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Information Highways and Social Change

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The International Development Research Centre
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Foreword

Once again, the world is at a turning point. Profound economic, political, and social changes are sweeping the globe, changes to which national governments are often hard-pressed to respond effectively. All of us are aware, however, that these changes are somehow connected with the revolution in information and communication technologies (ICTs) that is continuously and rapidly recreating itself.

A very real and pressing issue in this era is defining and subsequently developing a path toward a "productive information society." The "definition" aspect of this is both crucial and urgent, as we are being forced to rethink many of the traditional concepts of employment, governance, education, and the role of individuals in society.

Deciding on the form and content of the emerging national and global information infrastructures has become an intense and highly politicized occupation, often needlessly pitting private against public interests. In calmer moments, most people would agree, however, that neither side should eventually claim victory, that a balance is required.

The work of Canada's International Development Research Centre (IDRC) in the information field -- involving capacity building, development of networks, national policy support, and research and development -- gives it a solid base for supporting and initiating leading-edge policy research through its global networks and partnerships. IDRC is well-positioned to play a catalytic role in a field that is gaining greater recognition in the developing world and that is attracting the attention of other development donors and agencies on a daily basis.

To consolidate and extend IDRC's expertise in this field, it has developed a program initiative in information policy research (IPR). This initiative is intended to place information and ICT policy research firmly on the international research and political agendas and to ensure strong developing-country participation in setting and carrying out these agendas. The initiative will identify and study the public policy implications of ICTs, especially those that relate to education, employment, and governance. It will also promote the integration of ICTs into new social policy approaches and thus should

improve the effectiveness of information technology investments in developing countries.

To assist it in focusing the research agenda of its IPR initiative, IDRC is using a variety of approaches, including commissioning background papers such as "Information Highways and Social Change" which is the subject of this publication. In this paper, Christopher Freeman, a well-known international expert and professor at the Science Policy Research Unit (SPRU), University of Sussex, England, examines the social reformations required to capture the full benefits of the emerging "information highways" and the role for public policy in guiding these adjustments.

Freeman's central argument is that we shall not be able to realize the full economic and technical benefits of information and ICTs unless the necessary social and institutional changes are made. Freeman uses the word "change" to imply not only economic "structural adjustment", but also active social restructuring and passive, technologically-determined development. In any event, the aspired outcome is full "employment" (which we might consider to be individual involvement in a productive society) -- the basis for a healthy social fabric.

The need for sound public policy, Freeman argues, asserts itself in light of the "unforseeability" of the social consequences of adopting new techno-economic systems and the lack of sufficient information to make accurate choices among alternative possibilities. Complicating matters, the very definitions of these alternatives are malleable. They are determined by the interplay of social, political, and institutional actors that are each vying for their own interests -- interests that may not necessarily realize the goal of full employment.

Freeman does not attempt to define the exact roles for the public and private sectors in shaping the emerging global networks. However, it is clear that he believes that some form of public control is required.

These ideas merge in Freeman's discussion of the education reforms required to capture the "informating"[1] potential of ICTs and to prepare people for the increasingly

[1] Shoshana Zuboff coined this term in In the Age of the Smart Machine to describe the potential of information and communication technologies (ICTs) to inform and empower people.

technical and information-literate employment positions in our economies. Although the potential for multimedia software and distance learning is exciting, Freeman cautions us against the uncritical acceptance of technically-imposed changes which can lead to such statements as "schools are no longer useful." Freeman is convinced that social institutions are lagging in terms of using information systems to their full potential, but he clearly believes that certain qualities of "traditional" pedagogy (and other institutions) are worth preserving. Public policy, he concludes, must play an active role in developing new course material in cooperation with industry.

Freeman's discussion of education and training prepares his argument that only a knowledgeable and skilled population can extract the best from a techno-economic paradigm which has caused much structural disruption over the last 25 years. Outlining the negative social consequences of mass unemployment, Freeman echoes other writers, such as Robert Reich, who fear an ever-widening gulf forming between a class of "symbolic analysts"[2] and an underclass of people excluded from the rewards and opportunities of the information society. Education and life-long learning are consequently seen as social levellers, bringing more people into the "information fold."

Freeman's paper is one piece of the large puzzle that IDRC's initiative on information policy research will examine. For ICT policy research to be effective, it must also consider socio-cultural, legal, economic, and technological issues, as well as the relationships among these. IDRC looks forward to contributing to this important and exciting field and welcomes your comments, participation, and interest.

Robert Valantin
Chief Scientist, Information
IDRC

[2] See in particular pp. 301-303 of Robert Reich's The Work of Nations: Preparing Ourselves for 21st-Century Capitalism, 1992.

INFORMATION HIGHWAYS AND SOCIAL CHANGE

Introduction

"Characteristics of the New Infrastructure"

The expression "Information Highway" or "Super-Highway" is in itself revealing of the way in which human societies assimilate entirely new technological systems. What is now coming into existence throughout the world is of course entirely different from motor highways or railways, but the metaphor is nevertheless useful as it does serve to emphasize one fundamental characteristic of the new system: that it provides a basic infrastructure for the economy and for society. The descriptor "Information" also serves to distinguish this new infrastructure from the old voice telephony telecommunication infrastructure.

Moreover, all major infrastructural systems do have certain features in common even though they have their own unique technological characteristics. All of them facilitate the performance of a vast range of other industrial and service activities; they also lead to the emergence of entirely new industries and services. Consequently, they are associated with deep structural changes in the economic system, whether they are energy, transport or communication infrastructures.

Data traffic is already growing about six times as fast as voice traffic and as the telephone network is changed into a tele-computer network it is utterly transformed. It is not the purpose of this paper to describe the technical characteristics of this new infrastructure. That has been done ad nauseam elsewhere. However, it is essential to recognise that the technical innovations in micro-electronics, in opto-electronics and in computer technology have together brought about an orders-of-magnitude improvement in the speed with which vast quantities of information can be stored, processed and transmitted and a similar reduction in costs per bit of information. It is very rare in the history of technology to achieve such a powerful combination of new technical and economic characteristics. As the American consultant George Gilder (1994) puts it:

> "Propelling the new order is the most powerful juggernaut in the history of technology: an impending millionfold rise in the cost-effectiveness of computers and their networks." (page 92)

It is for this reason that the expression "change of techno-economic paradigm" (Perez, 1983) is increasingly used to describe the pervasive set of changes which we are now experiencing. However, as Carlota Perez (1983, 1990), who coined this expression, has always pointed out, a change of techno-economic paradigm cannot take place without widespread social and institutional changes affecting especially education, training, the labour market, management structures and the new infrastructure. Our present institutions are often still geared to the older technologies and infrastructures and it takes a long time for societies to adapt to such a major technical change. However, until we do make the necessary social and institutional changes, (partly learning as always from trial and error and from international experience), we shall not be able to realise the full economic and technical benefits of information and communication technology (ICT). The social changes which are associated with the rise of new technologies are often relatively neglected and this paper therefore concentrates on social and institutional change.

This does not mean that the social changes are entirely determined by the spread of the new technology ("technological determinism"). The technological and economic changes are themselves social processes and there is a continuous inter-action between the economy, society and technology. Nevertheless, it is frequently the case that some of the most important social changes are extremely difficult to foresee and even those that are recognised are often ignored in decision-making.

Recent examples of this are the effects of the automobile and of motor highways on city centres and suburbs, on patterns of shopping, on crime and perhaps most of all on air pollution and environmentalism. When the young Eisenhower, later to become President of the United States, took part in demonstrations soon after the First World War, to urge the construction of new motor highways, he could hardly have envisaged all these future changes. Even less could he have imagined that sixty or seventy years later, young people in Europe, Japan or North America would be demonstrating against the construction of new motorways and airports.

Of course, it is impossible to foresee the future precisely, whether in technology, economic affairs, social affairs or politics. It is possible only to envisage various alternative possibilities and to take action which we hope will either promote those which seem desirable and profitable, or prevent those which seem dangerous, unwelcome or damaging. This decision-making process takes place at all levels in society, sometimes on the basis of very little information or hardly any at all. Obviously in the case of major infrastructural investments with all their manifold consequences it is desirable that the debate and the decision-making should be rather well-informed. This means that despite all the limitations which necessarily attend any decisions stretching far into the future, technical, economic and social factors should all be taken into account.

This does not mean that decisions about the future shape and functions of information highways should all be taken exclusively at the level of central national governments or at inter-governmental level. Indeed, there are many who would argue that the best thing that governments can do is to keep out of the decision-making. A characteristically sharp article in "The Economist" magazine of February 25th 1995 entitled "Let the Digital Age Bloom", argued that

> "Apart from imposing a few familiar safeguards, the cleverest thing that governments can do about all these changes is to stand back and let them happen." (page 16)

However, later in the same article under the sub-heading "The case for watering and a little weeding", "The Economist" concedes that "governments cannot ignore cyberspace altogether". Even stimulating competition in the private sector is by no means straightforward. It is not the purpose of this paper to argue the case for or against a diminished or enhanced role for the public or private sectors. That is a matter of continuing political debate in every country and circumstances differ widely. But there are some functions, which as "The Economist" concedes, governments inevitably have to perform, at least for the foreseeable future, even if they wish to disengage as much as possible.

Historically, governments have always played an important role in relation to the creation and regulation of new infrastructures, even if this role was sometimes largely permissive and enabling legislation. The role of the US Department of Defence in

promoting INTERNET was crucial. Very often the new infrastructures were developed through a combination of public and private investment and regulation, although the scale of public involvement varied greatly between countries, over time and with differing technologies. For motorways and other roads, it was usually very high, for electricity less so. For the information highways a good case can certainly be made for a much greater role for a competitive private sector than was historically the case with the old voice telecommunication infrastructure and this has been the trend in most OECD countries. But even allowing for the continuation or indeed acceleration of this trend, a major role for public policy remains, both in relation to economic problems such as pricing and terms of access and other major social issues.

Vice President Al Gore (1995) has especially emphasised the crucial role of government in supporting research in his contribution to the special issue of "The Scientific American". However, he also stressed the role of government in investment:

> "Typically, software development follows hardware development and policy lags behind both. Yet it is policy that can determine whether we reap the benefits of this new technology. In too many cases we have mastered the technology but failed to muster the political commitment and the appropriate policies.
>
> Federal policies can make a difference in several key areas of the computer revolution. The US Advanced Research Projects Agency (ARPA), NASA, the NSF and the Department of Energy have all spent millions of dollars developing the next generation of super-computers. It is safe to say that without federal seed money, Cray Research and other American firms would not now dominate the world market for supercomputers ..... Most important, we need a commitment to build the high-speed data highways. Their absence constitutes the largest single barrier to realising the potential of the information age."

Some of the most desirable characteristics of the new ICT infrastructure have been tersely summarised in the computer journal Byte:

> "To meet the needs of society, the data highway has to be ubiquitous, affordable, easy to use, secure, multi-purpose, information-rich and open. If it is to be economically viable, service providers have to be able to bill customers for the time they spend on the network or the data they use." (March 1994, p. 48)

This sounds deceptively simple, but each one of the seven adjectives or expressions used to describe the desirable characteristics of the new highways conceals a multitude of technical and social problems.

At the technical level the highways should ideally use all the communication technologies already in use including satellites, micro-wave and fibre optics as well as co-axial, cable, copper and wireless to connect users to the highways.

> "Data servers will be super-computers, mainframes, mini-computers, micro-computers and massively parallel machines, while a great diversity of clients will populate the end-points of the network: conventional PCs, palm tops and PDAs, smart phones, set-top boxes and TVs. Software used in the network will include operating systems, networking protocols and services, user interfaces, data bases, data sources (or content) and a new generation of smart middleware ....." (page 48)

As with earlier infrastructures, some of the most important technical innovations have been and will be inter-face and inter-connecting innovations (such as "Middleware"). These are essential to make the network "ubiquitous, affordable, easy to use, open and multi-purpose". No less important are the social and institutional changes which are needed to achieve these objectives, the "by-ways" and the "ramps" may often be as important as the highways. The information which flows along this network can serve many different purposes and public policies will inevitably influence both access to the system and content of the traffic.

Everybody agrees that the Highways will carry a huge amount of "entertainment traffic" and "Business Week" speaks of "The Entertainment Economy". The role of the Highways in relation to education and training could be even more important.

Long before the advent of the "Information Highways" and even before the widespread diffusion of electronic computers, economists and sociologists had begun to talk about the "Information Economy" and the "Information Society". They did so not because of electronics but because of the change in employment from "blue-collar" jobs to "white-collar" jobs. In the main industrial countries the number of people handling "information" of one kind or another surpassed the number of people making and handling goods soon after the Second World War. This presupposes of course a very broad definition of "information" and in his pioneering book on "The Production and

Distribution of Knowledge", the American economist Machlup (1962) included the entertainment industry, financial services, estate agents, and bookmakers as well as teachers, scientists, publishers and secretaries under the heading of "information workers". The growth of information services and especially of office work was of course one of the main factors driving the production and diffusion of the typewriter, the copying machine, the telephone, the tabulating machine and eventually the computer itself.

The development of the new techno-economic paradigm means that education and training become more important than ever. There is now very little disagreement about this. A century ago, the great British economist Alfred Marshall designated "knowledge" as the "chief engine" of economic growth and the World Bank Report (1991) has described how in the so-called "New Growth Theory" formal neo-classical growth models now give pride of place to "intangible investment" in education, training, research and development as compared with physical investment in bricks, mortar and machines, which predominated in the "old" growth models.

At this point it is essential to make a distinction between "information" and "knowledge". The importance of education and training lies precisely in the capacity to process, analyse and transform information into useful knowledge. We are all increasingly familiar with the problems of "Information Overload", which were foreseen by scientists such as Derek Price (1961) and JD Bernal (1939) as well as by poets such as TS Eliot.

"Where is the life we have lost in
living?
Where is the wisdom we have lost in
knowledge?
Where is the knowledge we have lost in
information?"

T.S. Eliot
Chorus from "The Rock"

An information society without knowledge would be chaotic and unmanageable, a babel of sound and fury. For this reason, economists now talk more about the "knowledge economy" and rather less about the "information economy" as for example in the recent OECD Conference (1994). This does not in any way lessen the importance of the Information Highway or of information itself, but it does point to the crucial importance of connecting the Information Highway to all centres of education and training, as well as of course, to businesses and households.

This paper is concerned with the key social issues in the development and use of information highways but it is not possible in a short paper to cover all the social problems or even to discuss a large number. The paper therefore concentrates on two of the most fundamental issues which have already been introduced and in which public policies play a vital role. These are:

(i) Education and training

(ii) Future patterns of employment and skill requirements

However, the discussion of these two issues inevitably raises a third major topic - equity and universality in the provision of services - which is briefly taken up in the conclusions.

II
Education and Training

Universities were among the earliest and heaviest users of Internet and already have a massive investment in tele-computers. Nevertheless they still have a very long way to go in using ICT to improve their own teaching methods and curriculum design. However, it is not so much the universities as the schools which should be the main focus of attention in developing policies for education and the information highways. The new infrastructure offers the possibility of a transformation in the school system and in home learning comparable to the diffusion of printing technology at the close of the Middle Ages.

The printing press made information and knowledge available to millions of people who hitherto had no opportunity to acquire it, but it took several centuries before the social changes were made to achieve nearly universal literacy, through compulsory primary and secondary education, public libraries, newspapers and so forth. Once again today, social change lags behind the potential of the new technologies and our education system is still generally wedded to teaching techniques which were established in Mediaeval times or soon after. Yet the need for a highly educated work-force is universally recognised and the short-comings of semi-literacy and innumeracy are increasingly obvious to industry as technologies become more complex and communication skills become ever more essential. On social and economic grounds, as well as for cultural reasons, education has become the key to progress in our societies (see for example, Wiggenhorn (1990) on the experience of Motorola in training and education).

Moreover, the Information Highways now make it possible for the first time to realise the true goals of education for the entire population. Learning, rather than teaching is the important part of education, as the word itself implies. People who learn to acquire knowledge and information for themselves are truly educated and can be creative. Teachers will still be essential in the education systems of the future but their role will increasingly be that of guides and counsellors helping pupils to learn for themselves. As the Director of Research at British Telecom has put it, the "Sage on the Stage" will be partly replaced by the "Guide at your Side".

The Chairman of Alphameric plc, Alan Benjamin, gave an exciting vision of the future of education in his address to the Royal Society of Arts in January 1994. It is well worth quoting at some length:

> "Journey with me to a time when there is a powerful computer - a work station - on the desk of every learner and of every teacher and trainer. These work stations are connected to a network which enables them to reach any source of information, anywhere and at any time. They are also portable and can be used wherever there is a network connection, for example a telephone or a suitable radio signal.
>
> Those work stations are provided to learners at no initial cost. Each learner will have a unique identity and will pay for the capability only as the work station is used. In this context we can see similarities with other utilities such as electricity, gas and water..... This approach removes at a stroke, the capital barrier which has prevented 85 per cent of the population from using and benefitting from the new technologies.
>
> Now imagine that every learner can, at his or her own choice of time and place, access a world of multi-media material which is stored electronically and locally. Immediately the learner is unlocked from the shackles of fixed and rigid schedules, from physical limitations and most importantly, is released into an information world which reacts to his or her own pace of learning. A window to knowledge is open.
>
> Now at last the learner can revisit a solution not completely understood, view again how a problem was solved, call a colleague for a discussion, request advice from a teacher (to whom I want to refer from now on as an educator), or reach for help from a library. This is as true for the engineer who is reskilling and the adult who is retraining, as it is for the child learning at primary school.
>
> Individualised learning supported by educators and trainers who are a key stroke away, represents a transformation from the way in which our education and training are currently delivered and organised. It will create an opportunity for the individual to "do education" rather than have it done to them; it will reform and strengthen the relationship with the educator and give more emphasis to coaching, counselling and participation. It will transform teaching into learning." (page 49)

Many, of course, will be sceptical of Alan Benjamin's vision of the future of education, including both teachers and parents. They may dismiss his vision as Utopian, both unrealisable and undesirable, and they may often cling to an image of education in which strict teachers stand in front of a class of 30 or 40 pupils for 45-minute periods imparting basic "facts" and "theories", which the pupils must then

reproduce in written or oral form, sometimes with the aid of a battered textbook. This image is extremely powerful because it corresponds still to most adults' experience, but before dismissing Benjamin's alternative vision the sceptics should reflect on the experience of computer games. Many of them must have watched with admiration and amazement as their children and grandchildren learned with extraordinary speed to excel in these games, which they themselves could rarely tackle so fast or so well. Not only do many children concentrate for hours on end on games, but they will go on day after day. Yet the very same children will often say "School is boring" or "Homework is boring". Here surely is a tremendous challenge to the entire education profession all over the world. Learning should be exciting and interesting, not boring, and often it should be fun.

> "Tell me and I forget
> Teach me and I remember
> Involve me and I learn."
>
> Benjamin Franklin

Some ICT enthusiasts are so impressed by the versatility and potential of ICT that they imagine that the regular educational institutions can be partly, or even completely by-passed. Even some educationists are so depressed by conditions in schools and what are seen as the contemporary failures of the system that they also flirt with the idea of "de-schooling" to a greater or lesser extent.

It is true that there is a greatly increased potential for people of all ages (certainly not only children) to learn all kinds of things at home and it is certainly desirable to exploit this potential in a variety of ways. However, the idea of displacing the formal education system is not the best solution. Schools are needed more than ever for the following reasons.

(1) Although children can indeed show great concentration and determination in playing computer games and some can learn a lot at home, there are also subjects and activities which can less easily be learnt at home or not at all. Most children benefit from interacting with other children and learn from each

other, as well as from media and from teachers. Most also need some personal help, care and guidance in their studies.

(2) Schools are extremely important for socialization and communication. One of the major needs of the future work-place is communication skills; these are needed not only in work but also in social and political life. It is difficult, if not impossible to acquire these in isolation or purely through ICT. Schools have a major role in social cohesion and in national culture.

(3) The home environment for many children does not facilitate home learning on any kind of regular or systematic basis. One consequence of de-schooling would be to divide the population into information-rich households and information-poor households. It would generally further handicap the children of less wealthy parents, who are already disadvantaged educationally in various ways. One of the major advantages of the school system is universality, providing children from all kinds of households with opportunities to learn. There would almost certainly be a massive decline in educational standards of a large number of children if de-schooling was pushed a long way.

(4) In addition to the social and educational reasons for improving rather than by-passing the formal eduction system, there are also strong economic reasons. Much equipment which cannot conceivably be provided to every single household can be provided at reasonable cost in educational institutions. There are many indivisibilities in education as in industry and commerce and education can no more be a purely individualistic activity than production. "Video-on-demand" (VOD) is the goal of some of the big consortia which are being formed to deliver information services and entertainment to households via Cable TV networks or satellite but even if they succeed, as they probably will, this will not be a cheap service, so that there will still be big economic advantages in providing education services through the education system.

(5) Finally, schools do not only have an educational and a socialization function, they also have what some people call a "custodial" function. Even if a larger number of parents work at home, they do need time to work relatively free of interruptions. Children also need time to learn free of interruptions from

parents, brothers, sisters, friends etc. Indeed, a very strong argument can be made that so far from children spending less time at school, they should spend more.

Many schools already have a wide range of activities including "self-supported studies" and "industry-supported studies" in what are technically after-school hours. They are often the focus of computer-based activities too. The extension of these activities together with increased provision of nursery school education would greatly improve the possibilities for women, as well as men to work more flexible hours. They would also provide new opportunities for adult education, as already indicated in the case of the Motorola experiment (Wiggenhorn, 1990).

Thus, there is a strong argument in favour of an enhanced role for the public education system in disseminating and using ICT-based media of all kinds and in access to the Information Highways. It is essential for public education policy to play an active role in developing new course material in cooperation with industry; to develop new modules for new courses in every discipline and combination of disciplines, and to keep them up-to-date is an enormous educational undertaking. It requires the active participation of the teaching profession at all levels as well as research.

There is also a vital role for education policy in regulating the quality of what is disseminated over the computer network. This is especially well brought out by Kay (1995) in his contribution on "Computers, Networks and Education".

The objection is often raised: the schools and the teachers are too conservative or even that they are "Luddites". It is indeed true that the teaching profession or parts of it have not been specially receptive to new technologies. But just as in the case of industry and commerce, where there is also often resistance to the introduction of ICT, it is essential to understand the reasons for this suspicion or hostility. It is also essential to study the experience of successful institutional and technical change to understand why it often fails, whether in the class-room, the board-room, the factory, or the bank.

The commonest cause of failure in innovation is failure to involve the users of a new process or product in its design, development and application. Numerous case studies

over the past thirty years support this generalisation. There is no reason to suppose that education is any different in this respect. Lack of user-friendliness was the biggest problem with computer software and computer-based innovations generally for a long time. Not surprisingly then early efforts failed as did similar early efforts with robotics and office computers. Most of the teachers knew little or nothing about ICT which did not help matters either.

Now the situation has changed dramatically. Not only the teachers but the children are the users of ICT in education. The children are now often happy with computers. In many countries public policies have helped to achieve widespread availability of PCs in schools. Much of the software is easy to use and computer games are so popular that they have familiarised a new generation with inter-active learning. Many more of the teachers are now also computer-literate.

However, every new ICT product has to be developed with care and attention to user needs. User-friendliness is an absolutely essential ingredient. The computer companies learnt this the hard way as the market expanded from the first patient and mathematically inclined professional scientists to the wider market in industry and government. Now the lesson has often to be re-learnt with every new educational software package which is produced.

Consequently, a policy for developing the content for ICT in education should be based on the following principles:

(i) Multi-media teams to develop a CD ROM, CD-I, VR (virtual reality) or other IT-based product for education or even for edu-tainment should include not only software professionals but also educational professionals.

(ii) The education system should stimulate and assist the formation of multi-media teams and V teams in both the private and the public sector, partly through the secondment of teachers, partly through the use of educational activities for trial development.

(iii) Education policy should aim to provide all teachers with sabbaticals during which they should be attached to public agencies or the numerous private

publishers and other firms which are already designing and developing the thousands of new titles which are needed. They would join a multi-media team or V team working in their own subject area.[3]

(iv) Constant up-dating of ICT products is necessary and it is especially important to achieve flexible adaptation to local needs. This again points to the need to involve schools and teachers.

An especially important aspect of adaptation to local needs is the world-wide diffusion of education and training materials. This should not be conceived of simply as a top-down process in which the strongest companies and countries simply sell their own products and services to the less developed economies. The need for appropriate technologies geared to the special circumstances of the poorer countries has long been recognised in development economics and nowhere is this more relevant than in the context of education and training materials. The involvement of local educators in the design and development of these software packages is essential. The cultural factors affecting education and training are so important that they have major effects on the learning process. This consideration is important not only in relation to the Third World but also in relation to ethnic minorities within OECD countries and more obviously between these countries themselves and within such countries as Russia.

This does not of course mean that there should be no export market or a very restricted market for education (or entertainment) products and services. There obviously is already an enormous world-wide market for both hardware and software and it will continue to grow extremely rapidly. In many cases a world-wide standard product or service best satisfies the market but considerations of political sensitivity, as well as cultural variety imperatively require careful reflection and negotiation, including special measures to support local design and development efforts in certain areas. This could be an important factor in future "Aid" policies for the less developed countries.

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[3] A strong team might comprise: (1) A multi-media project coordinator (a job title not yet in the occupational classification but which may well become commonplace in the next century) (2) A computer software professional. (3) A teacher on sabbatical leave. (4) An artist or film or TV script writer or designer or other professional with similar experience. (5) A good humanities generalist. (6) A researcher in the relevant field with strong communication skills. They would typically work for 6-12 months as a team and would of course interact with relevant pupils, play-groups, students or whatever.

"If I have one message it is the importance of content.... The problem is not at all new for us. We live next door to the US and over the years have developed a balanced system, one which allows an open market but reserves a certain amount of space for Canadian products."

Michel Dupuy, Canadian Minister of Culture
as reported in the "Financial Times" of February 25th, 1995

This topic is so important for the future of education and training, as well as for the regulation of traffic on the information highways and for the worldwide service industries, that it merits far more serious study than it has so far received. It cannot simply be reduced to the status of paragraphs or chapters in GATT (or WTO) arguments, although of course, these are extremely important in the future regime of international regulation. One possible arrangement for financing the huge scale of knowledge transfer and other forms of aid to poor countries as well as local design and development was proposed by President Mitterand at the UNDP World Summit for Social Development in Copenhagen (March 1995) and this too merits careful research and study.[4]

[4] Mr. Mitterand was referring to the possibility of taxing short-term financial interactions in order to generate investment funds for developing countries committed to the conventions of the ILO. (Speech at the Opening of the World Summit for Social Development, Copenhagen, March 11, 1995)

III
Employment and Skills

The ways in which new infrastructures and other structural changes in the economy affect patterns of employment have already been touched upon in Section I. Economists have written a great deal about technical and structural change and how they affect employment and unemployment (see for example, OECD, 1994; ILO, 1995; Freeman and Soete, 1994; Boyer, 1993; Schettkat, 1990). It is not the intention to repeat this discussion of the economics of technical change and employment, but simply to point out that the disagreement is not so great as it often may appear. Almost all economists actually agree that the adjustment of employment to technical change is by no means an instantaneous or automatic process. Furthermore, all of them recognise that there are periods when the problems of structural adjustment and structural unemployment are particularly acute. They differ in their assessment of the speed and smoothness of the adjustment and the relative importance of the various adjustment and compensation mechanisms. At one extreme is the endogenous, self-adjusting market clearing model based on Say's Law, though as Keynes put it, neo-classicals mostly recognise that the adjustment takes place with many "creaks and groans". At the other extreme are political economy theories, such as those of Perez or Boyer, which hold that adjustment is achieved only through social and political changes to accommodate the characteristics of radically new technologies. The theories, however, are not quite so incompatible as they appear at first sight. Many neo-classical theorists would certainly accept the importance of institutional and technical change and some like Olson (1982) have themselves developed a theory of institutional rigidities. Furthermore, everyone would accept that regional disparities and the complications of trade and international competition may aggravate structural problems. We should endeavour to learn something from the experience of previous structural crises. In particular, we should endeavour to understand the long swings in unemployment which all industrialised countries have experienced during this century. These fluctuations cannot be explained in terms of conventional business cycle analysis but need to take into account additional dimensions of analysis: the rise of new technologies, the rise and decline of industries, major new infra-structural investments, changes in the international location of industries and technological leadership. It was

primarily Schumpeter, Kondratieff and other long wave theorists who introduced these topics into the debate.

Previous structural changes also required many new skills and led to the decline of old ones. This was particularly true of course with the rise of factory production (the so-called "Industrial Revolution") which gave rise to acute social problems. The changes in work organisation, in management systems and in skills may be even greater as a result of the tele-computer revolution. The scope for tele-commuting is but one instance of this. To some degree it is already reversing the shift from home (or farm) to factory and office, although "hot-desking" (shared use of office space on a part-time basis) is a more probable outcome than 100 per cent home working. Even half-time tele-commuting could help a great deal to solve the acute problems of urban traffic congestion and the associated pollution.

Sociologists like Daniel Bell (1974) already spoke twenty years ago of the coming of a "post-industrial society", even before computers became cheap and ubiquitous, whilst the rise of clerical and other "information" handling occupations has been going on far longer. What ICT and the new infrastructure have done is to provide a vastly superior technical basis for this "Information Society" and hence to ease and accelerate this transition. This historical perspective also explains why it is that the major service industries, such as financial services and entertainment are the area of the heaviest investment in computers and telecommunications, rather than manufacturing.

However, the applications of computers in machine tools, robotics, process control instruments and guided vehicles as well as in linking design with production and marketing, mean that ICT also facilitates the secular trend of long-term decline in the proportion of the work-force which is engaged in manufacturing. This does not mean that in some imaginary "post-industrial" society there will no longer be a manufacturing sector of the economy. We already live in a "post-agricultural" society in the sense that less than 5 per cent of the total labour force can now produce the needs of the richest countries, whereas two centuries ago (and still today in many less developed economies) this required over 50 per cent of the labour force. Manufacturing, like agriculture will continue to be an essential activity in the future information society, but it will not be such a major source of employment.

This has very big implications for our economies. It means that most new "jobs" (or self-employment) will have to be in the service sector and very many of them will be in information services delivered over information highways or mediated by them. This is a huge structural change and it is no wonder that the painful process which is usually called "structural adjustment" has dragged on through the last quarter of this century. Personal services, together with information services of one kind or another are now the fastest growing areas of new employment.

Table 1 illustrates this trend for the United States from the projections made by the Department of Labour. The trend is similar elsewhere but Germany and Japan continue to employ a higher proportion of the workforce in manufacturing. The competitive advantage of Asian countries in manufacturing means that changes in the international division of labour will also tend to promote the long-term shifts in the pattern of employment in the OECD countries.

These major structural shifts mean that the need for education, training and re-training becomes ever greater. Whilst very many less skilled employees will still find employment in such areas as distribution, catering and personal services, in these areas too, information technology will find numerous applications. Consequently, the demand for software skills will continue to increase at a high rate despite the advances in software engineering. Whereas the maintenance of buildings and machines requires the preservation of their existing capacity, software maintenance means constant re-design and development to match both organisational change and technical change. All of these considerations greatly reinforce the conclusions of Section II with respect to education and training.

As is constantly re-iterated, they also point to the need for a flexible labour force. Periods of part-time or even full-time education, training and re-training may be needed, not just for teenagers, but at any time during a person's working life. Moreover, part-time working and flexible working hours are likely to become far more common. The trend to part-time employment is already strong throughout the OECD area. Insofar as this is a voluntary trend, it is very welcome. Not only mothers, but also fathers may often wish to combine part-time work with child-care. However, as Figure 1 clearly indicates in the case of Canada, involuntary part-time work has also been increasing.

Table 1 Outlook: 1990-2005: Occupational Employment Forecasts for the United States
Occupations with the largest job growth, 1990-2005, moderate alternative projection (Numbers in thousands)

Occupation	Employment		Change	
	1990	2005	Numerical	Per cent
Salespersons, retail	3,619	4,506	887	24.5
Registered nurses	1,727	2,494	767	44.4
Cashiers	2,633	3,318	685	26.0
General Office Clerks	2,737	3,407	670	24.5
Truckdrivers, light & heavy	2,362	2,979	617	26.1
General managers and top executives	3,086	3,684	598	19.4
Janitors and cleaners, including maids and housekeeping cleaners	3,007	3,562	555	18.5
Nursing aides, orderlies and attendants	1,274	1,826	552	43.4
Food counter, fountain and related workers	1,607	2,158	550	34.2
Waiters and waitresses	1,747	2,196	449	25.7
Teachers, secondary school	1,280	1,717	437	34.2
Receptionists and information clerks	900	1,322	422	46.9
Systems analysts and computer scientists	463	829	368	78.9
Food preparation workers	1,156	1,521	365	31.6
Child care workers	725	1,078	353	48.8
Gardners and groundkeepers, except farm	874	1,222	348	39.8
Accounts and auditors	985	1,325	340	34.5
Computer programmers	565	882	317	56.1
Teachers, elementary	1,362	1,675	313	23.0
Guards	883	1,181	298	33.7
Teacher aides and educational assistants	808	1,086	278	34.4
Licensed practical nurses	644	913	269	41.9
Clerical supervisors and managers	1,218	1,481	263	21.6
Home health aides	287	550	263	91.7
Cooks, restaurant	615	872	257	41.8
Maintenance repairers, general utility	1,128	1,379	251	22.2
Secretaries, except legal and medical	3,064	3,312	248	8.1
Cooks, short order and fast food	743	989	246	33.0
Stock clerks, sales floor	1,242	1,451	209	16.8

and is evidence of the generally slack labour market even with the upturn in the economy.

In the midst of our "structural adjustment" and thirst for "flexibility," there is considerable danger that the social consequences of large-scale unemployment and of involuntary part-time employment may be neglected. Economists have always recognised the waste of resources associated with high unemployment but in the 1970s and 1980s there was a tendency to give a higher priority to other goals of economic policy, especially reduction of inflationary pressures and international trade competitiveness. Whereas in the 1950s and 1960s full employment was emphasised as one of the principal objectives of most governments, relatively high levels of unemployment were increasingly tolerated as a necessary evil or even as a supposedly necessary spur to greater efforts, or wage restraint.

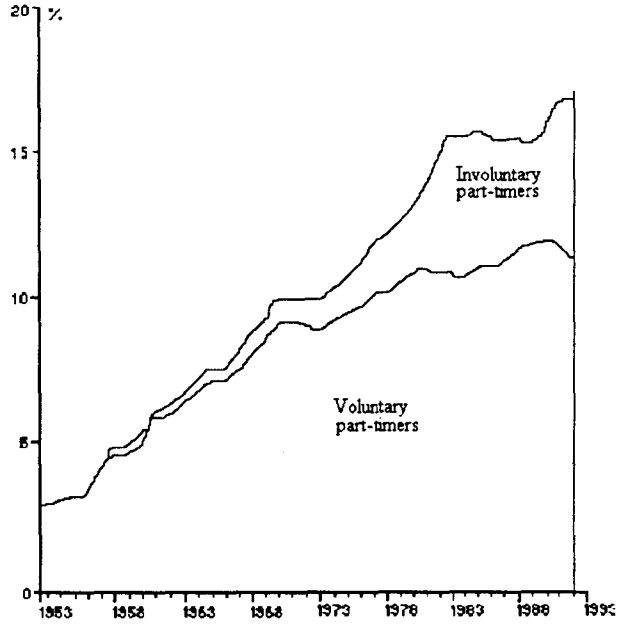

Figure 1. Part-time workers as percentage of all employed, Canada. 1953-1993. (Statistics Canada, reproduced in Kettle, 1994).

Full employment is not simply some do-good, woolly-minded, idealistic goal. It is an aspiration which is firmly grounded both in economics and other social sciences. For social psychologists the evidence is clear-cut: the vast majority of human beings need the opportunity for active participation in the work of society as much for non-economic as for economic reasons. The hidden costs of high unemployment are much greater than the more easily measurable economic costs. The economic advantages of high levels of employment and work-force participation are obvious and accepted by all schools of economists, even though they may differ to some degree on how far employment objectives can be reconciled with other policy objectives.

Large-scale unemployment is the main source of the growing social inequality in OECD countries.

As the example of Germany in the 1930s suggests, social, political and economic aspects of unemployment are indeed difficult to disentangle. When unemployment rises all kinds of social tensions increase because of the psychological effects on the unemployed workers and their families. Marie Jahoda (1933) was one of the first social psychologists to observe and measure these psychological effects in an industrial area of Austria which suffered from extremely high levels of unemployment already in the 1930s (Marienthal). Her book is a classic and was translated and reprinted in several European countries in the 1970s and 1980s.

More recently, she has found that despite the availability of a much better social security net in Europe than that which was available in the 1920s and 1930s, the adverse psychological effects of unemployment are nevertheless essentially similar today. The deprivation of poverty is severe, albeit that the absolute deprivation of the 1930s was worse than the deprivation of the 1980s. Nevertheless, the psychological consequences of unemployment give rise to social tensions and hidden costs which are no less severe. Most of these hidden costs cannot be expressed in monetary terms, but they affect in their consequences the entire society.

Mass unemployment is an unmitigated social disaster. It leads to loss of output of goods and services: it slows down the rate of new investment and economic growth; it inflicts enormous damage on social morale as well as on the numerous individuals affected; it inflicts social costs which cannot be measured as well as those which can be measured and contribute so greatly to the huge public sector deficits in many countries; finally, it generates moods of rejection, apathy, despair and irrational aggressiveness, which are a fertile soil for authoritarianism, crime, ethnic conflicts and the erosion of democratic institutions.

Just as unemployment alone cannot be blamed for the rise in crime and drug-taking, so too it cannot be regarded as the sole cause of ethnic conflicts and the rise of fascist-type movements. But one would have to be blind indeed not to observe the connections between unemployment and these phenomena, whether in the 1930s or the 1980s and 1990s. The prevention of persistent mass unemployment is consequently

not just a matter of increasing the output from the economic system. It is a question of the survival of civilised society.

IV
Conclusion

Policies for education and for full employment are highly interdependent. Full employment depends on successful structural adjustment and these in turn depend on education and training policies which take full advantage of the potential of the Information Highways. In designing policies for the Information infra-structure they deserve a high priority and much policy-oriented research. Both education and employment policies are vital also for realising the goals set out at the recent UNDP World Summit for Social Development (Copenhagen, March 1995). Both within the OECD countries, and between the OECD area and other countries, inequality has been increasing in the last decade. Large-scale unemployment and lack of access to modem education and training have greatly aggravated the problems of poverty and increased social tensions. Consequently, attention to these topics in designing and developing the world-wide network of information highways, could also contribute greatly to a third social objective - the alleviation of world-wide poverty.

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