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R & D Cooperation in AI: Report on the U.S. and Japanese Panel, IJACI 1985

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The substance of this issue between the U.S. and Japan in science and technology cannot be underestimated, as shown in Figure 1. In the last five years, Japan has made a 400% increase in total industry- and government-supported R&D. Japan's R&D was 20% of U.S. R&D in 1980 and 50% in 1985 when it attained R&D funding parity with the U.S. on a per capita and percentage of gross national product basis. What are the implications of this great increase? Japan is evolving from technology assimilator to innovator. Although language and distance are still barriers, this change will provide opportunities for cross-fertilization of innovation in AI and other sciences. It is necessary to channel these efforts for the benefit of all countries, rather than to erect political barriers. This is exactly what the U.S. and Japanese government spokesmen stressed during the presentation of this panel.

Government Officials

Dr. Jack Williams brings the experience of the U.S. government policy-makers assigned to the production of the 1984 National Cooperative Research Act, which helped spawn 38 projects of industrial collaboration, including MCC. His presentation pinpointed the world forces of change, the government role in fostering efficient technological innovation, and the need to adapt to flexible manufacturing quickly. In discussing the AI industry, he said, "There are many similarities between AI and biotechnology, namely, the entrepreneurship and many startup firms, few products yet, but much commercial potential, a shortage of qualified talent, and a potential to create vast social change. The aspects of world forces of change are serious in that they threaten the livelihood of the U.S. economy because 70% of the U.S. output is in world markets.

The author acknowledges the kind cooperation of Professor Aravind Joshi, IJCAI program chairman, in extending the opportunity to produce this timely panel discussion The panelists included Dr Jack Williams, director of the U S Department of Commerce Office of Productivity, Technology, and Innovation; Mr Nobuhiro Miyake, director of Japan's External Trade Organization, Technological Affairs; Dr Woodrow Bledsoe, president of AAAI and vice president of MCC; Dr Kazuhiro Fuchi, research director of ICOT; Professor Edward Feigenbaum, director of Stanford University's Knowledge Systems Laboratory and noted author of *The Fifth Generation: Artificial Intelligence and Japan's Computer Challenge to the World*; Mr Keishi Kawamo, director of Mitsubishi Research Institute's AI project; Mr Tom Kehler, vice president of IntelliCorp; and the author and panel chairman, Mr Howard Jacobson, executive vice president of Jacobson Corporation

Abstract

The consensus of government, academic, and industry leaders widely supports the strategic positioning of U.S. and Japanese research and development in mutually beneficial, two-way flows of innovation This report is derived from the IJCAI panel titled U S and Japanese Cooperation in AI and R&D Opportunities, held August 23, 1985 at the University of California at Los Angeles This panel discussed the sensitive topic of alternatives to nationalistic competitive strategies that have contributed to an extreme trade deficit surpassing $40 billion in 1985 The ideas offered by the panelists shed light on ways our countries' respective scientific communities can blend talents to achieve the best results in reducing trade frictions Each country has designated AI research as a key to unlock years of generations of technology and has directed billions of dollars to fund this development The most recognized projects are the U.S. Microelectronics Technology Computer Consortium (MCC) and Japan's Fifth Generation Computer Project (ICOT). Although noting the obstacles, the panelists encouraged specific, shared efforts to ensure the development of a closer working relationship to explore AI's benefits.

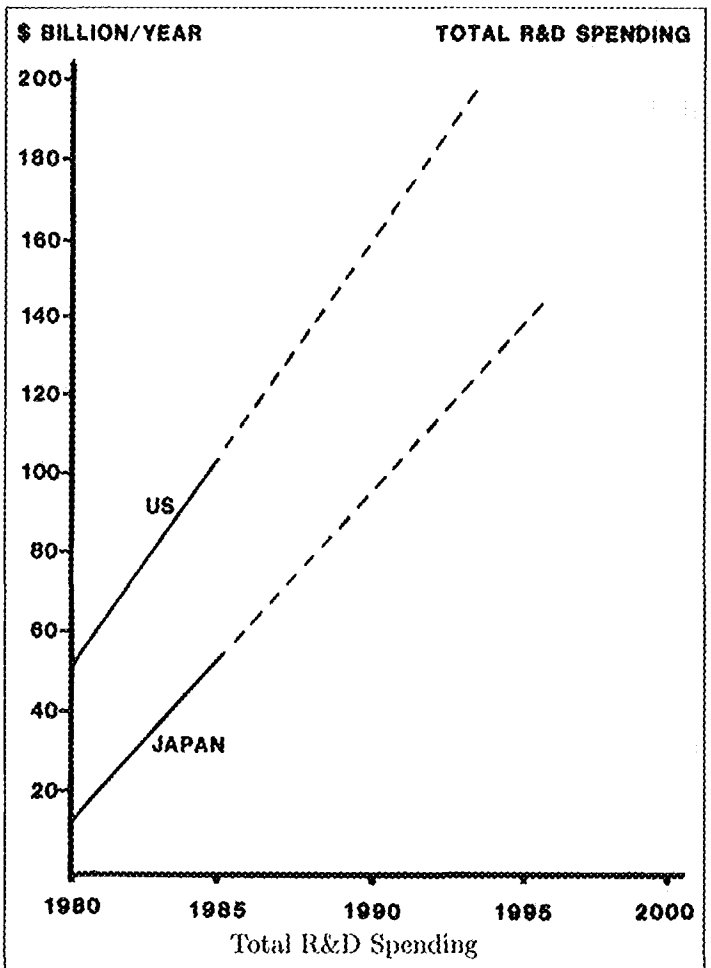


Figure 1

International competition from countries like Japan, Korea, Taiwan, and Mexico have recently ushered in an era of neoprotectionism. On the positive side, though, small business growth has contributed much of the 8.5 million jobs gained in the last 2.5 years. Also, the acceleration of technology innovation has produced a period of super-fast growth for markets. This has prompted a need for firms to adapt to the changing rules, and one method that increases feasibility in many cases is the process of innovation using cooperative R&D.

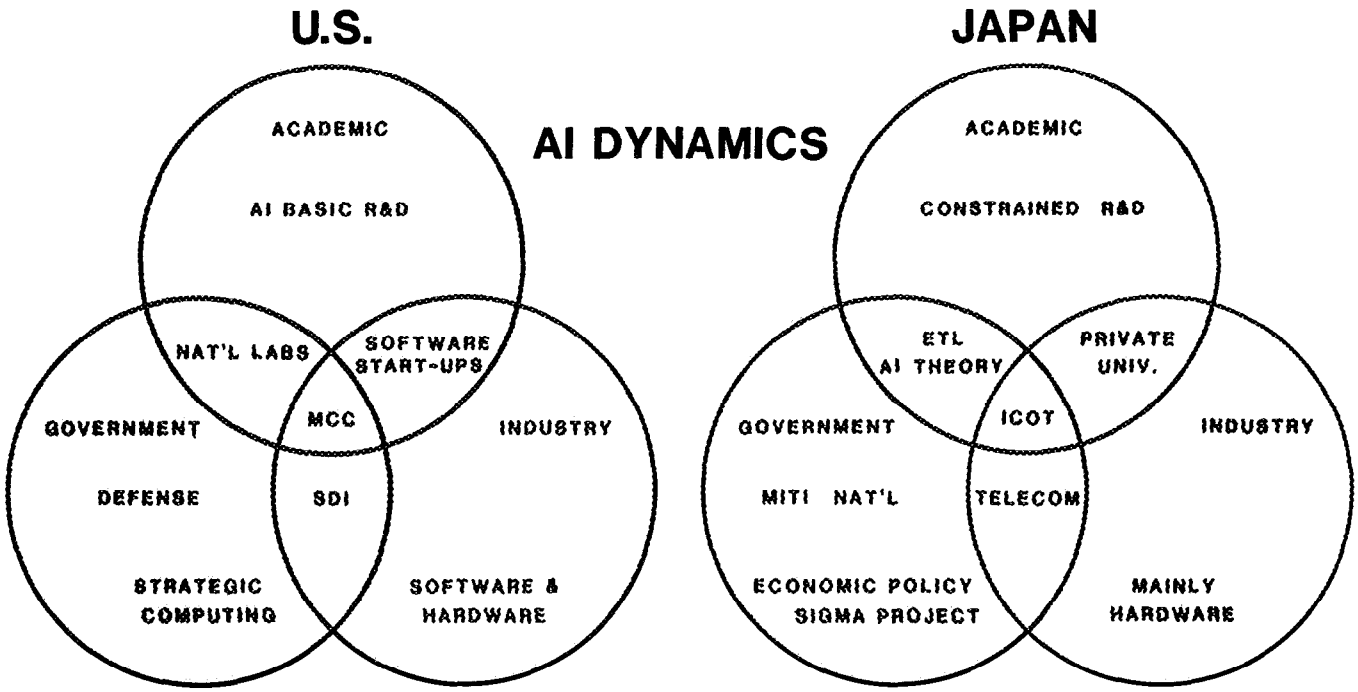
"The advantages of cooperative R&D are (1) cross-fertilization of ideas and processes; (2) economies of scale eliminate high cost of entry for individual firms; (3) reduced risks when knowledge is pooled; (4) solves the problem of free-riding, late entrants into the marketplace; and (5) reduces social costs of excess duplication. The 1984 National Cooperative Research Act is helpful by reducing antitrust treble penalties into actual damages and permitting consortiums like the MCC to take place. This, combined with lower capital gains tax rates, made $16 billion in venture capital and $20 billion in initial public offerings in the last two years. R&D limited partnerships raised another $2.5 billion in the last two years. The effect of these consortiums and industrial research partnerships will raise the productivity of innovation and allow greater competitive advantages. The fact that one-third of the 38 consortiums in the last year involve U.S. and international partner firms points to further benefits of reducing trade friction and nationalized trade practices."

Mr. Nobuhiro Miyake of Japan's External Trade Organization described the Japanese government's approach to solving trade imbalances and encouraging international technological cooperation and his views on AI in Japan. Since 1981 the Japanese government has been strongly encouraging international collaboration. The Center for International Technological Exchange and Cooperation was started to activate trade and investment among nations. As an example, "380 industrial projects were started in 1984 between U.S. and Japanese firms. 40% were in high technology, mainly computers and semiconductors. Over 440 Japanese firms are employing 80,000 U.S. employees. This suggests that an enormous amount of U.S. and Japanese collaboration is occurring now. A survey from Japan's Ministry of International Trade and Industry (MITI) shows that 70% of Japanese firms are interested in pursuing international collaboration

"The specifics for U.S. and Japan collaboration in AI is that Japanese firms started AI work later than their U.S. counterparts. Because ICOT started in 1982, users are exhibiting a strong interest in AI, but we have a shortage of knowledge engineers. Many U.S. manufacturers like IBM and DEC have research teams in Japan interested in AI. The Japanese manufacturers are scaling up their efforts to produce fast AI workstations, which should make a good attraction for U.S. software products that can be customized to Japanese users. In fact, U.S. AI firms have begun to start partnerships in Japan, such as IntelliCorp and CSK, Carnegie Group and ITI, and others. A figure provided by the Arthur D. Little Company projects Japan's AI market to reach $40 billion by 1995."

Research Leaders

Dr. Kazuhiro Fuchi directs the entire research effort of ICOT, which is a major $400 million consortium for the Japanese government and industrial firms. It was started in 1982 to undertake the mission of producing vastly different computing architecture and AI software capable of running at millions of information-processing statements each second. This goal is structured as a three-part process over ten years. The creation of ICOT started a flurry in the U.S. that Japan would use this to take the lead in technology. This event had an effect on the passage of the 1984 National Cooperative Research Act allowing U.S. firms to enjoy consortium research advantages. The interest in having Dr Fuchi as part of this panel was to allow him to express his desire to see ICOT's research serve the



The comparative difference between U S and Japanese AI evolution must be clearly understood before cooperative alliances can be successfully undertaken

AI Dynamics in the United States and Japan

Figure 2

whole community of AI researchers and to invite international collaboration.

Dr. Fuchi's talk centered on two points: (1) AI composed of business and research and (2) the role of ICOT in terms of AI.

"Things have changed rapidly in the last three or four years because of fifth generation projects and active AI businesses. The size of IJCAI has tripled mostly from the business side since people are searching for practical applications of AI. There is also an increase in experience and better research. But the interest is mostly in the business side. However, conventional computer architecture has a big limitation in running these current AI programs, and present efforts to use this hardware will soon reach their limits. AI will fully develop in the twentieth century, but not dependent on this current hardware. Excessive interest in the business side might complicate the potential for international collaboration.

"With AI research, much is to be done. Several basic aspects have been made into products, but many of the technical themes haven't been solved at all. There are three attitudes: (1) business, (2) pure research, and (3) AI tools in order to explore AI technology. Although ICOT's purpose is to rebuild the concept of the computer, it can contribute to the AI field with powerful tools. International cooperation in research is at a very good level. What can complicate it is mixing business issues with research issues."

When asked what system he uses to decide which Japanese firm builds their part of the fifth generation computer, Dr. Fuchi actually welcomed U.S. firms to take part in construction because the results of ICOT's research are open to any firm, not just Japanese firms. It would be rewarding to find a U.S. manufacturer that would approach ICOT this year on this basis.

Dr. Woodrow Bledsoe, president of AAAI and vice-president of MCC, lent his views on U.S. and Japanese cooperation in AI.

"One main comment deals with language, distance, and the question of computer networks. The obvious fact is that in the U.S. almost no one speaks Japanese, and almost everyone in Japan speaks English. Will there come a time soon when we in the U S. will have to learn Japanese to keep technically aware of advancements?"

This is a keen observation, and it is interesting to note that many U.S. universities are increasing their Japanese-language training courses for precisely this reason.

Dr. Edward Feigenbaum, whose knowledge of U.S. and Japanese relations in AI is well respected, had strong interests in international cooperation, but he stressed,

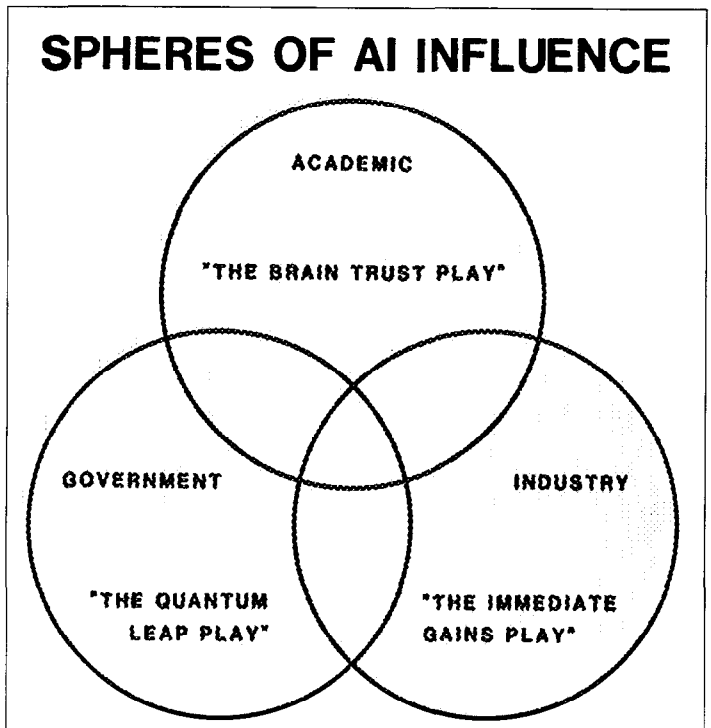
"From Adam Smith's *Wealth of Nations*, 'The reliance on self-interest to motivate and optimize transactions among people is the invisible hand If we do this, the invisible hand will work to everyone's benefit, if not,

we end up in a planning bureaucracy.'

"Cooperation requires the alignment of motivations to work out. Regarding the scientific motivation, I agree with Dr. Fuchi that cooperation is going well, and publication is prolific. The only inhibitions are, as Dr. Bledsoe put it, (1) the language and distance and two other points: (2) that cooperation–involving visits are seen as intrusions unless there is an important reason and (3) Department of Defense sponsorship of much AI work has created a nervousness on the Japanese part to collaborate. There is a decidedly antimilitaristic view among the scientists. The business motivation, on the other hand, is to make and sell products to make money. International cooperation in business is difficult but reliable. Joint ventures and cross-licensing will become the dominant form of cooperation between U.S. and Japanese firms, as well.

A project that is suggested for all countries as a multinational cooperative venture in AI is the construction of a large knowledge base. Programs do not perform well unless they are knowledgeable, and this project could start a long-term process concerned with general human experience, which would succeed in uniting many without stirring up competitive corporate sensitivities."

This type of project has great appeal to all countries and could be started through the efforts of leaders from the academic and research communities. Although a project of this scale would be long in coming, it is still worthy of beginning at this time.



Here we can begin to see the interplay between independently funded and motivated sectors of the AI world The extent of this interplay will determine the growth of the AI industry.

Spheres of AI Influence

Figure 3

Industry Executives

The industry has its own unique view of U.S. and Japanese cooperation in AI Because the government representatives have opened the door to these industrial projects in the last two years, it appears that the industrial firms of both countries are using consortiums and partnerships to facilitate the growth of technology. With projections of billions of dollars of AI products in both countries, the consequences of teamed U.S.–Japanese development in AI will play a major role in determining the actual growth factor.

Mr. Keishi Kawamo, heads up a unique research project for Mitsubishi Research Institute's AI division. His presentation marks a first to describe the status of Japan's AI usage. Japan's 50 top industrial firms have joined Mitsubishi's multiclient research project. The goal is to develop workable AI applications within the next year, which places it as the most active approach in Japanese business toward gaining acceptance of AI. His thoughts on AI in Japan were, "We just started, so we are behind U.S. counterparts. Development of hardware and software is rapid lately. The use of Dendral and Mycin, as well as ICOT, stimulates our expectation of AI. Compared to the forecast by Arthur D. Little Company, we forecast 1/10, or $4.4 billion, by 1995. The difference may be due to our survey not including the plant diagnostics machinees, only AI direct machines, languages, and tools. The Japanese AI industry consists of:

Japanese AI Workstations.
"U-Station/EIS (Sumitomo/DEC), Falcom Alpha, (Fujitsu), ELIS (NTT), TAO (NTT), PSI (ICOT/Mitsubishi), which I expect will be developed for commercial use; and FLATS (Chemical Research).

Japanese Expert Systems Tools.
"Brains (Toyo Joho [TIS]), Zeus (Mitsubishi Research), Comex (Tokyo Denki University/Fuji), Eureka (Hitachi), Mandala (Toshiba), CL (NEC), and E-Shell (Fujitsu).

Japanese Expert Systems.
"Medicine (glaucoma, rheumatism), Engineering (VLSI, lens design, imaging, train scheduling, plant maintenance, process control, processing software, power control repair), Business (labor prediction, stock prediction).

AI Technologies Imported to Japan.
"Symbolics (Nichimen/TIS), ART (Nichimen/TIS), Interlisp, Loops (Fuji/Xerox), Lambda (LMI/Hakuto), XCON, XSEL, ELIZA (Nihon DEC), TEK 4404 (Sony/Tektronics), KEE (IntelliCorp/CSK), MPROLOG (Nikei), Language Craft (Carnegie Group/ITI), Knowledge Craft (Carnegie Group/ITI).

"As one can see, the market is beginning to take on a lot of variety with the users' attention roughly 50% on

LISP and 50% on Prolog."

Mr Tom Kehler, of IntelliCorp described how his firm was the first AI tool company to create a Japanese tie-up with CSK, a large computer services firm.

"We have two levels of involvement. One is the arrangement with CSK for KEE, our AI tool. This has been in force two years and is a distribution and two-way technology sharing agreement. The other is biotechnology software with C. Itoh. Both agreements have been very satisfactory with our knowledge that a long-term commitment to the Japanese market is the only way to succeed. We conduct seminars, technical exchanges, and knowledge engineering training. CSK has set up a large AI research lab to support clients of KEE, and the effort has been dramatic. The types of application in Japan are engineering related. In fact, the first seminar I gave was to workers in hard hats and steel-toed shoes. Japanese needs are slightly different than in the U.S. at this stage. There is a need for practical integration of embedded systems. The greatest areas for potential collaboration are: (1) systems software standards, (2) technology for integration into existing systems and (3) application specific development, like a factory manufacturing system."

Since IntelliCorp first brought U.S. AI tool technology to Japan, both Carnegie Group and Inference have followed.

Mr. Howard Jacobson of the Jacobson Corporation has been active in creating two-way technology projects between U.S. and Japanese firms. Particularly in AI, there is a higher than average attraction because of the intense desire for Japan to catch up as well as the U.S interest in establishing market rewards from Japan (such as innovative ideas and sales of products in Japan). From spending a month in Japan visiting the AI labs and scientists, he concluded that there was a high degree of competence and that the scientists offered literally volumes of research papers, thereby contradicting the belief of a secretive barrier against sharing technology.

There are six major trends, that weigh heavily in favor of U.S. and Japanese cooperative projects: (1) the trade axis shifted to the Pacific basin in 1981, (2) the U.S. and Japan are the two largest high-technology producers and trading partners, (3) President Reagan and Prime Minister Nakasone are dismantling trade barriers, (4) R&D spending has risen 400% in 5 years in Japan, (5) numerous U.S. and Japan joint ventures are evolving, and (6) AI has recently been declared a critical technology for both nations.

The AI project currently being developed is a U.S. and Japanese consortium to combine advanced manufacturing methods, that will be for both U.S. and Japanese users. This project is called the Manufacturers' International Cognitive Values Alliance and will allow U.S. and Japanese firms to find some common ground for cooperation in the use of this technology. It will advance trade relations among the partner firms and provide a way for ownership of the technology. Both U.S. and Japanese AI scientists will be used on the project, setting an example of cooperation . All serious contributors to this project are being organized with the guidance of the U.S. Department of Commerce and MITI. The consortium is among several projects started under the 1984 National Cooperative Research Act.

Conclusion

Future relations in technology between the U.S. and Japan will have a great impact on the direction of our markets. As the countries prepare the next generations of technology by funding billions of dollars to AI R&D, the traditional pattern of nationalized competition must be diminished. It is important to increase opportunities for the scientific communities to share in their advancements without political barriers. Although language and culture are different, the combined effect of equal efforts will produce a higher net result. Because this is a sensitive issue, the panelists are to be commended for their honest leadership in providing us with their insights. Hopefully, the scientific communities' increasing prosperity in research will lead the way for industry, by the example of collaboration, to help reduce the trade frictions that resulted from artificial restrictions.

The AI Magazine

Production Notes: We have changed our printer and mailing house from Los Angeles to Midland, Michigan. This change has enabled us to cut our expenses, while maintaining a ten-day production time. Because of the location of the new printer, west coast members of the AAAI may experience a few extra days delay in receipt of their magazine. We are currently investigating second-class mailing permits, which should significantly speed up delivery of the magazine to all members.

New Arpanet Address: The arpanet address for editorial and production correspondence has been changed from AAAI@SRI-AI to AIMAG@SUMEX-AIM. Correspondence regarding membership, change of address, and AAAI association matters should continue to be sent to AAAI-OFFICE@SUMEX-AIM.

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