the Electronic Dictionary Research Project
    - LIFE - the Laboratory for International Fuzzy Engineering

The JTEC panel visited 19 sites during its one-week visit in Japan (March 23-27, 1992), and conferred with other Japanese computer scientists and business executives both before and after the official visits. The panel visited four major computer manufacturers, eight companies that are applying expert systems to their operations, three universities, three national projects, and the editors of *Nikkei AI*, a publication that conducts an annual survey of expert systems applications in Japan.

Conclusions

The panel drew a number of conclusions from these visits, which are discussed in Chapter 8. A comparison of expert systems activities in Japan and the U.S., drawn from those conclusions, is presented in Tables E.1 and E.2.

Although there are many similarities in both the research and applications activities in Japan and the U.S., the panel observed some noteworthy contrasts:

- Japanese computer manufacturers (JCMs) play a dominant role in the technology and business of expert systems. The JCMs have mastered and absorbed expert system technology as a core competence. They tend to use systems engineers rather than knowledge engineers to build systems. Consequently, integration with conventional information technology poses no special problem for them, and is handled routinely and smoothly, without friction. These large computer companies also build many application systems for their customers; smaller firms specializing in AI software play only a minor role in applications building, compared to the United States.
- The majority of the Japanese expert systems tools are developed, sold, and applied by the JCMs. They have the resources to conduct research, develop new products, and persist in the business. In the U.S. most of the expert systems tools are developed and marketed by a handful of small companies. The Japanese can continue to invest in the research and development of new tools (which they are doing) and are in a better position to survive lean times. In contrast, American vendors must work with short-term objectives and lean cash reserves.
- Japan has more experience than the United States in applications of knowledge-based systems technology to heavy industry, particularly the steel and construction industries. In certain application tasks, such as closed-loop control, expert systems have been assimilated into the suite of techniques available to the systems engineers, and do not require the special attention sometimes afforded new technologies.
- The Japanese are ahead of the United States in the integration of problem solving techniques, due to a combination of factors. These include substantial Japanese investments experimenting with a wide range of technologies and in-house development of expert systems tools by Japanese computer manufacturers and other large organizations. These factors provide the understanding necessary for full integration of software with other data processing components. Another factor is the avoidance of artificial partitions between various methodologies.
- Products based on the use of fuzzy control logic have had a big impact on consumer products, including camcorders, automobile transmissions and cruise controls, television, air conditioners, washer/dryers, and many others.
- The panel saw continued strong efforts by Japanese computer companies and industry-specific companies (e.g., Nippon Steel) to advance their KBS technology and business. This situation contrasts with that in the U.S., where there is a declining investment in knowledge-based systems technology; lack of venture capital; downsizing of computer company efforts; and few new product announcements. It is a familiar story, and one worthy of concern, as this trend may lead to Japanese superiority in this area relatively soon.

- Although the quality of research at a few top-level universities in Japan is in the same range as at top-level U.S. universities and research institutes, the quantity of Japanese research (in terms of number of projects and/or number of publications) is considerably smaller by nearly an order of magnitude.

Table E.1
Comparison of Applications of ES in U.S. and Japan

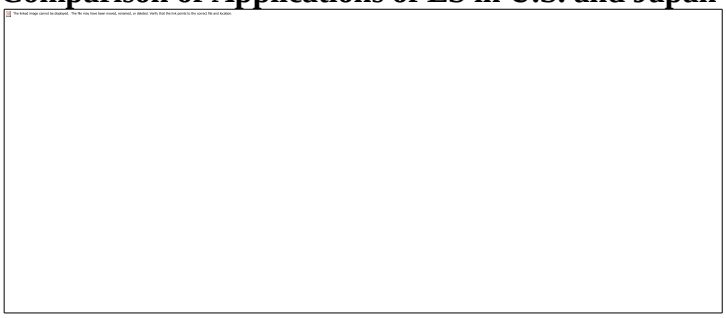

Table E.2
Comparison of KB Research in U.S. and Japan

Published: May 1993; *WTEC Hyper-Librarian*