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# Expanding Access to Science and Technology

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*The Role of Information Technologies*

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Edited by Ines Wesley-Tanaskovic, Jacques Tocatlian,  
and Kenneth H. Roberts

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# Expanding Access to Science and Technology: The Role of Information Technologies

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*Proceedings of the Second International Symposium on the Frontiers of  
Science and Technology Held in Kyoto, Japan, 12–14 May 1992*

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Edited by Ines Wesley-Tanaskovic, Jacques Tocatlian, and  
Kenneth H. Roberts

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### **Note to the Reader from the UNU**

With science and technology having an increasing impact on our social and natural environments as well as on the conduct of the scientific community itself, the UNU considered it important to create a forum for leading experts to contemplate the directions in which specific advances are leading us. To meet this end, a seminar series on “Frontiers of Science and Technology” was established in 1991. The first symposium under this series looked at the role of the emerging theory of chaos in discussing “The Impact of Chaos on Science and Society.”

The symposium on “Expanding Access to Science and Technology – The Role of Information Technologies” was the second symposium under the “Frontiers” series. New information technologies are fundamentally restructuring traditional ways of access to science and technology. However, with the growing amount of scientific information and the current rate of technological innovation there is a trend to greater disparities among nations in terms of information access and retrieval, and the ability to apply existing data to social and economic development. Based on the symposium, the current publication assesses the new technological potential in providing access to, retrieval, exchange, and handling of information. In this context intelligent information access and its impact on information retrieval and transfer as well as opportunities of developing countries in utilizing the new information technologies are of major concern.

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# Preface

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*Ines Wesley-Tanaskovic, Jacques Tocatlian, and  
Kenneth H. Roberts*

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Recognizing that science and technology have an increasing impact on our social and natural environments, the United Nations University decided to have a forum for international experts to contemplate the directions in which certain advances are leading society. To this end a series of international symposia on “Frontiers of Science and Technology” are being carried out in cooperation with major Japanese universities.

The first symposium in this series was held in 1991, in cooperation with the University of Tokyo, to assess the impact of chaos on science and society, reflecting the growing body of knowledge on chaotic behaviour in a variety of scientific disciplines.

The second symposium was held in Kyoto in 1992 in cooperation with Kyoto University, and its aim was to evaluate the potential of the new information technologies to improve information handling, retrieval, and exchange and, in general, to expand access to science and technology.

It is recognized that new information technologies are fundamentally restructuring traditional ways of providing access to science and technology. However, despite the current rate of technological innovation, there is a trend to greater disparities among nations in terms of access to information and the ability to apply knowledge for social and economic development. The opportunities of developing countries to use the new information technologies were a major concern of the second symposium.

The Kyoto symposium reviewed the experiences and strategies of major international information programmes over the last 25 years that aimed at improving the capabilities of countries, and recognized that a significant infrastructural gap and lack of a systematic approach persist. Therefore, the symposium took as its central focus the requirements for planning future

infrastructure development in a more systematic way by fully taking into account the new technological potential.

The symposium also examined technological experiences in database and data bank construction and use, communication networks, and the problems encountered by the developing countries in acquiring, adapting, and using the new information technologies.

One general area attracted particular attention: intelligent information access and its impact on information retrieval and transfer. Intelligent information access is a central area for research and development in information and computer sciences. It is expected that the advances in human-computer interaction and particularly in interactive technologies of natural language processing will open new perspectives. Access through natural language will become more creative for seeing in the computer an agent with a broad spectrum of communication means with the human user. Language must be integrated with other channels to attain multimodality for information access. The resulting hypermedia systems based on cognitive theories of human information processing open up horizons.

The paradigm of “sub-languages” that are domain-specific promises to offer an imaginative solution to the problems of user-computer interaction: the user as a processor of information. This approach encounters perceptual and processing limitations as well as applications to the user interface, such as input devices, displays, and dialogue design. “Flexible information processing” is another paradigm that is considered essential for the advancement of information technology applications in the real-world environment and that was examined at the symposium in terms of its future prospects.

A panel discussion at the symposium’s end evoked recommendations for international cooperation in expanding access to science and technology.

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# Opening Address

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*Heitor Gurgulino de Souza*  
*Rector, the United Nations University*

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Welcome ladies and gentlemen, distinguished guests, friends to the international symposium on “Access to Science and Technology: The Role of Information Technologies.” This conference is the second in a series of Japan-based events carried out by the United Nations University (UNU) under its programme on the Frontiers of Science and Technology.

The United Nations University is a young institution with a University Centre established in Tokyo in 1975 following a recommendation in 1969 by U Thant, the then Secretary-General of the United Nations. It was designed to be truly international and devoted to peace and progress. For mobilizing international scholarly resources, however, a completely new kind of academic institution was required. Accordingly, the work of the UNU is not limited to its University Centre here in Japan, but it pursues its objectives as well through worldwide networks of scholars and through centres and programmes in Helsinki, Maastricht, Nairobi, Caracas, and Macau. Professor Charles Cooper, Director of our UNU Institute for New Technologies in Maastricht, and Dr. Zhou Chao Chen, representing our International Institute for Software Technology that is currently being established in Macau, are with us at this conference.

The Charter of the United Nations University calls for “due attention to the social sciences and the humanities as well as natural sciences, pure and applied.” It expresses a particular concern that the UNU counteract the isolation of scholars and scientists from the third world. For this symposium we have invited computer scientists, mathematicians, economists, and social scientists to assess how the potential offered by new information technologies may be applied to improving access to science and how it may be used on behalf of the developing world.



The UNU's research programmes address global issues and their implications. Thus, global environmental change, third world development, cross-national implications of science and technology, as well as governance of growing mega-cities are among the objects of our attention. The increased awareness of the complexities underlying these issues requires multidisciplinary and new scientific approaches, sophisticated models, new ways of thinking and perceiving our natural and social environments. In this respect, information technologies have redefined the frontiers of science and technology over and over again for the past three decades, thus gradually shaping the path towards what is commonly referred to as "the information society."

Today we are experiencing a shift from single-purpose terminals to intelligent multi-purpose input-output devices, from limited to abundant storage capacity, and from dedicated to multi-purpose networks. The rate of diffusion of technological innovation is determined, though, by economic, social, political, and cultural factors. These are equally profound in developed and developing societies. However, the obstacles encountered by the developing countries in achieving technological innovation are high, and we must overcome a situation in which some parts of the world are connected to and other parts are disconnected from the information infrastructure, a world where the industrialized countries are "on-line" and the developing countries are "off-line." For the latter, the crucial issue is not just technological innovation but how to use it for improvements in the social and economic situation of their people. Only then will we be able to talk of truly "global technologies."

In organizing this conference I am grateful for the cooperation we received from the University of Kyoto, and my thanks go particularly to Professor Hiroo Imura, President of the University, and to its former President, Professor Yasunori Nishijima, who has been involved in this project since its very early planning stages.

Furthermore, my thanks go to Professor Huzihiro Araki of the Research Institute for Mathematical Sciences, whose support was essential for convening this symposium.

I am also grateful for the help we received from our international advisers, Dr. Jacques Tocatlian and Dr. Ines Wesley-Tanaskovic. Dr. Wesley-Tanaskovic has been in charge of our microprocessors and informatics training programmes for many years. Both of them will have the challenging task of synthesizing the diverse approaches from different scientific disciplines represented here this week for a future book publication. Finally, I would like to invite all of you to visit the special exhibition that will be set up by Fujitsu Corporation tomorrow, and in this context I want to thank Fujitsu also for its support of this symposium.

Before giving the floor to Professor Hiroo Imura, I thank all participants and observers for coming here today and I want to wish you a successful meeting. I look forward to the results and I hope to gain some new insights myself by talking to many of you personally during the reception given tonight here at the Kyoto International Community House.

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# Opening Address

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*Hiroo Imura*  
*President, Kyoto University*

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Good morning Dr. de Souza, Dr. Araki, ladies and gentlemen. On behalf of Kyoto University, one of the organizers of this symposium, I have the pleasure of extending a cordial welcome to all participants to the second International Symposium on the Frontiers of Science and Technology. I have to express my sincere thanks especially to all speakers who have come a long distance. As already mentioned by Dr. de Souza, the first symposium, which was held in Tokyo last year, was focused on chaos in science. This year the subject is information. In the field of science and technology, very rapid accumulation of information is causing a variety of problems. The increase of numbers of scientific papers is not linear but exponential, and this has caused increases of review journals, computerized retrieval systems, and many other sophisticated methods. The progress of information transfer, however, has caused disparities not only among countries as already discussed by Dr. de Souza, but also among individuals.

Let me discuss this a little more by taking the human body as a metaphor. The human body consists of about 60 trillion cells, 10,000 times greater than the population in the world. It is a society of cells. Among such an enormous number of cells, there are many ways of information transmission. The nervous system is like a telephone or telefax and sends information through the nerve fibres. It is a very rapid and efficient way of information transmission but wires and special instruments are required. In order to facilitate information transmission by this system, you have to increase wires and instruments. Another important system is the endocrinal system. The endocrinal system distributes information as chemical substances, that is, hormones, by the bloodstream throughout the body. The cells that have a special antenna, or receptor, can catch specific information. There are sev-

eral ways to facilitate information transfer in this system. One is to increase the number of receptors; another way is to change information in such a way as to enable it to be caught by different receptors. These functions and modifications are analogous to the development of information techniques to be discussed in this symposium.

In the past centuries, liberty, equality, and humanity have been considered most important for humankind. In such a global age as today, we must add one more important thing: communication. In the field of science and technology, communication of new information is, needless to say, quite important. In this symposium, the importance of transmission for science, economy, humankind, new technologies for information retrieval and transfer, and the need for international cooperation, especially for the developing countries, will be discussed.

We have to improve the nature of information and to increase the receptive mechanisms in order to achieve our goals. I hope that this three-day symposium will be a great success. Thank you very much.

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## Session 1

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# Access to Science and Technology and the Information Revolution

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*Chairperson: Huzihiro Araki*

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