

# Technology for Learning and Culture in the APEC Region to 2010

*Vol. II The Supporting Material*



**Asia-Pacific Economic Cooperation  
APEC Industrial Science and Technology  
Working Group**



**The APEC Center for Technology Foresight  
National Science and Technology Development Agency  
Bangkok, Thailand  
August 2000**

ISBN 974-7360-12-8



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September 2000

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This report was prepared for the APEC Center for Technology Foresight by  
*Professor Greg Tegart*, Executive Advisor to the APEC Center based on the Report of  
the Experts' Workshop 3-6 May 1999 by *Professor Ron Johnston*, Australian Centre for  
Innovation and International Competitiveness Limited (ACIIC), and *Ms Lucille Pacey*,  
Consultant, Canada, and the analysis of the Delphi survey by *Dr Taeyoung Shin*,  
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Published for the APEC Secretariat by:  
The APEC Center for Technology Foresight  
National Science and Technology Development Agency  
73/1 Rama VI Rd, Rajdhevee, Bangkok 10400, Thailand  
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Website: <http://www.apecsec.org.sg>

APEC # 00-IT-01.2

ISBN 974-7360-12-8

Printed and bound by Jirawat Express Co., Ltd, Bangkok, Thailand

Designed by  
The Public Information Department  
Thailand's National Science and Technology Development Agency  
[www.nstda.or.th](http://www.nstda.or.th)  
Bangkok, Thailand.  
September, 2000

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## Foreword

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The APEC Center for Technology Foresight was launched in Bangkok on 3 February 1998. The objectives of the Center are to:

- Promote the adoption of technology foresight across APEC member economies.
- Provide a means for comparison of technology foresight exercises and implementation in APEC member economies and across the world, with a view to stimulation of Best Practice in appropriate methodologies for Foresight in APEC economies.
- Conduct technology foresight exercise on an APEC-wide basis, and between relevant member economies.
- Improve the quality and effectiveness of technology-related planning and development and priority-setting for research, across APEC member economies.
- Develop a technology foresight research and application capability available to APEC member economies and international agencies.

## The Center has adopted the following definition of Foresight:

*“Foresight involves systematic attempts to look into the longer-term future of science, technology, the economy, the environment and society, with a view to identifying emerging generic technologies and the underpinning areas of strategic research likely to yield the greatest economic, social and environmental benefit.”*

As its second major project, the Center chose the topic of ‘Technology for Learning and Culture’, with a time horizon of 2010. The project was initiated with a large public seminar in Bangkok in November 1998, at which Mr Jacques Lyrette, Vice-President (Technology and Industry Support) of the National Research Council, Canada, presented an analysis of the issues associated with technology for learning and culture from a Canadian perspective.

This paper formed the basis of a subsequent Issues Paper. Experts were drawn together from a wide range of APEC member economies at a workshop in Vancouver hosted by the National Research Council of Canada. The roles of the Experts were to examine the various aspects raised in the Issues Paper, to represent their own national perspectives, and to develop possible scenarios of the future impacts of, and interactions between, technology and learning and culture. On the basis of these scenarios, a series of priority actions were identified.

In addition, based on these scenarios, and the discussion of the Issues Paper, the Experts developed a set of topic statements for a Delphi survey. These questions were subsequently refined to make them more appropriate to all APEC member economies. This questionnaire was distributed widely to identified experts across the APEC member economies in a two-stage Delphi survey.

Volume 1 provides a summary of the findings and policy implications designed for policy-makers and the interested public. This Volume contains the Issues Paper, an additional resource paper, the process and outcomes of the Experts’ Workshop held in Vancouver on 3-6 May 1999, the results of the Delphi survey, and a list of participants of the Experts’ Workshop in Vancouver.

We are grateful for the roles played by the various consultants and facilitators:

### Key Facilitator:

Professor Ron Johnston      Executive Director, Australian Centre for Innovation and International Competitiveness Limited (ACIIC), University of Sydney, Australia

### Co-Facilitator:

Ms Lucille Pacey              Private Consultant, Canada

### Delphi Facilitator:

Dr Taeyoung Shin              Director, Industrial Innovation Studies, Science and Technology Policy Institute (STEPI), Korea

**Honorary Consultants:**

- Mr Jacques Lyrette Vice President-Technology and Industry Support,  
the National Research Council Canada
- Mr Terutaka Kuwahara Director, Fourth Policy-oriented Research Group,  
National Institute of Science and Technology  
Policy, Japan

**Others who deserve special mention include:**

- Dr Arthur Carty President of the National Research Council  
Canada
- Dr Sadiq Hasnain Senior Strategy and Policy Advisor (International  
Relations) of the National Research Council  
Canada
- Mr Desmond Mullan Director of NRC Innovation Centre (Vancouver)
- Dr Ann Levi-Lloyd Facilitator (Advanced Skills Training) of the NRC  
Innovation Centre (Vancouver)
- Ms Marian Jones Supervisor (Administrative Services) of the NRC  
Innovation Centre

We are most grateful to all Experts participating in the Vancouver workshop as well as those experts who responded to our Delphi survey. In addition, particular thanks should go to Dr Sadiq Hasnain, Dr Filma De Guzman Brawner, Dr Craig George Blurton, Mr Abdul Hamid Abdul Rahman and Dr Jeffrey R Day for their assistance in the Delphi process.

The APEC Center for Technology Foresight would like to acknowledge the financial support from the APEC Central Fund, the National Research Council Canada, Thailand's National Science and Technology Development Agency, and other relevant institutions and organizations in other APEC member economies that supported the participation of their experts.

Finally, we are indebted to Monthida Sitathani, for her dedicated support and international coordination throughout the project. We are also grateful for the support of Tamsin Jewell, Mayuree Vathanakuljarus, Nalinrat Viwatanant, and Wandee Senglam.

**Greg Tegart**  
*Formerly Director, now  
Executive Advisor*

**Chatri Sripaipan**  
*Co-Director*

## Introduction

The APEC Center for Technology Foresight, was established with the objective of serving and involving all APEC member economies in developing and diffusing technology foresight expertise across the APEC region.<sup>1</sup> This was to be achieved not only by providing training and assisting member economies with their own foresight studies, but also through conducting foresight studies at a multi-economy level, focussed on issues which cross national boundaries.

Five criteria were established to identify foresight issues appropriate to the Centre:

- they must be of concern to most member economies, with at least four agreeing to take part in the study;
- they must transcend national boundaries;
- there must be potential for sharing the results with all APEC members;
- they should be of general public concern or benefit; and
- they should have significant technology (though not exclusively high-technology) components or implications.

The subject of ‘Technology for Culture and Learning’ emerged from an extensive consultative process, based on a survey of APEC members, followed by

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<sup>1</sup> More information can be found on the web site of the APEC Center for Technology Foresight <http://www.apectf.nstda.or.th>



prioritization of the 50 candidate issues at a Foresight Symposium attended by representatives from 16 APEC member economies. This issue not only met the five criteria; it also was a matter of considerable concern in many economies and for many commentators, and was itself evolving rapidly. In addition, advances in technology, particularly information technology (IT), when applied to learning and culture, carried considerable threats to minority languages and cultures across the APEC region.

It was argued:

*The convergence of telecommunications, computer technology and software is having a profound effect on the way we work, entertain ourselves and educate our present and future generations. The new wave of technology impacts on all economies and it is essential to ensure that technology is properly used as a tool for development and promotion of individual values and cultures. This is particularly true in the APEC member economies which vary widely not only in terms of physical information infrastructure but also in terms of culture and language. This project seeks to assess the situation in the APEC economies and to draw out the critical issues to be addressed by policy-makers, educators and the information industry. (APEC Technology Foresight Center, 1999).*

The Experts' Workshop in Vancouver in May 1999 brought together thirty-seven representatives from twelve APEC member economies. The overall approach of the project, and the processes of the Experts' Workshop, were designed to address the many challenges already identified by the APEC Center in the conduct of multi-economy foresight. These include:

- familiarization of the participants with the processes and anticipated outcomes of foresight;
- establishment of the necessary legitimacy and credibility for the project and its findings;
- the commitment of national experts to a project whose genesis lies outside their own systems, structures, and communities;
- the use of English as the only language of the project;
- determination of an 'APEC perspective'; and
- transformation of generic findings into economy-specific outcomes.

As a starting point of this study, Mr Jacques Lyrette, Vice-President, Technology and Industry Support, National Research Council Canada prepared an Issues Paper. The purpose of this was to identify the major issues involved in technology for learning and culture against the rapid developments in information communications and technology. The Issues Paper is reproduced in Section 2; it deals with general issues, using Canada as a reference.

This Issues Paper was presented by Mr Lyrette as the keynote address to a public meeting on "Technology for Learning and Culture" held in Bangkok on 4 November 1998. Other speakers dealing with aspects of the topic were Professor

Sippanondha Ketudat and Dr Pichet Durongkaveroj from Thailand and Professor Ron Johnston from Australia.

The National Research Council Canada generously offered to host an Experts' Workshop in Vancouver on 3-6 May 1999 and engaged a consultant, Ms Lucille Pacey to act as a facilitator. Ms Pacey has had many years of experience in the higher education field in distance education and learning partnerships. As a contribution to the Workshop, she prepared a Discussion Paper which is reproduced in Section 3; it complements Mr Lyrette's paper by focussing on learning and technology.

In Section 4, the processes of the Experts' Meeting at Vancouver are described in detail notably the identification of issues, the development of scenarios and the preliminary identification of issues for the Delphi survey. An interim report of the Experts' Meeting containing the material in Sections 3 and 4 was issued by the APEC Center for Technology Foresight in mid-1999.

Section 5 details the process of the Delphi survey and discusses the analysis of the results. This Section is based on the work carried out by Dr Taeyoung Shin, Director, Industrial Innovation Studies, STEPI, Korea.

Concluding remarks on the study are made in Section 6.

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## Key Issues in Technology for Learning and Culture (Jacques Lyrette)

.....

### 2.1 Preamble

The convergence of telecommunications, computer technologies and software often referred to as ICT (information and communication technologies) and most recently as the information highway, is having a profound impact on the way we work, entertain ourselves and educate our present and future generations.

This new wave of technology impacts all countries and each of us must take our rightful place within global information networks so that this technology may be used as a tool for development and promotion of our values and culture. The situation in each country varies widely not only in terms of physical information infrastructures, but also in terms of culture and language. It is vital that we all make every possible effort to take advantage of the full potential of existing and emerging technologies—in development, culture, training, education, trade and scientific research.

As you know predicting the future of technology is a risky business, especially as it relates to culture and learning. Some would even say that it is a fool's game because the future is usually not a logical extrapolation of the past. Many eminent scientists, philosophers and enlightened business people have made what they believed to be the reasoned projections only to find later that the rapid scientific

advances made a monkey of their prognostications. I have often been asked to attempt to attempt a prediction of what is ahead. Let us keep in mind what others have prophesized as the shape of things to come.

Consider these predictions:

“It will take 600 years to manipulate human reproduction and the body”  
Aldous Huxley (circa 1932).

“There is no likelihood man can ever tap the power of the atom”. Obert Millikan, Nobel Prize winner of Physics, 1923.

“I think there is a world market for maybe five computers”. Thomas Watson, 1943, Chairman of IBM.

“ There is no reason anyone would want a computer in their home”. Ken Olson, 1977, DEC Chairman.

“ 640 K ought to be enough for anyone”. Bill Gates, President and CEO, Microsoft.

And who could have predicted only five years ago the impact that the Internet is having on our lives.

So I shall not make any predictions. Instead, I will raise issues that should be addressed. This is not meant to be an exhaustive list but a way to initiate a dialogue within APEC. I will relate it to my own experience within Canada because it is difficult to extrapolate examples from one country's experience and apply them to that of other countries. In the end, we can only learn from each other.

## 2.2 Information and Communications Technology (ICT)

The development of ICT has been fuelled by quantum jumps in technology (figure 1). Although the information highway has been under construction for a number of years, its most recent and concrete manifestation is the Internet.

The Internet has provided a common denominator, a common protocol, by which we can exchange information from one end of the world to the other. In any language, given the proper interfaces, information moves in record time. For example, sending a 42-page document from New York to Tokyo through the Internet is 720 times faster and 260 times cheaper than using a courier.

The Internet's rate of adoption has eclipsed all other technologies that preceded it. Radio existed for 38 years before fifty million people tuned in. Television took 13 years to reach that level. Sixteen years after the first PC came out fifty million people were users. Within four years of the Internet being open to the general public (1997) there were fifty million users world-wide and now over 100 million are 'logging on'.

The development of ICT also brought fundamental changes in the mode of communications between people, interest groups and mass communications. The Internet has collapsed commonly held perceptions of space and time. Geographic

and intellectual borders have been made invisible by rapidly changing political, economic and technological dynamics.

The technological development has been paralleled by applications development (figure 4) in business, culture and education. Ongoing progress in information and communications technologies has not only brought us the information highway, but has profoundly changed our way of life, affecting our ways of working, doing business, organizing, educating, informing and training

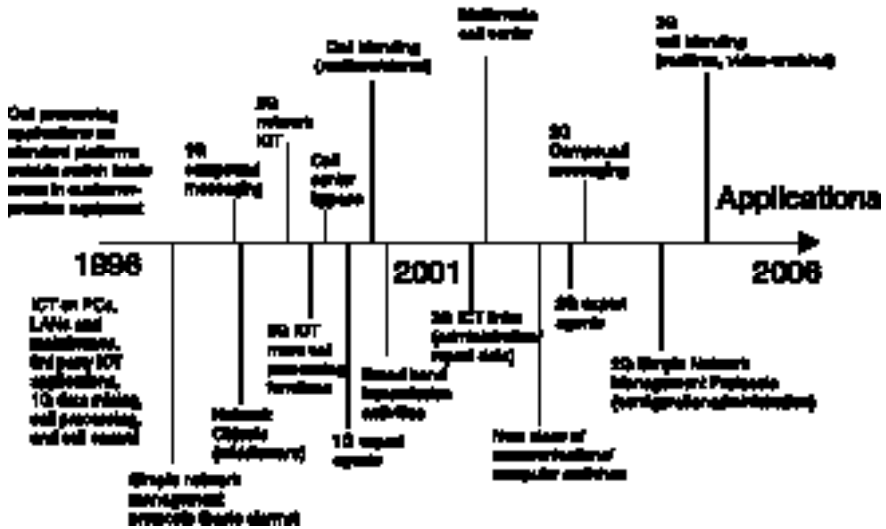


Figure 1: The Evolution of ICT

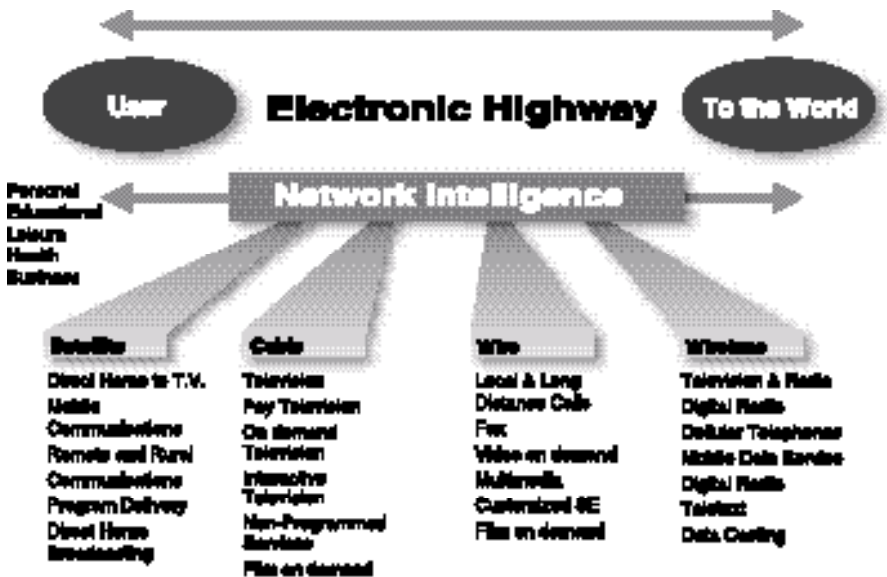


Figure 2: Electronic Highway, a Network Intelligence



The smooth and efficient transition of the world to a knowledge-based economy is one of the most important tasks facing us in the last year before the twenty-first century. The advent of the information highway has accelerated humanity's transition to the information age. APEC countries should ensure that we take full advantage of its potential and contribute to the global effort by integrating all nations into the information highway. Developing and developed countries must participate fully in this process, which will in turn provide them with the opportunity to stimulate and accelerate their own social, economic and cultural development.

These changes could benefit everyone and should not be used to further widen the gap between developing and developed nations. To succeed, the international community must promote the appropriate initiatives, investments and framework to encourage applications that are for the greater good of all. To optimize economic spin-offs for nations, initiatives and investments must be undertaken within a framework of increased co-operation and within the appropriate international agencies. These agencies include the World Trade Organization (WTO), International Telecommunication Union (ITU), World Intellectual Property Organization (WIPO), International Standards Organization (ISO), Organization for Economic Co-operation and Development (OECD) and the United Nation Educational, Scientific and Cultural Organization (UNESCO). In other words, the APEC community must join forces with the larger international effort in order to attain its own objective of becoming a strong presence on the information highway.

## **2.3 Canadian Experience with ICT**

The reputation of Canada in the communications field is well established. This reputation was acquired because of domestic needs to traverse great distances and to deliver services to remote rural communities in a very harsh climate. It was also necessary to support and promote a number of cultures and languages. The government had an objective: to make telephones accessible to all Canadians, wherever they were in Canada. In fact this is why Canada was the first country to launch a domestic geo-stationary satellite, demonstrating the potential of satellites in providing education and health services at great distances. Figure 5 shows how Canada established a number of firsts in communications, all of which were aimed at meeting the needs of Canadians.

Canada knows from experience that special measures are required to stimulate and sustain its economy. With the relatively small size of its domestic market and huge size of its territory, Canada has been forced to develop advanced communication systems to ensure an economic and cultural presence. Therefore it has also developed a competitive edge in the operation of the information highway. The information highway makes the rapid flow of information and exchanges between various economic stakeholders possible and thus mitigates problems of distance.

<b>1874</b>	Alexandra Graham Bell invented the telephone
<b>1901</b>	Guglielmo Marconi received the first transatlantic wireless message
<b>1906</b>	Canadian Reginal Fessenden broadcasts first program of voice and music over long-distance
<b>1971</b>	First domestic digital microwave transmission network
<b>1972</b>	First geostationary domestic satellite communications system
<b>1985</b>	World's longest fibre optic communication network
<b>1992</b>	Canada introduced the longest highspeed ATM network in the world
<b>1993</b>	CBC first national public broadcaster to offer radio programs
<b>1995</b>	Reboot, the first TV series generated entirely by computer
<b>1996</b>	First to license LMCS

Figure 5: Canada's History of Achievements

Canada was again quick to respond to the challenge of the information highway, by creating the Information Highway Advisory Council. The Council was mandated to bring together all the Canadian stakeholders. Telecommunicators, broadcasters, cable-casters, publishers, educators, government representatives developed an agenda for the Canadian Government. The report of the Council is available on the Internet (<http://strategis.ic.gc.ca/IHAC>). The Council commissioned a number of studies that are of interest to this gathering. Upon submission of its report, the Government took immediate action or continued to reinforce its commitment to initiatives that were initiated prior to the Council's Report.

The Government of Canada is dedicated to connecting Canadians and has put in place a set of initiatives with specific targets.

To promote access, the Government of Canada has set up SchoolNet, a partnership between public and private sectors which is committed to connecting all schools and libraries in Canada to Internet by the end of 1998. We will have achieved this objective two years before the US and four years ahead of the UK.

The Government also reinforced its commitment to the Canadian Network for Advanced Research in Industry and Education (CANARIE). The purpose of CANARIE is to provide the backbone of a high-speed network for Canadian research institutions (figure 7). This initiative was undertaken in close collaboration with industry. As you may know, all telecommunications are private in Canada, the Government only provides the regulatory framework. The CANARIE network operates at speeds of 155Gbs and the Government has just announced that it will upgrade to 40Gbs. The network is already being used by my own institution, the NRC, to conduct its research from coast to coast. For example in biotechnology and genomics research, high-powered computers are linked across Canada.



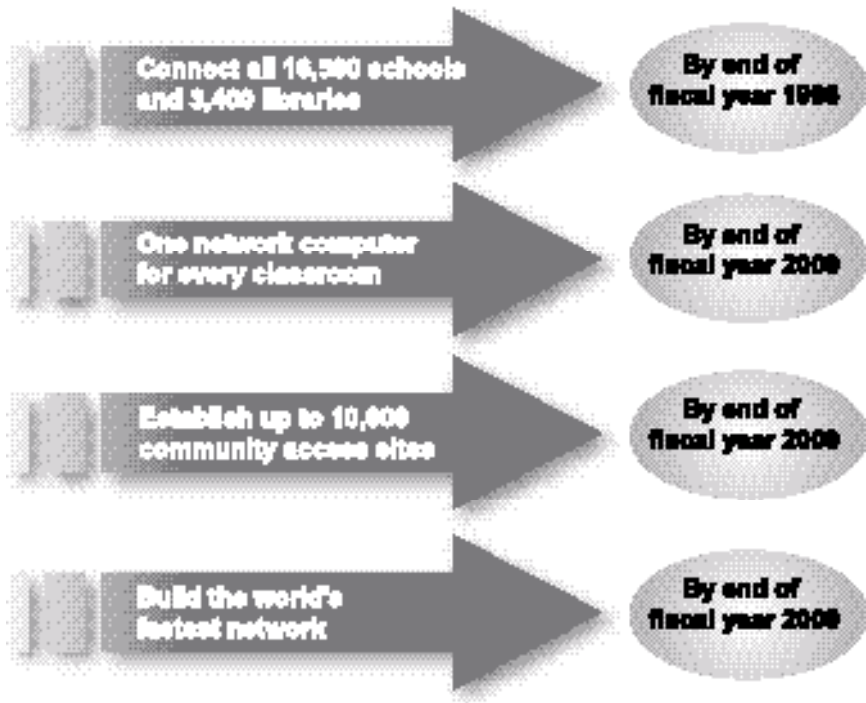


Figure 6: National Targets to Connect Canadians

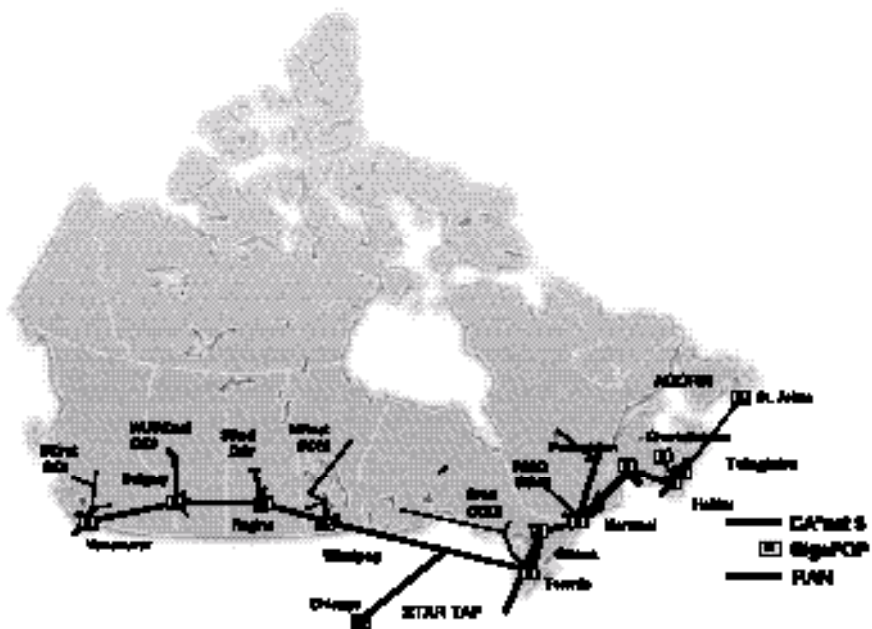


Figure 7: Canadian Network for Advanced Research in Industry and Education

Our latest commitment is to electronic commerce, or E-com. Canada has set a very aggressive agenda for itself by promising to deliver the regulatory framework by the end of this fiscal year. This regulatory framework will include proposals for regulation to protect privacy; the establishment of public key infrastructure; security and encryption; consumer protection; digital signatures; and tax neutrality.

Finally, the Canadian Government has just created an advisory committee to study and recommend ways to increase the connectivity of communities in Canada and build “smart communities” through the use of information technology.

We believe that a connected Canada will lead to a stronger Canada, building a stronger and more dynamic Canadian economy, a culture of learning, a more cohesive and united Canadian society and a stronger democracy, all through the direct participation of our citizens in the information highway (figure 8).

## 2.4 The Information Highway: Economy, Society and Development

*The area in which the information highway has the most important impact is in the rapidly changing area of economic dynamics. Embedded within this dynamic are the globalisation of economies and the disappearance of protectionism; the decentralisation of decision making, manufacturing, work, education, culture, mergers and acquisitions; ownership and intellectual property.*

The involvement of all nations in the new economy is essential if we are to create an economic environment that will allow all countries to participate. The benefits will include continuing education and improved quality of life.

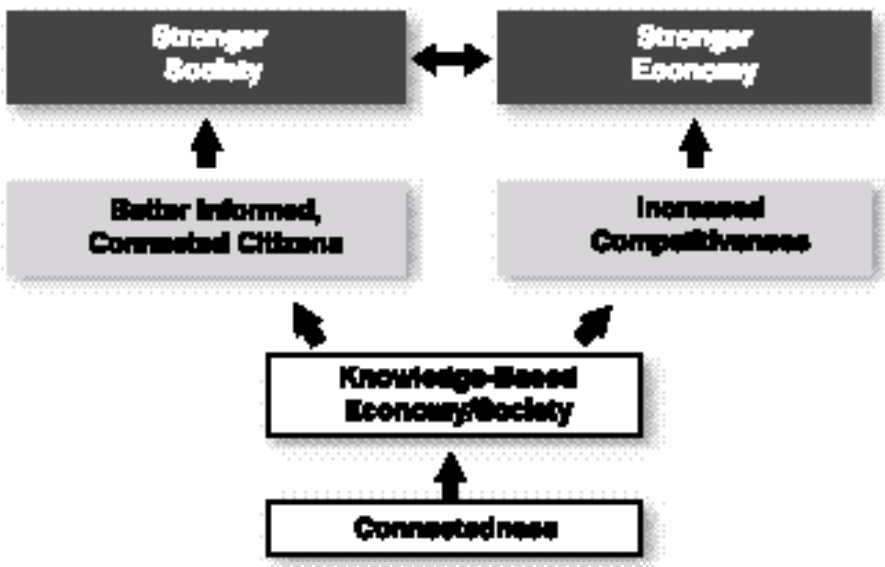


Figure 8: Why Connect Canadians?

Development of a knowledge-based economy will require greater open-mindedness in our schools, universities and continuing education services to help adults adapt and acquire new skills. The information highway offers many educational possibilities for the development of local and national culture. It improves access to knowledge, no matter where it is in the world. Improved access to expert information will foster better understanding between groups in various countries. Consequently, the question of access must be a priority to accelerate the adoption of new teaching and development tools in member nations. Improved access will, and is already, changing the way governments and institutions deliver services such as education, health and social services.

*The information highway must also be used to enrich the cultural lives of our peoples. The cultural and linguistic diversity of the member nations will be reflected through the dissemination of diversified content. Therefore, the APEC community must promote the development of information networks that are able to support environments with strong local content and products from member countries.*

Given the rapid development of global communications, it is absolutely essential to support the creation and distribution of local content and services in the areas of information, culture and entertainment, in order to meet national needs. There must be a push by the members to adapt the tools traditionally used in producing local content in order to create content for the information highway. In short, the objective of each member country must be “local production” along with global distribution. Such an exchange will help to extend the APEC countries’ sphere of influence.

The greater the diversity and extent of the information which is transmitted on the information highway, the greater will be the ability of all countries to take advantage of this information for development and growth. Global dissemination of cultural perspectives from around the world, to all countries, will enhance the quality of economic, social and political decision making.

The information highway must be a tool for creating business ties and facilitating the networking of small and medium-sized businesses. It will also open up new opportunities for firms in developing nations, by enabling them to penetrate new markets for their products and services and by giving them access to information which is crucial to their development.

In the future, development will be closely tied to education. Education is an important source of those skilled, qualified personnel, which are necessary to support research and sustainable growth. The information highway presents new opportunities and challenges in accessing and in disseminating both information and content.

*Interactive multimedia services and applications are the most obvious components of the information highway. The emergence of these technologies and their eventual penetration into all levels of our world provide an incentive to rethink and restructure traditional ways of scientific co-operation and supporting research. These emerging*

*technologies also change the vision that one has of the delivery of education and the acquisition of skills through training and retraining. International co-operation on joint projects provides an opportunity to demonstrate the advantages and applications of the information highway. By allowing access to resources and knowledge from around the world, the information highway allows APEC members to overcome one of its greatest challenges: access to expertise and information. It also provides a tool for disseminating knowledge, and facilitates the strengthening of ties between researchers.*

The Internet is facing some specific challenges including security for electronic commerce transactions, rapid turnover of new technologies, evolving standards and regulatory frameworks and growing need for additional bandwidth. Because of the nature of the Internet, there are concerns about security, privacy, intellectual property and legal liability of service providers. Some content providers have addressed these issues with filters and restricted access, but it is difficult to regulate content across international borders. Controversy has also arisen over who should be in charge of registration and administration of domain names, which are used instead of numeric addresses. The Internet was not designed to provide a mass market interchange of high density information so some elements of the network are strained. This strain results in slowdowns in retrieval time, unreliable transmission and denial of service by overloaded servers. Fortunately work is underway to improve the Internet and perhaps with increased bandwidth; faster routers; load balancing and management; smarter software and tiers of service; we will see improved performance and new applications.

Let me raise some of the issues we are all facing. Who makes the decisions? What is ownership? Who will have access to the information? Who will have access to intellectual property? What should be protected by patents? What is of public interest? How can we determine who will have access to information that is stored in massive databases? Who will determine the public good? How do we co-operate nationally and internationally? Where is the balance between competitiveness and international sharing of information?

The question is one of vision as to where this technology will take us. However, this vision must be broad because of the new realm into which we are moving at the great speed of human innovation. The information highway offers a number of opportunities in various areas of activity: democratization, communication and culture, economic presence, education and information management. Countries must take advantage of available technological tools in order to maximize the potential of the information highway.

Decision-makers looking at the issue of how to develop the information highway will have to address the following questions:

- a) How can the information highway be used as a development tool for government and educators? How might it provide support to governments and other institutions; to primary, secondary and post-secondary education; and to teaching?

- b) How can the information highway be used as a tool to strengthen culture and the arts? How will individual and collective interests support institutions, sphere of influence and cultural products, museums, archives, publishing and artistic and creative activities?
- c) How can this new tool be used to support development through the use of the appropriate technologies?
- d) How can the information highway become a tool for developing and consolidating APEC as an international economic presence?

## 2.5 Challenges

### 2.5.1 The infrastructures

One challenge we must address is the relative availability of telecommunications networks in different countries. Industrialized countries are working to improve the diversity and capacity of their infrastructures, their choice of services, and their access to networks and services in order to increase the choices for their citizens. For many nations, however, the main challenge is in setting up a basic infrastructure that is both reliable and efficient. But this challenge can also present the opportunity to make a quantum leap in technology.

APEC nations must accelerate the development of their infrastructures by prioritizing:

- access to technologies and expertise;
- development of navigational tools adapted to regional needs;
- promotion of network interconnectivity and interoperability;
- co-operation in research and development of new applications;
- participation in international forums on the information highway;
- access to those international networks which are outside the Internet;
- establishment of training programs;
- support for developing countries in obtaining World Bank financing in order to accelerate the installation of infrastructures; and
- access to resources and investments.

I believe it is essential to understand that, as part of the joint effort to establish a strong presence on the information highway, each country will have to progress at its own pace and use its own methods. In other words, to facilitate the advent of a true global information infrastructure, a great deal of flexibility will be required so that each nation may take its own realities into account. But, in an attempt to accelerate access to the information highway, we must avoid reinventing the wheel or providing solutions that do not take advantage of the technology available or that are not adapted to the needs of the country. Such an oversight would slow or stop the development of accessibility and the availability of services.

Let me raise a few issues related to infrastructures:

- **Ensuring access to the information highway through local and national markets.** This requires consultation on the extent and methods to be used in providing access to services. In particular on the issue of financing, access must include ensuring that the development of networks and the provision of those services can actually be achieved.
- **Allowing the development of global information systems.** This can be achieved through the liberalization of services, infrastructures, equipment purchases and investments, within an appropriate framework. Certain sectors should be emphasized as the basic elements required in establishing the information highway.
- **Achieving the interconnectivity of networks and interoperability of services.** A consensual approach to standardization, which takes into account the market and encourages the use of open interfaces, is key. Obtaining co-operation from all stakeholders requires that dialogue be initiated by the private sector, the purpose of which is the identification of critical interfaces. Accelerated testing to determine the appropriate standards for critical interfaces must be supported. By accelerating the standardization process initiated by international agencies, we will support the development of standards responding to market requirements.

### 2.5.2 Contents and services

To a great extent, the usefulness of the information highway will depend on the quality and quantity of the content and services it offers. For all countries, the production of content will center on information, arts, culture and cultural heritage. This will be achieved by creating new content and by transforming existing content into an interactive multimedia format that takes advantage of all the possibilities of this new communications technology.

The issue of ensuring a critical mass of content on the information highway, in other languages than English, has both national and international implications. Many countries sharing the use of a language other than English also share concerns over this issue. This concern captured much attention at the Francophone Summit in Cotonou in December 1995, the G-7 Ministerial Conference on the Information Society (Brussels, February 1995), the Conference of Ministers, UN Economic and Social Council (Addis-Ababa, May 1995) and the Information Society Development Conference (Midrand, May 1996). We must promote the creation, circulation and dissemination of a broad spectrum of contents and services, through the:

- ability of governments and the private sector to act as catalysts in the structuring of supply and demand for content;
- private sector involvement in developing the information highway and its content;
- development of policies and procedures for using the information highway that may stimulate a demand for content, particularly those products that can be exported; and

- promotion of both regional and national cultural heritage.

### 2.5.3 Regulatory framework

In order to create both national and international “visible and accessible” environments on the information highway, measures must be undertaken to ensure that member nations update their regulations and provide assistance and recognition programs targeting public and private sector agencies and firms. This will also pave the way towards the development of follow-up and joint initiatives promoting the production, adaptation, dissemination and marketing of content on the information highway. The experiences of certain developed countries in establishing suitable regulatory frameworks can be used to assist developing nations in the same endeavour, whether those experiences succeeded or failed.

Regulatory frameworks must emphasize sustainable development, the creation of an environment and the free flow of information over networks. It is essential that all member nations share their experiences to ensure that regulations do not become a barrier to the use of the information highway.

To ensure the creation of an environment on the information highway that optimizes opportunities for cross-fertilization by promoting cultural diversity, free expression and the free exchange of ideas, ease of access must be ensured to service and information providers and networks.

Regulations governing competition must be interpreted and applied taking into account the convergence of new technologies and services, the opening of markets, the advent of new market players and the growth in global competition. Agencies regulating competition must not prevent the emergence of new international competitors. Although productive cooperation to promote economic efficiency and the well being of consumers should be allowed, anti-competitive or monopolistic practices must be prevented, including abuse by market dominators.

Therefore, nations must agree on the importance of:

- **ensuring that service and information providers have easy access to networks.** Ensuring access to the information highway is essential in order to encourage firms to provide services, create jobs and provide opportunities for cultural understanding by promoting cultural and linguistic diversity and the free exchange of ideas.
- **setting up an efficient distribution system.** Ensuring the fair, equitable and efficient distribution of limited resources requires complete transparency. Furthermore, the establishment of efficient distribution systems that take advantage of new communication technologies must be encouraged. For example, governments and the private sector could support the marketing of content, encourage alliances and partnerships among producers and distributors and promote awareness of relevant issues in the international community at large.

- **allowing forms of cooperation that member countries from can benefit from without resorting to anti-competitive practices.** This requires that the agencies in charge of competition and regulation meet regularly at international forums such as ITU, WTO, OECD, and UNESCO to exchange information and ideas on the evolution of the regulatory process and the application of regulations concerning competition. Cooperation in enforcing the regulation of competition should be encouraged, while a special effort must be made to ensure the confidentiality of commercial and personal information. Initiatives to establish a multilateral framework for such work should be encouraged and pursued. In the first stage of this process, public decision-makers, dealing with the regulation of competition, should provide an exact description of their regulatory framework.

#### **2.5.4 Culture and Technology**

There is much utopian speculation about the potential of technologies to “bring down borders” between nations. This sort of speculation has to be tempered by the potentially negative effects of such eventualities. Bringing down borders can lead to a blurring of national identities. It can enable large population masses to dominate smaller cultures and define the emerging “global culture” by sheer economic force. It can also rekindle old ethnic, regional or religious divisions that national cultures now transcend.

Respect for cultural differences is an essential component of civilized life. At the G7 Conference on the Information Society in February 1995, all participants supported the principle of encouraging cultural and linguistic diversity. In international terms, the recognition and protection of cultural differences is an expression of goodwill. It is not about creating barriers. It is about tolerance.

As Canadians we have always been confronted with the dual challenge of a small domestic market in the face of our proximity to the world’s most powerful cultural exporter and generator of information technologies, the United States. We have also had to recognize that it is not always easy to promote and develop our cultural diversity.

Canada has nurtured its culture through a variety of measures which include direct assistance through programs such as those delivered under the auspices of the Canada Council and Telefilm Canada; public institutions such as the Canadian Broadcasting Corporation (CBC) and the national museums program to produce, distribute and showcase Canadian culture; and mechanisms such as the broadcasting Act, rules for advertising in foreign media and rules governing split-run publications.

But culture is not simply a product on the global market. It is also a process, an ongoing dialogue capable of focusing a spectrum of diverse perspectives into a shared vision. In contrast to the robust existence of exportable products, the cultural dialogue within our borders is fragile.



Will the new technologies enhance the role of providers or will we revert to the role of passive consumers? Will countries drive a content industry or will it become just another consumer group? Or will globalization, paradoxically, force us to withdraw into our conflicting individual, regional and ethnic shells? There are three fundamentals to consider:

1. The Information Highway is a natural extension of current communications environments such as broadcasting, telecommunications and production.
2. In the face of ferocious competition fuelled by technologies, the success of any national content is primarily due to its specificity to national needs in a global environment.
3. To ensure success in the future, content must be adjusted according to the changing relationship between consumers and producers.

I believe that cultural products must be promoted, not protected. Individuals must have access to all content, including a strong component of local products and services. We must recognize the value of the diversity of cultural and linguistic content and the opportunities that arise from a diversity of content.

In order to support culture though technology priority should be given to:

- **supporting the creation and dissemination of content.** In order to respond to national needs and help strengthen connectedness, the creation and dissemination of local content and services in the information, culture and entertainment sectors must be encouraged.
- **perfecting tools for content creation.** Tools traditionally used to facilitate the production of local content must be further perfected, with an emphasis on supporting the language, educational, cultural heritage, arts, and community information and entertainment sectors in the country itself.
- **promoting dissemination.** The more diverse and extensive the cultural information transmitted on the information highway is, the more all countries can benefit from it. This will strengthen links between APEC nations. The targeted objectives will encourage all countries to produce and distribute cultural content on the information highway that is in their national language, whether the subject is the arts, education, entertainment or information.

### 2.5.5 Learning and Technology

The global information and communications market will be US\$2 trillion by the year 2000 and sales will grow 60% faster than the world GDP (figure 9). Between 1990 and 1996, Canada's ICT has grown 6 times faster than our economy (Figure 10-11). In the old economy, natural resources and physical infrastructure determined our comparative advantage. In the new global economy, knowledge is the key resource, and the quality of the nation's workforce is critical to ensuring

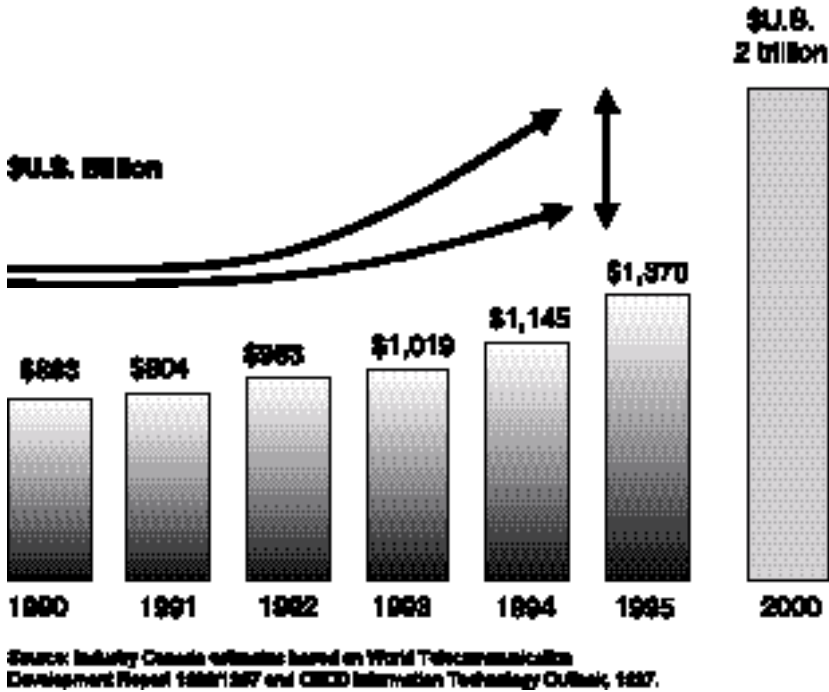


Figure 9: ICT revenues (World)

Real GDP Growth Information and Communication Technology Industries, 1990-96

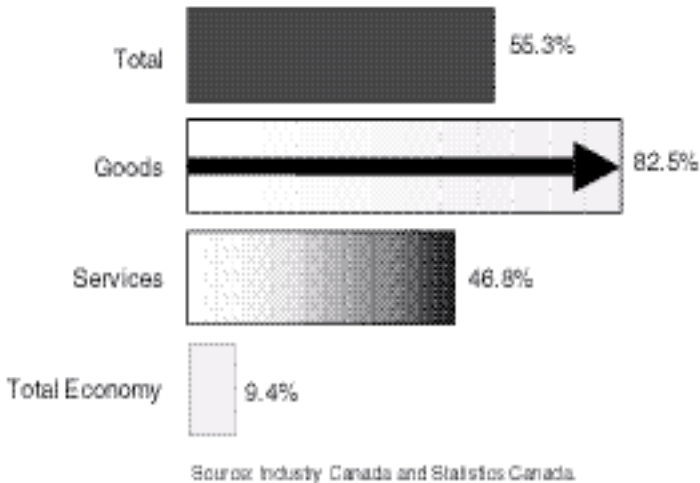
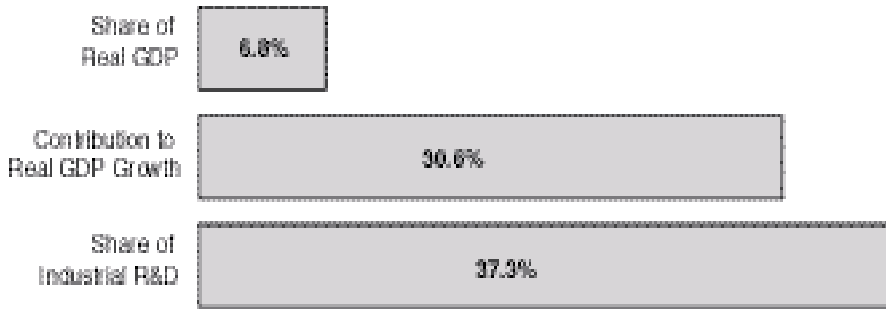


Figure10: ICT Growth in Canada

competitiveness. The key to this transition is for workers to make adequate use of information. As information acquisition will increasingly be the measure of their contribution to the economy, learning must span their working lives.

## ICT Industries Share and Contribution to Real GDP and R&D, 1994-96



Source: Industry Canada compilations

Figure 11: ICT share in Canada's GDP

It is people who exploit technology, not the other way around. In the new economy, information will be collected, shared and processed faster and in new ways. As a consequence, the social structure and economics of organizations will change and management and employees will need to find new ways of collaborating. The nature of work itself will change. To cope with continual change, businesses must have employees capable of acquiring new knowledge and skills and able to challenge traditional procedures and responses.

In spite of the development of audio-visual and multimedia tools, including voice recognition technology, basic literacy and computational skills are more important than ever. Higher levels of schooling, education and training are and will continue to be required. In Canada for example, in the next decade, 50% of new jobs will require at least 17 years of education. Those who expect to remain in the labour force throughout in the next couple of decades are immediately affected and many are likely to require retraining. Figure 12 shows the trend in skill distribution in the G7. This is especially important considering that it is the knowledge-intensive industries that are creating most of our jobs (Figure 13).

Experience has demonstrated that higher levels of formal education result in greater employability, further training, and ultimately, higher incomes. By contrast the cost of the present dropout rate from Canadian high schools represents an estimated \$1 billion in net loss of annual output. This represents a staggering loss of future economic opportunities.

As Canada keeps pace with the challenge of the global economy, its expenditures and activities which are devoted to learning must increase. The learning industry is already one the nation's largest economic sectors. Annual expenditures on formal education, excluding training expenditures or employer-based training, add up to approximately \$50 billion. Formal public and private education (excluding employer-based training) has a total payroll approximately equal to that of either

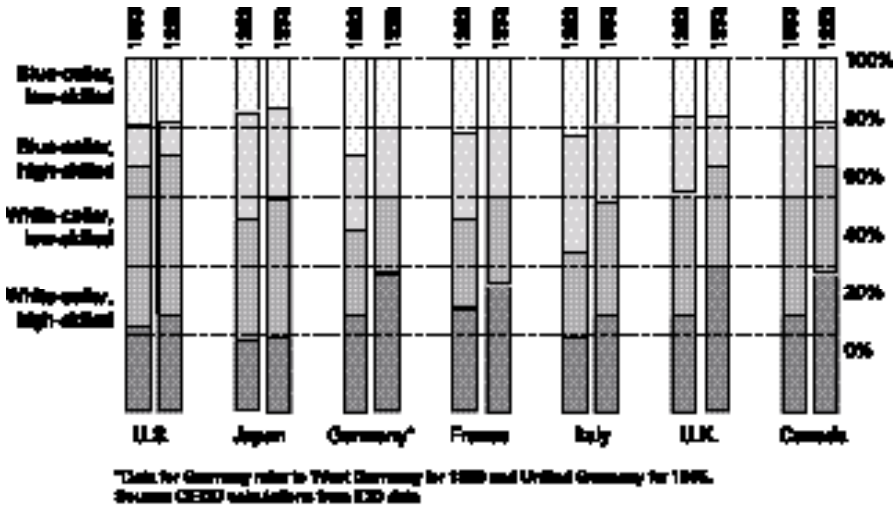


Figure 12: Skills distribution in G7

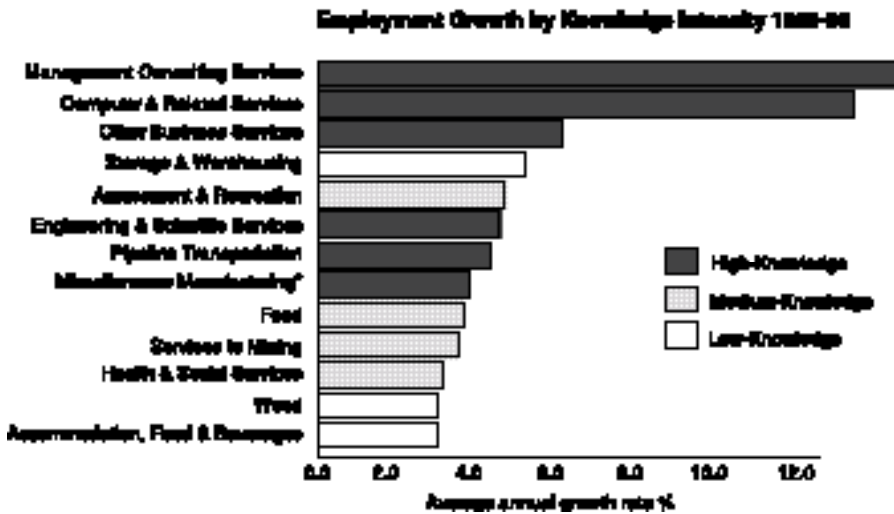


Figure 13: Employment in Knowledge-Intensive Industries (Canada)

the health or welfare sector or the transportation and communication sectors. Its payroll is larger than those of all levels of government in Canada combined.

Technology-based tools are effective because they allow the learner to interact with some sources of information. Unlike institutionalized education, where the learner must go to a classroom at an appointed hour, these tools can be adapted to the individuals pace and style of learning and can be used over distances and on demand. When indirect costs such as travel and time off the job are taken into account, technology-based tools are particularly cost-efficient and more so with increased usage. Today, a 1 page text may be downloaded in about 10 seconds with

a 28.8 modem, tomorrow 1,000 pages may be retrieved in 10 seconds with the next generation of learning networks.

The use of new computer-based technologies and related media formats will result in a redesigning of learning and training methods. Given existing fiscal pressures to reduce educational spending, governments and institutions will be forced to evaluate the benefits and costs of using new media learning technologies.

Indeed, for producers of learning materials, teachers, trainers and support staff, time is the highest cost in the learning and training process. Using technology can make the learning process faster and more efficient, therefore cutting costs. For example, TeleEducation New Brunswick delivers classes in French and English for a variety of educational and training organizations in 26 communities across the province. More than 2,000 students can access courses ranging from an astronomy class at Mount Allison University to health-care seminars at the University of New Brunswick.

Training the trainers in existing learning professions and organizations is a must. The current generation of trainers, educators, librarians and school administrations were trained in traditional institutions and need to be retrained for the new communications environment. They need to understand and use the technologies, so that they in turn can facilitate learning on the Information Highway. Increasingly, learners will want to access course-ware and learning and training materials from distant national and international sources. If learning and training institutions are to benefit from a larger pool of students and customers, they must make their courses transferable from institution to institution.

Targeted research is needed to develop cost-effective applications and effective navigational tools. The focus of such research should be to facilitate the development of and the access to both high quality content and the standards for its development and distribution. Assistance must be given for developing technology based learning and training. To help adapt to those employment shifts accompanying the transition to a knowledge-based society, governments should ensure that learning institutions provide individuals with marketable skills. As a way to link learning, training and employment institutions with economic opportunity, educators and businesses should jointly develop learning modules and certification mechanisms around their areas of practical expertise.

Copyright issues are complex and highly debatable, particularly in regard to that balance to be struck between the interests of educators and those of creators. The government should ensure that students and educators understand the principles and legislation respecting copyright, and governments should encourage corporate and private training associations to do the same.

To summarize, the use of ICT for learning raises the following issues:

- **Share experience.** Create collaborative teaching experiments by using the information highway to deliver education at all levels, and by promoting a forum for exchange.

- **Provide access.** Communities are developing educational content to be distributed on the Internet. These could be made available to member countries.
- **Train the trainers.** The use of the information highway for training purposes has many ramifications including the preparation and the richness of contents and the diffusion of content and its delivery. Trainers have to be trained.
- **Technologies.** These include facilities, equipment, and related services; copyright, availability and affordability of learning and training products and services; management of negative impacts, notably issues of privacy and information controls; development of international standards for equipment, software, navigational tools and skill sets; and research and development.

## 2.6 Conclusion

It is clear that we are in the midst of a fundamental economic and social transformation. The extent and implication of which, we can only partially grasp. This transformation is being driven by:

- an interplay of social and technological dynamics including, in particular, developments in information processing and telecommunications and the increasing links between those technologies;
- the emergence of an educated and informed population with associated changes in value;
- the increasing role of mass media;
- higher degrees of specialization in a more knowledge-based economy and consequent changes in the structure of work; and
- a much richer infrastructure of public and private organizations with a stronger degree of interaction among those organizations.

It would be no exaggeration to say that the social and cultural changes of the last three decades have been the most profound of the entire century. We live in a time where history is compressed. Changes that once took decades are now accomplished in a matter of months. There was a time when information was scarce, when it conferred power and when only a few were able to process and use it to shape their behaviour. Today, thanks largely to mass communication, we all have access to ever increasing amounts of information. We can process, analyze and use this information to become our own decision makers, our own strategic planners and our own learning program.

*Let me summarize the issues:*

1. **Democratization of access.** Establishing flexible universal service infrastructures will ensure that citizens have access to new information

services and are able to take advantage of the resulting opportunities that arise. By using existing organizational resources, the impacts of information services and technologies on society can be assessed. Strategies to prevent the marginalization or isolation of certain sectors of society must be formulated.

2. **Continue to study the impact of the information highway.** OECD should be encouraged to complete its research on the effect of information technologies on employment. The university community and public and private sectors must step up their efforts to assess the impact of the information highway on the economy, trade, the workplace and society at large. The results of research on employment can then be used in formulating policy.
3. **Ensure cultural enrichment for all citizens through the diversity of content.** People must have access to a wide range of content, including a strong component of local products and services. Diversity of cultural and linguistic content must be guaranteed.
4. **Encourage the private sector to develop information networks and offer new information services.** This encourages international cooperation in developing a global information infrastructure. This will promote the creation of a very high capacity infrastructure, with room for diversity and different mixtures of content.
5. **Improve education and training.** Countries must exchange information on new learning, training and skill upgrading methods. The use of information technology in teaching should be integrated into the school system. Developing adult distance learning programs using information technologies will help workers adapt to structural and organizational changes.
6. **Improve the understanding of social change.** Countries should promote joint projects and initiatives that demonstrate the possibility of improving and increasing the flexibility of working conditions, opportunities for leisure-time education, urban development and the greater participation of the handicapped in society.

This transformation and the more richly interconnected, complex and turbulent world, the vast increase in information availability, and the compression of both time and space can only be fully exploited through:

- people: education, training, retraining, lifelong learning and quality education;
- research: long term research, short term targeted research, consortia and partnerships;
- markets: competitiveness, globalization and free trade;
- time scales: time scale has collapsed, time scale of investments and return on investments, market place, strategic and corporate plans and capital markets.

In conclusion, the APEC Center for Technology Foresight provides a good forum in which to promote the use of ICT; to fully grasp and understand the issues on how to exploit the full potential of the technology; and to find ways to cooperate and carry out joint action. This objective must be achieved while respecting the social and cultural priorities and sovereignty of each member nation.

No country has yet devised a fail-safe strategy for guaranteeing that the introduction of the information society will be as positive as possible for all of its citizens. However, I believe that countries must support and promote collaboration in the research required to measure, and facilitate the changes in lifestyles that the advent of this new age will bring about in every aspect of our professional and private life.



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## **Implications of Technology for the Learning Process (Lucille Pacey)**

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### **3.1 Preamble**

The discussion on the impact of Information Communication Technologies (ICT) on the economy, trade, learning and culture has been in the forefront of many people's thinking for years. The question of the implications of the rate and penetration of ICT has been transformed to the question of the management and organization of the effective use of the emerging technologies to promote and sustain our cultures, our sense of community and the individual. At the same time there is an interest in promoting and sustaining economic growth on a global scene, and increasing the quality of learning in our societies.

Learning and skill development are acknowledged to be the core of a nation's economic engine - but this implies a commitment to learning continuously, a new model of learning where collaboration is at the root of the model, and relies on ICT to provide the tools and drivers needed for this transformation. Most importantly, it begs the question of how do we develop new educators and retrain the existing teaching population to ensure their work supports and reinforces this systemic change.

The increasing use of ICT requires a flexible and adaptable citizenry, new forms of work and new forms of organization. Success in this respect will be determined by the ability of countries, businesses, governments and the general population to adapt rapidly to changing conditions.

## 3.2 Context

In her book, *The Real World of Technology*, Ursula Franklin argues that “technology, like democracy, includes ideas and practices; it includes myths and various models of reality. And like democracy, technology changes the social and individual relationships between us. It has forced us to redefine our notions of power and of accountability.” Nowhere do we see this to be more evident than in the education system, where the role of the teacher is being reviewed and the learner is challenged to learn in a collaborative environment. The opportunities of using ICT in this new context far outweigh the concerns.

For the purposes of this meeting, the group operated under a very broad, comprehensive definition of technology, where any tool, process or system which extends individual and organizational capability was part of the lexicon. Indeed, many societies are engaged in the rollout of technologies which are considered by some to be outmoded. They are, however, very effective in remote locations; an example of this is the interest in using broadcast television for the delivery of education and training to hard-to-reach locations where there are few support structures for the learning process and the resident teacher.

For most countries the education system can be described as one which is institutionally oriented and geographically bounded, it is typically supply driven and is based on an industrial production model, the focus is primarily internal, with the concern being on the health of the organization, on information management processes with internal measures of success, Typically, the use of ICT is based upon segregated technology applications.

The future that we are facing is one in which the scope is global, with a relationship orientation, requiring new forms of partnerships and willingness for collaboration. The system will be demand driven and the key driver of the economy will be knowledge with a focus on creating that knowledge. The learning systems will have to become learner /client focussed and the measures of success will be external to the institution. Finally, digitization and the convergence of technologies will allow for integrated technological applications with ‘smart’ adaptive capacities.

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## Educational Context

Today	Future
Institutional orientation	Global orientation
Geographical orientation	Relationship orientation
Supply driven	Demand driven
Production based society	Knowledge based society
Information Management focus	Knowledge creation focus
Organisationally oriented	Client/learner oriented
Internal success measures	External success measures
Segregated technology applications	Integrated technology application

### 3.3 Moving Towards Distributed Learning

As convergence in the technologies emerges we are also witnessing convergence in the way learning and training are provided. The distinction between distance education and conventional education is quickly disappearing. Many institutions are providing services in a multiplicity of alternative forms, combining face-to-face classroom delivery with distributed learning, distance learning and many forms in between.

The concept of a 'home' institution may be less of a concern for learners, as they access their learning needs from the best sources in the world. We cannot and should not try to restrict or curb this phenomenon but we do need to ensure that the learner is protected. There is no more important agenda item than to establish standards for service in the educational field-the buyer beware attitude of the western societies will not suffice.

The contributions that distance education has made to this convergence are in the methods of student support and learner mentoring. They provide a basic framework from which to redefine learner support needs in a distributed learning environment. Student fulfillment obligations will radically shift from registration and faculty teaching to advising, technical support, facilitation, interaction and communication in the design of learning opportunities and quality control. Distributed learning is a concept of providing access to quality learning opportunities to individuals or groups through the effective combination of effective instructional strategies with high technology performance. There are a number of trends that are contributing to this move towards a more distributed concept of learning and these have both technology and learning components to them.

One view of these elements is illustrated in Table 1.

Table 1: Learner Centered Education Model

Old Models	New Models	Technology Implications
Didactic-primarily text based or instructor led	Multiple media, resource-based	Print, networked computers, multimedia
Passive learning	Active learning	Collaboration, performance support, communication
Individual work	Individual and team	Collaborative tools, interactive media
Static content	Dynamic content	Networks, just-in-time methods
Homogeneity in design	Diversity in design	Various access methods, tools and resources
Full-frontal teaching	Just-in time mentoring	Access to experts via networks

### 3.4 The Move to Wireless Learning

The move to wired learning is proving a strain on the way access to this learning is provided. “It is expected that a transition to a ‘knowledge society’ is taking place, in which ICTs are playing roles as both driver and facilitator. A knowledge society heightens the necessity for lifelong learning, which in turn implies new rhythms of working life...and learning in the future will have to focus on competencies and qualifications seen from two perspectives: requirements in relation to work, requirements in relation to the societal life.” (Issue 5 Networking)

**Access to hardware and bandwidth** - Computers in schools are still in highly controlled environments. Until consistent access to the pathways and the equipment is transparent and second nature to all learners and teachers, there will be the inclination to treat IT as an adjunct to the traditional teaching/learning process.

Access to this same functionality in the home is another opportunity for the full rollout of IT in societies. As technology penetrates the consumer market, the ability to use it effectively in the learning process is enhanced. The consumer marketplace helps to bring down the costs - both for telecommunications as well as for hardware and software. The other interesting advantage is that as the consumer market demands more user-friendly technology these benefits accrue to the learner. If we are to make strides in this area the focus must be on building the networks and getting everybody connected (universality). “ICTs can offer more and more possibilities for reducing the separation between school and the home and between school and work.” (OECD, 1997)

**Content Development** - All of these pathways and tools are not effective unless there is quality content to run on them. This will require standards-based course/content development systems and processes with flexible production systems. The convergence of the technologies will make the development, production and

delivery of multimedia content more affordable and more practical. “The new media open up means of access to private and public information of all types and provide new opportunities for working with information and cultural industries.” (OECD, 1997)

The costs of developing high end, relevant content will always be a strain in the early stages of building a thriving cultural industry that can sustain itself. In order to ensure that a country does not become a dependent importer of educational and therefore cultural content, mechanisms of financing must be introduced which support the continuous improvement and transition from old technologies to new ones. The existing guidelines for media production do not fit the model for new content development. New criteria that take into account the way new content is created and distributed must be struck.

Educational institutions have a history of developing educational products. Unlike the private sector, where development and production finance models include borrowing against current assets and permit risk taking, public educational institutions may be restricted through legislation from borrowing money to invest in the creation of exportable content. This opens the door to new, creative partnerships with the private sector for purposes of content development, marketing and distribution.

**Support for Managing Learning** -The complexity of managing an ever-widening information source, matching that with quality learning and demonstrable skill and knowledge development will require student and course management tools that are able to track and document the learning achieved throughout the individual's life. As the learner becomes more independent in their learning activities, the teacher will become more of a facilitator or guide. This will require ‘smart’ tools that support adaptive learning processes and at the same time allow learning to be measured and documented. This shift will require standards of competency that are portable and accepted in a variety of different contexts.

The engine of e-commerce will play an important role in the overall change process. As society is able to access information in smaller ‘chunks’ there will be a need to establish easy and fair pricing policies. The copyright laws have to accommodate not only access to complete bodies of work but also access to portions /bits of these for the purpose of storage, restructuring and redesigning. Content will be reused for and by different learners in different ways for different learning objectives.

### **3.5 Pedagogy**

If the vision of lifelong learning is to be realized, it must be understood that it requires a system of learning that is available on demand from any place, at any time and in a form that is useful to the learner. This will require a basic competency in computer utilization and the ability to synthesize and analyze information and to demonstrate the ability to critically evaluate these data to build knowledge. The

application of the knowledge in ways that are in keeping with the culture and values of society are the paths to wisdom.

The learner of the future will by nature be more independent of the teacher, but in return will require access to pre-produced materials (in any number of forms/media) and information and data, tools for the selection, storage, restructuring, and the creation of information, including the incorporation of pre-produced material, and the ability to access, combine, create and transmit audio, video text, and data as necessary. Finally, the lifelong learner will require direct communication with peers, mentors, faculty, and teachers on a synchronous and asynchronous basis.

The envisioned learner-centered model will require that teachers in the classroom not only understand how to use the technology and utility programs (i.e. spreadsheets and word processing programs). They will also need to learn how to use the technology effectively in their respective disciplines (i.e. improving and enhancing the teaching of math, science, or history). Most importantly, teachers of tomorrow, if they are to become facilitators and mentors of learning, will have to understand the fundamentals of pedagogy and the applications of technology to invent new and effective ways of learning.

The issues of effective use of technologies, learned-centered models of education, demand-driven learning for adults and access through ICT beg the question of the need for standards - in content design, in assessment and accreditation and in the credentials of teachers, faculty, and mentors. Technology can help in this transformation by the development of tools for collaborative learning and electronic conferencing to promote discussion and information exchange across institutional, provincial and country boundaries.

Standards-based content can be supported through strong publishing tools, and ubiquitous networks for efficiently transporting the content directly to the learner and gaining access for the learner to the best experts in the world. Homogeneity in education is rapidly being replaced by diversity - of the learners' styles, needs, ages and experiences. Technology can help by providing a variety of access tools and methodologies suited to the diversity of the population.

### **3.6 The Electronic Education Institution**

The highly networked, global, learner-centered institution of the future will be forced to re-think many of its roles. As institutions become more decentralized, and learners more independent, the institutions will want to provide the most timely and relevant information on learning and training opportunities. They will need to manage the provision of credit through independent assessment of learning, brokering and validating learning opportunities regardless of whether they were whole courses and programs or portions/modules/granules of the same. Institutions will have to enable learners to transport credits and demonstrated learning easily and in such a way that the learner is not losing ground by being a self-directed

learner. This interconnected, global registry will challenge even the most creative institution in the world.

Institutions will also play an important role in attending to overall quality control and in the provision of high quality materials. Technology will be an important element in this overall systemic change process. The technology provides the networking capacity, the tools for content development, and the tools and frameworks for information analysis and the creation of knowledge. This complex system of learning will also need to demonstrate effective support and management of the learning process, including the documentation of attainment of knowledge, skills and accreditation.

Individuals will evidence a further impact in the redesign of the nature of work in educational institutions. The debate is still flourishing regarding the power of technologies to effect time economies in the teaching and learning process while maintaining or improving the quality of learning. Until there are sufficient practical examples of best practices available to the teacher community the debate will continue.

Proof that technology integration makes a difference in teaching and learning and is academically justified in terms of improved student learning is an important consideration. There is sufficient documentation in the literature suggesting issues that still plague teachers include: technology access, time to retrain, and access to informed and supportive peer networks. Expert support for the learning process can be enhanced by the introduction of ICT through the use of adaptive learning systems and performance support systems that are easily linked to learner profiles with a capacity to follow learners throughout their lifelong learning.

### **3.7 Organizational Structure**

This agenda will not succeed without the active involvement of the private sector; public/private partnerships are key to moving forward. The agenda for change requires a multi-faceted solution; therefore it warrants partnerships and collaborations with multiple solution providers. This is the first time that one hears of cable companies working with book publishers and software developers to broker quality educational products to provide a rich array of approved curriculum-matched materials that can be accessed from the home and/or the school.

The advantages of this are numerous: first learners have transparent access to the materials they require. Secondly the informal support system for learning begins to flourish in the home; the adults in the home are exposed to the formal work of the learner but also have access to a rich array of learning opportunities that they could benefit from. Finally, the material is current, relevant and easily replenished. The barriers of the institution are torn down and the institution becomes more open and accessible to the public.

### 3.8 Knowledge Transfer

Continuous applications research will need to be fostered and encouraged throughout this systemic adjustment. As IT gains prominence and the networking and access issues are resolved, there is a strong argument to disseminate the knowledge that is gleaned and to use this knowledge as the stepping stone to creating higher order learning. Just as in the conditions for an effective adaptive learning environment, the principle of develop, test, and retest apply to the effective use of technologies in learning.

The transfer of knowledge in the application of technology must span country borders in order to support the natural opportunity for countries to leapfrog. Access to practical examples of applications that are accessible through robust networks with peer collaboration and opportunities for refinement will maximize the efforts that are put into the integration of technology, the curriculum and the learning design. This quick access to learning systems designs, discipline-based enhancements and models of mentor-ship can be shared among and between partner countries in an effort to widen and deepen the knowledge base for all.

### 3.9 Finance

The costs of developing and implementing robust technology-based systems merit a review of the way education and learning are funded.

**Networks/connectivity at the country level** - These are clearly a policy driven agenda, the costs of financing must be borne through creative partnerships with government and the private sector. The simple economic model of increasing supply to reduce costs translates in a positive way to the education agenda. For example, educational innovation in Canada was made possible through the intervention and support of government and its commitment to protected access to media based delivery systems for education as a matter of policy. Examples of this include the regulations governing Educational Broadcasting and the facilitation in the use of satellite for education delivery in the early stages of satellite distribution.

**Financing the lifelong learner** - Conventional finance models for education systems are based on full time student equivalencies. This model will no longer work effectively as the lifelong learner takes advantage of learning opportunities through the network environments and opts in and out of the formal learning institutions. The ability to 'track' the learner in the conventional manner, of hours in a class or attendance in a course will no longer prevail.

This is less of an issue for the learner, who through their work environment is provided with the tools and access for training and retraining. However, there is that ever-present gray area where the disenfranchised adult who requires basic literacy training is still required to go to a physical location and 'sign-in' in order to qualify for financial support.



The technology can and should play a role in opening up the options for these learners. If the technology can provide richer examples of simulations and real life experiences, as well as skill development, these same platforms can be used to help track and monitor the progress of the learner and to keep accurate records of the learning achieved.

**Replacement costs** - Few institutions/systems or governments have a plan in place for continuous upgrade and replacement. Hardware and software renewal needs to be viewed in the same way that paper and pencils are budgeted for in institutional operating budgets.

Second, there is the concern of renewing and refreshing content. This will be less of an issue when the content is developed in granular formats and is viewed as organic in nature; but in the interim there will always be large content areas that require conscious updating. Typically, the costs for this are not automatically loaded into the operational plan of an institution; they are seen as 'special' requirements. Public institutions typically cannot use operating dollars to undertake these initiatives. Linking the capital and the operating policies to interact with each other would be a positive step forward.

### **3.10 Conclusion**

Learning is a process, a part of human development, that begins at birth and, in principle, never ends; it occurs in formal and, more importantly, informal ways. Through the application of IT we should be able to reduce and eliminate barriers to learning while at the same time increasing the quality and style of learning overall. Information technology is not about accessing and processing data so much as it is about communication. "While technology acquisition is very important, the most difficult and important issues involve people. Investments in technology should be accompanied by substantial investments in human resources." (OECD, 1997)

The challenge is to enable people to use and manage these tools effectively, to exploit the technology for creation and innovation through the knowledge of the possibilities it provides and to help people invent new forms of knowledge.

Establishing robust networks that are linked internationally can help disseminate information and knowledge about and among diverse cultures to promote understanding and tolerance. Effective tools for learning that support collaboration and adaptive learning strategies and that can help in the assessment of learning can begin to open doors to portability and recognition of learning between cultures. IT can help learners and societies to do different things well, but more importantly it can allow them to do different things differently.

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## The Experts' Meeting in Vancouver, 3-6 May 1999

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### 4.1 Establishing the Issues

Thirty seven Experts from twelve economies (see Appendix 1) came together with facilitators and support staff from the National Research Council Canada and the APEC Center for Technology Foresight in Vancouver on 3-6 May, 1999 (see Appendix 2). The Experts first reported on their identified issues and then debated the papers of sections 2 and 3.

In order to ensure that, as far as possible, contributions and discussions were taking place within a common framework, some effort was devoted initially to arriving at a shared understanding of the three key phrases- learning, culture, and technology.

**Learning** was seen to be a process of acquiring, through trial and error, formally and informally, information, understanding and knowledge through experimentation, questioning and validation.

**Culture** represents a set of values that reflect what people have learned, the environment they live in and the historical context that they inherited. Culture also provides behavior patterns that people can interpret and interact with; it is a collective experience shared within a group and bound with a group.

**Technology** included all forms of information and communication tools, multi and mixed-media which enable individuals to access information, integrate this information into their daily lives and work and enable them to create new forms of knowledge.

Participants were asked to identify what they saw as the five most important issues in technology for learning and culture from their own perspective. These ranged over a very wide spectrum as the future of post-compulsory education, and of schools; the fear of excessive reliance on technology; the effect of demographic trends on the teaching profession; financial constraints on implementation of new technologies, and the impact of globalization on course content.

The major issues raised in Jacques Lyrette's paper included:

- democratization of access - flexible, universal service infrastructures linked with a commitment to equity in access;
- the need for continuing study of the impact of the information highway on economic activity, trade, the workplace, the community and society at large;
- ensuring cultural enrichment for all citizens through strong commitment to diversity of cultural and linguistic content;
- encouraging the private sector to develop information networks and offer new information services, thereby encouraging international cooperation in developing a global information infrastructure;
- the need to improve, and exchange experience of, new developments in learning, training and skill upgrading, both in the school and higher education systems and through adult learning distance programs;
- the need to improve the understanding of social change, through initiatives that demonstrate the possibility of improving and increasing the flexibility of working conditions, opportunities for leisure-time education, urban life-styles, and the greater participation of disadvantaged in society.

Lucille Pacey's paper raised issues which related to the nature of the learning process and the changing relationship between teachers and students resulting from the introduction of information and communication technology which reflected many of the concerns raised by the Experts.

This wide range of issues was then clustered into eleven key or core issues, which were accepted as providing a suitable focus for further consideration and guiding the Workshop. There is some overlap, and inevitable uncertainty about quite where some boundaries should be drawn. In addition, policy issues were not distinguished, but rather were to be treated as aspects of each issue. The eleven key issues were:

1. **Economic** aspects of learning and culture - human capital development and deployment, cost-benefit assessment of new technologies and methods, human resource development, globalized competitive education industry.
2. **Learning** - changing theories of learning, drive towards life-long and/or continuous learning, importance of un-learning, learning models, collaboration/sharing in learning development.
3. **Technology** - infra- (or 'info-') structure, capacity, standards, bandwidth availability, means of delivery and access.

4. **Access** - controlled (by government or private sector) versus free availability with little or no restrictions, information rich versus information poor.
5. **Culture** - values, sovereignty (as opposed to domination/imperialism), ethical issues.
6. **Language** - of the medium and technology - mono-lingual (English) or multi-lingual, content dominance.
7. **Institutions** - patterns of organization, corporatization, management.
8. **Diversity** - age, demography, gender.
9. **Social and cultural impacts/changes**.
10. **IT for education** - training, content, equipment, networking
11. **Accreditation** - including consumer protection, quality control.

## 4.2 Establishing the Key Drivers

The expert group examined the key issues systematically, in order to identify the key drivers which would be likely to shape technology for learning and culture over the coming decade, to 2010.

On this basis, nine key drivers were identified and agreed as being likely to shape the future of technology for learning and culture:

1. Trade/economics;
2. Tribe (membership of cultural/ethnic/professional/common interest communities);
3. Technology (stability, reliability);
4. Governments;
5. Learning (research, basic to living);
6. Integration (digital, personal, global);
7. Quality of life ('wealth');
8. Environment;
9. Competition.

## 4.3 Developing the Uncertainties

Identification of 'Uncertainties' that can produce unexpected 'step-changes' is a crucial stage in the development of plausible but divergent scenarios of possible futures. Uncertainties that represent critical axes of possible change are the driving force for effective scenarios.

Typically, technical experts have some difficulty in addressing the concept of uncertainties; by personality and psychology they wish to find underlying explanations that will maintain a rational view of the world. Participants were encouraged to escape from the normal and comfortable mindsets, by dramatic examples of possible future events, and encouragement to engage in brainstorming and other right-brain techniques, while suspending judgment. Through these

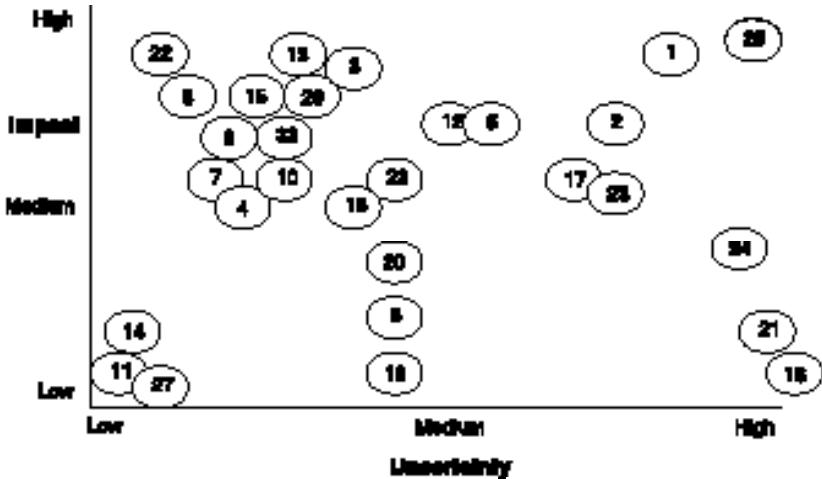
processes, each group developed up to ten major uncertainties, which were condensed into the list below:

1. A dramatic electro-magnetic pulse destroys all computer memory.
2. An epidemic which kills a substantial part of the world population.
3. A major backlash against the values and effects of technology.
4. World War III breaks out.
5. Dramatic global warming.
6. India (or China) becomes the dominant IT power through a major technology advance.
7. Artificial intelligence is 'perfected' (hugely advanced).
8. Digital mentors are established as 'best practice' in schools.
9. Intellectual property rights are abolished.
10. 'Big Brother Gates' - computers monitor users.
11. A 'World President' is elected.
12. Computers are held responsible for a new rash of crippling neurological diseases.
13. Learning can be achieved through biological implants.
14. The 'age-ing' gene is identified.
15. 'Virtual war' breaks out on the Internet.
16. Use (providing and seeking information) of the Internet is regulated.
17. A major global economic depression.
18. Extra-terrestrial life (ET) is conclusively demonstrated.
19. A new non-polluting energy source is identified.
20. A new biological virus selectively sterilizes women.
21. A new religious Messiah with world-wide following emerges.
22. The concept, and experience, of youth (adolescence) evaporates - children enter the adult world and experience at 8.
23. International economic and political institutions collapse.
24. A new element, which challenges the Chemical Periodic Table, is discovered.
25. Netcrime sweeps the Net, leading most consumers, to boycott it.
26. One-third of the Chinese population has direct access to the Internet.
27. A staple human need (e.g. water) is simply no longer available.
28. A combination of (1) - an e.m.p. destroys computer memory, and (25) - netcrime closes Net, has led to the abandonment of computers in all learning and culture applications.

In order to rank these uncertainties for the purpose of their value in determining scenario logics, all participants collectively engaged in assessing each uncertainty against their impact on technology for learning and culture to 2010, and the extent of their uncertainty.

The latter process always proves challenging to some expert participants, accustomed to the calculation and application of probability judgments. The challenge is to distinguish not between the probability of the events occurring, but the knowledge base that allows such judgments to be made. Hence, events to which either a high or a low probability can be confidently assigned have a low uncertainty. It is those events for which there is no reasonable basis for making such a judgment that have high uncertainty.

The outcome is captured in Figure 1 below:



#### 4.4 Developing the Scenarios

Participants were divided into four groups of 8-9 members, each group containing at least one person with some experience in scenario development.

The scenario drivers selected, based on Figure 1 and the judgment of the facilitators, were as follows:

- X-Ys - a major environmental disruption - global warming (event 5); an epidemic (event 2) was initially included but it proved redundant in driving the uncertainty;
- Quasi-realists - a major economic disruption - global economic depression (event 17) and collapse of international trade and finance regulating institutions (event 23); these two events also effectively merged into one;
- Cybernots - loss of technological capacity - emp destroys computer memory (event 1), Netcrime closes Net (event 25), consequence of rejection of IT in learning and culture (event 28);
- Virtual Messiahs - a dramatic increase in technological capacity - extra-terrestrial life confirmed (event 18), new element discovered (event 24), new Messiah emerges (event 21).

During the development and reflection on the implications for outcomes and actions, there was a level of concern among participants that a negative catastrophe had dominated three of the scenarios, and hence pessimistic outcomes were inevitable.

A review of the other uncertainties suggested that other major disruptors that might have had a substantial influence on technology for learning and culture, though with lower levels of uncertainty or impact, are:

- a shift in the dominance of the IT industry by the US;
- national and international regulation of the Internet;
- rapid adoption of IT-based learning;
- rejection of IP rights;
- loss of key basis of social identity.

To this might be added uncertainties associated with the agreed drivers, such as:

- demographics;
- political change;
- social/values change;
- government policies (e.g. the Malaysian Government investment in the Multi-Media SuperCorridor).

However, consideration of each of these issues suggested to the facilitators that, while they were undoubtedly important and should be considered in strategic planning, they would not have introduced an alternative major dimension of step-change.

## 4.5 The Scenarios

### I Water, Water Everywhere (X-Ys)

Headline 5 May 2005 - Antarctic Archipelago Collapses.

The long feared effects of global warming, reflected in earlier years by dramatic variation in weather patterns, and an increase in the frequency of 'natural disasters', have manifested themselves with a vengeance. Ice sheets flowing into the ocean from the collapse of the Antarctic Icesheet has caused the Equatorial Conveyor belt current to break down.

Rapid meltdown of the ice caps has raised the sea level by 33 meters. Most of the world's former major cities are now under water, two-thirds of the world population has had to relocate, creating a massive refugee problem, and systems of production and distribution have broken down. The loss of established water supply and disposal systems has produced an epidemic of cholera and dysentery.

Shorelines are changing drastically and national boundaries are being lost and obscured. National disputes are rising. This has required a huge response on the part of the UN to supervise disputes, to establish new national boundaries and organize settlements for the many refugees.

Singapore, the Philippines and the Pacific Ocean Islands are gone. The Singaporean population has been moved to the mountains of mainland China, Thailand and Malaysia. They took as much of their culture as they could, mostly on CD-ROM and other digital repositories. The epidemic has been curtailed by restricting public gatherings.

Schooling is now largely home-based. Engineers, health workers, and teachers have the skills that are most in demand. Teachers, in particular, are seen as crucial carriers of heritage and culture, and providers of education for the new future. Their position as an elite is reinforced by the need for the community to preserve and re-capture cultural heritage. This increases the importance of the network of teachers for archiving since a functioning material culture has been essentially destroyed. The people have to re-learn the practices of a subsistence economy, joined with other subsistence cultures in agricultural highlands.

The virtual community offers services such as home-based education, telemedicine diagnostics, and electronic town hall meetings. Through this electronic community, they practice participatory democracy. The digital results of votes and value discussions are fed into the APEC repository and returned through an intelligent tutor who is known as their virtual leader, Jacqueline Chan.

Electronic services, such as medical diagnostics and home-based schooling, form the basis of trade between the new Singaporean settlers and the original residents of the highlands. In return, indigenous understanding of plants and animals that are appropriate sources of food and medicines are shared. Online trading augments community-based bartering.

The grandparents are now largely in charge of educating young children. The twenty-year old, university educated boy, is now taking practical lessons from the indigenous villagers on how to farm. He is able to apply his ability to learn by going online to extract information from the world's available databases on sustainable agriculture and aquaculture and how to manage e-bartering. New modes of intensive subsistence agriculture and aquaculture systems are integrated to the extent that membrane technology has permitted sewage to be treated in order to restore its portability.

In order to preserve energy, housing has been largely developed underground with light pipe technology bringing natural light down into the caves and caverns. Boating and outdoor "adventure living" has become popular as recreation and use of leisure time.

In general, groups have tended to retain their own ethnicity, but recognize the need, and develop mechanisms, to learn to live together. Containing the epidemic, and addressing the reconstruction challenges, has required people to develop their own, localized technologies, combining indigenous and modern techniques and thinking.

Learning is largely home-based, drawing from a centralized APEC education bank, accessed through wireless Internet. Common concepts and learning artefacts are shared (e.g. science, math, etc). Knowledge workers, such as doctors and teachers,



are responsible for access to both the electronic and the human network, but require high levels of cultural sensitivity;

## II Learning through Adversity (Quasi-Realists)

Seattle Evening News

April 26, 2010 ~ Special Edition ~ 5 sea shells

“Billionaire Found Selling Apples on Main Street!”

MS-ABC World Service

In the early hours of this morning, a middle-aged man was spotted on Main Street selling macintosh apples to help feed his family. The rain was falling steadily but the man did not seem to mind it; he was more concerned with clearing all his apple stock before the Internet access time begins at 10 AM Pacific Time.

“This is my night to cook. I want to serve Sushi but I’m worried about how to prepare the fish and other ingredients.” With the extreme shortage of fossil fuel, many families have reverted to some traditional forms of food preparation which do not require cooking. “I don’t want to make a mistake with the Sushi recipe and end up making the family sick! My search agent should have found the answer by now but I may not be able to check the information before the noon shutdown.”

The man is none other than Bill Doerr, the ex-president of Macrosoft World, who lost his fortune overnight because of the great depression that hit the information industry most.

“I have tried to obtain more access time from CERN, the last institution on earth, but they turned me down flat! My complaint fell on deaf ears.” It is true. The world economy is in deep depression and is out of control. As a result, all major institutions of the world (governments, financial institutions, regulatory agencies, military forces, health organizations) have collapsed under the weight of global non-confidence.

Only CERN, the original institution of the World Wide Web in Switzerland, has survived. CERN alone controls what is left of the world’s Internet-10 500 Gb/sec Infrastructure. They alone are trusted to allocate user access time, limited globally to a maximum of two hours per time zone per day.

His misfortune seems to spill over to his family. Janet Doerr, Bill Doerr’ eldest daughter, has recently lost her job as the CEO of Macrosoft Child. She has been on a job search for three months -- without luck. “People don’t hire me because they think that I have no adequate language skills,” Janet Doerr said.

According to a recent evaluation by a typesetting company, Janet Doerr is deficient in language skills needed for the company. She uses only Interglish, which is of no value to the company, and she does not speak Chinese, which is on demand in the market. In addition, her VB2000 skills are not in fashion anymore because of the limited access to the Internet and to computers.

His sons find that their excellent computer skills are no longer useful. They now struggle to learn basic survival skills. Their virtual teachers no longer exist.

They now have to use books to learn to do things like putting the stove on. They cannot communicate with others as their verbal skills are deficient and email no longer exists and ICQ is dead. They learn how to work out the value of their personal belongings in order that they may barter for food and medicine. They pay exorbitantly for books and dictionaries. They fight over comics and the skipping rope.

The Doerr children walk each day to the Community Centre and look over the weekly schedule of learning activities lead by Joe She who is an opinion leader on the topic of fishing. Joe, a former university professor, is now a teacher-learner. Knowledge transfer is largely experiential plus that taken from the books in the archives, complementary to that which is hard-obtained information mined from the Internet.

Now the Doerr family value their culture in a new way. Their life seems to move at a slower pace, commercial competition has become greatly relaxed, and their extended family provides a comforting social support system. They have found religion, although they worship alone and in a highly personalized and idiosyncratic fashion.

That evening, as Bill went up his rented house, he wanted to talk to his wife but he realized that he no longer had a phone, nor could he go into a teleconference with her and the other members of the family. So he had to go around his room and tell his wife and children that it was time for dinner.

For the first time in many years everybody was present at the dinner table. For the first time in many years did the whole family get to talk to each other, face to face, physically that is. It used to be that they largely communicated or talked to each other through the phone, e-mail, or computer. This time they were able to talk and share each other what they did during the day.

His children used to get most of the information from the Internet. With two hours only in the Internet, the children have to be highly selective of the materials they have to get from the Internet. They now think that they have to be creative in looking for other sources of information.

Even though it is difficult to make the day selling apples, Bill Doerr seems to enjoy his life. The thing he enjoys most, he said, is the newly found antagonistic ethnic diversity. "It is so different from the homogenous Microsoft culture," he said. "People are fighting against each other for my apples, and they don't seem to care about political correctness anymore."

Carrying an armful of apples and dripping with rain, Bill Doerr returned to his one-room flat. Peering through his window, he wondered if a new Sushi recipe could be exchanged on E-Bay for an increase to his Internet access time.

### **III Helpless and Hopeless...(Cybernots)**

The date: 5 May 2010. A mysterious massive electromagnetic pulse has wiped out all the operations of computers. This sudden surge came at a time when various governments were debating whether to shut down the Internet.

After enjoying two decades of tremendous growth in geometric proportions that saw a multitude of new exciting applications reaching out to the masses even in third world countries, the Internet faced a possible premature demise. The proposal to shut down the Internet has stirred a lot of controversy. Governments started thinking about shutting down the Internet because e-commerce gave a new lease of life and sophistication to organized crime. Money laundering was done with so much ease that turnaround time to legitimize drug money took only 24 hours. Driven to their wits' end, the G7 governments were seriously thinking about shutting down the Internet to buy some time to freeze organized crime whilst they thought of a long term solution to the problem.

A period of chaos and anarchy...

The mysterious electromagnetic surge, codenamed S27Z, has practically wiped out all computers. The computers were now as good as gone, and none could be salvaged. All that were left were just empty boxes. There was a period of economic chaos, and breakdown of politics and governments. Trade volume fell drastically.

But some groups were quicker to get their act together. They went down to the basics immediately. Surprisingly, the changeover was swift. These people knew that there was no other alternative. There was no time to whine, and to ask why. There was only one rule to the new game - you either survive or you perish.

It soon became clear who would be the winners of the game. The agriculture-based economy had an immediate advantage. Third world countries like Laos and Burma were least affected by the cyber-meltdown. They continued to make good steady progress, whilst once technology-powered economies struggled to make sense of a world without computers. For more than five years, it looked like the power shift would move to the so-called less-developed countries.

A second group of economies soon emerged. These were the small city-states such as Hong Kong, Singapore and Ireland. Being compact, they had the advantage of being able to get themselves organized quickly. The mega-cities, on the other hand, were just too huge and complex. People were quick to recognize that "small is now big". New York was one of the first mega-cities to 'split' into smaller entities. Manhattanpolis, as they now call themselves, was one of the first to break away from the "big is power" mentality, and their progress has shown great success. The advantages of having a centralized government which could make quick decisions and implement policies became obvious. Decentralized management looked like something that could not work anymore.

Pedagogy survived...

In the education scene, the impact of the loss of computers was less pronounced, especially in the earlier grades. Good teachers were still good teachers, albeit having to make do with less available resources to support their work. The learning theories still prevailed. However, because of the decrease in the onslaught of information, there was no longer a rush to cover the syllabus. There was now more time to ponder over issues. A more reflective learning environment was slowly

emerging. It was also a time to go back to basics. The educators confirmed what they had always suspected - the kids could not add or subtract! There was a revamp of the curriculum so that basic literacy in the 3Rs became important again. The teachers were also pleased that the handwriting and penmanship of their charges improved in a computer-less environment.

Teaching as an important and critical profession surfaced once again. With the loss of computers, an alternative resource base had to be quickly sought, in addition to the need to recruit more teachers. The answer lay in the backyard. Community-based instruction became a trend. The printing press flourished once again. Libraries and museums became centers of knowledge.

The scenario at the tertiary institutions was less positive. Universities were highly dependent on the Internet and the computer as a working tool. With the computers gone, it was a period of the dark ages where academics struggled with not knowing what to do. The research community in particular was very badly hit.

The impact of the loss of computers on the quality of life was ambivalent. While the disappearance of e-commerce caused much anxiety and inconvenience, people were now finding more time to breathe in the fresh air, and smell the roses. Where once individual family members logged into the Internet pursuing their own individual interests, there was now time to take the family for a stroll in the park.

During the five years of post-S27Z confusion, a quiet revolution was taking place in the big China mainland. These people, brought up in a disciplined environment, could calculate faster and better using their abacus. With its massive population base, human number crunching became the logical mainstay in income generation for the country. In addition, with English losing its place as an international language of electronic communication, the playing field was levelled, non-English-speaking communities now having an equal chance of success as any other.

The phoenix rises from the ashes...

After the initial years of confusion, and adjustments in power balance, the implicit universal understanding was that whoever is the first to re-build the computer rules the world. The race to re-invent the computer began.

Humankind however became wiser. Computers would now have to be built such that the dependency factor is removed. We needed to start from a different baseline. Computers would not be allowed to evolve to the extent that nobody could predict its outcome. Knowledge on building computers was now a controlled item, in the same way as information on building nuclear devices was jealously guarded.

A non-proliferation treaty on making computers was signed by USA and China, the first two countries to succeed in building the computer. However, this soon led to an underground black market computer mastering activities.

Although the computer-less era was over, many useful lessons were culled. In schools, the back-to-basics movement led to a change in curriculum to revisit fundamentals.

... after the baptism of fire, the phoenix flies !

#### IV The Pholkes Next Door (The Virtual Messiahs)

The newspaper has just downloaded into his machine as Prof. Knight is ready for another cup of coffee after a whole night working on his troublesome project. His task is to explore the badly needed solution to overcome the acute energy crisis, big E. He reflected how, just three years ago, such a simulation would have been quite unthinkable on even a desktop computer! Then desktops, despite Moore's Law had simply not been able to cope with such a task! Now with a 60 GHz clock and terabytes of ram, thanks to the magic of Saskalbertium, his personal headputer, with the photochromic display, allowed him to do everything his desktop had done in 1999, and so much more. With wireless connections to digital imaging, scanners, his Viewscreen wall, and his everyday domestic needs, life had changed so much for his family, and in various ways for almost every family in the world.

He also looked guiltily at the newly awarded plaque from the Nobel Committee and considered how, it should have been displayed only in the home next door, from where, quite literally his extra-ordinary neighbour, Franklin Benjamin, had ascended again into heaven. For, Franklin had returned home, to bring back more supplies and the tumultuous computing revolution which he had brought about, and which had brought them both earthly fame and fortune, and conferred upon them the world's highest scientific honour, was well under way.

Back in 2004, with the world already experiencing the development of the Information Superhighway, Benjamin's arrival in a small econocar heralded the most revolutionary change in computing since the Pentium V chip in 2001. It had changed the whole pace of the electronic revolution.

As usual, there was nothing special in the newspaper that he browsed. He contemplated however, how impossible his father considered the conception of almost every word written there. For instance, he browsed the paper by sight, but if he wanted to "read" an article in detail, he simply voiced the command, and the text was spoken gently in his ear, improving retention of its ideas by a factor of 3 over reading alone. Keyboards were a thing of the past, reserved only for people with disabilities of speech, sight or hearing, or when it was inconvenient to talk to the computer. However, with the "mobile phone" revolution of the late 90' no-one bothered anymore about "half conversation" in public, as long as it was quiet. Of course private places, like restaurants, had banned such things because it disrupted ambience, and with greater leisure time such bans were generally accepted.

He had been tasked to "foresight simulate the threatening problem of the big E", and was developing scenarios for consideration by means of an e-conference with 20 world experts who had flown to be within comfortable timezone range, so important was it that this problem be addressed. It was most unusual, in the growing "E-crisis" to do real-time conferencing, but as long as separations could be reduced to 14 hours or less, it was thought desirable in some cases, as spin offs from such

events were more powerful than chat or mail conferences which handled routine matters with no great energy cost.

The day Franklin had entered his life would be etched forever in his memory. After a sleepless night, like today, he had been idly browsing the paper, then only as an e-book download on his desktop, which desktop had again proved insufficient for the task he was asking of it. Another complex simulation which he would have to get time on the University's overworked supercomputer (what a joke) to run effectively. However, as one of the world's expert simulators, he had delayed global warming problems by a few years and now he had a more complex development which would run on his headputer, to offer for the big E solution and he and Benjamin had shared the Nobel prize

For only he knew that Benjamin, the New Messiah, was not of this world, and the chip which he had been given those few years ago, had come not from Canada, but from another world! Only he knew that the long period pulsar identified by astronomers was in fact Benjamin's ship as it parked in geostationary earth orbit when he regularly beamed down to the little home in the Vancouver suburb, to replenish stocks for the world of the rare chip apparently developed in Knight's UBC research lab and supplied so cheaply that not even Bill Gates had managed to stop the market being flooded.

Anyone could now afford a headputer, and everyone saw the value of giving the chips to underprivileged nations to upgrade everything from agricultural production computers to other human needs manufacture so that poverty and hunger would largely be eliminated, along with a 30% reduction in human energy needs by 2015. That was a key factor in his E-problem solution.

Knight remembered again how, after heading out to greet his new neighbour, he had spent a while learning that Benjamin had come from "back east" to settle in Vancouver and recruit followers for the "millenicult", a sect devoted to human improvement through computer applications. That had led Knight to tell Benjamin of his own computing power problems. Benjamin had heard of Knight's renown in simulations which was partly why he had come to UBC, he said, but to have landed up living next door was such a strange coincidence. Perhaps, he had suggested, I can help you right away! Put this in a spare ramslot in your desktop and see if it helps in your problem!

Having helped Benjamin to unload his few belongings, he had gone back inside, and decided to have one more crack at the problem before heading, exhausted, to his office for the new day's work. He opened his CPU, and inserted the new chip into a free ramslot. There was only one, as he had upgraded so that he could work as much as possible at home. His video-simulations were memory hungry, but the family situation and the difficulty of getting supercomputer time made "homeworking" so much more comfortable and bandwidth problems were almost solved, so if he kept his videos short, he could ftp the files back and forth as he developed segments.

With the new chip in place he rebooted the machine. A single beep signified the P.O.S.T. and the rolling number indicating the memory in the machine rolled on, but now seemed to run endlessly. To his amazement, it didn't stop until it reached a thousand time of the size it had been.

What could this signify? How had this increase occurred? The new chip had given him 1000 times the already prodigious memory. Now he could simulate!!! His previously problematic memory problem had mysteriously disappeared and what a revolution that had started.

Now he considered again four years of secrecy coupled with world computing development. Changes were beginning in formerly backward economies. The supply of chips was seemingly endless, and there was no cost! What had the change done.

Already schools had been changing from knowledge transfer stations to higher learning centers in 2003, but now the transfer function had gone, they were socialization and knowledge integration centers, and with the youngest children already going to them with good computer skills, the most amazing potential was being seen from the best students who now spent almost no time in drudgery learning. Good pedagogy of 2001 had been transferred to the no-bandwidth problem net and true multisensorial stimulation, already developing in the VR games centers of 1999 had become a learning tool.

In developed societies, all historical and cultural artefacts had been placed in electronic reach of all, ancient cultural narratives, songs, music and art were there. Special research programs, mindful of eco-disasters, had begun to ensure that cultural heritage of the less developed world was protected at least by e-storage as those countries were encouraged by the new technology, to develop to late 20th century first world standards, minus mistakes!

The new potential had enhanced family values, both Knight and his wife had time to spend showing the youngest boy how to use his shape-keyboard where, rewarded for shape-matching he would be led into voice and eye-movement control of his headputer. They were already seeing co-ordination skill improvements that would help his physical development later and let aggressive tendencies be worked out relatively harmlessly in rewarding sports play instead of social disharmony. They both had time while their older daughter was at school developing social knowledge skills, such as cooperative simulation and interactive development, to work at their 'real-product' job.

Now, lower end computing jobs were less well credited, and everyone was being encouraged by high value e-credit to take some responsibility for a 'real-product' job, such as local growth of organic produce to augment the efficient bulk-farming of staple foods which was needed to feed the world. Some had returned with vigour to much sought after cottage skills such as home baking which could be bartered for another's local e-skills.

The big E crisis had been somewhat delayed as e-commerce, e-communication, e-working, and even e-farming of many "crops" such as chickens had reduced

commuting, travel and other fuel needs and to some extent, industrial waste of energy. New chips had made automatic pollution control more possible.

Now the major need for long-distance travel was to develop the e-economies of less developed countries to reduce their burden to the first world. E-Rewards for population self control were being offered. Free headputers and peripherals for two children only families (one child in China), but her grasp of e-development was so rapid that self-regulation was becoming the norm and self-sufficiency, because the non-e skills were still present in the population, was developing very rapidly.

Of course Benjamin's "discovery" apparently with Knight, had made him the new Bill Gates, but because he was not interested in profit, and took his chips and the hardware they made possible directly from manufacture to "need base" charging only the e-credits needed for the manufacture and minimal distribution costs in his "super-transporter" (in reality his gyron-drive ship, pollution free, cost nothing to run), he was seen as a new messiah, not as an anti-trust breaking megaloplutocrat

Once the distribution of computers powered by the superchip had got well underway, and at such low cost, use increased dramatically within the first year. When Benjamin had explained the truth to Knight and his wife and his "New Messiah" plan had begun to unfold, change had followed rapidly. The first headputers had been given away in Vancouver's Internet cafes, the churches of the new religion! At first governments and conservative groups had been resistant, and even now, four years in there was a significant anti-Benjamin lobby and even a harder line anti-computer lobby, but the world stage seemed set for a genuine revolution.

There had already been a 30% reduction in first world energy use. Some communities were already wired separately for power from national grids, and locally with new battery storage and low power solartrons made possible also by Saskalbertium.(Sa)! Of course, although they had looked, no-one had found another seam of the ore, and the substance of the new chip, whose chemistry was halfway between silicon and phosphorus in the periodic table, had led to some doubts about there being yet more undiscovered similar elements in a new "period" of the elements.

All still believed the element came only from a single mine, owned by Benjamin in Saskatchewan and had been developed secretly in UBC. A good thing Benjamin had carefully chosen non-Imperialist Canada to offer his gift for world salvation. Some countries would have made it a "state secret", arrested him and buried Saskalbertium as a threat to world trade, while developing it themselves, like they had ARPANET in the '80's for military purposes.

Now it had brought such changes in e-civilization! No one worried about IPR any more, people with a good product uploaded it to unregulated megaservers with an e-credit price-tag for a download. From innovations to pornography, you had to have enough e-credits to get it. Parents simply credit barred children from getting what they did not want their children to see, and with parentally assigned access codes, it was difficult for anyone with ethical parents to get material of an unsuitable nature. Of course there was a black market, but with much younger



understanding of sexual responsibility and less need to experiment because maturity and its outcomes were understood much earlier, it was not very significant.

Other obscene materials of political or violent nature too were less sought by young people because teachers now had time to work more on sociology and culture as content provision was dealt with by the new INET 4. Specialized departments in the super-universities dealt with a basic knowledge curriculum for all, mediated by a beginning world education foundation to which local cultures could add content or other material accredited by their local education panel chosen from those with agreed pedagogical expertise borne of contributions to the working educational data-base at appropriate levels.

One major shortcoming was now that people's experiences were more virtual than real, but in a "Star Trek" holodeck way which only left out aromatic sensations, a problem not yet solved in cyberspace! Practical skills were assessed in real settings in schools in everything from horticulture to needlepoint for both genders.

Some super-universities had been demarcated, several in Asia-Pacific, to validate no longer courses and qualifications, but web-contributions, and children as young as 15 had submitted work deemed satisfactory for Ph.D. dissertations. The problem was that they were rather specialized and their authors now had to wait to show breadth of educational development, including practical skills, now being assessed in the new socio-schools, before their contributions in their specialist field could be accredited with all their contributions to give them high socio-academic status, now of much greater importance than socio-economic status.

Personal possessions of note were no longer a suit and tie or a smart car, (fossil fuel use was now well restricted not because of shortage but because of emission control needs), but the attributes of the happy professor, a balance of physical, intellectual and productivity, topped off by sufficient leisure. The workaholic was no longer admired because he tended to deluge the net with too much that was routine. He was encouraged to "produce" less and to share and socialize more for quality rather than quantity in collaborative output. He would be encouraged to shut up for a while and go work out in his computer monitored and controlled supergym.

A world office of fair e-trading could deal with complaints simply by removing, with e-consensus of its members, an unfair trader from the net for a period of time, so that e-courts effectively dealt with e-crime. Reselling someone else's uploads at a cheaper price was similarly dealt with and hot-bots soon informed two parties if two or more uploads were sufficiently similar, but not clearly identical, so that the two (more) could communicate and agree a market share or a common price.

Benjamin's whole attitude to this development was that, in universal terms it was beneficial to turn around a planet's development from global suicide to global sustainability. His world's governing council had millennia of planetary development to its credit, and was being joined in interplanetary collaboration as they reached a Universal nirvana. Of course there had been earthly cultural help before, but only

by 2004 had its lifeforms, and particularly man progressed far enough that the New Messiah could become a global phenomenon and the work done with and before the Dinosaur calamity, with Atlantis, the Indo-Buddhist transition, the rise of Judaeism, Christianity and Mohammedanism, the Mayan Empire, the Anasazi, the Aztecs and the Incas be brought to its next more global stage.

The threat of dictatorship by the New Messiah had never seemed a possibility. Although he was worshipped and feted, with Knight; he was never a “God” yet perhaps he was the first true saviour of the world? Of course, with global development a reality, global conflict and neo-imperialism coming to an end and some hope of a more sustainable world, it was the view of the interplanetary council that Franklin Benjamin would, at the right time, marry and bring children to earth so that his new role as World Science and Technology Adviser to the United Nations could be assured with an appropriate locally born successor!

## 4.6 Outcomes and Actions

Each team was asked to identify a maximum of ten outcomes significant for technology for learning and culture arising from their professional discipline, and to identify, through backcasting, the key actions which would have had to be taken at some earlier time to achieve, mitigate or eliminate these outcomes, as appropriate.

### X-Ys

#### Outcomes:

1. Teachers as an elite - bonus credit systems established to attract the best people; new training of teachers encourages them to mentor learners as a “guide on the side”
2. Creation of APEC repository - create consensus around shared protocols and standards; digitized artefacts
3. Wireless community using satellite systems - refined wireless communication technologies, satellite up-linking is now embedded into a hand-held digital personal communications system
4. Multilingual and multicultural society - instantaneous translations software developed and improved language teaching systems deployed
5. E-bartering - standards are formulated
6. Recapturing cultural heritage - capturing religious and social traditions, as well as courseware, in digital formats and recording oral histories, building up the resources of the APEC repository with digital libraries and museums has brought together the grandparents and the young
7. Home-based and community-based learning - extensive distance learning programs are established, standardized learning outcomes and technologies are developed

8. Virtual Singaporean community (government, President, etc) - Singaporean consensus on renewed social values was built up and, through the APEC repository, were implemented through the creation of an intelligent avatar who appears to be universally available anytime, anywhere, to anyone. The female persona, Jacqueline Chan, emerged as a reflection of renewed attention to caring for the earth and its environment
9. Subsistence living - basic survival skills are taught as part of national service.

### Quasi-Realists

#### Outcomes:

1. Limited access to information
2. Deterioration of language, social and communication skills
3. Crumbled formal educational systems
4. Unidirectional information flow in education
5. Loss of tacit (personal, undocumented) knowledge
6. Increased diversity of culture, return of tribal feuds
7. The rise to power of non-governmental international institutions (e.g., CERN)
8. Reduced commercial competition; slower pace to life
9. Fatalistic outlook on life and tending towards 'learned helplessness' and sense of futility

#### Key Actions:

1. Preserve archival information in both digital and traditional forms, use more mirrored servers, develop redundant multiple media for storage
2. Strengthen language education; return to disciplined spoken and written language, with on-going centralized language proficiency testing, coaching from teachers in the schools but with parental involvement from the home
3. Combine the traditional (off-line) and virtual education system in an effective way to produce complementary learning structures, processes, media and intellectual property; where feasible, implement back-ups of material; validate and authenticate documented knowledge of all forms with discipline-based peer review for quality control
4. Develop a database of personal expertise, to make possible more efficient access to the tacit knowledge of experts -- it remains private, unmodified, embedded know-how but the location of experts is published widely
5. Reduce the work week to not more than five days
6. Strengthen non-governmental organizations but prevent monopolistic control of international standards and infrastructures at the same time; implement mechanisms for checks and balances to minimize chance of abuse of power

7. Let it be ... whisper words of wisdom, let it be; have researchers explore the competitive advantages derived from cooperation and collaboration
8. Work hard to increase harmony among ethnic groups and diverse cultures; more international exchanges (governmental, academic and industrial)
9. Orient education of the young toward sense of control over technology, and exercise more self-confidence, and trust in others.

### **Cybernots**

Outcomes:

1. Back to basics - teachers teach, theory, method, writing (teaching without technology); investment in retraining teachers based on sound pedagogy; curriculum scope
2. More and better teachers needed - better incentives for recruiting and retaining teachers
3. Impact on primary/secondary/tertiary education (greater impact on research community, lesser impact on K-12) - more libraries in universities; revise curriculum scope
4. Less IT-based communication and connectivity - strengthen verbal communication
5. Computer system rebuilt differently - virus immune software; R&D for new concept computer; reduce dependency on IT
6. English as international language
7. Computer technology control - intranet-based IT courseware for greater security; early warning system in place
8. Community-based education - local curriculum; development of national and international standards; more community and parental involvement.

### **Virtual Messiahs**

Outcomes:

1. Minimum world curriculum database
2. World heritage total database
3. Peer review for valuation of real/e jobs - IPR
4. Redefine roles for aged, disabled and the under-privileged
5. Good and new pedagogy teachers - high value real jobs developed
6. Home working culture criteria
7. Parental pricing control system of I-highway
8. Socialization profile indices
9. Enhanced family values - global sustainability
10. 5 year sabbatical - re-skilling, recuperation and relaxation

The Teams were then asked to identify the five most important actions, from the standpoint of the present (1999).

### **X-Ys**

1. Digitize all resources, “cultural capital”
2. Agree on APEC common protocols
3. Invest in language translation and teaching systems
4. Invest in refining the wireless communication technology and satellite systems
5. Teach the teachers IT skills and how to create community learning resources.

### **Quasi-Realists**

1. Preservation of information
2. Combination of virtual and traditional education
3. Language education
4. Regulated competition
5. Cultural exchange

### **Cybernots**

1. Investment in teacher re-training based on sound pedagogy
2. Better incentives to recruit/retain teachers
3. More libraries in universities
4. New concept computer
5. Intranet-based education

### **Virtual Messiahs**

1. Define world curriculum/heritage database
2. Aged redefined
3. Derive good and new pedagogy for teachers
4. Systemic recognition of ‘home-working’ and IPR
5. Enhance family values

All participants were then provided with 3 tokens to vote for their preferences among the twenty action options that had been developed. The voting was fairly highly clustered, in favour of five actions:

1. Investment in new concept computers
2. Development of wireless/satellite technology
3. Capture and preservation of information
4. Common international protocol and standards for learning and culture
5. Investment in teachers upgrading/retraining.

One interesting outcome of the scenario-based process appears to have been a recognition among participants of potential drawbacks and vulnerabilities associated with the drive to a much higher level of technology dependence in learning and cultural formation and transmission.

## 4.7 Developing Delphi Topics

Since the APEC TF Center had decided to undertake a Delphi study on technology for learning and culture in the APEC region to 2010, the Vancouver workshop dedicated one day to the development of Delphi topics.

In technology foresight, there are two major concerns for the selection of technological topics, i.e., what to consider and the outcomes of the Delphi survey. In the process, the Delphi includes several stages, preliminary brainstorming for selecting topics and refining them, and main foresight, i.e., two-round Delphi. In the Vancouver workshop, the primary purpose was to select Delphi topics before the Delphi surveys were carried out. This was done by brainstorming among experts from APEC member economies.

In the Vancouver workshop, before the participants moved into the development of Delphi topics, the two-day exercise for scenario writing provided a good opportunity to share common understanding for technology for learning and culture. After the scenario exercise, the participants were ready to move into developing Delphi topics as they already had background knowledge on how to deal with future environments of learning and culture and they also had the issues in mind. Such a process worked out nicely.

In the session of developing Delphi topics, the participants were grouped into four groups, as in the scenario writing session. Each group was assigned to produce about 20 Delphi topics, looking ahead over the next 20 years. Before producing and developing topics, the Experts were provided with background about the innovation process, characteristics of Delphi, and guidelines by Dr. Taeyoung Shin, while Mr. Terutaka Kuwahara described the procedure and outcomes of the sixth Japanese National Delphi survey. The participants in Vancouver were given the following guidelines in developing Delphi topics:

- Avoid compound statements of events;
- Avoid ambiguous statements of event;
- Avoid too little or too much information in the statement

The four groups produced more than 80 topic statements. The facilitators then put them together, reduced the number to 57 and the Experts reviewed the topics in a plenary session.

The topics were classified into 6 sub-areas: (1) technologies, (2) management, (3) content and learning resources, (4) government policies, (5) human resource development/training, and (6) cultures.

### (1) Technologies

1. **Widespread use** of a portable device (watch, belt etc.) incorporating the function of multimedia entertaining (MD player, CD/VCD player); mobile phone and wireless to be worn like an eyeglass and an earphone with a microphone.

2. IT is ubiquitous, easily accessible in most places
3. Development of solar power batteries that can last for at least 12 hours and fully charged within 1 hour.
4. Widespread availability of cheap devices for universal availability of computer/ sensory i/o.
5. Widespread use of electronic real-time inter-language translation of newspapers at about 95% accuracy.
6. The system for instantaneous download from the internet is established and widely available.
7. The system for automatic identification and screening of the age of electronic documents is widely available.
8. Widespread use of user-friendly teleconferencing
9. Access, by about 90% of student population across all grades, to computer network in economies is possible.
10. Development of end-user friendly technology to prevent transmission of objectionable material
11. Development of cheap technologies for the digitization of content
12. Widespread use of bio-processing implants
13. Development of Artificial Intelligence for adaptive learning
14. Widespread use of wireless networks for broad access to information
15. Widespread adoption of speech recognition in personal computers.
16. Language translation technology is developed to the point where knowledge can be input and retrieved in any language
17. Cheap and secure computers for learning are widely available.

## **(2) Management**

18. About 50% of the working population are being engaged in teleworking
19. Creation of a Council for Validation and Accreditation of Digital Education Content

## **(3) Content and Learning Resources**

20. 50% of school-age population are being educated at home.
21. Widespread use of international taxonomy for educational content storage and retrieval, for easy search and access.
22. Widespread replacement of about 30% of university degrees by competency-based assessment
23. Widespread separation of the researcher function from the teacher/facilitator function
24. Widespread application of validated pedagogy in IT-enabled teaching and learning.
25. Parents have equal say with policy and system managers in formalized teaching and learning

26. Development of international accreditation of educational programs
27. Establishment of international agreement on content rating system (as for films).
28. Widespread identification of best practices in IT-based teaching and learning
29. Creation of a network of digital libraries/museums
30. Development of networked centers for multimedia research in many places.
31. IT literacy integrated throughout school-based curriculum.
32. Development of a comprehensive web-site on how to develop and implement tele-learning.
33. Practical use of virtual worlds in which people experience different cultures.
34. Widespread availability of learning and culture research repositories free of intellectual property rights.
35. Enhanced pre-service IT curriculum in about 90% of teacher education institutions.
36. Establishment of Public InfoBank for information literacy and information ethics.
37. Widespread practice of professional workforce contracted on a project basis (rather than permanent hire)
38. Cheap rates for telecommunication charges for electronic learning is widely applicable.
39. Web-based content on life skills is widely available.

#### **(4) Government Policies**

40. Widespread use of a complementary system of school and home education.
41. Government policy for social education to regulate IT device-use for community good is widely implemented.
42. Government subsidized learning programs for elderly retirees are widely available; more than 50% of them living in urban areas.
43. Chinese characters are appeared to about 50% of www pages.
44. Widespread use of an internationally accepted comparative index of education achievements.
45. Widespread use of new technology to capture and store cultural artifacts.
46. Establishment of community access to School ITC resources in many places.
47. Evaluation system of use and effectiveness of the Internet by primary and secondary school students is in widespread use.
48. Development of international cyber-laws (laws governing the use of IT)
49. Creation of an international “Cyber Court”



### **(5) Human Resource Development: Training**

50. Widespread use of IT systems for the aged and disabled that help them to keep working, so as to increase employment of them by greater than 50% over current level.
51. Widespread existence of new professions such as cyber-counsellors and community knowledge managers
52. All school managers are certified in the management of the use of technology in education.
53. About 75% of K-12 teachers are IT literate.

### **(6) Cultures**

54. Widespread use of holography for cultural art effects.
55. Widespread support for intercultural education can be made due to widespread use of IT.
56. Widespread use of online newspapers and news sources.
57. Replacement of about 50% of print newspapers by electronic newspapers

## **4.8 Reporting of the Vancouver Workshop**

Following the workshop, a printed report covering the material of Sections 1 to 4 was prepared by Ron Johnston, Lucille Pacey and Taeyoung Shin and distributed to the Experts and to the ISTWG contact points. The same material was also placed on the APEC Center website. This was intended as an interim report, until the final outcome of the Delphi Survey was known, and incorporated into this final report.

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## **5. THE DELPHI SURVEY**

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### **5.1 THE FIRST ROUND QUESTIONNAIRE**

The Delphi topics developed in the Vancouver workshop were refined and clarified in a series of interactive consultations with the Experts from the workshop, the International Advisory Board, the facilitators and the staff of the APEC Center. The experience from the first APEC Center multi-economy Delphi study on Water Supply and Management in 1998 was drawn on, in the formulation of the questionnaire.

The Time Horizon was set at 2020 with six time slots of 4 years each for Time of Realization in APEC and in the respondent's own economy, while Constraints to Occurrence were factored in from the first round. As in the case of Water Supply and Management, only two rounds were carried out due to the logistical problems of dealing with a large number of experts in the widespread APEC economies.

After the refining of topics, 51 topics were posed to respondents in the first round questionnaire which is reproduced here.

## DELPHI QUESTIONNAIRE

### Research Study      Technology for Learning and Culture

#### Introduction

This survey is a core part of the APEC Technology Foresight Center study on “Technology for Learning and Culture”. The topics in the survey are based on a discussion paper outlining key issues concerning Technology for Learning and Culture the APEC region. Scenarios were then created by APEC education / IT experts at a meeting in Vancouver during 3-6 May 1999, as a means of identifying topics for this survey. Topics were further refined by subsequent inputs from the same experts and from others. The report meeting and the Issues Paper are published on the APEC Technology Foresight web site along with other details of this project such as the consultants and experts involved, the background and rationale for the study. The web site can be found at: <http://www.apectf.nstda.or.th>. The research study information is listed under “Our Activities”.

Asia-Pacific-Economic-Cooperation has 21 full member economies, which are: Australia, Brunei Darussalam, Canada, Chile, China, Hong Kong China, Indonesia, Japan, Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, the Philippines, Russia, Singapore, Chinese Taipei, Thailand, the USA, and Vietnam. Your answers will make a major contribution to the identification of those topics that you, as part of the APEC community, consider likely to shape the future of technology for learning and culture in these APEC economies. This research study aims to provide a valuable opportunity to think seriously about significant technological and policy trends in the field of education / IT, and their contribution to quality of life and wealth creation over the next 20 years.

This survey has 2 rounds. Firstly, you are asked to give your views on a number of topics. Then, in a second round, you will be given a summary report of the responses of the first round. You will then be asked to review your responses and complete a second survey. The second survey will be sent to you a few weeks after the first. This approach, known as Delphi survey methodology, has been used in many APEC economies, for example, in Japan, South Korea, Australia and Thailand, and in Europe.

In this survey, some topics refer to futures that we can expect by extrapolating current trends. Other topics refer to preferred futures, and others refer to possible futures for which there may be only weak signals at the moment. You do not have to answer every topic. You should use your judgement to decide whether to respond to a topic, according to your interest and expertise. We also invite you to suggest new topics in the blank space at the end of the questionnaire.

We would be very grateful for your cooperation in completing and returning the form by the due date.

### Confidentiality

Your answers will remain confidential to the APEC Center and its consultants. No information will be released which allows your responses to be identified.

### Due Date

Please return the completed questionnaire by: **6 September 1999.**

For *postal returns*, an addressed envelope has been provided. We regret that we were unable to provide a stamp since postal rates vary around the APEC region. We would be most grateful for your support in this respect.

*Faxed returns* should be sent to: (662) 644 8027 or 8194, and clearly marked for the attention of the APEC Center.

*Email returns* should be addressed to: [apectf@nstda.or.th](mailto:apectf@nstda.or.th).

### Help Available

If you have any problems completing this questionnaire, please contact: **Dr Chatri Sripaipan**, on 662 2 644 8009 (direct phone), or email: [chatri@nstda.or.th](mailto:chatri@nstda.or.th) or Ms Mayuree Vathanakuljarus at [mayuree@nstda.or.th](mailto:mayuree@nstda.or.th) or 662 2 644 8150 to 9 ext. 706

We would like to thank you for your kind cooperation.

Professor Greg Tegart  
Director

Dr Chatri Sripaipan  
Co-Director

### Guidelines for Questionnaire.

- This questionnaire is the first round of an APEC-wide survey, concerning issues and technologies in the area of “Technology for Learning and Culture.” The questionnaire contains 51 topics which could, and perhaps should, occur within the next 20 years.
- Each topic includes survey parameters, such as degree of expertise, degree of importance and year of realization. These parameters are explained below.
- You will also be asked to make open comments on these topics, and to suggest new topics.
- Your answers will be compiled anonymously. You will be sent a summary of all the answers we receive. You will then be asked to reconsider your answers and fill in the questionnaire again.

## A. Definition of terminology:

(1) Many of the topics in the first “Technologies” section refer to “Innovation Stages”. These are:

- Elucidation:** the earliest stage - scientists have discovered the principles or ideas in an APEC member economy and are exploring it further. Elucidation will probably occur in just one (or a few) member economies, with transfer to other member economies at a later innovation stage.
- Development:** scientists have reached a specific technological goal , e.g., completion of the first prototype in the lab. Development will probably occur in just one (or a few) member economies, with transfer to other member economies at a later innovation stage.
- Practical use:** the technology or idea has been proved possible and economically viable, and has been used a few times outside laboratory or prototype conditions. Practical use *in the APEC region* refers to more than one APEC member economy.
- Widespread use:** after the technology or policy was introduced for practical use, it has been adopted in many different places. Widespread use *in the APEC region* refers to at least 11 of the 21 member economies.

*These innovation stages may not be applicable to the other four sections: Management, Contents and Learning Resources, Government Policies, and HRD: Training and Culture.*

(2) Degree of Expertise: Please check one of the following.

- High:** you have considerable specialist knowledge about the topic, through current research or current work.
- Medium:** you have engaged in research or work related to the topic in the past; or you have some specialist knowledge about the topic through research or work in adjoining areas.
- Low:** you have read technical books or literature about the topic or you have listened to discussions by experts on the topic.
- None:** you have no special knowledge of this area

(3) Degree of importance: Please check one of the following.

- High:** extremely important
- Medium:** important
- Low:** somewhat important
- Unnecessary:** not important

**(4) Year of realization:**

Please try to estimate the period in which you think this topic will be realized.

- ‘Year of realization in the APEC region’ should be taken to mean ‘Year of realization in a majority of APEC member economies’.
- Please note that there may be topics where the category of ‘Year of realization in your country’ is not applicable. This is because some topics will be adopted in your economy at a later ‘innovation stage’- after the technology has been elucidated and developed in more advanced economies. In these cases, please put a line through the boxes.

Year of Realization In Your Economy						
Before 2000	2000-2004	2005-2009	2010-2014	2015-2019	Beyond 2020	Not applicable

**B. Survey instructions**

- (1) Please read the guidelines above carefully and then respond to the topics.
- (2) Please assume that there will be no sudden changes in the APEC region, such as wars, major (natural and/or human-made) disaster, and so on.
- (3) Please make comments about the topics on the sheet provided. For example, you could describe the major actions that need to be taken to achieve the goal, or you could describe the major constraints on achieving the goal. If you think a topic is unnecessary or undesirable, you could explain why. All your comments are welcome.
- (4) Have we missed anything important? Please make suggestions and recommendations for additional topics, if any, which should be included in this questionnaire on the final sheet.

**Thank you for reading these instructions carefully.**

Please answer the following questions, and then proceed to the topics.

Age:     20- 29     30-39     40-49     50-59     60-69     70+

Family Name: ..... Given Name: .....

Institution to which you are affiliated: .....

Address: .....

.....

.....

Tel: ..... Fax: ..... E-Mail: .....

APEC member economy: .....

Number of years experience in your specialist area: .....

Key words for the area of your specialization:

(1) .....(2).....(3).....

For each of questions below, please check relevant boxes, and send this part back to APEC Center for Technology Foresight.

Area	Topic Number	Topics	Degree of Expertise			Degree of Importance			Year of Realization In APEC Region					Year of Realization In Your Economy					Probability				Constraints to Occurrence								
			High	Medium	Low	None	High	Medium	Low	Not necessary	Before 2000	2000-2004	2005-2009	2010-2014	2015-2019	Beyond 2020	Before 2000	2000-2004	2005-2009	2010-2014	2015-2019	Beyond 2020	Not applicable	High	Medium	Low	Social factors	Economic factors	Cultural factors	Political factors	Others
Technologies	1	Portable devices (walking belts, etc) incorporating the function of multimedia entertaining (Multimedia player, Compact Disk / Video Compact Disk player), mobile phone, radio & television are in widespread use.																													
	2	Information and communications technologies are accessible by 90% of the population.																													
	3	Chargeable batteries, which are three times as powerful as current state-of-the-art, are in practical use.																													
	4	Computer Input / Output devices which have user friendly interface are in widespread use.																													
	5	Software for real-time inter-language translation of 10 major languages at 95% accuracy is in widespread use.																													
	6	Knowledge management systems on the Internet are in widespread use.																													













For each of questions below, please check relevant boxes, and send this part back to APEC Center for Technology Foresight.

Area	Topic Number	Topics	Degree of Expertise			Degree of Importance			Year of Realization In								Probability				Constraints to Occurrence													
			High	Medium	Low	None	High	Medium	Low	Not necessary	Before 2000	2000-2004	2005-2009	2010-2014	2015-2019	Beyond 2020	Before 2000	2000-2004	2005-2009	2010-2014	2015-2019	Beyond 2020	High	Medium	Low	Social factors	Economic factors	Cultural factors	Political factors	Others				
	39	Community access to school Information and Communication Technologies learning resources is freely available.																																
Government Policies	40	Use of the Internet by primary and secondary school students is widespread.																																
	41	International cyber-laws to cover digital signature, electronic evidence, electronic transaction and documents, computer crimes are developed.																																
	42	Telecommunication charges for access to identified sites for resources for learning in schools and universities are 25% of normal rates.																																
	43	Policies to prevent transmission of objectionable material by electronic means are enforced.																																



For each of questions below, please check relevant boxes, and send this part back to APEC Center for Technology Foresight.																															
Area	Topic Number	Topics	Degree of Expertise				Degree of Importance				Year of Realization In APEC Region				Year of Realization In Your Economy				Probability				Constraints to Occurrence								
			High	Medium	Low	None	High	Medium	Low	Not necessary	Before 2000	2000~2004	2005~2009	2010~2014	2015~2019	Beyond 2020	Before 2000	2000~2004	2005~2009	2010~2014	2015~2019	Beyond 2020	Not applicable	High	Medium	Low	Social factors	Economic factors	Cultural factors	Political factors	Others
Culture	50	Preserved cultural heritage is freely available through networked resource centers. Improved understanding of cultural differences by the use of new technologies leads to a reduction of international conflicts.	High	Medium	Low	None	High	Medium	Low	Not necessary	Before 2000	2000~2004	2005~2009	2010~2014	2015~2019	Beyond 2020	Before 2000	2000~2004	2005~2009	2010~2014	2015~2019	Beyond 2020	Not applicable	High	Medium	Low	Social factors	Economic factors	Cultural factors	Political factors	Others
	51		High	Medium	Low	None	High	Medium	Low	Not necessary	Before 2000	2000~2004	2005~2009	2010~2014	2015~2019	Beyond 2020	Before 2000	2000~2004	2005~2009	2010~2014	2015~2019	Beyond 2020	Not applicable	High	Medium	Low	Social factors	Economic factors	Cultural factors	Political factors	Others



Please write down your comments on any topic:

For example, you could describe the major actions that need to be taken to realize the topic, or you could describe the major constraints on achieving the topic. If you think a topic is unnecessary or undesirable, you could explain why. All your comments are welcome. Please feel free to add extra sheets if you want to.

Topic	Comments

*Suggestions for additional topics*

*Please feel free to add extra sheets if you want to.*

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*This is the end. Thank you for completing this survey.*

## 5.2 Conduct of the Delphi Survey

The sample of Delphi experts was obtained through the APEC Experts that attended the workshop, through the APEC Industrial Science and Technology Working Group, and through other contacts of the Center and its consultants. As in the case of the Delphi survey on Water Supply and Management, it proved difficult to obtain experts in a number of APEC economies. In the end, the number of potential respondents to whom questionnaires were sent was 520.

As in the earlier Delphi survey, the response rate varied between economies with a number of those represented at the Vancouver workshop producing reasonable responses (see Table 1). The issue of how representative the responses are of opinion in a particular economy is difficult to answer but the response level from at least half a dozen economies suggested that there is a reasonable view presented.

**Table 1 Responses to Delphi Questionnaire**

Economy	Participants at Workshop	First Round	Second Round
Australia	3	8	4
Canada	8	11	8
China	-	2	-
Hong Kong, China	10	18	8
Indonesia	1	7	3
Japan	1	3	2
Korea	3	13	9
Malaysia	1	8	3
Philippines	2	20	5
Singapore	1	6	3
Chinese Taipei	3	11	4
Thailand	4	23	11
USA	-	3	-
Vietnam	1	1	-
		134	60

The response rate in the first round was 25.8 percent. This is higher than that achieved in the first APEC Delphi survey on Water Supply and Management (18.8 percent) and, is close to the rates achieved in national Delphi surveys.

The questionnaire invited respondents to make comments on the survey and these offered considerable insights into the reactions of respondents and need to be taken into account in future multi-economy Delphi surveys. These comments are reproduced in Appendix 3 and were conveyed back to respondents in the second round.

In the second round, the questionnaire included the results from the first round and the format was altered as:-

- 1) an additional statement was included as suggested by respondents, namely:- 52: “80% of websites published within APEC are at least bilingual.”;
- 2) a specific “Year of Realization in the APEC region” was sought against the upper (75%), median (50%), and lower (25%) quartiles established in the first round;
- 3) a specific “Year of Realization in Your Own Economy” was sought on customized forms against the upper, median and lower quartiles established in the first round;
- 4) an additional set on the “Need for APEC-wide Cooperation” with four categories. “High, Medium, Low, Not Necessary” was included instead of “Constraints to Occurrence.”

The altered questionnaire was sent to the respondents of the first round with the outcome shown in Table 1. The response rate was 45.8 percent, which was lower than that achieved in the Delphi survey on Water Supply and Management at 58.8 per cent. This is well below the 80 per cent of first round respondents answering the second round in national Delphi surveys and highlights the problems of maintaining interest by respondents when the Delphi survey process is spread out over several months and the first round has taken most of their attention.

### **5.3 ANALYSIS OF THE RESULTS (Taeyoung Shin)**

Against the background of the experience with the Korean national Delphi survey, Dr Taeyoung Shin carried out the following analysis. The overall results are presented in Appendix 4.

#### **5.3.1. Expertise of Respondents**

Experts were asked to evaluate their own expertise for each topic to which they responded. On average, the expertise of the participants is not very high. About 60% show medium or low degree of expertise. Although the distribution of expertise is relatively balanced over the TLC areas, the expertise of most participants is related to software such as management, contents and learning resources, policies and HRD-training, rather than hardware like technology itself. On the other hand, their expertise is relatively lower in the area of culture, more focusing on the area of learning.

**Table 2 Average Expertise by Area**

Areas	High		Medium		Low		None	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Technologies	18.4	14.9	29.1	28.3	34.3	38.6	18.2	18.3
Management	20.7	18.6	29.8	21.7	31.6	40.9	17.8	16.4
Contents and Learning	28.2	28.6	32.2	30.7	27.0	30.2	12.5	10.5
Resources	22.6	19.6	30.5	28.8	29.7	35.2	17.2	16.5
Government Policies	22.4	19.6	28.2	26.1	32.9	37.8	16.6	16.5
HRD-Training Culture	10.7	12.3	27.4	23.7	36.1	40.2	25.8	23.7
Overall	22.1	20.4	30.2	28.0	31.1	35.7	16.6	15.7

Since the degree of expertise in Delphi studies is always controversial, for convenience, we separate the survey results of higher expertise from the full sample. This was done because many people want to find a justification of the results based on the expertise of the participants.

### 5.3.2 Importance of Topics

The degree of importance was evaluated in terms of technological progress and policies to cope with foreseeable future problems. The survey results measure the degree of importance by using the following equation;

$$I=10xH+5xM+1xL+0xU$$

where I denotes the index for the degree of importance; H the percentage of “high”, M the percentage of “medium”, L the percentage of “low”, and U the percentage of “unnecessary.” The index varies between 0 and 10, i.e.,  $0 \leq I \leq 10$ .

Using the index as shown above, the topics are rearranged and listed in Table 3. From the top 10 topics in order of degree of importance, we have 4 topics for technologies (#2, #4, #11, #13); 3 for contents and learning (#20, #25, #29), 1 for management (#19) and 1 for HRD-training (#44). In summary, connecting students, teachers and others is highly important for schooling or (re)training people. To do so, cheap computers should be available. Computer-aided learning environments are necessary. IT literacy will become increasingly important for individual competitiveness and therefore it has to be integrated throughout the curricula of schools. More people will have easy and friendly access to the net, which connects domestically and globally. In this line, it seems that the development stage of TLC focuses more on construction of IT infrastructure and availability, and then on its uses.

**Table 3 Degree of Importance**

Importance Index	Topic Number	Topics
9.561	29	Information Technology literacy is integrated throughout the curricula of schools.
9.474	13	Cheap computers for education and interactive learning are in widespread use.
9.211	40	Use of the Internet by primary and secondary school students is widespread.
9.140	25	All teachers in schools are trained in Information Technology-enabled teaching and learning.
9.138	20	90% of the students in all grades have access to computer-aided learning environments.
8.964	2	Information and communications technologies are accessible by 90% of the population.
8.889	19	Best practices in Information Technology-based learning and teaching are identified on a continuing basis by national and international bodies.
8.836	4	Computer Input / Output devices which have user friendly interface are in widespread use.
8.796	11	Global wireless networks to allow global communications at a thousand times current speeds are in widespread use.
8.649	44	Websites designed to assist people to reskill themselves are freely available.
8.508	41	International cyber-laws to cover digital signature, electronic evidence, electronic transaction and documents, computer crimes are developed.
8.414	39	Community access to school Information and Communication Technologies learning resources is freely available.
8.397	27	A network of digital libraries and museums is in place.
8.393	6	Knowledge management systems on the Internet are in widespread use.
8.321	18	Common international protocols and standards for technology for learning and culture are developed.
8.316	30	A web-site to implement telelearning with an expertise database is developed.
8.155	32	Intellectual property rights for learning contents and software are waived for research repositories for learning and culture.
7.966	47	All school administrators have qualifications in the management of technology in education.

Table 3 Degree of Importance (Cont'd)

Importance Index	Topic Number	Topics
7.966	47	All school administrators have qualifications in the management of technology in education.
7.947	14	Online publishing is in widespread use.
7.793	28	A network of centers for multimedia research is in place.
7.789	34	Digital and interactive science museums capable of fostering scientific skills of children through play are in widespread use.
7.782	51	Improved understanding of cultural differences by the use of new technologies leads to a reduction of international conflicts.
7.661	42	Telecommunication charges for access to identified sites for resources for learning in schools and universities are 25% of normal rates.
7.293	33	A Public Info-bank for information literacy is established.
7.148	43	Policies to prevent transmission of objectionable material by electronic means are enforced.
7.125	45	International Communication and Technologies systems to enable the aged and disabled to work more effectively are in widespread use.
6.945	1	Portable devices (walking belts, etc) incorporating the function of multimedia entertaining (Multimedia player, Compact Disk / Video Compact Disk player), mobile phone, radio & television are in widespread use.
6.585	3	Chargeable batteries, which are three times as powerful as current state-of-the-art, are in practical use.
6.482	22	International taxonomy for educational content storage and retrieval is established.
6.414	37	Subsidized programs for developing computer literacy for rural people are widely available.
6.414	31	Virtual worlds in which people can educate themselves about different cultures are available through multimedia centers.
6.339	10	Artificial intelligence systems for adaptive learning are in practical use.
6.298	7	Desktop videoconferencing enabling linking of participants in different places is in widespread use.
6.211	52	Improved understanding of cultural differences by the use of new technologies leads to a reduction of international conflicts.
6.190	26	Parents have a significant input to school curricula.

Table 3 Degree of Importance (Cont'd)

Importance Index	Topic Number	Topics
5.947	50	Preserved cultural heritage is freely available through networked resource centers.
5.862	49	Multimedia technology is widely used to capture cultural artifacts, such as works of art and historic building to preserve cultural heritage.
5.836	24	Funding limitations in universities lead to widespread separation of the researcher function from the teacher / facilitator function.
5.786	12	Widespread adoption of personal computers, for use in training and producing materials for the blind.
5.717	5	Software for real-time inter-language translation of 10 major languages at 95% accuracy is in widespread use.
5.696	23	30% of university degrees are replaced by competency-based assessment.
5.661	8	Input devices such as speech recognition and voice command are in widespread use.
5.193	21	50 % of school age population are being educated by home school using interactive learning technology.
5.148	17	An APEC Council for Validation and Accreditation of Digital Education Content is created.
5.053	38	An international agreement for rating educational and cultural content on the Internet (as for films) is established.
5.035	16	50% of the working population are engaged in teleworking.
4.897	46	New professions such as cyber-counselors and community knowledge managers are recognized by employers, both private and public.
4.778	9	Electronic chip implants which allow inter-language translation are developed.
4.724	36	Subsidized programs for developing computer literacy for elderly retirees are widely available.
3.881	35	Some on-line teachers become "superstars," demanding higher salaries for their courses and working on contracts from remote locations for multiple institutions.
2.148	48	Chinese characters appear on 50 percent of www pages.
1.632	15	Emergence of robots capable of acting as opponents to humans in sports and activities.

### 5.2.3 Forecast Time of Realization

The year of occurrence for each topic was estimated. To do this, we calculated the inter-quartile range from the survey results. The inter-quartile range (IQR) includes the lower-quartile, median and upper-quartile. The lower-quartile represents the year corresponding to the response at the 25th percentile of all responses in chronological order; the median at the 50th percentile and the upper-quartile at the 75th percentile. Then, the estimated year of occurrence for the topic was obtained from the median. However, it can be said in a different way that the 50 percent of all responses evaluate the topic would occur before the median or after the median; those 50% also evaluate that the topic would occur between lower- and upper-quartile.

**Table 4 Distribution of Topics by Estimated of Year of Occurrence**

Year of Occurrence	Technologies	Management	Contents & Learning Resources	Government Policies	HRD-Training	Culture	Total
Before 2000	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0
2005	5	1	1	0	0	0	7
2006	1	0	1	1	0	0	3
2007	3	0	4	2	1	0	10
2008	1	0	3	3	0	1	8
2009	1	2	5	1	2	1	12
2010	2	1	2	0	1	2	8
2011	0	0	0	0	0	0	0
2012	1	0	1	0	0	0	2
2013	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0
2015	0	0	0	0	0	1	1
2016	0	0	0	0	0	0	0
2017	1	0	0	0	0	0	1
2018	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0
After 2020	0	0	0	0	0	0	0
<b>Total</b>	<b>15</b>	<b>4</b>	<b>17</b>	<b>7</b>	<b>4</b>	<b>5</b>	<b>52</b>



Most topics are expected to be realized between 2005 and 2010. It might be said that by the year of 2010 a major technological achievement in the area of learning and culture would be made in many member economies. Therefore, it becomes important that member economies particularly such as developing economies should make greater efforts to catch up. Otherwise, the future competitiveness of the economy might weaken (even with an acceleration of activity) in view of the speed of development and implementation of information technologies.

Most topics showed that there was a significant convergence of opinions for the year of occurrence, after two rounds of the Delphi survey. The experts predictions of the year of occurrence of future TLC events is shown in table 5. Appendix 4 contains the full results.

**Table 5 Chronology of Future TLC Events**

Year of Occurrence	Topic Number	Topics
2005	1	Portable devices (walking belts, etc) incorporating the function of multimedia entertaining (Multimedia player, Compact Disk / Video Compact Disk player), mobile phone, radio & television are in widespread use.
	4	Computer Input / Output devices which have user friendly interface are in widespread use.
	6	Knowledge management systems on the Internet are in widespread use.
	13	Cheap computers for education and interactive learning are in widespread use.
	14	Online publishing is in widespread use.
	19	Best practices in Information Technology-based learning and teaching are identified on a continuing basis by national and international bodies.
	29	Information Technology literacy is integrated throughout the curricula of schools.
2006	3	Chargeable batteries, which are three times as powerful as current state-of-the-art, are in practical use.
	30	A web-site to implement telelearning with an expertise database is developed.
	40	Use of the Internet by primary and secondary school students is widespread.

Table 5 Chronology of Future TLC Events (Cont'd)

Year of Occurrence	Topic Number	Topics
2007	7	Desktop videoconferencing enabling linking of participants in different places is in widespread use.
	8	Input devices such as speech recognition and voice command are in widespread use.
	12	Widespread adoption of personal computers, for use in training and producing materials for the blind.
	25	All teachers in schools are trained in Information Technology-enabled teaching and learning.
2007	26	Parents have a significant input to school curricula.
	27	A network of digital libraries and museums is in place.
	32	Intellectual property rights for learning contents and software are waived for research repositories for learning and culture.
	41	International cyber-laws to cover digital signature, electronic evidence, electronic transaction and documents, computer crimes are developed.
	43	Policies to prevent transmission of objectionable material by electronic means are enforced.
	44	Websites designed to assist people to reskill themselves are freely available.
2008	11	Global wireless networks to allow global communications at a thousand times current speeds are in widespread use.
	20	90% of the students in all grades have access to computer-aided learning environments.
	28	A network of centers for multimedia research is in place.
	33	A Public Info-bank for information literacy is established.
	38	An international agreement for rating educational and cultural content on the Internet (as for films) is established.
	39	Community access to school Information and Communication Technologies learning resources is freely available.
	42	Telecommunication charges for access to identified sites for resources for learning in schools and universities are 25% of normal rates.
	50	Preserved cultural heritage is freely available through networked resource centers.

Table 5 Chronology of Future TLC Events (Cont'd)

Year of Occurrence	Topic Number	Topics
2009	17	An APEC Council for Validation and Accreditation of Digital Education Content is created.
	18	Common international protocols and standards for technology for learning and culture are developed.
	22	International taxonomy for educational content storage and retrieval is established.
	24	Funding limitations in universities lead to widespread separation of the researcher function from the teacher / facilitator function.
	31	Virtual worlds in which people can educate themselves about different cultures are available through multimedia centers.
	34	Digital and interactive science museums capable of fostering scientific skills of children through play are in widespread use.
	35	Some on-line teachers become "superstars," demanding higher salaries for their courses and working on contracts from remote locations for multiple institutions.
	37	Subsidized programs for developing computer literacy for rural people are widely available.
	46	New professions such as cyber-counselors and community knowledge managers are recognized by employers, both private and public.
	47	All school administrators have qualifications in the management of technology in education.
	49	Multimedia technology is widely used to capture cultural artifacts, such as works of art and historic building to preserve cultural heritage.
		2
2010	5	Software for real-time inter-language translation of 10 major languages at 95% accuracy is in widespread use.
	10	Artificial intelligence systems for adaptive learning are in practical use.
	16	50% of the working population are engaged in teleworking.

Table 5 Chronology of Future TLC Events (Cont'd)

Year of Occurrence	Topic Number	Topics
2010	23	30% of university degrees are replaced by competency-based assessment.
	36	Subsidized programs for developing computer literacy for elderly retirees are widely available.
	45	International Communication and Technologies systems to enable the aged and disabled to work more effectively are in widespread use.
	51	Improved understanding of cultural differences by the use of new technologies leads to a reduction of international conflicts.
	52	Improved understanding of cultural differences by the use of new technologies leads to a reduction of international conflicts.
2012	9	Electronic chip implants which allow inter-language translation are developed.
	21	50 % of school age population are being educated by home school using interactive learning technology.
2015	48	Chinese characters appear on 50 percent of www pages.
2017	15	Emergence of robots capable of acting as opponents to humans in sports and activities.

### 5.3.4 Forecast Time by Member Economies

Due to the low number of participants, it is not possible to obtain significant results for individual member economies. Instead, we grouped the participating economies into two groups; industrialized and industrializing ones. Group A includes Australia; Canada; Hong Kong China; Japan; Korea; Singapore; and Chinese Taipei. Group B includes Indonesia; Malaysia; Philippines; and Thailand.<sup>2</sup> Then, we obtained, by each group, estimates of the forecast time for the APEC region and own group.

Approximately speaking, the results say that Group A expected most topics to be realized earlier than the average APEC economies; and that Group B later than the average APEC economies. The average years of realization estimated by Group A and B for all topics were 2009 and 2007 for the APEC region; and 2006 and 2008 for their own group, respectively. This shows that each group has a different view on the course of development of TLC in the APEC region on average. The experts

<sup>2</sup> Some economies were dropped out because no responses were made in the second round.

of Group A have a view that their economies on average are moving ahead in “technology for learning and culture” by about 3 years than an average economy in the region, while those of Group B have a view that their economies on average are falling behind by about 2 years. Such difference of the views is shown more clearly when examining individual topics. It implies that experts from industrializing economies are more optimistic in comparison that those from industrialized economies are in the course of development of “technology for learning and culture.” That is, experts of Group B estimate that they are closer to the average APEC economy than those of Group A do. The experts of Group A consider that they are moving ahead of average APEC economies by about 2 years, and those of Group B that they are falling behind of them by about 1 year. In view of estimates of forecast year, thus, the gap between two groups would be about 3 years on average at most.

**Table 6 Forecast Time by Groups**

Topic Number	Topics	Group A		Group B	
		APEC	Own Group	APEC	Own Group
1	Portable devices (walking belts, etc) incorporating the function of multimedia entertaining (Multimedia player, Compact Disk / Video Compact Disk player), mobile phone, radio & television are in widespread use.	2006	2003	2003	2003
2	Information and communications technologies are accessible by 90% of the population.	2010	2004	2009	2010
3	Chargeable batteries, which are three times as powerful as current state-of-the-art, are in practical use.	2006	2004	2006	2007
4	Computer Input / Output devices which have user friendly interface are in widespread use.	2005	2004	2005	2006
5	Software for real-time inter-language translation of 10 major languages at 95% accuracy is in widespread use.	2010	2009	2010	2015
6	Knowledge management systems on the Internet are in widespread use.	2006	2004	2005	2005
7	Desktop videoconferencing enabling linking of participants in different places is in widespread use.	2008	2005	2007	2006
8	Input devices such as speech recognition and voice command are in widespread use.	2007	2004	2007	2010
9	Electronic chip implants which allow inter-language translation are developed.	2014	2010	2010	2013
10	Artificial intelligence systems for adaptive learning are in practical use.	2010	2008	2009	2010
11	Global wireless networks to allow global communications at a thousand times current speeds are in widespread use.	2009	2005	2008	2009

Table 6 Forecast Time by Groups (Cont'd)

Topic Number	Topics	Group A		Group B	
		APEC	Own Group	APEC	Own Group
12	Widespread adoption of personal computers, for use in training and producing materials for the blind.	2007	2005	2008	2008
13	Cheap computers for education and interactive learning are in widespread use.	2005	2002	2005	2005
14	Online publishing is in widespread use.	2005	2002	2005	2005
15	Emergence of robots capable of acting as opponents to humans in sports and activities.	2019	2014	2015	2018
16	50% of the working population are engaged in teleworking.	2014	2009	2010	2013
17	An APEC Council for Validation and Accreditation of Digital Education Content is created.	2010	2020	2007	2010
18	Common international protocols and standards for technology for learning and culture are developed.	2010	2006	2007	2008
19	Best practices in Information Technology-based learning and teaching are identified on a continuing basis by national and international bodies.	2007	2004	2005	2006
20	90% of the students in all grades have access to computer-aided learning environments.	2008	2003	2008	2010
21	50 % of school age population are being educated by home school using interactive learning technology.	2013	2010	2012	2015
22	International taxonomy for educational content storage and retrieval is established.	2009	2008	2008	2010
23	30% of university degrees are replaced by competency-based assessment.	2011	2010	2010	2010
24	Funding limitations in universities lead to widespread separation of the researcher function from the teacher / facilitator function.	2010	2005	2007	2008
25	All teachers in schools are trained in Information Technology-enabled teaching and learning.	2008	2003	2007	2009
26	Parents have a significant input to school curricula.	2010	2005	2005	2005
27	A network of digital libraries and museums is in place.	2009	2005	2007	2009
28	A network of centers for multimedia research is in place.	2008	2004	2008	2010
29	Information Technology literacy is integrated throughout the curricula of schools.	2005	2002	2005	2005
30	A web-site to implement telelearning with an expertise database is developed.	2008	2004	2006	2006
31	Virtual worlds in which people can educate themselves about different cultures are available through multimedia centers.	2010	2007	2008	2010

Table 6 Forecast Time by Groups (Cont'd)

Topic Number	Topics	Group A		Group B	
		APEC	Own Group	APEC	Own Group
32	Intellectual property rights for learning contents and software are waived for research repositories for learning and culture.	2009	2008	2007	2006
33	A Public Info-bank for information literacy is established.	2008	2007	2008	2007
34	Digital and interactive science museums capable of fostering scientific skills of children through play are in widespread use.	2010	2006	2008	2009
35	Some on-line teachers become "superstars," demanding higher salaries for their courses and working on contracts from remote locations for multiple institutions.	34/33	2008	2008	2009
36	Subsidized programs for developing computer literacy for elderly retirees are widely available.	2010	2006	2010	2009
37	Subsidized programs for developing computer literacy for rural people are widely available.	2010	2005	2009	2010
38	An international agreement for rating educational and cultural content on the Internet (as for films) is established.	2009	2008	2008	2007
39	Community access to school Information and Communication Technologies learning resources is freely available.	2009	2004	2008	2008
40	Use of the Internet by primary and secondary school students is widespread.	2005	2001	2006	2007
41	International cyber-laws to cover digital signature, electronic evidence, electronic transaction and documents, computer crimes are developed.	2007	2004	2007	2007
42	Telecommunication charges for access to identified sites for resources for learning in schools and universities are 25% of normal rates.	2009	2005	2007	2007
43	Policies to prevent transmission of objectionable material by electronic means are enforced.	2007	2005	2007	2007
44	Websites designed to assist people to reskill themselves are freely available.	2009	2004	2005	2006
45	International Communication and Technologies systems to enable the aged and disabled to work more effectively are in widespread use.	2010	2007	2010	2009
46	New professions such as cyber-counselors and community knowledge managers are recognized by employers, both private and public.	2010	2007	2008	2010
47	All school administrators have qualifications in the management of technology in education.	2010	2007	2008	2009

**Table 6 Forecast Time by Groups (Cont'd)**

Topic Number	Topics	Group A		Group B	
		APEC	Own Group	APEC	Own Group
48	Chinese characters appear on 50 percent of www pages.	2015	2010	2010	2020
49	Multimedia technology is widely used to capture cultural artifacts, such as works of art and historic building to preserve cultural heritage.	2010	2005	2008	2009
50	Preserved cultural heritage is freely available through networked resource centers.	2010	2008	2008	2010
51	Improved understanding of cultural differences by the use of new technologies leads to a reduction of international conflicts.	2010	2010	2010	2010
52	Improved understanding of cultural differences by the use of new technologies leads to a reduction of international conflicts.	2010	2006	2010	2008

### 5.3.5 Needs for APEC -Wide Cooperation

To assess the need for APEC-wide cooperation, we included this survey parameter. The high priority for APEC-wide cooperation goes with the topics regarding international standardization, safety across the economies, pooling the learning resources, reducing international conflicts and others. Such are inevitable because more conflicts are foreseeable when the nets connect globally and people with different interests and backgrounds meet frequently in the cyber space. Therefore, the international efforts in those issues should be made as fast in view of the speed of adopting information technologies in learning and culture.

**Table 7 Priority of Needs for APEC-wide Cooperation**

Topic Number	Topics	% of High
18	Common international protocols and standards for technology for learning and culture are developed.	67.9
41	International cyber-laws to cover digital signature, electronic evidence, electronic transaction and documents, computer crimes are developed.	61.4
27	A network of digital libraries and museums is in place.	58.6
6	Knowledge management systems on the Internet are in widespread use.	57.9
19	Best practices in Information Technology-based learning and teaching are identified on a continuing basis by national and international bodies.	57.4
51	Improved understanding of cultural differences by the use of new technologies leads to a reduction of international conflicts.	56.4



Table 7 Priority of Needs for APEC-wide Cooperation (Cont'd)

Topic Number	Topics	% of High
32	Intellectual property rights for learning contents and software are waived for research repositories for learning and culture.	55.4
43	Policies to prevent transmission of objectionable material by electronic means are enforced.	54.5
30	A web-site to implement telelearning with an expertise database is developed.	54.2
11	Global wireless networks to allow global communications at a thousand times current speeds are in widespread use.	53.6
5	Software for real-time inter-language translation of 10 major languages at 95% accuracy is in widespread use.	52.6
38	An international agreement for rating educational and cultural content on the Internet (as for films) is established.	51.8
17	An APEC Council for Validation and Accreditation of Digital Education Content is created.	50.9
22	International taxonomy for educational content storage and retrieval is established.	50.9
13	Cheap computers for education and interactive learning are in widespread use.	48.3

### 5.3.6 Constraints for Realization

To identify major impediments, we included social, economic, political and cultural factors. Multiple choices were allowed for this parameter. For the entire list of topics, the average percentage of responses for each constraint is 26.6% for social factors, 58.8% for economic factors, 24.1% for political factors, and 24.0% for cultural factors. Thus, it could be said that major impediment in technological progress for learning and culture could be economic factors. In particular, internet use by (#40) and computer-aided learning environment (#20) for students are regarded as highly important.

**Table 8 Topics Influenced by Social Factors in Descending Order**

Topic Number	Topics	% of Social Factors
26	Parents have a significant input to school curricula.	49.6
23	30% of university degrees are replaced by competency-based assessment.	46.5
21	50 % of school age population are being educated by home school using interactive learning technology.	45.9
46	New professions such as cyber-counselors and community knowledge managers are recognized by employers, both private and public.	42.3
35	Some on-line teachers become “superstars,” demanding higher salaries for their courses and working on contracts from remote locations for multiple institutions.	41.9
16	50% of the working population are engaged in teleworking.	40.6
36	Subsidized programs for developing computer literacy for elderly retirees are widely available.	38.6
51	Improved understanding of cultural differences by the use of new technologies leads to a reduction of international conflicts.	36.3
15	Emergence of robots capable of acting as opponents to humans in sports and activities.	36.0
37	Subsidized programs for developing computer literacy for rural people are widely available.	36.0

Such connectivity is recognized as essential, but the economic condition would have a crucial influence, in many member economies. In addition, if technological development in the area of learning and culture would determine economic competitiveness in future, the economy could fall into a vicious circle with lagging technological development in this TLC area.

**Table 9 Topics Influenced by Economic Factors in Descending Order**

Topic Number	Topics	% of Economic Factors
11	Global wireless networks to allow global communications at a thousand times current speeds are in widespread use.	85.7
40	Use of the Internet by primary and secondary school students is widespread.	82.7
27	A network of digital libraries and museums is in place.	82.7
20	90% of the students in all grades have access to computer-aided learning environments.	82.6
28	A network of centers for multimedia research is in place.	81.3

**Table 9 Topics Influenced by Economic Factors in Descending Order (Cont'd)**

Topic Number	Topics	% of Economic Factors
2	Information and communications technologies are accessible by 90% of the population.	80.6
4	Computer Input / Output devices which have user friendly interface are in widespread use.	77.2
13	Cheap computers for education and interactive learning are in widespread use.	76.9
1	Portable devices (walking belts, etc) incorporating the function of multimedia entertaining (Multimedia player, Compact Disk / Video Compact Disk player), mobile phone, radio & television are in widespread use.	76.6
42	Telecommunication charges for access to identified sites for resources for learning in schools and universities are 25% of normal rates.	75.6

**Table 10 Topics Influenced by Cultural Factors in Descending Order**

Topic Number	Topics	% of Cultural Factors
26	Parents have a significant input to school curricula.	49.6
48	Chinese characters appear on 50 percent of www pages.	44.0
51	Improved understanding of cultural differences by the use of new technologies leads to a reduction of international conflicts.	42.7
50	Preserved cultural heritage is freely available through networked resource centers.	40.5
5	Software for real-time inter-language translation of 10 major languages at 95% accuracy is in widespread use.	38.5
38	An international agreement for rating educational and cultural content on the Internet (as for films) is established.	37.6
35	Some on-line teachers become "superstars," demanding higher salaries for their courses and working on contracts from remote locations for multiple institutions.	36.4
16	50% of the working population are engaged in teleworking.	35.9
31	Virtual worlds in which people can educate themselves about different cultures are available through multimedia centers.	33.9
49	Multimedia technology is widely used to capture cultural artifacts, such as works of art and historic building to preserve cultural heritage.	33.3

**Table 11 Topics Influenced by Political Factors in Descending Order**

Topic Number	Topics	% of Cultural Factors
43	Policies to prevent transmission of objectionable material by electronic means are enforced.	61.5
41	International cyber-laws to cover digital signature, electronic evidence, electronic transaction and documents, computer crimes are developed.	60.0
51	Improved understanding of cultural differences by the use of new technologies leads to a reduction of international conflicts.	51.6
38	An international agreement for rating educational and cultural content on the Internet (as for films) is established.	48.0
17	An APEC Council for Validation and Accreditation of Digital Education Content is created.	47.5
32	Intellectual property rights for learning contents and software are waived for research repositories for learning and culture.	46.0
18	Common international protocols and standards for technology for learning and culture are developed.	45.2
23	30% of university degrees are replaced by competency-based assessment.	35.4
22	International taxonomy for educational content storage and retrieval is established.	34.1
24	Funding limitations in universities lead to widespread separation of the researcher function from the teacher / facilitator function.	33.1

## 5.4. Summary

Delphi is an effective method by which we can carry out technology foresight on a large number of events at a one time. However, it is costly and time-consuming. The fundamental requirement is to have enough experts in the Delphi panel. The management of the panel—recruiting experts and keeping them throughout the survey—is no easy matter, particularly in international collaboration. However, the Center was able to get in the first round more than 100 experts from member economies. The response rate in the second round was less than 50 percent, with the majority of responses coming from the East Asian economies. A similar pattern occurred in the Delphi survey on Water Supply and Management suggesting that many East Asian economies pay greater attention to Foresight activities possibly because of its perceived importance in their strategic planning. The Delphi technique may also have greater acceptance in such cultures.

This exercise shows that Delphi is an effective method to identify relevant issues when combined with scenario development. Most topics identified in this exercise turned out to be important to some degree for the APEC region. Further,

most topics are expected to be realized by the year of 2010, implying that a major achievement in technology for learning and culture could be made by that time. This could be an important signal particularly to industrializing economies. Since connectivity and uses of IT in learning and culture are recognized as highly important, industrializing economies have to make greater efforts to catch up with industrialized economies. Otherwise, the technological gap will be widened and its consequence might be crucial for the domestic economy. Major constraints for the development of technology for learning and culture are linked to economic factors, particularly in industrializing economies.

In the regional context, major concerns are identified in international standardization, safety across the economies, pooling the learning resources, reducing international conflicts and others. Such issues are easily foreseeable as IT becomes more widespread. Therefore, international cooperation is urgently called for to cope with these issues.

Finally, due to the low number of experts in the survey, we are not able to obtain a significant result for individual economies. Instead, we grouped the participants into two groups; Group A from industrializing and Group B from industrialized economies. Group A includes Australia; Canada; Hong Kong China; Japan; Korea; Singapore; and Chinese Taipei. Group B includes Indonesia; Malaysia; Philippines; and Thailand. Then, we obtained the estimates of forecast time for APEC region and each group separately. The experts of Group B seem to consider that they are closer to the average APEC economies than those of Group A do. In view of estimates of forecast year, the gap between two groups would be about 3 years on average at most.

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## Concluding Remarks

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### 6.1 Challenges of Multi-Economy Foresight

The first study by the APEC Center for Technology Foresight on “Water Supply and Management in the APEC Region’ brought out some of the difficulties in operating an effective multi-economy foresight study. As stated here:

‘The relatively simple issue of engaging a range of national experts and stakeholders in a project whose genesis lies entirely outside their own structures and systems, and of conducting a challenging exercise in a single language presents many practical obstacles.’

In the present study the scenarios workshop was very successful with excellent interaction among participants and a strong commitment to outcomes. The computer literacy of the overall group was high and it was possible to rapidly diffuse results among the four working groups and to come to a consensus. The details of the Workshop were set out in a Report of the Workshop produced within a short time and placed on the APEC Center website for wider diffusion.

The Workshop produced a draft set of Delphi questions and these were subsequently refined by interaction with experts and stakeholder. However, as in the Water Supply and Management Delphi, there was considerable difficulty in ensuring that the Delphi statements were ambiguous, clear and understandable by respondents whose first language is not English. The feedback from respondents

highlighted a number of difficulties which may have contributed to the low response rate. This was higher than Water Supply and Management but still lower than most national Delphi studies which have averaged over 30 per cent.

## 6.2 The Scientific and Technological Base for Addressing the Future of Technology for Learning and Culture

A number of technological issues were raised during the study as playing an important role in addressing the future of technology for learning and culture in the APEC region. The technologies that were identified at the Experts' Workshop were:

- Wireless community using satellite technology
- Data storage for digital libraries and museums
- Virus-immune software
- Language translation and teaching systems
- New concept, more user-friendly computers

They were reinforced by the needs identified in the Delphi survey as :

- Cheaper computers for education and interactive learning
- Computer input/ output devices with user-friendly interface
- Global wireless networks operating at 1000x current speeds.

Given the massive R&D efforts in the ICT industry there is no doubt that these needs will be met in the next decade.

An area which was mentioned but not explored in the study is cognitive science which is exploding with new findings about the plasticity of the brain and how learning takes place at different ages. Computer firms are trying to capitalize on this research but there is yet no evidence for increased learning based on cognitive science. Nevertheless this is an area that needs to be closely followed by experts in APEC economies.

## Appendix 1

.....  
**List of Participants in the Expert's Meeting**

3-6 May 1999, Vancouver  
.....

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**APPENDIX 2**

.....

**Program for Experts' Meeting**

Innovation Centre, National Research Council Canada

Vancouver, Canada 3-6 May 1999

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**Organizers:**

- APEC Center for Technology Foresight
- National Science and Technology Development Agency, Thailand
- National Research Council Canada
- APEC Industrial Science and Technology Working Group

**Program:**

Saturday 1 May 1999	Arrival of APEC TF Center staff to Vancouver
Sunday 2 May 1999	Arrival of experts in Vancouver
16.00-18.00h	Meeting of IAB of APEC Center for Technology Foresight
20.00-22.00h	Reception at the Coast Plaza Suite Hotel Shoreline Horizon Rooms, 35th floor
Monday 3 May 1999	
9.00h	Welcoming Speech Dr Arthur J Carty President, National Research Council, Canada
9.10h	Introduction to Project and Roles of Participants Professor Greg Tegart Director, APEC Center for Technology Foresight And Dr Chatri Sripaipan Co-Director, APEC Center for Technology Foresight
9.30h	Presentations of Experts on Technology for Learning and Culture in their Economies Chaired by Professor Greg Tegart
11.00h	Break
11.30h	Continuation of Presentations Chaired by Dr Chatri Sripaipan
13.00h	Lunch and Break
14.30h	Presentation of Issues Paper Mr Jacques Lyrette Vice-President, Technology and Industry Support National Research Council, Canada
14.45h	Discussion of Issues Paper Chaired by Ms Lucille Pacey President, Non-Profit Society Art Starts in Schools, Canada
15.45h	Break
16.15h	Discussion
17.00h	Close

**Tuesday 4 May 1999**

- 9.00h Introduction to Foresight  
Greg Tegart
- 9.30h Some Model Scenarios  
Professor Ron Johnston  
Executive Director, Australian Centre for Innovation  
And International Competitiveness, Australia
- 10.00h Identification of Uncertainties  
Facilitated by Professor Ron Johnston
- 11.00h Break
- 11.30h Techniques for Scenario Development  
Professor Ron Johnston
- 12.45h Lunch and Break
- 14.30h Scenario Logics  
Ron Johnston
- 14.45h Developments of Scenarios (small groups)  
Facilitated by Ron Johnston and Lucille Pacey
- 17.15h Group Reports
- 18.00h Close

**Wednesday 5 May 1999**

- 9.00h Site Visits to the TeleLearning Centre and the Electronic Arts  
Arranged by the National Research Council
- 12.00h Lunch at the Electronic Arts
- 14.00h Refinement of Scenarios (small groups)  
Facilitated by Ron Johnston and Lucille Pacey
- 15.30h Break
- 16.00h Presentation and Discussion  
Facilitated by Professor Ron Johnston
- 18.00h Close
- 19.30h Dinner Banquet in the Barclay/Gilford Banquet Room,  
The Coast Plaza Suite Hotel

**Thursday 6 May 1999**

- 9.00h Delphi Study Presentation  
Dr Taeyoung Shin  
Head, S&T Indicator and Analyses  
Science and Technology Policy Institute (STEP), Korea
- 9.30h Delphi Study Presentation  
Mr Terutaka Kuwahara  
Director, Fourth Policy-oriented Research Group  
National Institute of Science and Technology Policy (NISTEP), Japan
- 10.00h Break
- 10.30h Development of Topics for Delphi Survey  
Facilitated by Dr Taeyoung Shin
- 12.45h Lunch and Break
- 14.30h Further Developments of Topics for Delphi Survey
- 16.30h Summary and Conclusions  
Ms Lucille Pacey
- 16.45h Future Plan  
Professor Greg Tegart
- 17.00h Close
- 19.00-21.30h Dinner and Wrap-Up Meeting of the NRC and the APEC TF  
Center Staff on the Outcomes of the Experts' Meeting and next  
moves of the research activity

**Friday 7 May 1999**

- Site Visits

**APPENDIX 3**

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**Delphi First Round Comments**  
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Topic #	Comments
<p>General About the Issues</p>	<p>Thought provoking survey A number of interrelationship need to be emphasized regarding infrastructure development, eg electricity supply is essential step implicit in all technology discussions</p>
	<p>As a whole, the main constraints in the realization of the topics is basically economic factors. In the Philippines, the gap between the rich and the poor is becoming wider and access to IT (Information Technology) may widen further this gap. Items that deal on IT to the aged and retirees seem not to apply in the Philippines when retirement age is 65 for government employees. For cultural orientation the aged do not entertain anymore these stuffs.</p>
	<p>Barriers are: - Time; education needs time (the sooner, the better) - Resources; this all takes money</p>
	<p>Many topics have something to do with the training (or education) through computers (or via network). The pre-requirement is that one has to be capable of using computers. Conventionally, the cost of this kind of training is sky-high. Nevertheless, we have found that the best way to quickly and efficiently learn computer knowledge is to have one learn a programming language (recommend the simplest Basic language). If one has known one programming language, then it will dramatically cut down the time needed to learn other computer skills.</p>
	<p>Programming language training would be the first step for these topics.</p>
	<p>You have asked when Chinese will occupy 50% of the web, but what about how the technology will make English more widespread</p>
	<p>There is lack of human resource capability on topics 1-17 more particularly in the field of education and the problem is acute on the public, school systems.</p>
	<p>These are not much of a problem to the business sector.</p>
	<p>Science education is experimental and the emphasis that is put on virtual interaction may be misplaced.</p>
	<p>Telecommunications technology will be no more help in practice with disabled, cultural exchange, violence reduction than present conditions.</p>



(Cont'd)

Topic #	Comments
General About the Issues	<p>What will new technologies mean to our sense of greed versus self-restraint? Assumes that most new technologies cannot be effectively “policed”. Good technologies could be in bad hands - what are APEC options for resolving abuse by violent government without punishing individuals who have no say in their government?</p>
	<p>I believe that increased interaction between people of different cultures through new technologies will not lead to a reduction of international conflicts, because cultural differences will be misunderstood and lead to suspicion, mistrust and entrenchment. This is most unfortunate</p>
	<p>The Asian region practices top-down, centrally-managed educational systems; a lot of the policies are top-down driven. Thus, with respect to the topics listed that need policy intervention in order to be realized: Government think-tank agencies can play a role to recommend policy intervention on these topics. They are never likely to be realized by following natural forces of market demand</p>
	1 Creation of video based content difficult
	3 Somewhat undesirable, too micro Batteries in which context?
	4 Not clear about the level of friendliness 'Input/Output' in what terms? -vague.
	5 How many languages do people in APEC member speak? Answer: 19 official languages but many more actually spoken within APEC.
	8 Speech recognition should be given priority especially for teaching and learning purposes, research and writing. This will make it much more efficient for transfer messages between humans and machines. Using the keyboard or mouse can be quite restrictive in group learning mode, especially where we have more than 2 students to a group. Thus I feel more research should be carried out in this area.
	9 Too futuristic
	10 Artificial intelligence for adaptive learning is very important in achieving the pedagogical ideals in the teaching-learning process. The most well-thought out instructional design practices, still need a non-human support that is powerful, especially when teaching in a class of 30-35 mixed ability students Look at R&D setups in universities in US and Japan
	11 Thousand times current speed should be specified in quantitative units (eg. More than 1 Giga BPS)
	12 Could also add physically and mentally disabled
	13 I still believe in what Bill Gates said - 'a computer on every desk' (pardon me if I am not too precise). Portable Computer for teachers and students with seamless access to the internet is what we need, cheap, strong, powerful, durable. How would you define cheap?

(Cont'd)

Topic #	Comments
15	A misconception in the development of robotics Too new for us; again, look at US & Japan (eg mechatronics)
16	High competency for using advanced technologies is required in all working places.
19	This Topic is very important to realize because it can afford to improve not only knowledge but also skill of the students and teachers. If perhaps this topic can be implemented immediately it would create innovation particularly information technology
20	Inter-Communication skills and cooperational skills under the IT/cyber environment are considered as major goals of future education
21	“home school” (home schooling) might activate different meanings for different people. Technology will not replace human interaction Education in isolation from a variety of social contact is highly undesirable. Community schools are preferable.
23	Competency-based assignment has to narrow a scope to encompass the outcome of learning described by a degree Vocational education of all types will increase; university degrees may lose currency and status, inflating the level of qualification for many professions but I see no basis for supposing that degrees per se will be replaced by other forms of education. However, credit banks will certainly be developed and knowledge and skill acquired in many different ways will be counted towards university degrees.
24	Does this relate to technology? Not a good question, because funding situation of universities in different countries could be very different While predicted by a number of writers, I see widespread separation of these roles as undesirable, because knowledge-discovery and knowledge-building are parts of a continuum which should be applied in the real world. Unnecessary: teaching VS research will continue to be a persistent conflict in higher education
25	Teachers in system now will be in the system for about the next 40 years.
27	We should probably work hard towards this.
28	What is “multimedia research”? It is a vague term. It had better be defined. We should probably work hard towards this.
31	What is a “multimedia center”?
34	“Skills” ability = knowledge + skill + attitude I have included the Powerhouse Museum in this group.
38	Content is too cultural-biased to have verified international views

(Cont'd)

Topic #	Comments
40	Students need to access the internet at least 2-3 hours for extra curriculum activities. It will lead to student-centered learning and will enhance IT throughout the formal and non-formal educational program.
41	This topic includes two overlapping items
42	Telecommunication charges are less and less significant, especially with dedicated high speed networks. Control of the telecommunication networks by multi-national companies makes this desirable situation highly unlikely Market pressures will prevent such a high differential.
43	Our communications Minister tried - his efforts showed that only partial prevention is possible
48	Why is it necessary to uniquely mention the Chinese character? I think it is a little bit unfair to other languages. Layout of Probability question made it difficult to know if you intended this to relate to all of APEC or just my country. I have answered as if it was my country. But why not Indian characters? What a strange question. Undesirable: it should be continuously thought out on this item: are we for regionalism? It would be more logical to have APEC economies to address bilinguality in their local WWW sites with their own mother tongue as the main lingua franca on the web plus the international language as alternatives, eg. Indonesia - Bahasa Indonesia and English; Malaysia - Bahasa Malay and English; Hong Kong - Mandarin and English, etc, rather than just as Chinese characters
50	Is a networked resource centre a building, or a web address?
51	I'm not sure if improved understanding of cultural differences would lead to reduction of international conflicts. Because as we have seen majority of international conflicts are out of political or economic reasons Power and money perhaps more important than culture Major actions to realize cultural understanding: - increased face to face contact - increased travel/living across borders especially for next generation (1-2 year student visas for all) - increasing use of behavioral tools to interpret behavior in cultural context - greater spread of Christian peace & understanding and acceptance of others - major shift in USA from "foreigner phobia" to cultural interest and literacy - never underestimate the power of player "Kofi Annan" - greater sharing of science & technology research - alternative methods of conflict resolution to replace war - exposure of international arms dealing and managed reduction

(Cont'd)

Topic #

Comments

May the university be kept updated on the issues and developments being undertaken by your sectors. We could participate more actively if we have information on those developments

2 words for constraints "Local" & "APEC" would have been better. It is difficult to distinguish cultural from social constraints since a society is "governed" by its culture.

As you can see I have only answered with respect to my own economy. I do not feel I know other economies well enough to comment and thus I would only be speculating. Also you will see that I am quite low in my estimates of "widespread" availability as in Canada- we have a wide distance in availability between urban and rural groups and low and high socio-economic groups. My definition of widespread includes all these groups not just urban or higher economic groups.

The questionnaire is not so clear, it can easily mislead the reader.

More importantly, the coherence of the questionnaire in one category is not proper. Adjectives/modifiers such as "wide spread" "accessible", "user-friendly" "95 %" "cheap, are subjective and relative. Optimists and technology hype will continue to suggest goals have been achieved when the "evidence" meets only a minimalist or liberal interpretation of the target objectives. Most of the topics are too cryptically worded to be meaningful.

Social factors, economic factors, cultural factors, political factors and other factors should be defined.

Literacy - information literacy, computer literacy etc should be defined.

Degree of expertise-instructions missing ; self-rating is hard to compare consistently. Qualifications, objective area of expertise, discipline etc vary.

This survey is pecked with some superficial stereotypes-as in training for rural and elderly who are adopting this technology at exactly the same pace as urban and young people. So to make this type of survey more effective and look to the future, please review existing surveys

There are a number of topics which are similar and can be used to cross-check the validity of answers.

Technology & Demography major areas where constraints omitted.

The year of realization in APEC should come after realization in your economy (more logical)

APPENDIX 4

Summary of the APEC Delphi:  
Technology for Learning and Culture

A. 1 Illustrations

Area	Topic Number	Topics	Round #	# of Responses	Degree of Expertise (%)				Degree of Importance (%)			
					High	Medium	Low	None	High	Medium	Low	Not necessary
			1		%	%	%	%	%	%	%	%
			2		%	%	%	%	%	%	%	%
			EX						%	%	%	%

Constraints to Realization					Need for APEC-wide Cooperation			
Social factors	Economic factors	Cultural factors	Political factors	Others	High	Medium	Low	Not Necessary
%	%	%	%	%				
					%	%	%	%
%	%	%	%	%	%	%	%	%

1. "EX" Represents the experts with "high" degree of expertise.
2. "Constraints to Realization" was included only in the first round; and multiple choice was allowed.
3. "Need for APEC-wide Cooperation" was included only in the second round.
4. "Year of Realization" is represented by the following figures;