

Report on my Visit to ICOT

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1 Introduction

More than ten years ago, in August 1979, I came to Japan for the first time to attend IJCAI-79. It was at that occasion that I got into contact with Dr. Fuchi and several other researchers in Artificial Intelligence from Japan, learning of their attempts to launch a major project in our field. Two years later I was honored to give an Invited Talk at the first FGCS Conference, held in Tokyo in 1981. Needless to say that I have attentively been observing from distance the progress that this ambitious project has been making in the time since.

I was all the more delighted to accept an invitation extended to me by Dr. Furukawa at IJCAI-89 to visit ICOT (6 Feb - 17 Febr 1990), about a decade after our first contacts. This has given me a particular chance to see in more detail what has been achieved in the first two phases of the project. But of course it gave me also the opportunity to present some of our own results achieved on topics that are similar in spirit with the goals pursued at ICOT.

2 Project evaluation

Any major advanced computer systems project has to consider the following different components.

1. A high-performance hardware consisting of one, preferably several or even many, processors realized in VLSI technique, as well as a high-capacity memory and storage component.

2. A kernel, low-level software system providing the link to any software to be developed for the machine.
3. Medium level basic software realizing functions like OS, logical inference, KB management, programming environments with various programming support subfunctions, intelligent interface functions for comfortable man-machine interaction, and so forth.
4. High level applications functions such as program synthesis, theorem proving, common sense reasoning, language and speech understanding, vision, robotics, and so forth.

Considering these components does not necessarily mean to develop each of them from scratch. Still I fully agree with the approach taken at ICOT which is to span KIPS from the basic machinery through the basic software tools up to sophisticated application software such as natural language understanding, automated theorem proving, program synthesis, and so forth. Unless one has a broad view of a general system exhibiting all these components, one would not be able to design each of these components in an unbiased way.

However, at the present point of the state of the art, the development of each of these topics is still a very demanding task with many fundamental problems yet completely unsolved. In some cases we do not even know exactly what the problems actually are. In this situation it might be worthwhile to consider, while retaining the broad system in its entirety in mind, nevertheless focussing the attention to special aspects and components that together still make for a reasonable subsystem. Since only a very short time is left for the FGCS project, such focussing would appear to me to be particularly important now.

So far the project has been extremely successful in the developments of the items 1, 2, and much of 3. The PSI machines, the Multi-PSI system, the steps towards a PIM are the keywords for the successful handling of item 1; the KL0 and KL1-c represent the success wrt. item 2; while SIMPOS, PIMOS, ESP, KL1-u, Argus/v, and others demonstrate impressively the success so far wrt. item 3. It is the high level functions that seem to deserve most of the attention for the remaining project phase while completing at the same time the development of PIM, its VLSI version, the portation of medium level software already developed in ESP to the KL1 environment, and other ongoing basic developments.

In view of such focussing of attention I have the following remarks to offer. At present there are many separate investigations towards such higher level systems being carried out at ICOT and at the companies involved. It is especially in that area where I lead many interesting discussions with some twenty ICOT researchers during my stay during the past two weeks. Each of these different projects has its particular merit. To be more specific I mention some of them explicitly.

There is the Argus project whose program synthesis aspect I am particularly looking forward to see more to come out of it. Further, the constraint logic programming programming project CAL, as well as the work on partial evaluation, which both are related from my own view-point of logical systems. This is because these different attempts (constraints, partial evaluation, theory resolution, etc.) all have in common an attempt to get specific information about the theory involved into the steps of logical inference rather than realizing the same as separate logical inference steps carried out independently, as a uniform deductive system would do. Further I mention the work on non-monotonic reasoning, especially that on circumscription. Also I mention CAP-LA supporting a human oriented interface supporting a novice mathematician in developing linear algebra proofs. Finally, there is DUALS, a discourse understanding problem solver. Once again, in selecting those mentioned here, I do not mean to disqualify any of the others; it is just that I had particular opportunity to familiarize myself with them, and they well serve to illustrating my point.

Now, the role of ICOT is not seen from the international research community simply in developing a particular hardware system such as PIM, supported by some basic software system, and various, relatively abstract, applications such as those just mentioned. Many rather expect some more general system to eventually come out as a result that is capable of various intelligent functions at the same time. They also expect such a system to be demonstrated in a way so that ordinary people can at least superficially see the result of these intelligent functions in concrete (rather than abstract) applications.

One might obviously ignore such expectations from the public, and rather just continue in developing those different systems. Unfortunately, this might result in a negative impact on the support that this kind of research receives internationally in the future. I personally would therefore rather prefer to see attempts being made now to merge different of these initiatives (possibly just selected ones) into one more general and uniform application system. In addition, it would be more impressive if such a sys-

tem could be demonstrated in a concrete application in which the incorporated intelligence could be visualized to the less-informed as well. I have discussed these two major suggestions, ie. *systems-unification* and *concrete application*, in many of the discussions with many researchers here including Dr. Furukawa and Dr. Hasegawa. One of the main themes in my formal presentation also dealt with this issue.

In a few sentences, my ideas towards such a more general system are based on a two-layer architecture of the following kind. The top layer consists of a general logical reasoning system (like SETHEO or PTP) — the generalist. The lower layer in future systems might comprise many specially coded subsystems that specialize in narrowly defined subareas (like equality reasoning, constraint reasoning, rewriting techniques for special theories, etc.) — the specialists. It is of fundamental importance to provide along with each of these specialists a transformational link to the generalist (in both directions). This would enable the system as a whole to take advantage of one of its specialists whenever possible thus enhancing efficiency, and get back into general mode of reasoning whenever no specialist is available for the particular task under consideration. It would also allow for ongoing modification of the entire system as research continues via the explicit transformational links provided between the specialists and the generalist.

To sum up my evaluation, I personally consider the entire project so far a great success, in terms of the technical achievements, its impact on the direction of research worldwide, last not least its impact on the development of a research culture in Information Technology in Japan on an internationally outstanding level that will have a great impact on further enhancing the economic strength of Japanese industry (since all the researchers working at ICOT and eventually going back to the industrial basis will act as effective multipliers). If work is continued as scheduled in this way, and if the suggestions just made will be taken into account, then I am convinced that in 1992/3 everyone will consider FGCS an overall successfully completed project. I am personally looking forward to many interesting results coming out from it, and wish all my colleagues here fruitful work for the remaining years within the project.

2.1 Work environment

Having worked myself in various environments both in Europe and North-America, there are a number of specifics that strike me as being different here at ICOT in comparison to those places. Since, from my own experience

as leader of research groups, I am deeply convinced that such issues are of great importance for the success of any project, I would like to comment on these observations.

There are a number of very positive aspects. The open space office hosting all researchers from the Director to the young researcher probably supports a deep commitment to the common research goals. A visitor is particularly impressed by the concentration with which everyone is working at his or her desk, restraining from distraction as much as possible. For instance, I have never been at a place where people are hanging on the phone so rarely as here.

On the other hand, I think it would be good to allow for more social communication among the members of the institute. There should, in my view, be a lounge where everyone can take a break over a cup of Japanese tea or coffee, and casually chat with someone coming by as well.

Perhaps more important is the lack of an established way of bringing the entire crew together in certain intervals for exchanging experiences across different laboratories and discuss desirable goals for the institute as a whole. I understand that at present this interaction crossing the laboratories boundaries is going on mainly at the level of Chiefs of Labs (and in casual interactions on an individual basis). I would think this could be arranged, for instance, in the form of a monthly half (or full) day workshop where members of different laboratories would present their achievements (and problems) to all of ICOT. This way most researchers would be on the stage roughly once a year. This would also contribute to an improvement of presentation skills which at present is not the strongest side of Japanese scientists.

Another weakness that may be generally witnessed of Japanese researchers is limited writing skills, especially in the English language. The quality of the work done here is much better than one might conclude from the number of papers appearing in international journals or conferences. In a place with 100 researchers it would definitely pay to give special attention to training these writing techniques. Possibly a person might be hired full-time for this particular task who must however have technical background along with a good command of writing in English as well as writing technical papers (obviously a difficult-to-find person). As editor of journals I am looking forward to receiving more submissions from Japanese laboratories like ICOT.

3 Presentations

I was granted the opportunity to lecture twice to excellent audiences. First, I presented in a more informal way technical details of our work on Automated Deduction in a three hour lecture to an audience of informed specialists within ICOT. Second, I gave a formal talk on "Perspectives of Automated Deduction" for a larger audience. In the latter talk I tried to focus the attention to a number of key issues of current interest in our field that might enhance the performance of deductive systems significantly once incorporated in our present technology. With this lecture I, at the same time, tried to provide a perspective of how a unified system I talked about in the previous section might be achieved. Both lectures were very enjoyable for me.

4 Conclusions

Although the time of my stay was limited (due to so many other obligations), I think this report indicates that the stay nevertheless allowed for an intensive exchange of mutual experience and results. At least I learned a lot that will support progress in the work of my own group in Darmstadt (and Munich). It would be very satisfactory for me to have been able to give some stimulations for the work here at ICOT as well to the benefit of the progress in the pursuit of our shared goals.

I would like also to point out the kind hospitality of my hosts here at ICOT which made my stay such an enjoyable one in all respects. Our friendship has deepened by these many technical as well as social interactions. I am therefore very grateful for being honored with this invitation, having been hosted so generously, and would like to express my special thanks to Dr. Fuchi, Dir. Hiroshige, Dr. Furukawa, Dr. Hasegawa, Dr. Iwata, Mr. H. Fujita, and Dr. Sakai, as well as to all others which spared their time with me and invested efforts in my stay.

Sayonara,

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Résumé

Wolfgang Bibel is Professor for Intellectics at the Department of Computer Science of the Technical University Darmstadt in Germany. He also maintains affiliations with the University of British Columbia as Adjunct Professor and with the Canadian Institute for Advanced Research as Associate.

In 1968 he received his Ph.D. degree from the Ludwig-Maximilian University of Munich, Germany. For many years he worked at the Technical University of Munich as a Senior Researcher, building up the AI group there. In 1987 he became a Professor in Computer Science at the University of British Columbia, Vancouver, and a Fellow of the Canadian Institute for Advanced Research.

His more than one hundred publications range over various areas in Artificial Intelligence such as Automated Deduction, Machine Architecture for deductive systems, Program Synthesis, Knowledge Representation as well as the implications of AI technology for society.

Dr. Bibel is Section Editor of the Artificial Intelligence Journal, Associate Editor of the Journal for Symbolic Computation, Editor of the AI book series of Vieweg Verlag, and on the board of several other journals and series. From 1982 through 1986 he served as the first Chairman of ECCAI, the European AI organization. Since 1987 he is a Trustee of the International Joint Conferences for Artificial Intelligence, Inc., and held the Conference Chair of IJCAI'89.