Information Technology: A Critical Perspective on its Economic Effects[1]

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ABSTRACT *Information Technology (IT) is commonly seen as the most important motor for growth and economic restructuring in the near future. Visions about massive benefits to be derived from these developments are contrasted by frustration over productivity effects, by uncertainty about impacts on employment, and by concerns about a general 'information overflow' in a global network society. The contradictions between enthusiastic forecasts and much more sober outcomes have given rise to a debate on the potential and danger of IT. The present paper intends to add to this debate. Promises of common IT scenarios will be confronted with problem-oriented and critical approaches. The paper proceeds from an analysis of deficits in the current debates towards the identification of new elements of a critical approach in IT research.*

Keywords: information technology, information society, critical research, impact assessment.

A Shared Vision of Human Enrichment: Hopes and Myths about Information Technology

At a conference on the Information Society held in Brussels in February 1995, leaders of the G-7 countries summed up their hopes for Information Technology (IT) in a document entitled: *A Shared Vision of Human Enrichment.* This document includes a number of scenarios and hypotheses which express a widely shared myth about the future consequences of IT:[2]

- IT will lead to revolutionary changes and will bring about the Information Age.
- All countries will be integrated by global IT networks, and so developing countries will be given an opportunity to leapfrog stages in technology development.
- There are enticing benefits in the usage of IT for all citizens.
- Jobs will be created, and the quality of work will be improved by IT.
- The information society will culturally enrich the global population.
- Multimedia services and applications will penetrate all aspects of society and provide a new quality of consumption and life styles.

The optimism of the leaders of the G-7 countries is supported by the European Commission. In its White Paper, *Growth, Competitiveness and Employment*, the Commission envisages "that information and communication technologies and related services have the potential to promote steady and sustainable growth, to increase competitiveness, to open new job opportunities and to improve the quality of life of all Europeans".[3] In a similar vein, the President and the Vice-President of the United States have given IT

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high priority for future economic policies in their paper on *Technology for America's Economic Growth*, where the benefits for the private business sector and for public services are extensively outlined.[4] In addition, the German Federal Ministry of Economics (Bundeswirtschaftsministerium) has recently expressed far-reaching expectations for the growth and employment effects of IT.[5] These political strategies are in accordance with innumerable academic and journalistic publications, which predict vast benefits from the diffusion and adoption of IT for employment, information supply, the environment and the integration of all countries and regions into one world economy.

However, there is a remarkable contrast between politicians' and IT experts' optimistic scenarios of a future Information Society and the actual results observed in IT producing and adopting industries. This gap has been noted in critical debates of the potential and danger of IT. This paper intends to add to these debates. It discusses promises of IT scenarios and confronts them with problem-oriented and critical approaches. In analysing the deficits of critical IT research, the paper introduces elements of a critical approach that could transcend existing attempts.

Three types of critical research can be distinguished:

- studies emphasising the gaps between promises of IT impacts and the reality of economic processes;
- studies concerning the socio-economic problems of IT, e.g. privacy, regulation, access to information and to information channels, and the communication culture; and
- critiques of ideologies underlying IT scenarios.

IT is usually referred to in a general and indistinct manner. The term comprises information technology in the narrow sense, i.e. computer hardware and software, as well as communication networks and communication services. Official publications and many academic studies use similarly general concepts by referring to IT as 'Trans-European Information Networks',[6] 'Information Super-Highways',[7] 'Information Society',[8] 'Advanced Communications',[9] or 'Telematics'.[10] However, this generalisation needs to be challenged. Such an approach leads to inappropriate and uncritical conclusions, it omits differences in the histories of technology generation, of diffusion and of implementation of the individual technological inventions or IT services. Thus, IT should not be treated as a unit. A systematic analytical concept of IT would—at least—have to distinguish between the following components and aspects of IT and the Information Society:

Supply of IT

- production of IT goods (computers, cables, telephones, etc.);
- information and communication services (bespoke software, IT consultancy, communication services);
- communication infrastructures.

Adoption of IT

- impact of IT in manufacturing and service industries and in public administration;
- new IT-based products and services;
- impact of IT in private households;
- impact of IT in society.

IT Impacts on the Economy

Soon after the technical potential of computers and electronic information transmission became obvious, discussions of its shortcomings revealed (a) that IT did not quasi-automatically penetrate all aspects of public, business and private life and thus lead to the information society, and (b) that the impact of IT adoption remained far behind expectations.[11] These puzzling phenomena led to important observations about IT impact on companies as well as on the economy and society:

- The potential of IT to restructure processes of production and company strategies was not fully exploited.[12]
- Despite large investments in IT, increases in productivity attributable to these investments remained insignificant.[13]
- The diffusion of IT equipment and services varied significantly among firms, industries and countries, and was often remarkably slow.[14]
- Implementation of IT and its efficient use turned out to be more difficult than expected.[15]
- IT did not create enough new jobs to counter growing rates of unemployment.[16]

IT Implementation: The Management Perspective

Management-oriented IT research tends to focus on methods and recipes that might 'make IT work'. In a number of articles which appeared in *Harvard Business Review* in the mid-eighties, the strategic importance of IT for competitiveness was stressed and guidance in finding the right implementation patterns was provided.[17] This was achieved by referring to a small number of spectacular cases in which IT adoption was indeed very successful.[18] These articles tended to be prescriptive and normative. They, therefore, could not contribute much to a critical analysis of IT impacts.[19]

In academic analyses, an 'impact gap' was discovered. For example, Couger diagnosed that IT had produced impressive growth figures in the supplying industries, but had failed to have a major impact in the adopting ones. The full benefits of IT can be gained only if adequate IT adoption strategies lead to the realization of impacts in applying firms.[20] Five years later, Scott Morton's *The Corporation of the 1990s* presented a variety of papers that express concerns over IT implementation and the definition of an effective role for IT in the restructuring of companies.[21] It summarised state-of-the-art IT management approaches and emphasised the need for organisational adjustments in firms which wanted to adopt IT successfully. Recently, Leverick, Littler, Bruce and Wilson studied the failure of IT impacts on marketing.[22] They listed barriers to the use of IT and concluded that the commitment of marketing managers and executive managers to IT approaches is still too weak to establish the IT systems in marketing which are needed to fulfil promises of a marketing revolution induced by IT. At the European level, the political debate is similarly concerned with the lag of European companies in the realisation of an IT-based production paradigm. Pilot applications of new technologies and services are promoted. Support is given to a more widespread use of IT.[23]

Dissatisfaction with IT, expressed by many users, was attributed to difficulties in implementation, in the diffusion of information about IT opportunities and potentials, in the functioning of markets and in regulation, without, however, questioning the 'usefulness' of computers and networks. Business management literature did not leave any doubt that the information society will provide an increase in welfare, once everybody has understood its rules and the initial barriers to dissemination and efficient use of IT

have been removed. This type of management studies takes a 'marketing-and-promotion-approach' to IT. It avoids questioning the underlying ideology of the information society and the interests of important players involved in its realisation. Furthermore, it tends to ignore findings which raise doubts and indicate the limits of IT. It does not engage in a radical analysis of failures of IT as a prerequisite for a better handling of the technology.[24]

In the IT impact literature, failures in the implementation of IT equipment and services are rarely examined. An exception is a study by Robertson, Swann and Newell, which analyses the decision making process preceding the introduction of an integrative software programme for manufacturing, MPR II, in a number of firms. In the majority of these cases, implementation had failed, and this particular technology had been abandoned. The study concludes that companies adopted the software because it was promoted by consultants and professional organisations, which either had a vested interest in software supply industries or were innovation enthusiasts. A strong technology push bias and uncertainty in the choice of products led to failures in investment in IT equipment and related projects.[25]

IT and Productivity

Technological innovation is usually motivated by the prospect of an increase in productivity in the innovating entities. Therefore, it is taken for granted that investment in IT will enhance productivity. However, productivity statistics have not confirmed these beliefs. They do not reveal the expected increases, despite massive investment in computer technology. This so-called productivity paradox—the fact that enormous investment in IT has been accompanied by a slow-down in productivity growth in the United States over the last three decades—has led to extensive discussion about the causes and possible remedies. The paradox recurred at both the macro level and at the level of individual companies, where large expenditures on IT systems often failed to result in the expected cost savings. Many researchers tried to find explanations for the phenomenon. These explanations can be roughly grouped into the following categories.[26]

Problems of measurement. Since IT involves many features (hardware, software, networks), and changes induced by it may well be of a qualitative nature or may show up only indirectly, benefits are not easily detectable and measurable.[27] The arbitrariness of productivity measures is illustrated by Cronin *et al.* who argue that positive productivity and growth effects of investment in telecommunications infrastructure can be detected in the US economy, if the right observation period is chosen.[28]

Disturbing factors. Economic performance has been influenced by a whole series of events and variables: e.g. world wide recession, oil crisis, environmental problems and budget crises. These effects might have countered the beneficial effects of IT.

Time factor. It has been argued that the benefits of IT need time to mature.[29] Experience in the financial sector, for example, seems to justify this explanation. It took British banks about ten years to rationalise clearing centres for the processing of cheques by introducing computer systems. Only recently has this process led to substantial cuts in the number of employees. Further redundancies are now being announced for the near future.

Diffusion, Implementation and Adjustment. The diffusion of IT differs from that of other innovative technologies because IT is not sold as a single product, but as a system. The studies of diffusion patterns of IT systems have accordingly adopted critical mass or network approaches.[30] Furthermore, IT induces a paradigm shift in production and distribution. Only when the nature of this paradigm shift is fully acknowledged by firms and consumers and when they have adjusted to the new way of conducting business and of consuming, can IT be exploited efficiently.[31] As a result, computers and networks are rarely used in a way that challenges their full potential. It has been argued in this context that the system and network characteristics of IT require managers to think in terms of integrated processes rather than isolated events.[32]

The learning curve. This provides further explanation for the paradox. In facing the strategic challenge of IT, companies introduce a fundamentally new technology. This requires a learning process, which is accompanied by initial fluctuations in productivity and a slow reaping of benefits. The OECD and European Commission have addressed this point in recent publications.[33] The Commission now provides funds for the dissemination of experiences from pilot studies to small and medium-sized enterprises.

Regulation. Some authors emphasise overregulation of markets as being responsible for a slow growth in productivity. An OECD project detected deficits on the supply side of communication technology because of unsatisfactory regulatory patterns in several countries.[34] While this group concluded that a combination of regulated basic technologies with guaranteed general standards and flexible privately-operated services achieved the best results, others advocate unlimited liberalisation of telecommunication markets.[35] However, communication systems require common standards for the exchange of information for the sender and receiver to 'understand' each other. National and international standards are either achieved by regulation, or are the result of imposition by a dominant industry (with possible disadvantages for the functioning of competition). Participants at the G-7 Conference in Brussels diagnosed inefficient standardisation and incompatibility as main reasons for unsatisfactory performance of IT systems.[36]

User participation. More recently, difficulties in IT adoption have been attributed to a lack of participation of users. The typical technology push scenario leads to products and services which fail to meet users' needs.[37] This view assumes that an evaluation of the potential of IT should ideally start by analysing the needs and problems of individuals, households, firms and society as a whole, and then define the contribution of IT in satisfying these needs and in solving urgent economic and social problems. The fundamental prerequisite for success in a market economy—that providers of IT goods and services have to adjust their product and supply policies to customers' requirements—is largely neglected in the technology-driven rather than user-driven IT markets. The central concern still is how to adjust the user to the technology and not how to adjust technological development to the users' needs.[38] However, in Landauer's view, it is lack of user participation which causes the trouble with computers. For him, problems can be resolved by adopting a user-oriented approach in design and implementation, replacing the prevailing technology-led paradigm.[39]

The common thread of the arguments is an attempt to explain the IT productivity paradox. However, some of the explanations are more convincing than others. For example, Cronin's proof of the positive effects of telecommunication infrastructures on

GDP only demonstrates benefits of infrastructure investment in general. He fails to explain why rates of productivity growth are low in general and why IT investment has not changed this. Furthermore, historical analogies between IT and previous technological developments display fundamental flaws. IT is not comparable with earlier basic technologies, such as the steam-engine or the dynamo, because time lags are inconsistent and vary according to the specific historical example chosen for the argument.

In addition, problems with implementation may explain some part of the efficiency gaps in adopting companies. However, the difficulties are in general attributed to a lack of sensible use. The discussion hardly admits that IT might not always be the best or the only way to enhance performance and competitiveness. Proposals for increased user-participation often use an unspecified concept of 'users'. IT systems might require quite different features if the users are managers making investment decisions, or employees using computers as work tools; if users are data base providers or their customers; if users are local authorities striving for efficiency or citizens requesting better public service. Certain IT systems satisfy the needs of one group of users and are completely useless for others or, in the worst case, make life more difficult. User participation is not a viable concept, unless 'users' and their interests are clearly defined.

Despite the solutions and explanations for the productivity paradox discussed so far, suspicion remains that more fundamental processes are at stake. Indeed, in a critical discussion of IT, the question of the contribution of IT to enhancing productivity in economies in general has to be raised. Landauer could be right in insisting that computers have not fulfilled the hopes attributed to them and that we are confronted with an enormous waste of resources invested in IT.[40] A whole range of factors can be listed which have contributed to this waste. The rapid technological ageing of computers results in truncated product life cycles. Computers are written off and replaced by new models in very short intervals, though they are still working and often were never used to their full capacity. Furthermore, incompatibilities do not allow the combination of equipment and software of different brands or even of different generations of the same brands. As a consequence, new equipment has to be bought to build up functional systems. Finally, there is the ecological problem of discharging tons of superfluous computers. The IT industry is wasting a gigantic amount of raw materials, labour and energy and has created new problems of waste disposal.

Critical technology assessment of IT needs to move away from traditional discussions of investment and productivity growth. The justification for investment in IT does not necessarily have to be its contribution to improvements in productivity. New concepts have to be developed in evaluating the benefits of technological innovations. These should include changes in working conditions, organisational patterns, operational procedures and the strategic orientation of firms. Furthermore, product/service design and definition should become objects of analysis for IT impact studies, thereby replacing the narrow productivity question.

Employment

Official publications on the Information Society are usually confident that IT will create jobs, will improve working conditions, and will eventually provide the solution for Europe's unemployment problem.[41] The structural change induced by the IT revolution is seen as outweighing job losses in the declining industries with new jobs in the rising (IT-based) industries. The promise of a net job creating potential of IT is particularly popular in a climate characterized by high and increasing rates of unemployment. The forecasts of the positive employment effects of IT are based on four arguments:

(1) Product innovation, especially the evolution of new IT-based services, provides employment opportunities. The notion of 'multi-media services' is central to this argument.
(2) The production of more and more sophisticated IT equipment will save jobs in high-tech industries and provide new ones.
(3) Increased competitiveness attributable to IT adoption will save existing jobs and create new employment generated by additional demand in new markets.
(4) The production of IT goods and services will induce growth, which will result in additional employment.

Four equally strong arguments support a negative scenario:

(1) Economies of scale in the supply of IT goods and services (especially in a Single European Market) will be achieved by labour saving rationalisation. The supply of IT goods and services at low prices, achieved in highly automated processes of production, is a prerequisite for the take-off of an IT revolution.
(2) In IT-adopting industries, productivity effects will eventually occur and lead to redundancies. This will be particularly relevant in the service sector, which, until recently, absorbed labour made redundant in manufacturing. Now IT introduces technical progress in services and thus induces labour saving innovations;
(3) Although new IT-based services will offer new job opportunities, the order of magnitude of these processes has to be weighed against jobs lost in manufacturing (not only those lost because of IT investment) and against existing unemployment.[42]
(4) Economic growth no longer guarantees growth in employment. Indeed, 'jobless growth' has characterised labour markets in most modern market economies over the last decade.

This confusing picture, however, is probably typical in the emerging phase of a new techno-economic paradigm. The question which dominates the employment impact debates is whether the job creating or the job destroying effects will prevail. It is hard to find studies that adequately assess the balance of the contradicting employment impacts. The AD-Employ project concludes (with respect to advanced communication technologies) that ". . . the increasing take up of advanced communications services . . . is strongly contributing to job creation".[43] According to later passages of this report, the "net creation of jobs is possible", if:

(1) the benefits of advanced communications are turned into product innovation and productive organisational schemes
(2) appropriate management strategies provide for the necessary organisational adjustments
(3) income and demand rise sufficiently
(4) an appropriate institutional framework is created.

Thus, the final conclusion that IT creates jobs seems to be subject to conditions under which almost any economic scenario would show increasing employment. The report itself does not discuss the probability of these conditions being met.

In analyses of employment impacts of IT, either the job killing or the job creating potential is emphasised, depending on the purpose of the study. Politicians and press announcements erroneously count persons employed in certain occupations and industries and present the result as new jobs created by IT. A closer look at the figures often reveals that few of these jobs add to existing employment. Roland Berger, a German consultancy firm, estimates that only 2.5% of the employment potential forecast for

multimedia services consists of new jobs.[44] It is not always clear whether the figures provided refer to employment or growth of employment.[45] Sometimes investment figures or other indicators are used to estimate employment growth on the basis of dubious assumptions. Optimistic forecasts of employment creation in IT services tend to use unrealistic assumptions about the labour intensity of new IT-based services.[46] IT services will have to command a turnover that is higher than the average of traditional services because IT-related services are likely to be quite capital-intensive. Positive effects of IT on employment eventually seem to rely almost entirely on growth stimuli generated by the new technology.The unreliability of the link between growth and employment, the 'jobless growth' argument which was at the centre of labour market debates for many years, is simply being ignored.

A common argument in a situation of technological and structural change in a global economy is that innovation is essential to prevent job losses. In effect, this statement means only that the labour market situation would be worse without investment in IT.[47] However, this hardly captures the optimistic promises about IT employment effects. It seems unlikely that IT alone can provide an effective remedy for persisting problems of unemployment. In a critical perspective, it is necessary to broaden the analysis and to consider the conditions under which positive impacts might prevail. Furthermore, it is necessary to quantify both the negative as well as the positive effects. It is not sufficient to see massive job losses as a necessary tribute to modernisation and technical progress and to rely on the assumption that the growth effects involved in the process will resolve the employment problem.

In addition to job creation, IT is supposed to have a positive effect on working conditions. The argument assumes that enhanced qualifications are required for work with sophisticated computer systems, a trend that will lead to better paid jobs—IT will increase the flexibility of working cycles and the degree of independence and responsibility attributed to individuals. Indeed, there is some evidence that IT-related jobs require high levels of skill and yield high wages.[48] However, as with all technological innovations, there will be winners and losers. In the transition from traditional to IT-based employment, new arrangements concerning working hours, performance control, minimum ergonomic standards and job security will have to be negotiated between employers and employees. The balance of power in labour markets will determine the climate in which these negotiations take place and the actual design of new working conditions.[49]

IT implementation studies commonly point out that IT requires 'flexible' work—part-time contracts, telework, flexible working hours—and that labour markets therefore have to be deregulated.[50] Such proposals aim at a reduction of employment protection and at a loss of bargaining power of employees. An example is the AD-Employ report, which starts with the general message that ". . . the increasing take up of advanced communications services . . . is strongly contributing to job creation and to improvements in the quality of work".[51] However, in the actual report (the small print), a different story emerges:

> However, more is being demanded of workers as these changes take place, they often have to work longer hours (perhaps with little increase in pay), subject themselves to performance measurement (some of which is automated), and in many cases they seem to do this with a reduced level of security in the form of work contracts and union representation.[52]

A few pages later the report forecasts the "end of stable career path", and states that "nobody is immune to redundancy" as well as that "people have to take risks". This is

an accurate analysis of the likely impact of advanced communications on working conditions. It is, however, quite difficult to comprehend how the report comes to the conclusion that the technology will "improve the quality of work".

Since IT-supported information services have to rely on computers for access to information, work stops whenever the computer fails to deliver. Most computer-oriented services—reservation, flight and hotel check-in, invoicing or simple sales—cannot operate, if "the computer system is down", if certain items or procedures are not part of the system or if the screen provides only nonsense. Employees normally do not have the skills or the competence or the authorization to use different procedures, make decisions not confirmed or supported by computer information, or to by-pass the computer altogether.[53] Thus, in reality, working with a computer hardly increases the flexibility, autonomy and competence of employees.

To sum up, a critical perspective requires the analysis of conditions under which "improvements" of working conditions are likely to be realized. This involves an assessment of bargaining relations in labour markets and in companies. Furthermore, labour market regulations have to be considered. In particular, minimum standards for working conditions in IT jobs are of some importance.

Geographical Distribution of Economic Activities

The Integration of Less Developed Regions and Countries

Technically IT has the potential to reduce the impact of distance and thus to ease problems of regional imbalance. Activities requiring interaction among individuals can be achieved without the physical presence of the parties. From this technical characteristic of computer networks it has been concluded that IT will connect remote areas to centres of economic activity and thus compensate for locational disadvantages. Marginalised regions within industrialised countries as well as third world countries are supposed to benefit from a better integration in national and international markets.

IT seems to be an ideal instrument for gaining a better distribution of economic activities at the global level, and for creating a decisive growth push for less developed countries.[54] There is no doubt that IT has the technical potential to let all countries participate in a global market. However, the assumption that this technical possibility leads to a new quality of integration of third world countries into the world economy[55] is based on an unrealistic conception of international economic relations. Globally operating companies will locate in markets that promise good business opportunities, and then make sure that the necessary communication facilities are installed. Only if countries or regions are interesting in terms of resources and/or markets for goods and services will they become part of the global network economy. Lack of communication facilities is likely to hinder or slow down economic development. Infrastructure is indeed a necessary condition for economic growth. Even if network infrastructures are provided, however, they alone are not a sufficient condition for development. There is also no reason to assume that integration of third world countries into a networked economy should happen under conditions that are favourable for the dependent partners. It is more likely that, with IT, the structures of dependency will be reproduced at a different level, as has happened in previous phases of the evolution of the international division of labour. Some countries will specialise in the provision of standard software and other labour-intensive IT-based services and in the production of some highly standardized IT equipment, while others will be centres of control over investment and technology. Examples of dynamic software and data processing firms in India that serve large

companies in the industrialised world confirm rather than contradict the traditional patterns of cooperation. For the moment, the involvement of third world countries in international IT-based services is almost entirely based on wage differentials. Low wages make these countries attractive for labour-intensive production. Only if the skills and expertise acquired in the process of production can be used to achieve access to the centres of the global IT market can the current patterns in the international division of labour be overcome.

Telework

An analogous argument holds for regional problems in Europe. Despite the diminished importance of distance, firms still locate their headquarters in the centres of big cities, and the advantages of on-line real-time connections have led to a dispersion of locations within the periphery of economic centres and not to more remote areas.[56] Locations of employees who engage in telework schemes and of regional telework centres show a similar pattern.[57] Telework brings about new forms of work organisation, characterised by contract rather than employment relationships. Its attractiveness for employers derives as much from these more variable employment relationships and the inherent flexibility of labour supply, as from the possibility of letting employees work in distant locations. However, the repercussions in industrial relations caused by this new form of 'homework' play only a very minor role in public discussions about telework and its potential impact on the economy.[58] Few IT impact analyses critically examine the effects of IT on the international division of labour in the light of current power relations rather than simply IT's technical potential. Some spectacular examples of dynamic Indian or Hungarian companies which supply cheap and inventive software to the industrialised world have not yet been evaluated in terms of their effect on the integration of third world countries in the global economy. Furthermore, telework needs to be analysed with respect to its effects on work contracts, unionisation and working conditions.

The Socio-economic Perspective

Research Questions in Socio-economic IT Analysis

A branch of research has developed on the border between sociology and economics, which focuses on the relations between IT and the socio-economic environment in which the technology is implemented. It transcends an economic analysis of technical change, which analyses impacts only from the perspective of the technical characteristics of IT. Socio-economic research regards IT implementation as a social process, and not merely as a question of developing and adopting the 'right' technology. Socio-economic analyses have focused on changes in working conditions,[59] on structural changes in labour markets,[60] and on the emergence of new production paradigms.[61] Furthermore, research under this heading is concerned with the consequences of IT for human communication and for civic society.

The UK Programme on Information and Communication Technologies (PICT) conducted a number of projects which took a socio-economic approach in analysing IT impacts. These projects put technological developments in a social context to find more socially adequate ways of defining and implementing technology.[62] However, despite the wide coverage of topics and the richness of the research results provided, the projects remain quite fragmented, and the results were not used to develop a critical approach to IT.

Economic technology assessment has generally ignored social impacts. It is considered to belong to the field of sociological rather than economic research. However, socio-economic factors may well be responsible for failures in the economic performance of IT systems. Access to networks and to information, for example, is a key issue in the private *versus* public infrastructure debate. It determines diffusion patterns of IT and potential market size of IT related services, and thus affects price levels and price structures. A lack of democratic decision-making in the design of regulatory frameworks for technological systems which have a major impact on people's lives and their individual rights, causes suspicion and reduces the acceptability of new technologies. Many delays in the diffusion of IT result from insufficient acceptability. The question of who owns and controls data in electronic systems is of central importance not only for citizens' rights to privacy, but also for the functioning of markets which rely on clearly defined property rights and exclusion.

In the following sections this paper will focus on the features of IT which are generally attributed to the social or political sphere, but which are important for the economic system as well. The following topics of socio-economic IT analysis will be addressed:

- access to information;
- the commercialisation of communication and information;
- control of the network.

Access to Information

The central asset in an information society is information. Participation in its core activities depends on access to information. Providing access to networks, and thus to information, for as many individuals as possible is not only a critical issue in terms of democratic structures in a future information society. It also affects the value of communication networks as such because of external network effects.[63] Diffusion of IT services might be delayed because the number of participants in a network is not sufficient to make the network attractive to potential subscribers. The smaller the number of people who get access to a network the less valuable is the network.[64]

Thus, the first step in providing good access to information is the provision of sufficient and affordable network services. The general approach in Europe and the US is to delegate the provision of these communication networks to the private sector and to competitive markets.[65] In fact, privatisation and competition are seen as the foundations in constructing information superhighways. It is believed that only private initiative can create the flexibility and diversity needed for the development of high capacity infrastructures. Deficits in government budgets seem to prohibit any major contribution of public funds to the task, and so network infrastructure is left to the private sector in liberalised markets. However, so far, no private network provider in Europe has been able to build up a blanket cover network which is comparable to the public telephone network. 'Fibre to the home'—high capacity communication lines for everyone, wherever he/she is located—is a concept which is usually not compatible with profit-maximising strategies. Privately built networks tend to connect large cities or centres of economic activity, just like private railway systems, which offer excellent connections on intercity lines, and forget to connect small villages to the system. There have already been complaints about insufficient access to networks in Wales, where BT, for economic reasons, will not provide the necessary facilities to connect some of the more remote areas to modern data transmission networks. The public commitment to ensure universal

service is limited to service provision which is 'reasonably practicable' and satisfies 'reasonable demand'.[66] Thus, there will no longer be a full network service for all parts of Wales.

Another example is the computerisation of library services. This is usually introduced with the promise to provide more information which is easily accessible. However, in practice library computerisation can also lead to less information being available. The *Business Periodicals Ondisk* (BPO) service, for example, which is used by many British universities, informs its users that periodicals will eventually no longer be available in printed form but only in the BPO system. In order to access the new system, diskettes/cd roms have to be loaded onto a special computer which is located somewhere in the library. Often, there is only one of these computers. Given the high demand from people who would like to read journals, there usually exist long waiting lists for the use of these computers, and usage tends to be limited to an hour per session. The systems allow users to print out articles from journals. However, the price for one page is around 20 pence, prohibitive if one actually wants to read a whole article (which does not seem to be very popular any longer). In addition, the print quality is often so bad that figures in tables cannot be deciphered. The user cannot read the article on the screen either, as the next person in the queue is already waiting. Compared with the availability of journals on shelves (usually in annual volumes), which can be consulted simultaneously by many persons, access to the information provided has decreased dramatically. BPO also prohibits an informal browsing of new journals, once a user is in the library for other purposes—for many a fruitful (and enjoyable) exercise—because computer time has to be booked well in advance. One might argue that this is a transitory phenomenon since more computers will be installed step by step, and bottlenecks will thus be eliminated. However, BPO has been introduced in order to save money, and additional systems would put this aim in jeopardy.

The promise that IT allows a choice of many sources of information often turns out to be of limited value because some data bases can be accessed only with specific hardware and software. Furthermore, compatability and capacity problems do not permit the use of certain programmes and, once a customer subscribes to a certain provider of information services, the cost of taking in additional providers or of changing suppliers is very high. Thus, the user is dependent on the information available in the system he/she has subscribed to. An example is the German cable TV network. It provides a certain range of programmes, but does not guarantee continuity of a specific programme. When the cable operators in Berlin decided to cancel CNN, the news channel, from their list of programmes, customers organised circular letters and other forms of public protest, but without success. Terminating the subscription was no longer an option because the antenna had usually been removed from the roof top, and satellite dishes were not allowed in all the rented apartments (still the dominant form of accommodation in Berlin). No alternative to cable was available. Thus, being electronically connected increases dependency on the information provider and on the choices made by the supply side regarding quantity and quality of information.

On the supply side, limited access to transmission channels influences market structures and business opportunities. Furthermore, it shapes the cultural content of the new media world. This topic gave rise to concerns of domination of certain cultures over others in the global entertainment industry.[67] Multi-channel TV systems are far from providing the 'democratic' means of information and communication advertised in the early stages of broadband IT. The question of a democratic Internet has only just begun to stimulate discussions among sociologists, politicians and IT experts. The economic success of broadband information services depends on the number of customers which

determines financial contributions from advertisements and sponsors. So-called 'minority programmes' or 'culturally outstanding' transmissions, which are supposed to ensure the cultural richness of a global information society, will find it difficult to conquer and defend spaces in transmission channels against financially more potent commercial competitors offering conventional programmes.

Critical research shows how information is selected and channelled and how access is organised in different regulatory and economic scenarios of the Information Society. It broadens the analysis beyond the technical potential of IT to multiply, transmit and store information virtually without limits, to include aspects of the actual accessibility of information sources and of capacities for the diffusion of information.

Commodification of Information

IT promotes and accelerates the commodification of information. Access to information requires the appropriate equipment—computers, software, connection to a network. Furthermore, information is available only against the payment of a market price or fee. This commodification excludes not only the poorer segments of society, but also, for example, researchers from gaining the benefits of the Information Society. Research results are increasingly treated as assets by the collecting institutions and offered for sale at prohibitive prices, and are thus not available to the scientific community.

The nature of information implies that one cannot search for it, unless one knows that it exists.[68] It is therefore difficult to ask for it or to create a demand. Furthermore, the customer often does not know what he/she will get from the purchase because the good is revealed only after the sale takes place. Thus, often large amounts of information have to be acquired of which little turns out to be useful. Information can be multiplied at a very low cost, which implies high economies of scale. This may result in an overflow of data which—after a time-consuming selection process—do not contain more information than provided by traditional sources. Furthermore, information tends to be a rather perishable good, which increases risks for suppliers.[69] The availability of vast amounts of information does not *per se* increase the quality of decision making.[70] In fact, Macdonald concludes that "managerial decision-making may be more hampered by a glut of information than by a shortage".[71] This leads to a quite selective handling of information by senior managers (and not to a systematic exploitation of hundreds of sources made available by IT).

There is a risk that commodification results in the diminution of informal information. Macdonald argues that, with the rise of IT, information is regarded as "synonymous with IT".[72] However, the bulk of information has nothing to do with IT; it is exchanged through traditional, often informal channels which also allow for random, unstructured interaction. And no IT—however sophisticated it is—can substitute stimulating impulses resulting from spontaneous encounters.[73] During informal meetings, information may be given which the recipient would never have asked for, because he/she did not know it existed. The problem is that IT is often used on the supposition that it can fulfil *all* information requirements. Using a computer data base for bibliographic information, for example, creates the illusion of completeness. However, critical questions could be raised as to the selection criteria used to put these bibliographies together and to the expertise of the collector or possible biases in his/her perspective on the subject under investigation.

IT reduces information flows to electronically processed forms of information. The neglect and eventual abolition of informal information channels has negative effects on the amounts and quality of information available in an organisation in the long run.[74]

The commercialisation of information and communication concentrates on the 'marketable' and electronically processed elements of information. As long as new forms of communication complement traditional ones and do not substitute for them, IT can in fact lead to an enrichment of the communication culture. However, IT is often introduced with the explicit aim of reducing travelling (personal meetings), and IT promoters and suppliers advertise IT-based communication as a full (or even more complete) equivalent of personal communication. Given the significant negative economic consequences, it is surprising that socio-economic impact analyses are still not taken seriously by mainstream economists.

The overwhelming quantitites of information accessible in global networks lead to confusion between information and knowledge. Information itself is meaningless and cannot be interpreted if it is not used in the right context and embedded in background knowledge. Huge information data banks tend to give the impression that accessing the fact itself is the essential step. Roszak discusses this phenomenon and introduces a distinction between ideas and information. He argues that to collect information one needs an idea. Only ideas provide selection criteria for vast flows of information.[75]

IT promoters generally promise to provide better quality of information. Anybody who has tried to get information from an automated train directory will question this claim. Landauer presents examples of answering machines leading callers through a nightmare of loops until they reach the starting point of their investigation without having received the information they were looking for.[76] Apart from the frustration involved and a considerable deterioration of service quality, the user of such information systems is charged with communication costs for extended calls. Thus, the argument over information quality seems to be more complex. IT standardises services for an 'average user'. This process is comparable to the industrialisation of tailoring. Nobody would claim that the transition from a tailor-made suit to an industrially-produced one represented an increase in quality. These suits were just much cheaper, and their quality was more predictable. Similarly, individualised services, where people deal with clients, are reserved for a small group of important customers who are ready to pay a high price, while all the others will receive standardised routine services provided by IT-supported systems.

A nice twist in this respect is emphasised by the AD-Employ research team. They discovered that in a world where communication is handled by advanced communication technology there is additional need for people who provide a 'human touch' to services.[77] This new requirement is supposed to open up new opportunities for service jobs. Since services using communication technology without the human touch tend to lose business, a human element has to be re-introduced in the depersonalised automated service. The phenomenon is similar to the modern way of treating milk: after all the natural ingredients are taken out with enormous inputs of sophisticated technology, the milk is 'fortified' with minerals, vitamins, stabilisers and fat substitutes. The AD-Employ team views the well-organised endowment of services with a human element as an opportunity for service employees to have more exciting and diversified jobs, but the retrospective human touch approach is a rather sad affair and should be seen as a negative consequence of the introduction of IT.

IT provides capacities for the distribution and transmission of multimedia products that reflect a diversity of cultural groups and their traditions. There is hope that the Information Society will foster opportunities to develop and keep alive a vast diversity of cultural expressions and thus enable all groups in society to enhance and strengthen their cultural identity.[78] This vision of the potential of IT to enrich the cultural environment in Europe is in strong contrast to the concentration of multimedia production in the

world. Publicly-supported multicultural TV programmes are being replaced by private channels whose programme mixture follows a uniform pattern of popular movies, sports and entertainment. The survival of the cultural heritage of minorities in a global multimedia market is consequently endangered.

Global Networks: The Risks of Large-scale Technology

Some authors have criticised free market approaches to IT regulation. They argue that communication infrastructure, broadcasting systems and networking technologies have to be scrutinised by democratic decision-making procedures and cannot be left to the inventiveness of engineers and the rules of profit-making.[79] Information and communication are seen as goods of high public interest, and access to them should not be organised via a price mechanism. Major concern is over disutilities for economically disadvantaged groups and those who do not have access to electronic information systems, as well as over the democratic control of inputs into information systems and information flows within the network.

There is pressure for public control of mass media and for measures to guarantee data protection and privacy.[80] In Germany and elsewhere, sociologists, jurists and civil rights activists have initiated a discussion about 'informational self-determination'. This concept stresses the need to give individuals full rights over information on their personal affairs. These rights may be in danger with IT's potential to multiply, transfer and commercialise information in virtually uncontrollable systems. Information on individuals that has been collected in the course of routine procedures in public administration for certain purposes can be used by government against citizens for other purposes.[81]

This research tradition is rooted in a wider approach of critical technology assessment. In response to risks embedded in large-scale technology, such as nuclear power plants, studies have emerged which are sceptical of the benefits of modern technology itself. These authors criticise, for example, Marxist approaches which view technology uncritically as a means for promoting social progress and civilisation. Indeed, democratic control of large scale technology, and more specifically, a tight control of technical capabilities of communication networks and of the processing of data on individual IT systems, is promoted to reduce the negative effects of commodity production and capitalist accumulation

In broad perspective, the dangers of IT are related to debates on the ecological risks from nuclear energy, genetic engineering and large-scale dam projects. These debates oppose an irresponsible exploitation of nature by men and emphasise the dangers in the uncontrollable dynamics of technological development. The anthropocentric view of the world claiming supremacy of man over nature, bears the risk in a world of high technology of destroying mankind together with the ecological system.

Furthermore, there are political implications in large-scale technology. Nuclear energy, for example, requires enormous amounts of public subsidies. Like other large-scale technologies, it presents an unforeseen security risk. Society is forced to finance security systems to prevent disasters. Furthermore, keeping large-scale technology under control involves massive intervention in civil liberties, and the prevention of attacks on technological systems can result in a highly controlled and monitored society. The use of IT to exercise these controls will make them more efficient and thus more damaging to an open, democratic community. IT networks are capable of storing, transmitting and manipulating sensitive data. As in the case of other large-scale technology, problems of copyrights, computer fraud, violation of privacy and hacking indicate the limits of democratic control of IT systems. The globalisation of information flows creates activities

which cannot be regulated within individual nation states and ultimately threatens national political systems.

Authoritarian states encounter particular problems. The Chinese government, for example, recently tried to control the use of the Internet in its country. The Communist Party wants to ban not only pornography from Chinese computer screens, but also what it calls 'harmful materials' of a political nature.[82] However, the use of IT is regarded by the government as a central prerequisite for economic development, and it will be difficult to separate harmful from beneficial information flows. Thus, the ability to distribute information in virtually uncontrollable international systems gives enormous power to those who have access to the input channels of these systems and can avoid national legislation.

Some politicians have been more aware of the social dimension of IT. In his Charles Read Lecture in July 1995, the European Commissioner, Martin Bangemann, emphasised that IT is not only about economics and technology, but also about society. However, this is in striking contrast to the Commission's action plan for the Information Society. According to this plan, only a small fraction of the money invested in IT will be dedicated to the study of the social consequences of IT. The bulk of financial resources will be invested in technological development and the support of pilot applications.[83]

The analysis of the consequences of IT adoption for civil rights and systems of political decision making and control plays a prominent role in critical IT research. Further subjects of analysis are the social processes which shape specific IT solutions. If it is assumed that IT in itself is to a certain extent neutral with respect to its socio-economic effects, the direction and intensity of IT impact depend on how the technology is used. The final design of IT systems is often determined in the implementation process, and users fulfil an important role in the social shaping of IT. Given the degree of user involvement, it is of crucial importance which options are made available by IT technicians.

Conclusion: Elements of a Critical Perspective

A general problem in the critical analysis of IT is the lack of the data that would allow full presentation of the facts. Landauer draws attention to a phenomenon which is typical in uncritical studies of IT impact: most authors tend to focus on success stories of IT in individual applications and base their findings on empirically and statistically poor evidence. Positive assessments of IT impact tend to take the form of a forecast or prediction of future benefits, whereas pessimistic pictures result from *ex-post* analyses of the actual effects of IT.[84] Soete stresses the *potential* of IT to enhance productivity and growth, and challenges economic policy to provide the means to encourage exploitation of this potential.[85] The use of 'can', 'might' or is 'likely to' in many analyses suggests that the realistion of IT effects depends on conditions and circumstances that are difficult to predict, and that it is by no means certain that the effects will materialise.[86] Politicians, however, tend to transform these phrases into statements without questioning the forecasts.

Thus, scenarios of the information society typically promise future benefits which are derived from an analysis of the technical potential of IT. However, most impact analyses of IT show that the technology alone will not be the main driver of change on the path to the Information Society. IT can produce contradictory effects. It can indeed produce more flexibility and more rigidity; it can support centralisation as well as decentralisation, enhance workers' participation in company decision-making and citizens' participation in

political processes, but it can also lead to tighter control of both workers and citizens. Increased amounts of information are accompanied by restricted access and less communication. Increased employment in IT-based services is outweighed by job losses in manufacturing and traditional services. IT provides new means to improve the protection of natural environments, but it also puts additional stress on resources and causes pollution.

Several elements of a critical IT approach can be deduced from this:

- The effects of IT depend upon how the technology is used;
- The question of whose interests guide the design of IT systems, their implementation and their adoption is of crucial importance;
- There must be reasons for an over-emphasis of positive potential and a neglect of negative results.

Critical impact analysis has to investigate the balance of power in markets and organisations, and the inherent mechanisms of decision-making that control the technological development of IT, its implementation and the way it is used. This includes the analysis of social and political frameworks that determine shifts in socio-economic paradigms, and—more generally—the conditions of production and reproduction in a techno-economic paradigm based on IT. In the tradition of the Frankfurt School, critical analysis is supposed to lay open the ideological foundations of theories: i.e. it has to question the assumptions made to detect the interests and the contradictions involved. The final purpose of critical IT research in this tradition is therefore to de-mystify the rationality governing IT scenarios by detecting its ideological background.

Critical research has to investigate the conditions under which IT generates actual benefits and the barriers that prevent these conditions to be met. These barriers are often related to conflicts of interest. Critical literature on IT points to a number of areas in which these conflicts of interest accompany the evolution of the Information Society. Flexibility in IT-based jobs, privacy of information, consumer rights, service quality, automated provision of information, and electronic domination of human communication are only a few examples. A common denominator of many IT problems is that applications are technology-driven. New IT goods and services are a product of autopoietic technological systems, and options for users are confined to what these systems produce. On the other hand, technologies are developed which allow applications that not everyone regards as desirable, but which, nevertheless, cannot be prevented from being adopted. Devices to compile personal records enable the authorities to control citizens' lives, and computers which control employee performance belong to this category. Although it is neither possible nor sensible to stop technological evolution, ignoring the problem of technologies which might not always be desirable, makes it impossible to establish measures which control the unwanted side effects of technological development, to prevent these effects and not just the damage done.

There are massive business interests at stake. Electronic information services will provide profitable investment opportunities for service providers. If doubts are expressed regarding the superiority of electronic information systems in terms of quantity and quality of information provided, the success of new IT products may be threatened, and the business interests involved may be harmed. The enthusiasm of politicians for IT and their unmitigated belief in its benefits, however, might also have other roots. A look at the characteristics attributed to IT and the promises made for its effects, shows that they relate to some of the most urgent problems in the world economy. Productivity, competitiveness, employment, regional disequilibria, development of third world countries and environmental problems do indeed deserve high priority. As a solution to these

problems, IT takes on the role of a miracle weapon in many IT scenarios. Research on IT impacts has shown quite clearly, however, that the promotion of IT diffusion and adoption by no means resolves these problems, and that the driving forces for change usually lie somewhere else. But if solutions can be claimed to lie in the promotion of technical progress and of widespread IT applications, no specific policies have to be developed, and no conflicts of interest have to be made transparent and eventually resolved. A critical perspective on IT reveals the problems hidden in political and academic discussions and confronts the forces that have an interest in promoting IT as an ideal solution rather than providing suitable economic policies.

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