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Advanced Information and Communications Technologies: Challenges and Opportunities

by Wolfgang Michalski, Paris*

The progressive diffusion of information and communication technologies will bring about far-reaching changes in society. How can the opportunities offered by the new technologies be maximised, while minimising the attendant risks?

In at least one important respect, information and communications technologies have much in common with other major innovations in the history of mankind: they are set to change dramatically the social and economic fabric of our societies. They are already having far-reaching repercussions on methods of production, employment patterns and the structures of industry; on the conduct of financial transactions; on the lifestyles of whole communities and entire nations – their patterns of behaviour and social contact, their cultural values and their language. With the further advance and sophistication of information technologies, these changes will continue unabated.

But let it be clear from the outset: information technologies, like all major technical advances, are an integral part of the social and economic systems of industrialised and industrialising nations. This interaction is dynamic and very complicated: just as technological change affects our economic, political and social structures so is technological change itself dependent on the resources our economies produce, on the functioning of the political machinery, and most importantly on the capacity of our social and cultural systems both to generate and to absorb new ideas.

It follows from this that the term “information and communications technologies” is used here in its

broader sense, to cover all technologies used in the collection, processing and transmission of information. It includes micro-electronic and opto-electronic based technologies incorporated in many products, production processes and increasingly used in services. It covers, inter alia, computers, electronic office equipment, telecommunications, industrial robots and computer controlled machines, electronic components and software products.

It is the intention of this paper to offer a broad review of the implications of information and communications technologies for society, the economy and international relations. It is a far from exhaustive review. The field is too vast and diverse, and much too complex, to attempt such a feat. Rather, attention will be focused on a selection of areas in which information and communications technologies are likely to make a profound impact both within and between countries. The paper will endeavour to sketch out in each area the opportunities offered by those new technologies, but also to identify some of the risks that they carry.

Implications for Society

There is an interesting double edge to information and communications technology: while it contributes significantly to the increasing complexities of modern society, it also provides the means for managing those same complexities. Nowhere is this more abundantly evident than in industry, commerce and new service activities, where the marriage of computers with telecommunications is creating a fundamentally new

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basis for business transactions. Similarly complex, interlocking information and communications networks exist in government administrations and quasi-government organisations. Medicine and national defence systems are further examples of sophisticated applications of information technologies.

But as our capability to manage these complexities increases, so does our dependence on the technologies we use. Awareness of this vulnerability gives rise to concern for our safety – the safety of society as an organisation; and our safety as individuals. In the event of a technical or functional breakdown of these systems, or of their politically or economically motivated abuse, the ensuing disruptions might cause grave harm to whole groups of society, business and industries, and possibly to the economy and society of a region, or an entire nation.

As individuals, there is concern for the security of information about our private lives. In the early stages of the computerisation of society, the corporate sector, in particular banking, insurance and private health, was believed to be the biggest threat to privacy. That role is now associated more with the state. As a consequence of their wide-ranging activities in tax collection, health care, education and social assistance, public authorities now collect, process and store more personal data than anybody else. When thousands of terminals are connected to centralised data bases, the term “secrecy” assumes a very different dimension. In a modern, computerised welfare society, there can be no such thing as absolute privacy or data security.

Nonetheless, experience gained in many OECD countries has shown that privacy protection laws can be a valuable instrument for striking a balance between the information needs of bureaucracies and the rights of citizens to unsurveilled political and personal development. However, despite the important work done by the OECD and the Council of Europe, it is becoming increasingly clear that continuing technological developments and concomitant changes in both the sources of danger and the means of controlling them may necessitate new responses and strategies to safeguard individual liberties and check the vulnerability of society.

This is not to say that data protection and freedom of information are necessarily conflicting notions; rather they are integral parts of a single comprehensive concept. Within reason, unhindered distribution of data and access to information gathered by industry and administrations is a constituent element of democratic society. Of course, the implementation of equal

opportunity to distribute and access data is not constrained only by institutional and legal factors. There are other barriers. For instance: the availability of hardware and software; excessive information costs; uneven balance of power between and among individuals, organisations and bureaucracies; and differences in computer literacy and skills in handling information technologies generally.

The problems of technical vulnerability, privacy, access to and distribution of data apart, the progressive diffusion of information technologies looks fairly certain to bring about far-reaching changes in individual and collective social behaviour and in fundamental social and cultural value patterns. By its very nature, this area is completely open to speculation; and the challenges to policy-makers have still to emerge more clearly. Nevertheless, reflection is called for. Our societies must not be caught completely unawares when such profound changes begin to unfold.

The impact of information technologies on human contact is one such case in point. Will they facilitate interpersonal communications for people in remote areas or for the handicapped? Will they intensify social interaction generally? The optimistic stance on this is that information technologies will lead to a sort of social revitalisation – high-tech resulting in a higher rate of human contact. The more pessimistic among us may believe that the new technologies could well transform many people's lifestyle into one of increasing social isolation and depersonalisation of human communication.

Clearly, the extent to which either the revitalisation or human isolation scenario occurs also depends on the wider social context. Part of this wider context is man's relation to reality. Increasing use of information technologies can create an artificial environment in which the real world is replaced by one of a binary logic of Yes/No and If/Then. Such artificial realities can become a kind of “substitute knowledge” which unduly restricts living experience as a yardstick for judgment, and leaves virtually no scope for the tolerance of ambiguity or acceptance of different points of view. Artificial worlds, though rational and self-contained as such, are devoid of meaning. They represent a threat to human creativity, limiting the ability to cope with problems encountered in work and other life situations; and inhibiting our capacity to accommodate the unexpected, explore new avenues, and reason along new lines.

The likely impacts on society that have been touched upon here form but the tip of an iceberg. There are

implications for language and other means of expression, for national and cultural identity, for possible shifts in morals and value patterns. The list is virtually infinite.

Implications for the Economy

There is a noticeable tendency in many circles to underestimate persistently the contribution of information technologies – and for that matter of technological change in general – to economic growth and welfare. At first glance this is surprising. Both theory and history should lead us to believe the contrary.

Theory tells us that, together with demand, technical progress is a major determinant of economic growth. It generally leads to increased demand for investment goods. And to the extent that it sharpens competition and raises profit margins, it enhances the economy's responsiveness to changing conditions through improved factor allocation. In areas where innovation is accompanied by positive income effects domestically and/or by improved competitiveness internationally, it creates further scope for economies of scale which may spill over into other activities. At the same time, demand for qualified labour rises, generating incentives for education and training.

History tells us that technological innovation has played a major role in the past in augmenting efficiency and welfare. Indeed, it would seem to be making an ever increasing contribution to total factor productivity. According to Kendrick, it accounted for about half of total factor productivity growth in the United States between 1948 and 1966; for about 70 per cent between 1966 and 1973; and for almost all the increment in total factor productivity between 1973 and the end of the decade. All major technical advances – and information and communications technologies clearly fall into this category – tend to raise the productivity of labour: it is estimated that technological change has raised the productivity of the workforce at an average rate of about 2 per cent per annum over the past century. However, a particular feature of information technologies is that, at the same time, they also tend to raise the productivity of capital.

Failure to anticipate the contribution of technology to economic growth is due in part to the uneven incidence of the impact of new technologies. First, there is the time-scale. Many of the adverse economic and social effects of technological innovation typically occur in the short term. They are often concentrated on a few groups or areas, and thus tend to be highly visible. The benefits of technological change, on the other hand, are of a

more long-term nature and tend to be more diffuse. Secondly, there is the geographical factor. Not all countries benefit from new technologies to the same extent or with the same rapidity, so that some countries may be perceived as lagging in terms of technological development. But dynamic reorganisation of the international division of labour leads to the gradual relocation of production activities towards the countries on the periphery of technological development, thus sustaining the momentum of global growth.

New technologies, and in particular information technologies, are proving to be a major driving force behind economic development and growth not only because the information technologies sector is in itself a highly dynamic and expanding field of activity which creates new markets and generates investment, income and new jobs; but because information technologies facilitate the adjustment of economic and industrial structures generally. This happens through a number of avenues: the impact of information technologies in established industries is in most cases a revitalising one, assisting sectors to respond more rapidly and more efficiently to shifts in demand patterns and changes in international comparative advantage through more efficient production processes and new or improved products. Information technologies open up greater opportunities for the exploitation of economies of scale and scope; they make for more flexible production and use of labour and equipment, and promote the internationalisation of production and markets. Information technologies make for greater mobility and flexibility in capital and financial flows and services, and are frequently the precondition for the creation of innovative financial instruments.

But it is becoming increasingly evident that the rapid changes taking place in financial markets, and the growing internationalisation of production and product markets are revealing supervisory structures to be inadequate, and competitive and regulatory frameworks to be insufficiently dynamic and flexible. Technological advances in these fields, while enhancing adjustment, are also producing outcomes which tend to weaken government control over the course of the economy. For example, the increasing international mobility of financial capital flows due to faster communication reduces the effectiveness of monetary policy.

Employment

The centre stage, however, in the debate surrounding the interaction between new technologies and structural adjustment is occupied by the employment question. Generally speaking, new technologies affect

employment in two ways: they influence the level of employment; and they influence the composition of skills and jobs.

Understandably, perhaps, public attention tends to focus on the negative implications of technological change on overall employment levels. Let it be said that here, too, an unmistakably pessimistic note can be detected – particularly in Europe. And yet past events provide us with abundant grounds for optimism. There is little convincing evidence that high unemployment has been due chiefly to the spread of robotics, automatisisation and other information technologies. In fact, the evidence could equally be interpreted as pointing in the opposite direction. A striking example is offered by the American experience of the last 15 years or so, a period strongly marked both by rapid technological progress and increasing job creation.

European studies show that over the long term employment gains tend to be concentrated in branches and companies which generate above-average increases in labour productivity. Conversely, job losses tend to be greatest in industries and companies which do not innovate.

The pessimistic bias in perceptions of longer term employment prospects may well have its roots in the fact that the employment-displacing effects of technological change are more readily visible and predictable than the job-creating effects. But what counts in the final analysis is whether the overall balance is positive or negative.

Changes in the aggregate level of employment are, of course, the outcome of developments taking place at the industry, company and workplace level. The introduction of information technologies is already bringing about far-reaching modifications in the content

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V E R L A G W E L T A R C H I V G M B H – H A M B U R G

and organisation of work. Job scope and skill are shifting towards diagnosis and problem-solving which emphasise the capacity for logical, analytical and abstract thought. There is increasing stress in many industries on multiplicity of skills, involving the integration in one single worker of several tasks previously assigned to a number of operatives. Traditional boundaries between scientists, engineers, technologists, technicians, craftsmen and managers are becoming increasingly blurred. And an increasing interdependence can be observed between jobs, functions, departments and plants.

What these developments in job requirements in fact reflect is a fundamental feature of new technologies: while they may eliminate jobs in one place, they create them in another. Many existing skills are set to become virtually obsolete (e.g. telephone operators, newspaper compositors) while others are already expanding dramatically (e.g. electronics engineers, business systems consultants). New skills will emerge (e.g. videotext page creators, data base designers and managers) while others "emigrate", e.g. through the transfer of assembly operations to newly industrialised countries.

Many of the skill requirement impacts of new technologies can be adequately met by existing policies and programmes. But the speed and pervasiveness of innovation and the sudden obsolescence of skills and entire occupations inevitably give rise to structural imbalances which are not easy to handle. Labour markets and social security systems are coming under considerable pressure, and the efficiency of education and training systems is already being severely tested.

Impact on International Relations

As new information technologies expand their uses and coverage, the world shrinks. Travel times become shorter, information flows faster and in more detail, and both personal and business contacts proliferate. The result is an unprecedented growth in interdependence which, for all its virtues, impinges dramatically on every country's economic, political and cultural autonomy. Not only have national economies become more susceptible to the impacts of policy decisions taken at the international level; there remains hardly a policy area in which governments can implement measures at the domestic level without their having some impact on domestic policy in other countries. The pace of technological change, particularly in the field of information and communications, will likely accelerate this process. The chances are that its effect on international relations will prove to be double-edged. It

will put an unwelcome strain on countries' economic and political relations with other states; but as governments find themselves faced with an expanding range of constraints, the pressure to cooperate may well increase.

Much, of course, will depend on the general economic environment in which the process of accelerating interdependence evolves. The strains on international relations will, for example, probably be less severe in a context of expanding world trade. But will the spread of information technologies promote or hinder the growth of world trade? Clearly there are forces working in both directions. The advance of telecommunications and computerisation enlarges the scope for subjecting widely dispersed plants to direct managerial control from a single location; and computer-aided design and production and flexible manufacturing systems may well reduce the optimum scale of production facilities and make batch production far more flexible. The combination of these developments allows for decentralised production in market proximity with centralised financial control. This would seem to operate in favour of international investment, but against international trade. On the other hand the internationalisation of production and assembly will itself augment trade flows; cheap telecommunications permit long distance merchandising and direct order from distant sources of supply; lower transport costs promote trade in merchandise; and improved communications make for further expansion in the international exchange of services, such as banking and insurance.

However, perhaps more important than the impact of information technologies on the level of world trade is that they will re-order the competitive standing of individual countries, change their comparative advantages, and create new trading patterns. As for nations at the centre of innovation, development and application of new technologies will pursue their transition to the high-tech and service based economy, leaving much of the production and assembly of the more mature product groups to the industrialising countries at the periphery. The result could be a fundamental shift in the geographical flows not only of finished and semi-finished goods but also of raw materials.

Reorganisation of the international division of labour and production along these lines should prove generally beneficial to world growth and economic welfare in general. However, major problems arise for those industrialised countries caught in the middle: they would be confronted by a widening technological gap between

themselves and the more advanced economies, and a shortening industrial gap between themselves and the labour-abundant, price-competitive countries on the newly industrialising periphery. There is a real risk in the face of this dilemma that these countries might perceive defensive measures – such as trade restrictions and subsidies to protect uncompetitive industries – as the only feasible course of action available to them, and thus reduce the openness of their economies.

Scenarios such as these serve to remind us of the vast degree to which countries differ in their technological capabilities. To an increasing extent, governments perceive themselves as having an important role to play in narrowing the technology gap on their rivals. The dangers to international relations inherent in this strategy are broadly familiar – the tendency in some cases to competitive subsidisation and to the build-up of surplus capacities; and the risk of exporting the resultant adjustment problems to other countries. But the scope for constructive action within such a strategy must also be recognised. The opportunities for international collaboration to compensate for national deficiencies in technological capability are undoubtedly real.

There are numerous other ways in which the international political landscape will change with the spread and increasing sophistication of information and communications technologies. In the not too distant future, political leaders or groups may well be able to appeal directly to selected publics in other countries. This would pave the way for the creation of transnational constituencies on a much greater scale than we have ever experienced before. To the extent that direct address entails the circumvention of official channels in the target country or countries, it would lead to complex repercussions on international relations. But even small political groups and minority factions would be well placed to reach a much wider national and international audience in pleading their cause.

It is in this context that many countries view with concern the difficulty in maintaining cultural values and a degree of cultural identity in the face of advanced communications technologies. Not only do these tend to promote world markets and the consumption of similar goods; but they can also foster a common lifestyle across national borders. Not surprisingly, governments have already begun to develop a variety of defensive responses in the form of restrictions on access to, or the movement of, data and TV programming across national frontiers. But also at regional and local level, the advance of new information technologies has met with a vigorous response in some countries from groups

seeking to preserve their cultural identity, traditions and language.

This is not to say that no progress at all has been made towards fostering the unhampered flow of information between countries. In their recent Declaration on Transborder Data Flows, OECD governments stated their intention: to promote access to data and information and related services, and avoid the creation of unjustified barriers to the international exchange of data and information; to seek transparency in regulations and policies relating to information, computer and communications services affecting transborder data flows; and to develop common approaches for dealing with issues related to transborder data flows and, when appropriate, develop harmonised solutions.

Conclusions

The diversity of issues which emerge from this general overview of the impacts of information and communications technologies on society, the economy and international relations is matched only by the diversity in social and economic policy concerns and priorities pursued by the advanced industrialised nations. The main thrust of US policy at the domestic level is on deregulation and, at the international level, on obstacles to trade and investment. Europe is preoccupied with the impact on domestic employment and, internationally, with problems of industrial and technological competitiveness. The focus of domestic interest in Japan is on the emerging information society, while at the international level it is acutely aware of the implications of information technologies for increasing global interdependence.

Given this wide range of policy issues on the one hand and the diversity of policy approach on the other, policy responses are urgently required at the national and international level. If these responses are to be successful in maximising the opportunities offered by the advance of information and communications technology and in minimising the attendant risks, three principles have to be observed. Firstly, the diversity of policy concerns and priorities discussed here needs to be taken into account in a balanced way in the international dialogue. Secondly, in the light of increased world interdependence domestic policies must be formulated bearing in mind their possible international implications. And thirdly, awareness of the benefits of international cooperation should be heightened, in particular by demonstrating that global welfare can be significantly enhanced if domestic policies are oriented to an agreed concept of internationally coherent action.