Rethinking Organisation in the Information Society

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November 2000
[paper presented at the SOWING Conference in Karlsruhe]

The Evolving Information Society

The terms "information economy" and "Information Society" were being used in Japan in the early 1970s, but really became popular in the 1980s. In the 1990s the “Information Society” concept – or, rather, a version of it - was widely incorporated into the official discourse of the European Union and many of its member governments. There are very different concepts of the Information Society, as Alistair Duff has reminded us in his Information Society Studies (2000).

It is helpful to situate this within the context of a diverse set of efforts to find useful ways of describing (various aspects of) the broad socioeconomic changes apparent in (at least) Western societies as we approached and entered the new millennium. At some cost in simplification, we distinguish between three main types of approach: those centred on cultural change, on economic and managerial change, and on sociotechnical change. Each has something to offer by way of understanding Information Society.

Post-Modern?

First, some commentators focus on *cultural* changes – often summed up under the heading “post-modernism”, though there are other features emphasised as signified by terms such as “risk society” (Beck****). Here the main themes include: the growth of differentiated lifestyles and subcultures; associated with this, a changed and enhanced role of consumption in the forging and reshaping of identities; the decline of the iconic value of modernity as older elements are recombined with new ones; and the greater role ascribed to human action in generating and managing social, environmental and technological risks.

These themes are related to the more familiar accounts of Information Society in several ways. Three of these may be cited immediately, though the list is far from exhaustive. First, the “post-modern” developments in terms of the appreciation of symbolic value, and shaping of identities around non-workplace-based forms of value, are seen as underpinned by the burgeoning media environment and ever-expanding circulation of symbols. Second, new technology is seen as facilitating and reinforcing post-modern cultural and aesthetic moves, e.g. permitting a move from mass media to more customised “narrowcasting”, putting “sampling” and recombining elements of music and other cultural forms within the reach of a wide populace. Third, increasing access to a

clamour off views and opinions dovetails with an increasingly sceptical approach to informational authority; this scepticism, related in turn to the growth of "risk society" attitudes, is associated with the ability to mobilise counter-expertise and critiques of the truth claims of the powerful. While the wilder shores of the post-modernist literature harbour some strange beats indeed, there are some powerful accounts of cultural change developed by some of the authors in this tradition. It must be said, though, that these authors would often be sceptical of the term "Information Society" itself, seeing this as yet another effort at a modernist grand narrative of social progress. And some of the more utopian descriptions of Information Society, especially when mobilised by corporate or political interests, do seem vulnerable to such a critique.

Post-Industrial? Post-Fordist?

A second line of analysis is more *economic* and *managerial*, stressing changes often captured under the label "post-Fordism". Post-modernists may make big claims about the breakdown of mass consumption; post-Fordists turn their conceptual weapons onto mass production. The argument is that we are moving into an era where, partly in order to cope with increasing turbulence associated with fragmented markets and the new competitive challenges associated with globalisation, firms have had to become more flexible and innovative. In consequence, knowledge of how to change has become a more central competitive asset (thus the "knowledge-driven economy"), and research and development, marketing, logistics and other functions (and the intangible assets associated with them) have become strategic. As well as internal functions of knowledge management, firms need to co-operate with each other to access new and diverse forms of knowledge and related assets; knowledge-intensive business services, outsourcing, interfirm networks, and the like are indicators of such developments (and Foresight programmes are a similar reflection at the level of policy). The "Information Society" and "knowledge economy" are practically synonymous in many of these accounts.

Such approaches build upon earlier accounts of "post-industrial society" – for example the work of Daniel Bell (1972), who early on identified the growing centrality of formal knowledge and the rise of the service sectors of the economy as key elements of a socioeconomic transformation. One weakness of these theories was the rather uncritical view that the service sector and service occupations within all sectors were inexorably growing in importance due to shifts in final demand toward services ("superior goods", in the economists' sense of the term, demand for which grows particularly rapidly as people become more affluent) and that this would mean a weakening of economic power based on the ownership of material capital. The role of business services (accounting for a great deal of employment growth) was neglected, as was the challenge posed by new Information Technology (IT) for services.

Influential accounts of Information Society – especially those inspired by the quantitative efforts of Marc Porat (1977) – effectively added a "quaternary sector" of information services to the tertiary services sector discussed by Bell et al. These "information" categories differ from the familiar classifications of official statistics. Porat and his followers put considerable effort into reclassifying available data, and studies such as

those of the OECD (1986) do indeed depict substantial increase in employment and economic output in these categories. This confirmed the expectations of information economy theorists concerning the growth of an information sector, of information occupations, of information products (as "superior goods"). While statistical reclassifications have not managed to demonstrate another element of the account - that of (mainly technical) knowledge displacing material wealth as the basis of power – it might be argued in some quarters that the increased income inequalities characterising Western societies in the 1980s and 1990s are in some way indicative of a shift in the reward structures of our economies associated with the growing power of a new class.

While there are significant limitations to this approach, both in terms of its statistical orientation and its tendency to assume a clear break in terms of power relations, it should be recognised that it did early on identify some of the phenomena which some thirty years later were exciting analysts of the “knowledge economy”. Furthermore, it attempted to give the term “Information Society” some historical specificity. One reason for many commentators to hold back from endorsing the terminologies of “Information Society” and “knowledge economy” is simply that information has always been a constitutive feature of human activity and thus of social and economic affairs. How could any societies not be information societies, any economies knowledge-based ones? But, the argument here is that an important change is and has been underway, which renders such terms particularly apposite in signalling the distinctiveness of contemporary socioeconomics. At the heart of this change is the expansion of specialised information products, sectors and occupations, to the extent that these are quantitatively extremely important, and in some cases dominant, shares of national economies.

The analyses that followed in the wake of Porat’s first efforts both built on the post-industrial approach, and addressed one of its main the weaknesses. This weakness was the treatment of "services" as effectively homogeneous – a weakness still evidenced in much current literature on services. Even cursory examination of the evidence demonstrates that different branches of the service sector have displayed very different trends. Some branches have declined while others have grown, some are extremely IT-intensive while others are among the slowest to adopt the new technologies, the composition of the workforce varies from professionals carrying out highly skilled and autonomous tasks to low-paid workers performing unskilled “McJobs”. In distinguishing an "information sector", the information economy approach has introduced a somewhat more subtle differentiation among services. Furthermore, the information sector here identified is one that has displayed rapid growth – as post-industrial accounts implied that all services would. The manifold reproduction of the graphs produced by Porat and his successors, showing the seemingly inevitable displacement of primary, secondary, and tertiary sectors by a quaternary sector, in terms of employment shares, testifies to the iconic influence of this account. Indeed, just as post-industrial theories seem to have been particularly congenial to the (often public sector) professions, before the neoconservative accession in the 1980s, so the Information Society theories have had great appeal to proponents of information industries and technologies.

The Information Society envisioned in this account is, significantly, seen as marking a threshold in the development of civilisation. The "information revolution" is compared with the agricultural and (most commonly) the industrial revolution. Information Society is thus to be seen as being as distinctive a formation, as epochal in human history, as agricultural and industrial civilisations. While the long-term growth of information occupations and sectors well predates modern IT, the revolutionary nature of IT is often invoked as the keystone of this social transformation.

Elsewhere (Miles et al 1989) we have discussed various problems with this approach to the information economy developed by Porat and others (see also Duff, 2000). Most critically, perhaps, we take issue with the view that Information Society marks a clear break with the social formations of, industrial capitalism. In a few moments this paper will take up the role of IT in more detail, but first we should note that many other problems are associated with this approach. Some involve the specificity of information employment and information products. All human labour involves information-processing and all commodities are produced using informational inputs and themselves are carriers of information. In attempting to define information sectors, many cases turn out to be marginal ones, where we are forced to attribute some portions of the activity to information labour, for example, other portions to physical work, etc. It is a matter of judgement as to how far symbolic output is the major output of an activity, central content of a product, etc.

Following on from this, we see that just as post-industrial theory treated services as if they were an amorphous mass, so Information Society accounts of this type are forced to lump very heterogeneous activities together. This is so even when they attempt to identify information subsectors - for instance the OECD studies refer to primary and secondary information sectors – but still aggregate together information occupations as diverse as "information machine workers" (including bookbinders!), "process control and supervisory workers" (including sales supervisors), "communication workers" (including stage directors) to "scientific and technical workers" (the most conventional category). The factors behind the growth of such diverse activities are themselves too various to be reduced to a growing demand for (superior) information products and communication services. One of these factors is, rather, the division of labour: some (but never all) of the informational components of many jobs have been transferred to specialised staff, making this information work more visible and tying it to a particular set of workers. This is a long-term trend, and while new IT allows for further division of labour, there are actually countertendencies associated with new IT. On the one hand, IT may be applied to rationalise the efforts of information workers – though to date, fears that desktop computers would spell the end of secretarial and clerical employment have turned out to be considerably overstated. On the other hand, one of the features of postFordism is actually the recombination of tasks, and delegation of more responsibility to field and front-office workers, assisted by the installation of new communication and database facilities.

The quantitative growth of (often not-so-new) information occupations is an inadequate basis for claiming that the information economy marks and epochal change; indeed, it is not really a solid base for identification of a new stage of development as an Information

Society. The emergence of new IT, incorporated into these accounts as we have seen above, warrants rather more attention in terms of claims as to revolutionary change.

A New Sociotechnical System?

The third approach, then, has more of a *technological* – or strictly, *sociotechnical* - focus. "Sociotechnical" is accurate because, in its more articulate versions, this approach firmly locates the development and application of technological knowledge as a matter of social practice. It sees the development and accumulation of knowledge dealing with how human beings can reshape their environments as being a major factor in economic and social development. There are important changes which have little directly to do with such knowledge – political revolutions, cultural innovations, and the like (though often these are intimately linked to changing technological capabilities). But there are also important developments which we refer to as technological revolutions – which require the development of particular kinds of technological knowledge and its application to social and economic purposes. The term "Information Society" is here used to signify the transformations in social and economic affairs associated with the development and diffusion of new IT – and it is the new knowledge that underpins this technology, and that informs its applications, that is constitutive of more than a quantitative elaboration of established social trends.

IT involves a revolutionary new technology, the creation and application of knowledge about how to effect transformations in the world in dramatically new ways. Claims as to the revolutionary nature of this or that innovation are two a penny. Thus, it is as well to consider the well-reasoned case as to the nature of technological revolutions made by analysts such as Chris Freeman and Carlota Perez (see Freeman and Perez (1988)).

A technological revolution, in this account, involves new basic knowledge about fundamental chemical, physical, biological or other processes having been established. (Usually this will be based on scientific discoveries, possibly carried out by pure scientists in non-industrial settings, e.g. "basic research" in Universities and specialised laboratories, though much cutting-edge work is now also performed in industry.) This new knowledge, and the techniques associated with it, allows for changes to be made in an extremely wide range of products and processes - not just improvements limited to a particular class of product (as is typical with incremental and even some radical innovations), or even to a whole industrial sector (as with many other radical innovations). The knowledge is employed to develop fundamentally new and far-reaching inventions - allowing for the introduction of what Freeman terms new "heartland technologies" that can be applied to operations common to a wide spectrum of economic activities.

A technological revolution, then, involves the application of the new heartland technologies across broad swathes of the economy. This requires that these technologies have certain attractive features for users, and are not constrained by factors that would substantially limit their diffusion.

Perez argued that this means that a revolutionary technology has to have:

- clearly perceived low - and descending - relative cost;
- unlimited supply for all practical purposes;
- potential all-pervasiveness[1];
- a capacity to reduce the costs of capital, labour and products as well as to change them qualitatively."

(Perez, 1983, p361)

The uptake of such a technology is thus motivated by expectations as to how costs can be reduced, product quality enhanced, and so on, and informed by the belief that any risks or social problems associated with it can be avoided or contained. This adoption of new tools and techniques implies changes in products and processes and in working practices. These changes are not "impacts" of the technology; rather they are the results of action and counteraction in the application of the new knowledge. Changes are also likely in interfirm relationships – in part because new firms and industrial sectors arise around the new knowledge and its applications, in part because the changing calculus of costs leads to different costs and benefits being associated with various types of transaction, transport, logistics, etc. Centres of economic power, too, may emerge, grow, or decline as new opportunities are recognised and seized. As we have seen in the technological revolutions associated with steam and electrical energy, such developments are liable to unfold over a long period of diffusion and experiment, during which many social, institutional and organisational innovations are also tried out. The societal context – be it demographic change or warfare, modernism or Fordism (and their precursors) – is also evidently critical to shaping the patterns of application and further development of the new knowledge.

IT seems to fulfil the characteristics of a revolutionary technology. It is based on new knowledge – especially that concerned with semiconductors and microprocessors, but also that involved in the complementary fields of optronics, software, and information systems design. The development of microelectronics is central to the Information Society. Microelectronics has provided unprecedented information-processing capabilities, in a form (small, light, low-power devices) that can be applied to a wide range of economic activities. Not only conventional computers, but other information-handling devices - telecommunications equipment, scientific instruments, and many more (indeed just about any device that controls or monitors a system) have been redesigned so as to incorporate microelectronics. IT is often described as involving "the convergence of computing and communications" – an account early articulated in Japanese analyses, which also refer to "C&C". This "convergence" reflects the application of microelectronics, and the adoption of common standards (an important "technology" in its own right): networks become "intelligent" and computer-based data communication becomes an increasingly large part of network traffic. This is again not a trend driven by technological "impacts" – it is

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[1] "All-pervasivenss" may be an overstatement - a very wide range of applications is more to the point. Note, too, an aspect implied by this definition - that the new technology is socially acceptable, and that there are no major political or ethical barriers to its adoption. This is not the case for all innovations - for example, nuclear power has remained controversial. There is scope for controversy around some IT applications.

prompted by human efforts to increase the functionalities of communications (by adding error-trapping and other data-processing features to systems) and of computers (by allowing them to share data with each other and with devices like sensors, robots, etc.). Furthermore, information of all kinds is handled as digital data: this makes it easier to transport information from one device to another, to create new multimedia products, and so on.

IT thus enables major innovations in practically all economic processes (design, production, transactions, etc.), and in practically all economic sectors. While its introduction has frequently been associated with – and often seen as causal of - new employment patterns (e.g. more flexible working) and skill requirements, such developments should be seen as a matter of the interaction of social forces, social forces that come together in new ways as the actors involve grasp the perceived opportunities of the new technology with the cognitive and economic resources at their disposal. The calculus of economic decision-making is reconstructed, as new opportunities are created by some actors, and suddenly appear on the horizon of others. Costs and markets are challenged as the practicability of applying the new heartland technology is recognised. A favourable calculus means that innovators will seek to realise opportunities and effect change in production processes, products and markets. New ideas of what constitutes best-practice production, in the light of the changes wrought in the availability and capability of factors of production, are established, and new products are let loose in the market (usually to find themselves competing with a number of similar new products simultaneously developed out of the same core technological knowledge and understanding of user requirements).

Entrepreneurs (and others, such as hobbyists and public benefactors) are liable to seek ways of applying the capabilities of the new heartland technologies, to create applications of the new knowledge to effect useful transformations. Many innovations are thus liable to be developed - many unsuccessful as well as many successful ones, and often with innovations competing to offer solutions to similar problems. A framework of understandings and expectations about the characteristics of and opportunities offered by new technology (and about the nature of the market for such opportunities) will be developed by innovators. This framework (a “paradigm”) includes perceptions about what is technologically feasible to achieve, and what users will pay for. Heartland technologies allow for substantially new common-sense to be developed about where production and consumption can be located in space and time, how costly energy or information-processing will be, and so on. Such perceptions inform a concentration of efforts along particular lines, which tends to mean that technologies tend to develop in particular ways - along **technological trajectories**. These can involving broad trends in the performance of the heartland technologies and the performance of applications, as numerous firms and research establishments compete to provide successful improvements. The trajectory is created by the technological efforts of firms acting within the above-mentioned paradigms.

A technological revolution is a time of great excitement and uncertainty. There is much hyperbole - some justified, other not. There are liable to be a great many new products emerging onto the market, with various design configurations, aimed at applying the

revolutionary new technology to industrial and consumer activities. Innovations will be competing with each other, in many cases, as well as with traditional ways of doing things. Numerous products are liable to offer overlapping functionality, and it is by no mean clear which of the 'solutions in search of a problem' will come to dominate. The process of change is liable to be lengthy, with considerable uncertainty as to how the constellation of successful new products will be used. Uncertainty is accentuated by the rate of ongoing change in the heartland technology itself.

The development and application of IT is thus a sociotechnical process, an outcome of the strategies undertaken by social actors such as employers, labour forces, and governments. These strategies are informed by their understanding of the potentials of new IT, as well as by assessment of the changing competitive context implied by globalisation and the strategies of competitors and partners, by the economic and symbolic rewards which they are striving for, and so on. IT itself does not force people to make particular choices. However, as is characteristic of a technological revolution, awareness of the potential significance of the new knowledge for organisations of all sorts is liable to grow.

Miles (1996) argues that the patterns of development that emerge involve *bounded* social choice, explicated as follows:

> • IT makes many new options available. But it is a material technology, not a magical apparatus capable of fulfilling every wish (or nightmare) on demand.
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> • IT is an extremely malleable technology, which handles a very pervasive factor of production and consumption - information - it can be applied to many purposes and embodied in many artefacts.
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> • IT is associated with a greater internationalisation of economic activities, which may erode national economies and cultures.
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> • The choice of any one actor or set of actors is strongly conditioned by the choices of others, as are the results of these choices.
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> • All actors are making decisions under conditions of considerable uncertainty - even those with the best understanding of the technical aspects may be ignorant of associated technological developments. They are more likely to be unaware of the social and organisational innovations, but these are nonetheless a standard feature of the learning processes around the introduction of new technologies, particularly those of a large-scale nature."

"Information Society", in the light of this account, thus really does refer to the whole economy, the whole society. It does not simply refer to "information sectors", nor to an economy dominated by these sectors.[2] For all sectors are potentially IT-using sectors -

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[2] Of course, IT developments have substantial implications for the "information sector": thus the emergence of electronic publishing, online databases, management information systems, and new media. The point here is simply that IT-related developments are far from being confined to these sectors. For instance, e-commerce involves the transactional activities of potentially all sectors.

and thus parts of the Information Society, parts whose role and functioning may be transformed through the application of new IT and associated developments.

Furthermore, the logic of this argument does not necessarily imply that Information Society constitutes a radical break away from industrial society. While it may be that the ultimate course of the changes now underway will be a society so thoroughly transformed as to be have little continuity with everything that has gone before – a world (or solar system) of cyborgs, nanobots, artificial intelligence agents, even group minds – this is a conjectural future. For now, Information Society appears more to constitute a particular formation within the development of industrial society. (Such formations may be referred to as "technoeconomic paradigms", "modes of accumulation", or " sociotechnical systems". (For a discussion of some of the early Information Society literature on this theme, see Miles (1985).)

Revolution in the Revolution: Phases of Information Society

One of the persistent questions raised about practically any account of Information Society is: precisely when is a society supposed to have entered this new state of affairs? There may be some value in adopting a strict demarcation point – say 50% of the workforce in information occupations, or involved in using IT at work. For instance, this could be used as a basis for classifying regions or sets of countries in order to undertake comparative statistical analyses. However, none of the accounts outlined above point to a sharp break in social and economic affairs happening when some specific threshold value has been passed. What they are talking about is more in the nature of a trajectory of socioeconomic development, along which it may be easy enough to claim categorically that a society close to one extreme of the parameter(s) of choice is clearly not an Information Society, while that closer to the other extreme clearly is. Somewhere along the middle of the parameter is a smaller or larger grey area, where some cases may be clearly definable, others not, and where the elements of Information Society are becoming progressively stronger but analysts may well debate about whether individual cases do fulfil their understandings of the nature of the beast.

Additionally, long processes of social learning are typically required for the different elements of a social system to be adapted to each other. Indeed, the idea that the elements of a social system can reach some kind of equilibrium, as is supposed in a great deal of economic modelling, is in stark contradiction with the restless nature of capitalism.

The point that we want to stress here takes the discussion in a rather different direction – though it does reflect again the fragility of efforts to draw sharp lines of demarcation round Information Society, and the folly of assuming that a final and stable set of affairs has been reached.

This point is that it is possible, indeed important, to see Information Society not as a fixed things, but as an evolving society within which there have been extremely different constellations. This point becomes quite clear when one looks back at the early literature on Information Society, especially that appearing in the 1980s. In the studies that address

new IT, it was commonplace to hold out visions of a world in which online information, communications, and access to information-processing power, is available effectively anywhere, at any time. This is a vision which is yet to be realised – though recent developments have taken us a great deal closer to it. What is more, the moves toward achievement of the vision have been a matter of much more than the steady diffusion of new IT across workplaces and homes. It has involved, equally, the development of mobile communications and the associated infrastructure, the diffusion of the Internet and the particularly important establishment of the Web as the paradigm for all sorts of information and communication activities to be delivered online. What these developments force us to recognise is first, that a networked Information Society is very different from one based on stand-alone systems, and likewise one based upon highly mobile portable systems is liable to be quite different from one based on bulky systems in fixed locations. Second, they highlight that the visions of Information Society enunciated in the 1980s really rested upon these issues of mobile, networked computing and communication, though they remained rather discreet as to how these facilities might be realised in practice.

Alongside the familiar explications of the trajectory of change in new IT – Moore's "law" and its analogues displaying dramatic long-term performance improvements in various other components of IT systems – there have also been numerous efforts to distinguish "generations" in the technology. In an earlier analysis, we pointed to the problems this poses for statistical analysis – for instance, counts of the number of computers in a workplace, or the proportion of the workforce actually employing computers in their daily life, run into the problem that the devices in question may be of different vintages, varying in capabilities by immense amounts. A desktop computer today, even some pocket-sized devices, is liable to have computational power and memory similar to that of a mainframe of a few decades ago – while today's mainframes and even workstations have capabilities like that of the supercomputers of the past. In this earlier analysis, we discussed efforts made in the 1980s to describe as many as five generations in IT, spanning 1946-56 (1st), 1957-63 (2nd), 1964-81 (3rd) and 1982-89 (4th), with a 5th generation emerging in the 1990s. But in order to better map sociotechnical change, a rather cruder and broader-brush approach is helpful.

The work of Marc Weiser (1991, 1993) has been particularly influential here. He talks of two historic stages (*one computer for many people* in the mainframe age, *one computer for one person* in the PC age) and an emerging stage (*many computers* – embedded in a wide range of devices – *for each person*, in the age of "ubiquitous computing"). Other commentators talk of a move from centralised information processing to mobile processing, and imminently to *environmental* information processing. If Information Society is a stage in the development of industrial society, then it is a stage with its own internal ministages. We can currently see **four such** phases in the development of Information Society, as outlined below; we roughly identify these with the decades from 1970 on.

Phase 1: "Islands"

In the earliest periods of the introduction of electronic and microelectronic IT – up to, say, the late 1970s – the computer, telecommunications, and broadcasting systems were highly distinctive, and talk of "convergence" practically unheard. Telephone and television use was widespread, but phones were used almost entirely for speech (telex was a rare business application of telecommunications) and were far from portable (indeed, in many places they were not even unpluggable!) Telephone exchanges operated on electromechanical or even mechanical principles. Televisions - and especially radios – were moving from being valve-based to being transistorised; they operated mainly by means of terrestrial broadcasts (with some cable TV in certain urban areas, relaying these broadcast channels).

Computers were remote artefacts, encountered by very few people – typically *one to many* in Weiser's terms. Mainframe and minicomputers were in use, mainly in four application areas. (These were: large-scale administrative data processing in government and very large enterprises; financial data processing in large banks and financial service companies; process control systems in power stations, chemicals, and a few other sectors; and scientific computation and analysis especially in "big science" areas like nuclear physics.) High levels of expertise were required to make use of these computers: the user had to travel to a specialised computer room, or make use of a simple terminal attached remotely to such a facility. These terminals had very limited power to process information themselves, and used at best primitive visual displays and keyboard interfaces. Data processing tended to be centralised, and the message of the data processing system was *"come to me" – "at my place"*. We use the term "islands" to signify that the IT facilities of this early phase of Information Society are few, small (by current standards), and detached from one another.

Public attitudes to the new technology were very mixed, with fears about the dehumanising effect of large databases (placards at a demonstration against automating a University timetabling system read "I am a human being – do not fold, spindle or mutilate") and a small group of proponents of "computer liberation", having to contend with lack of experience and some awe of computers. One piece of evidence here is the way in which the Meadows' famous study The Limits to Growth (1972) could trade on the notion that a computerised analysis of global problems somehow represented a detached, almost omniscient overview of human affairs. The popular reception of this study could roughly be summarised as: "they fed in all the available data into the computer, and this was the conclusion it came to" – contrasted with which some of the nascent IT community retorted by deploying their own mantra: "garbage in, garbage out". Governments widely recognised the growing importance of the computer sector, and in the US this was effectively supported by military programmes, in Europe by national plans for the IT industry, generally oriented toward supporting national champions (who typically produced their own designs of computer, with their own particular "standards").

Towards the end of the 1970s, PCs appeared as hobbyist devices – one of the first was sold as a self-assembly kit. A first foothold in the business world was secured by the

invention of the spreadsheet - Visicalc offered a way of easily and rapidly manipulating data, in ways that were immediately appealing to many company accountants and financial analysts. Over a few years, the result was a diffusion of early microcomputers into offices, often without the knowledge let alone the blessing of the heads of data processing (DP) departments. In contrast with a model based upon giving many people terminals to access large corporate data resources – with associated issues of "need to know" and "version management" – these users were pioneering a kind of barefoot computing model, giving access to local, decentralised IT power. They helped pave the way for the PC explosion of the next decade.

Alongside this was the growing sense among academic and media commentators that microelectronics signified something rather profound. Post-industrial theories had been developed in the 1960s, but achieved real prominence in the 1970s. Now they began to take on board the application of new IT, and the first uses of the term "Information Society" were encountered. The first TV documentaries and newspaper articles about the "micro revolution" were produced, raising fears that huge swathes of the workforce would be displaced by a cheaper and more extensive form of automation. These analyses typically proceeded by reasoning that the application of microelectronics in devices such as word processors would treble or quadruple the productivity of secretarial and clerical staff, and thus lead to the massive displacement of white-collar staff. As well as these fears, politicians were alerted to the possibility that a new industrial revolution would shortly be underway, and that their national IT industries and the prospective users of new IT, would both need support for their countries to remain competitive. R&D programmes and other measures – awareness raising, consultancy etc. – were to follow. But the traditional means of shoring up national champions were to be moderated by the neoconservative governments that came to power across the Western world – famously championed by Margaret Thatcher in the UK in 1979.

Phase 2: "Archipelago"

The 1980s saw huge changes in the state of affairs described above. We describe the new environment as being like an archipelago, because it is characterised by a proliferation of IT devices, of many sizes, with limited (two-way) communication between them being the norm. Telecommunications "deregulation" and satellite television were introduced in many industrial countries. Microelectronics were rapidly introduced into telephone exchanges (digital exchanges coming to replace electromechanical ones), into TV sets (and indeed into a wide range of consumer appliances, with controls, displays, and internal systems mediated through the new technology.[3]) While many new devices were introduced and/or widely diffused in this decade, including videorecorders, telephone answering machines, microprocessor-controlled equipment such as microwave ovens, the Personal Computer (PC) and the first online information systems aimed at mass audiences are of particular interest.

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3 Cf Miles (1998).

Knowledge of microelectronics enabled the continued improvement and cheapening of microcomputers. The early hobbyist machines were developed into desktop devices for business use – the label PC came to be applied generically over the decade – and as consumer devices – "home computers" – that were hyped as being of use for all sorts of domestic application, but whose primary uses were for playing games, and for self-education about new IT and especially about software. One of the important lessons of the 1980s was the power of standards; a wide range of quite distinctive systems in the early part of the decade came to be replaced by a much smaller range of models, with those conforming to IBM's standards achieving dominance more because of the market power of the IBM brand than because of any technical superiority. The patterns of uptake of home computers varied considerably across countries, in part reflecting the promotional efforts of governments and mass media – for instance, the UK model was highly influenced by the "BBC micro" featured in educational TV programmes, widely adopted in schools, and an entry point for many community activists and self-employed people into word processing, desktop publishing, and similar applications. (Like the later Amstrad devices, which brought cheap and cheerful word processing to an even wider community of small business users in the UK, the BBC micro did not conform to the IBM standards: it was not really till the 1990s that these market niches were brought into conformance with IBM – or Apple – standards.) Information Society looked as if it would combine much emphasis on new IT in formal education, with a great deal of hobbyist experimentation, informal sharing of ideas within user communities, and self-education with new products. The importance of software and peripherals became evident, with many success stories being circulated about teenagers who were wizards at writing computer games, small firms who had made (for instance) musical instruments or security systems that could be connected together through computer media.

One of the important developments of the decade was the reception awarded to Japanese announcement of the "5th Generation" Programme, promoted as bringing into being new IT capabilities (artificial intelligence, speech recognition, etc.). Japan had been as a miracle economy, pulling itself up at an amazing rate from a low-end imitator of cheap Western goods, to the major power behind many of the most successful consumer electronics. Its vision of technological leadership in future generations of computing and communications sent a shock round the world. National R&D programmes were started, and the European Commission launched its ESPRIT and RACE programmes (for computers and telecommunications respectively – still significantly separate, despite the arguments as to their "convergence").

Fears about the impact of IT use on employment were joined by the concern about "deskilling", the idea that the application of new technologies under capitalist management strategies would overwhelmingly result in a degradation of work as jobs were routinised and higher functions captured in the new equipment. With such concerns widely raised, there was a perception among some of the political elite that IT use was being inhibited by negative public attitudes. A number of major studies of this theme were launched, in several Western countries. Their results were remarkably similar, concluding instead that attitudes to new IT were generally very positive, that workplace conflict over its introduction was mainly confined to a very few sectors (e.g. newspapers) where the

technology was introduced as part of strategies to break the power of particular groups of craft workers, that management uncertainties were more likely to slow IT use than general public concerns, and, finally, that microelectronic systems were actually being introduced into manufacturing industry and large offices at an unprecedented rate. (See Ducatel, 1994, for a review.)

With this high level of uptake of PCs and other equipment at workplaces and in homes, it seemed in many respects that all ITs were well-accepted. Perhaps there were standards wars, such than non-IBM-compatible PCs and nonVHS videorecorders were losing out: but these were cases where the technologies themselves were welcomed, the problem being that certain specific configurations were driving out competitors. However, there was one outstanding case of failure of a new IT to meet with mass market approval.

Early proponents of the "convergence" of computers and telecommunications had been working with the notion of **mass access to large-scale information utilities** for some time. IT users in the 1970s were familiar with the notion of large computers being accessed by fairly feeble peripherals, through special communications links. A few vanguard business sectors, where access to large and/or rapidly-changing masses of information was vital, had been actively applying communications systems to access databases (for financial and legal information, in particular), or to exchange large volumes of timely information (e.g. interbank and international financial transactions). What if ordinary telephone systems could be used to offer such links to a wider public? Simple terminals could be linked, via phone lines, to relevant and user-friendly databases (and user-friendly for people who had no previous experience of computers!). Relevant databases might be those supplying access to information services such as news, timetables, and public service information, and analogues to the financial, legal and business information offered to professionals; furthermore transactional services from retailers and possibly professional services could be delivered via such systems. The aim was to provide resources to the mass of people beyond the research community and those few sectors of business (finance, law) prepared to pay big bucks for information. This vision was at the heart of videotex (in Europe, Singapore, Canada) and the USA's similar early computer-communications systems for the public (CompuServe, Prodigy, etc. – these differed from videotex in being overtly aimed at computer users, rather than presupposing a computer-illiterate user base employing specialised terminals). Information Society, then, would involve new content industries supplementing the computer and telecommunications sectors, and perhaps some marginal improvement in the effectiveness of delivery of educational, financial, and other information.

These ideas were being nurtured in the 1970s, and determined efforts were made in the early 1980s to establish videotex as a mass consumer product. This was to be the decisive step towards a mass online economy, or in France "la telematique grand publique"). But the telecommunications authorities had misjudged their market: videotex generally failed to achieve the expected public acclaim. The new technology did succeed in extending the business base of online services, especially to sectors like the travel and insurance industries. But, it became clear over a very few years where videotex was successful as a consumer medium - mainly in France, through the (highly subsidised, but

also well-designed) Minitel experience - what proved most dynamic was not access to databases, but interpersonal messaging. A similar pattern emerged when videotex systems did succeed in attracting user interest in the midst of general apathy (Britain, Germany, etc.), and in the US analogues to videotex. While messaging was a central activity, with text messaging offering opportunities for many-to-many chat, specialised services, anonymity, etc. were had not been available via telephone, a few specialist and hobbyist news services and early forms of consumer Electronic Commerce (then known as "teleshopping") also attracted some traffic. While videotex languished, PCs gradually became established as commonplaces in most offices and many homes. A community of users with basic skills and demanding expectations as to what IT could provide was established; the technology had been rapidly domesticated, and was variously seen as a tool for personal empowerment, an entertainment medium, and a colossal waste of time.

As noted above, we refer to this period in terms of an "archipelago", to signify that there are now a great many islands of IT use, of varying size and shape, but still generally isolated one from another. This isolation is in terms of connection via data communication networks, in fact; actually there is extensive connection between IT users, with a high level of discourse about the new technology evidenced through hobbyist magazines, computer clubs, and so on. And, if the message of computing in the phase of IT islands was "*come to me, at my place*", the message now was "*come to me, I'm at your place*". PCs were available on a one-to-one or one-to-few basis. They were largely stand-alone machines, and their proliferation was causing a problem for corporate DP managers. Again and again, the IT professional press ran stories about the challenge of end-user computing, of the difficulties associated with previously unknown and often incompatible software being introduced, with users seeking help with maintaining and supporting all sorts of equipment in diverse premises, of shifting expectations as to what the DP department should deliver. Experience accumulated to the effect that IT was rarely associated with large job losses, and that if anything it was more often associated with demand for new skills (even among secretarial staff) than with deskilling. Against the centralising of DP in large organisations was now also set the increased decentralisation of computing power associated with PCs: a decentralisation that many commentators expected to be reflected in organisational design. Another vision of working life came to be widely circulated: the notion of (home-based) teleworking, with the idea that large shares of the workforce could work out of their own homes or from local telecottages, rather than make time-consuming and pollution-generating journeys to work.

With powerful local processing becoming commonplace on many desktops, IT analysts foresaw a boom in electronic mail. The increasing dominance of the IBM PC standard showed that people wanted to share data across computers – surely they would want to be able to communicate rapidly, and to transmit material that collaborators could use directly without having to reinput it. The levels of use of email did grow steadily through the 1980s, though difficulties in locating people's addresses and in sending messages across different email systems meant that much of this use was confined to messaging within large corporations, and to specialised communities like academics and scientists. What did take off dramatically was, however, a much older and apparently less technically sophisticated technology – facsimile, or fax. The fax machine was substantially reduced

in cost, noticeably in quality; offering a rapid means of communicating text (and basic diagrams), requiring the use of telephone lines, no particular skill in keyboard use, and no subscription to an email service. It fitted well within existing office routines, where few managers were using keyboards of any sort, and could request secretaries to prepare and send faxes just as they did letters. Fax use took off at extremely rapid rates, and it was not unknown for material to be printed out from computers at one organisation, faxed to another, and then manually retyped into the recipient's computer systems.

During the 1980s, many local computer and telecommunications industries faced strong challenges, with US and Japanese firms rising to dominance in many sectors. As neoconservative political parties gained increased influence, the move in Europe was generally away from traditional industrial policies (with their support for national champions – or their efforts to create such champions by supporting mergers between fragmented local firms to build new industrial giants). R&D programmes, supporting precompetitive research, were widely adopted, and we have already seen that EU programmes such as ESPRIT and RACE stressed collaboration across European countries and between industry and academic research. Social theories of post-modernism, meanwhile, were becoming established, with the new media helping to lend them credence; and industrial economists and others were also seeking to deepen understanding of Information Society, not least through analyses of the characteristics of technological revolutions, and of new IT as a revolutionary technology.

But if a technological revolution was underway, where was its reflection in economic affairs? In a famous comment made in 1987, Robert Solow noted that "you can see the computer age everywhere but in the productivity statistics". In other words, despite major investments in new IT for well over a decade, standard economic statistics showed little sign of the investment having achieved a great deal. The 1990s saw a great deal of discussion of this "productivity paradox" (or "Solow paradox"), with arguments about it spanning:

- **The statistics are wrong**. This argument goes: Real achievements in productivity are being overlooked, for example because quality improvements in all types of products (but especially IT) are routinely, significantly, perhaps increasingly underestimated. This is applies especially to improvements in services: it is hard to assess the quantity as well as the quality of many service outputs.
- **The technology is hyped**. This argument goes: The new technology is evolutionary, not revolutionary, and oversold to users; it is far less efficient and effective than proponents claim. System failures are common; frequent (and often unnecessary) upgrades contribute to these failures, wastes user time in learning new procedures; and provides opportunities for time wasting by employees – fiddling with aesthetic details of screen layout, etc., writing emails and surfing websites, etc.
- **The investment is less substantial than believed.** This argument goes: IT investment is still a low share of overall capital investment. Its effects are thus liable to be less than the visibility of computers might indicate.
- **The necessary organisational change is yet to come**. This argument goes: New IT has been largely applied to automate established ways of doing things – the scope for carrying out activities in quite new ways has been neglected. (A familiar example: in

many organisations, PCs were introduced as "word processors", little more than glorified typewriters to be used by clerical and secretarial staff.) A long process of organisational learning is required in order to identify potentially effective new ways of structuring work – new divisions of labour, new functions, new management practices based on the recognition that accessible information and information processing is widely available. Only after this process will the full gains from IT investment be visible.

- **Networking is required to realise IT potentials**. This argument goes: IT has largely been introduced in "islands of automation"; stand-alone units of IT hardware and software have been the norm, with automation of self-contained tasks. Utilisation of the networking capabilities of IT, where something really new in addition to the speeding-up of information processing activities is involved, is central to achieving new ways of doing things – this argument is actually very close to the point about organisational change made above.

Phase 3: "Continent"

The 1990s witnessed continuation of the trends of the '80s, but with some significant shifts – not least the moderation of the neoconservative hegemony in Western politics. This should not be overstated: the collapse of communism in the late '80s/early '90s had strong impacts on the left around the world, and socialist and social democratic parties continued to adopt elements of the neoconservative logic about, for example, the primacy of markets, the limitations of government.

We refer to the phase that became apparent in the 1990s as a "continent", since in this period the islands of automation discussed above are increasingly linked by networks. The Internet in particular became a near-universal medium for these linkages. We thus move from an archipelago to a continent of IT devices, crossed by "information superhighways". Furthermore, the continent is populated by devices of more and more sorts – not only mainframes and PCs, but also mobile devices of all kinds – especially laptop and handheld computers and personal digital assistants, and digital mobile telephones (mainly used for voice communications, but by the end of the decade being used for the restricted form of email that is SMS). Other devices proliferated – including, for example, games consoles, which many commentators had expected to disappear with the advent of powerful PCs: instead the most up-to-date consoles incorporated chips and other functionalities ahead of those of most PCs, despite being stripped-down computers in most respects). And countries continued to display very uneven rates of technology adoption – Japan for example, displays lower levels of PC and Internet use than might be expected from its level of economic development (perhaps because of the difficulties in using Japanese script with conventional keyboards); France, with its high usage of Minitel, was well behind comparable countries in Internet use; the pace of uptake of digital mobile telephones was slow in the US, fast in Nordic and some Southern European countries (in part reflecting varying national regulatory and market frameworks, in addition to the well-known phenomenon of consolidation of standards around those developed by European countries).

The Information Society is not just characterised by a high adoption of IT systems, but also by high levels of use of systems that are effectively networked. This is now apparent in statistics of IT use, as well as in the rise of terms like “cyberspace” to describe the new arena for social relationships established by networking.

This is not to say that networking was universally diffused – many computer systems remained stand-alone – nor that it was particularly easy to use – indeed, network connectivity issues offset some of the move to making computing a more user-friendly activity, and many organisations found that they required new skills in the form of network administrators and managers, website authors and editors, etc. One sign of the problems confronting networking was the slow adoption of Electronic Data Interchange, EDI, a set of tools and standards applying IT to the exchange of orders and other transactional and business information among and between firms and government organisations. The technology had long been in place, though bedevilled by proprietary standards, and the 1990s were seen as the decade for rapid take-off. In practice, while EDI use did grow steadily, it was at levels far below those forecast, to the bewilderment of proponents who reiterated their assessments of cost savings and flexibility increases associated with EDI. The costs of learning the new procedures and of restructuring internal databases and procedures to conform to it, together with the cumbersomeness of data communication systems and services, played roles in this slow adoption. It was not till late in the decade, when access to the Internet was widespread, and the Web provided a familiar design paradigm for information exchange, that many more businesses and government organisations became active in the online transfer of transactional and related data (we return to the theme of ecommerce below).

The Internet had been in place for a long time, of course, though its use was mainly restricted to researchers. As a standard and simple system of addresses was generalised, breaking away from the obscure proprietary methods used by different email services, and as it became possible to easily send formatted text and images as attachments, the use of email boomed. But what drove Internet use forward was especially two innovations. In the late 1970s the basic ideas of the Web were established – page structures, hypertext concepts and authoring tools – proving to be the design paradigm which the proponents of videotex had hoped that the latter systems would establish. This was a design which fitted the world of PCs (improved quality screens and keyboards) and users equipped with the skills to use them in familiar ways. Then the invention of browsers in the early 1990s enabled rapid search for Web pages with particular content – and the Web took off as a medium for publishing, as a system accessed year on year by exponentially growing numbers of users. Self-publishing and interest group publishing emerged, followed by countless new sources of information of all kinds. The image of the “Wild Wild Web” displaced the earlier idea that large information utilities would service largely passive consumers. The new image featured much greater, and potentially anarchic, competition to supply information. Anyone with a PC, in effect, could set up a website: the skills and motivation that were required were the province of millions of people, especially as user-friendly authoring tools were developed and cheap website hosting was offered by Internet Service Providers.

This expanding user base, including professionals and hobbyists of all kinds, led to established online services turning to the Web. Over the course of the '90s, the Internet Web format became the design paradigm a vehicle for the exchange of online information, and existing services "migrated" to these media en masse – even when a few years earlier they had been ridiculing them for lack of security and professionalism. Indeed, many of these services discovered that there were new business opportunities available, as they could reach out to broader and less specialised user bases than could previously be reached. At the end of the decade there was a "dot com frenzy", as stock markets went into overdrive, excited by the prospects of huge fortunes waiting to be made out of e-commerce and related Web activities.

Even as increasing numbers of desktop PCs were linked up to the Web, so two other success stories pointed in divergent directions. A large market developed for laptop computers, and for a variety of different types of personal digital assistant – ranging from electronic diaries to far more sophisticated handheld or palmtop computers. Typically, these small devices offered the same sort of power that a desktop machine had done a couple of years previously; and typically, too, they were not networked. Some mobile computing was accompanied by modems linking the users to phone networks, and this was commonplace by the end of the decade – but the typical situation was far from featuring the near-continuous connectivity of many desktop devices. In terms of the ration of computers to users, the situation was now moving from one-to-one to several-to-one; and if a message was coming from the devices to the users, it would have been "*I'll come with you*".

The other important development was the mass uptake of mobile telephones, whose rates of diffusion caught almost all commentators off-guard. The uptake of mobile communications had hardly been considered in the "IT revolution" studies of the 1980s, and it cast a new light on some of the cherished assumptions of these studies. For example, mobile working came into the foreground – there might be very few home-based teleworkers, but there were large numbers of people on the move, supported by their laptop computers and mobile phones. But rarely were the two integrated: the use of mobile phones for data communications was a growth area, but still decidedly an unusual phenomenon for phone or laptop users. Voice communications dominated mobile telephony – just as telephone based shopping was more important than consumer e-commerce, and the growth of the call centre was a notable feature of both marketing and sales, and of corporate restructuring, in the late '90s.

So we have many users, carrying with them, or travelling to, a widening array of IT-enabled devices, across continents traversed by Information Superhighways. The European Union adopted the term *Information Society* in part to distinguish its programmes from those of the USA. Partly this was to maintain a degree of distance from the Internet, which was seen as US-dominated: many of the products of European research programmes had to make the painful transition to Web/Internet media that commercial players had done, in fact. Europe was perceived in being strong in the field of mobile communications, in contrast, where its telephone manufacturers were among the most successful IT suppliers in a continent eager for success stories. And digital TV

(DTV) was another medium, just entering the market at the end of the decade, where there were European strengths, and which could serve as a platform for interactive communications. Europe's new research programmes were described as being about ISTs – Information Society Technologies, now, rather than the earlier IT or ICT (Information and Communications Technologies, the "C" being added at the behest of the telecommunications sector, and implicitly bearing witness to the slow pace of convergence!). Two positive elements of the IST terminology should be noted: first, it stresses technology as supporting society (even though a cynic might well see this as merely an effort to stress the distinctiveness of European societies as compared to US Internet culture); second, the technology which supports Information Society can be seen to extend beyond IT narrowly conceived, to include all sorts of other devices and systems (e.g. DTV, transport telematics, and so on).

Alongside the success stories – unexpected realisation of the vision of networking through the Web, the unexpected explosion of mobile telephony - some developments eagerly anticipated in the 1980s failed to materialise in the 1990s. Notable here was the extremely slow developed of "smart houses", "home automation", or "interactive home systems", small area networks linking together household devices to enable user-friendly control and information for household members. At the beginning of the decade there had been several major programmes seeking to commercialise such systems, but these met with limited success. This may have been due to the limited progress toward standardisation and the limited adoption of standards by equipment manufacturers, the overambitiousness of system designers (a much-promoted US initiative fell far short of technical targets), the disincentive of rewiring one's home - or misjudgement of consumer requirements. Only in the next century did it appear that a standard would be widely adopted. Bluetooth, available on cheap chips, allows for short-range wireless communication between devices. It offers numerous professional applications in addition to domestic functions of entertainment, security, energy and environmental management, and so on. And, crucially, it has the support of a wide range of major firms from computer, communications, and automotive, consumer electronics and appliances sectors.

By the turn of the millennium, there were arguments that Solow's productivity paradox was beginning to be overcome. There was evidence of firm-level changes: several studies in the '90s indicated that performance improvements in IT-using firms could be associated with this IT use (e.g. Brynjolfsson and Hitt (1998) reported a correlation between higher levels of IT capital and increased productivity in large companies - especially when the IT was being applied to enhance customer services). Evidence had become available that something was happening, at more macro levels, not least in the productivity trends in the US economy. (See Schreyer, 2000.) Many commentators were quick to seize upon such data to argue that the increased use of networking capabilities (and perhaps, organisational learning), was finally effecting substantial change in performance in visible ways. The question was whether this trend would become apparent in Europe, too, as networking capabilities were adopted, and organisational learning accomplished.

By applying new IT – and particularly the Internet and Web - to the transactional elements of economic activities, what now became known as electronic commerce (ecommerce,

EC) was the focus of a great deal of activity at the run of the millennium. EC represents a significant extension of networking across the islands of automation of factory floor production, warehouses, offices, etc. Even though current incarnations of EC are extremely limited in terms of the sorts of content that can be exchanged, and the extent to which processes are indeed fully automated, there is still considerable scope for changes in economic practices so as to exploit its capabilities. The excitement about Web-based EC contrasts with the slow uptake of an earlier generation of e-commerce facilities – Electronic Data Interchange, EDI. This case demonstrates, as mentioned above, that apparently persuasive arguments as to cost savings may not be sufficient to convince many firms to move towards putting their transactions online (cf. Bolisani et al 1999). Much of the resistance to using EDI had to do with the problems of accommodating to standardised classifications required to interact with other parties on the network. Many small firms were only using EDI due to pressure from large business partners on whom they depended, and often they had to employ frameworks imposed by their larger partners. (In some cases, indeed, small firms had to maintain several distinct systems in order to deal with different partners.)

In principle, the new models of EC on the Web are very different from EDI. They work to common standards, rather than within proprietary networks. New entrants can rapidly set up EC systems, tailored to the company's own established frameworks for describing products and product characteristics. While the technical complexity of an advanced EC operation should not be underestimated, by the end of the 1990s it was possible to buy off-the-shelf software systems allowing businesses to design and implement their own solutions. There has been, as a result, a proliferation of idiosyncratic web sites. Though these may be individually more user-friendly (at least, more aesthetically pleasing) than EDI systems, the variety of styles and formats for organising the information creates search costs on users, who may be forced to re-enter details repeatedly for accessing information or making purchases from different suppliers. While the latter may be able to represent themselves in their own preferred terms, and to engage in innovation in design and facilities, the costs to users are such that new systems are being introduced to ease EC. Two such should be mentioned: "infomediaries", who undertake the task of searching for relevant information (e.g. finding the lowest prices for a particular product, or bringing together users in online auctions of aggregation of demand to win purchasing power economies of scale); and "electronic marketplaces", generally set up by a large firm or consortium of such firms, where invitations to tender and other requests and offers can be rapidly distributed in a common (still Web-based) format to a large number of partners (usually entrance to such marketplaces is limited to trusted partners of various kinds). The electronic marketplaces are recreating some of the EDI model within the new world of the Web; and they offer much more scope for the sort of automated ordering and transaction brokering promised by EDI than does the proliferation of anarchic websites.

EC thus offers scope for new modes of doing business. It allows for integration of internal and external processes, and restructuring of supply chains. The benefits should be not only cost savings, but also more rapid response, innovation, and collaboration across organisations. Lewney (2000) describes one set of organisational changes as involving a **restructuring of the value chain**. This can involve 'disintermediation', for example via

direct sales from manufacturers, service providers, and wholesalers to purchasers. It can also involve 'reintermediation', in the form of the new "infomediaries" mentioned above, and other new agents who institutionalise systems of e-money, who authenticate the credentials of businesses on the Web (these are known as "trust services") – and those whose roles are to support web hosting, or, since even advanced Information Society cannot live on bits alone, to conduct the delivery of physical goods.

However, the achievement of such benefits may require considerable organisational learning and re-engineering – as implied in our earlier discussion of the arguments concerning the Solow paradox, and the extent to which this was bound up with processes of organisational change and learning.

Phase 4: "Ecosystem"

The opening years of the twenty-first century see the further consolidation of the "continent" phase of Information Society. The first efforts to establish the mobile Internet as a mass phenomenon in Europe, through WAP-enabled mobile phones, were generally regarded as disappointing, though in Japan a technically rather more basic system called I-Mode was much more successful (perhaps benefiting from the limited development of the more conventional Internet in Japan). Telecommunications industries continued to invest large sums in establishing more powerful devices and networks, which could make access to online services, and data downloads, much more rapid. How far the slowness of the systems, how far the limited range of useful services available through them, and how far the limited capabilities of the small screens featured on the telephones, was to blame for what was seen as a rare hiccough in the onward advance of mobile communications,[4] remains debatable. Turmoil in stock exchanges, with "dot com" companies' share prices falling speedily as anticipations of a huge surge in consumer e-commerce proved to be unfounded, added to uncertainty as to the evolution of Information Society at the beginning of the millennium.

While this turmoil led many commentators to again assert that there was far too much hype about the new technology and its applicability, some significant developments received rather less attention. One of these was the idea of P2P – peer-to-peer – networking as an organisational principle. This was most notably signified by the impact of Napster, a service which gained tens of millions of users in a matter of months, providing them with access to the music files stored in compressed MP3 formats on each others' computers. Napster hoped to evade copyright regulations by holding no music centrally, merely acting as a focal point for what was in effect a huge distributed database of music spread over many thousands of computers online at any point in time. The recorded music industry, sensing a threat to its profits as Napster grew and portable MP3

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4 There had been other failures of mobile communications. One notable case was telepoint services (these allowed for outgoing calls to be made from cheap and light handsets, as long as the user was fairly near a base station) which did achieve temporary success in some Asian markets, but repeatedly failed to make the expected impact in the West.

players became popular, sought to close the service – but other innovators had already come up with yet more distributed P2P models (e.g. Gnutella), which required no centralised compilation of current users and the files they made available. While it remained unclear exactly what profitable business models could be developed around such decentralised computing paradigms, their appeal to mass markets, and the scope for using them within corporations and communities of various kinds as powerful tools for information management, meant that P2P attracted a great deal of interest within the technological vanguard.

Looking further ahead, to the end of the first decade of the twenty first century, or a little beyond, parts of this vanguard were also developing notions of what the next phase of Information Society might look like – describing it with many terms, such as "ubiquitous", "pervasive", "disappearing computing" or even "ambient intelligence". The notion here is that information societies are gradually evolving towards a situation where there will typically be many computing devices per user – embedded in equipment of all sorts (and even in things we do not consider as equipment, such as walls, furniture, clothing… and in disposable items as well as in valuable ones). The IT is part of the environment instead of being something that has to be carried around or travelled to. The message would be "*all around you*", which leads us to the metaphor of an ecosystem. The technology would need to be user-friendly, capable of responding conversationally to speech and even gestures.

Considerable technical difficulties confront this image of pervasive access to networked information and local information processing, as well as social challenges (especially around the privacy and trust issues implied by the ubiquitous systems being able to "recognise" individual users). Much of the model requires the sort of break-throughs in artificial intelligence, speech recognition, and the like, that were proposed in the ill-fated "fifth generation" programme in the 1980s – the argument being that technological capabilities have now moved on far enough for such demanding challenges to be met. But even if only few of its elements are realised, there are likely to be many applications in education, healthcare, consumer services, and business organisation. It seems likely that the next decade will see the emergence of a new phase of Information Society characterised by at least some elements of such a vision.

Further on, advances in nanotechnology, bionics, and related technologies could mean even more radical developments (indeed, biotechnology has all the hallmarks of an emerging technological revolution, and nanotechnology may also acquire these features in years to come). Perhaps we will see the fusion of human and technology in cyborgs – "*we are one*" would be the message. In this event, Information Society could indeed mean a civilisational break rather than a phase of industrial society. But this is not the place to enter into such futurological speculations. Future transformations of Information Society are highly germane to considering the implications of the organisational trajectories we can see today, but to examine these trajectories we nee to draw are lessons from the discussion above.

Summing Up, Moving On

The brief account above of phases in the development of Information Society has necessarily been extremely condensed, and failed to do sufficient justice to the diversity of experiences across countries, social groups, and different technologies. It is quite possibly Eurocentric, and certainly fails to grapple with the intricacies of IT development in transition and developing societies. Nevertheless, the account has at least hinted as to the great diversity in the evolution of Information Society across countries – as has been the case for earlier stages of industrial society. Some of these variations show the influence of policy choices - e.g. in investments into Minitel, in the regulation of mobile communications. Others seem to have more to do with cultural and economic factors – the wealth of the economy, familiarity with the English language, consumption practices (e.g. TV use, out-of-home leisure, etc.). Within societies, too, there has been considerable variation in levels and styles of IT use, across and within sectors of the economy. Even among organisations of similar types in the same country, studies have recorded wide differences in the ways in which the new technologies have been used, for example in terms of whether strategies relying on upgrading worker skills in general, or based on deskilling and polarisation, are pursued (cf Rajan 1987). The SOWING project[5] has cast substantial light upon the different paths of the Information Society among various organisations in different regions of Europe (SOWING, 2000).

One immediate implication of this is that generalisations like those made above as to phases of Information Society are problematic: they cannot possibly capture the richness of social evolution. Efforts to provide descriptions of the nature of future phases of Information Society are likewise likely to provide only dim anticipations of variegated realties. But additionally, a major feature of the account above is that the phases of Information Society we have so far seen are so distinctive one from another, that it is indeed difficult to generalise across these phases. While some continuities and trends are readily apparent, there are also shifts in trajectory, new phenomena, changing social and organisational concerns. We cannot simply assume that the future will be a continuation of the past – and in the case of Information Society, we would also have to ask which past is being extrapolated to provide the vision of the future?

Another related point is that there have been several surprises in the evolution of information society to date, and we may be pretty sure that there will be more to come. Probably some elements of the account of the emerging ecosystem of IT will look rather archaic by the 2010s. Some of these surprises have concerned the slow adoption of particular types of IT application: home automation systems, EDI, etc. However, there are more striking imaginative failures of three kinds. First is the unexpected success of particular applications – mobile communications being the outstanding case. Second is the emergence of design paradigms, and the evident need for such widely accepted standard ways of doing things, as prerequisites for mass adoption of some applications – the Web proved the unexpected but now unquestioned enabling system for mass use of the Internet (and has posed a major challenge to established EDI and online services).

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[5] Its homepage is http://www.uta.fi/laitokset/tyoelama/sowing/sowing.html

Perhaps Bluetooth will similarly support home automation and similar applications of IT to everyday life. The emergence of design paradigms is not a foregone thing – in some circumstances several divergent designs can coexist, for a particular product class – one famous example is (nondigital) cameras. But there have been several cases in the IT world, most notably concerning PCs and videorecorders, where many suppliers have been taken aback by the speed of dominance of a design other than that which they had favoured. Third, there are quite a few instances of the new technologies being taken up for purposes other than those anticipated by the original innovators – the application of PCs to computer gaming, the Internet to pornography, being just two cases in point.

Our warning about generalising from past Information Society to prospective developments is both confirmed and further elaborated by such experiences. The future is liable to feature the slow or even negligible adoption of some applications of IT, the wildfire success of systems whose role is seen as marginal to us now, and the application of new products in surprising ways as users "reinvent" and "domesticate" them (cf. Cawson et al 1995, Silverstone and Haddon1996). The technical capabilities generated by the new knowledge are often viewed in a different light as the products that embody these capabilities move from the laboratory to the market. We might say that it is only when these capabilities are combined with the practical knowledge of users that the critical functionalities become apparent. The next phases of Information Society will also involve this process of combining new artefacts and systems with the evolving experience and activities of the members of these societies.

As well as developing new technological knowledge, innovators are learning about what products and product features are liable to gain market success, to what extent and in which markets, and why. And users are also learning – about the (current and likely future) availability and price of new products, about what these products can and cannot do (and might accomplish in the future), about how different product offerings compare, and so on; and they are liable to be gaining skills for using particular innovations, for getting the most functionality out of them, for appropriating the products into their work and leisure activities in ways that may have been foreseen or unintended on the part of suppliers. In addition to suppliers learning what users require; and users learning what they can achieve from various products; there may be numerous intermediary sites of learning in the system. For example, new entrants can provide add-ons, software, services that are unanticipated by the original supplier – consider the computer games industry that sprang up from what was initially a hobbyist activity. In addition to formal and informal user groups, actors as diverse as hobbyist magazines and TV programmes, educationalists and librarians, and regulators, have played roles in the evolving Information Society. Thus, ultimately Information Society involves the (very partial and uneven) creation, acquisition and use of knowledge by different parties, and the use of this knowledge in social and economic, as well as more narrowly technological, activities.

Organisational and Institutional Change

A systematic exploration of the implications of the evolution of Information Society for social change would be not only challenging to prepare, but also extremely difficult to contain within a few pages. It would need to cover the Working and Living conditions and practices of individuals, the relations within which they exist (and which they help reproduce or reshape) within organisations, and the relations between organisations and within social systems more generally, In concluding this essay, we focus on one of the focal areas in development of IT applications and Information Society organisational structures – ecommerce (EC).

EC firms – especially those offering business to consumer ("B2C") EC were at the heart of the stock market storm of 1999/2000. At the time many commentators accurately foresaw that this was a bubble waiting to be burst, with money being invested in the most implausible ventured. More generally, the media frenzy about B2C contrasted with standard industry estimates and forecasts about EC. These suggest that 75 to 95% of EC activity is, and is likely to remain focused on, business to business ("B2B") transactions. Certainly the effort to create new electronic markets suggested that there was a great deal of business activity in EC oriented to building on B2B capabilities.

Along with the evolution of views of Information Society outlined in the discussion of its different phases above, has been an evolution in views of EC. EDI was portrayed as a tool for business efficiency – reducing search and transaction costs and increasing speed of response and flexibility, and as a B2B activity especially involving the bigger players. With the development of Web-based EC, the idea grew that networking would bring about **more perfect markets**, eliminating the information imperfections of traditional markets. As well as allowing for reduced transaction costs, greater efficiency, and so on, the openness of the Web provided scope for small players to compete on more level playing fields with big operators. The vision here is broadly in line with libertarian capitalism. But this has been offset to some extent by such developments as large businesses creating new electronic markets to govern their relationships with partners, and the high costs of developing and maintaining a professional Web presence – not to mention a WAP presence and even one on the limited Internet offered in the walled gardens of digital TV. The argument can be elaborated further: the financial and learning costs associated with changing service providers mean that many users of the Internet are effectively "locked in" to particular commercial portals, who are liable to promote certain "websites" and even limit access to these only, especially in the new platforms of mobile phones and digital TV. In the "walled gardens" of some new media the range of sites and services that can be accessed is very heavily selected by the network provider/broadcaster, with this selection favouring cash-rich firms.

So at the present moment, we are faced by several visions of the future of EC - differing, in particular, as to whether it will operate as a much more level playing field, offering access to a wider range of commercial and non-commercial providers of resources, goods and services, or as a complex of constructed and collusively constrained markets. But this is not the only focus of debate.

The success of *Napster* – gaining tens of millions of users in 2000 - sent shivers down the spine of the recorded music industry, and of electronic content providers more generally. *Napster*, as mentioned above, provides for the exchange of (mainly) MP3 music files within its user community, and other types of P2P framework are also being disseminated. Other information resources – including copyrighted material like films and books – can also be exchanged. While the content industry initially saw this as piracy, pure and simple, some other commentators saw instead a resurgence of the gift economy. A few information producers have placed their own material in the public domain – musicians seeking publicity for their performances (or simply frustrated by the lack of a recording contract), academics and consultants who gain from the dissemination of their work, governmental and lobbying organisations, etc. And several businesses are also examining how they might utilise P2P principles employed for their own (internal and interorganisational) applications.

The emerging EC markets can be described in various ways, but we can appropriate the familiar military acronym C3I to some effect here. The markets are, as the brief account above indicates, **constructed**, **collusive**, **contested**, and **immature**:

- *Constructed*, rather than being a natural state of affairs – or rather, the natural state of affairs, liberated from the shackles of archaic institutions by new IT. What we see is new marketplaces and market relations, new forms of exchange (e-money and gift economy alike) being actively experimented with, promoted, in some cases enforced, by a variety of players. The new institutional structures that emerge will reflect this complex of forces.
- *Collusive* because in many cases we can see major initiatives being undertaken by a very few actors, who clearly find it in their mutual interests to be first movers in the field. This is apparent, for example, in many of the electronic market initiatives, in which a few large purchasers have banded together to create systems allowing them o rapidly access and direct their large flotillas of small suppliers. Questions of anti-trust and competition are bound to be raised here. Additionally, we should note that there is a good deal of collusion surrounding some infomediaries – services that claim to be searching out information resources or the best prices for products are quite frequently (and without announcing the fact to users) prioritising websites because they are making a payment to the infomediary, rather than on more technical criteria
- *Contested internally* because, despite the shake-out in the Internet industry, there are still many different providers of portals to the conventional Internet/Web environment. On some other platforms (WAP, digital TV) the situation is much more monopolistic / oligopolistic, and in some countries the range of services available is more restricted. *Contested externally*, by players from within and without the IT industry who seek to keep the Web as open and free ov commercial as possible. Thus such players develop tools enabling users to escape the portals, to erase the cookies left on their PCs, and so on. Furthermore, the collusive aspects of EC are beginning to attract the attention of regulators – they are coming to the party rather late, and it is widely held that national authorities can do little to regulate the nonterritorial virtual environment of the Internet. But regulators can still exert considerable influence over the institutional structures of EC, as moves to enshrine consumer protection law (and more

controversial imposition of rules as to what content can be accessed by nationals) demonstrate.

- *Immature*, finally, because we are still in the early stages of the development of EC systems, frameworks, institutions. The pace of change in media and applications depicted above is such that there is bound to be a great deal of scope for further innovation in the social and technical forms of EC. New business models – for example, the "virtual organisations" about which much has been heard but little seen to date – could well come into fruition. P2P systems may well offer new styles of use of network capabilities – and they are liable to give rise to new sorts of intermediaries and software agents in order to support the wide range of technically demanding services that can be envisaged for them. EC of one form or another is likely to be at the heart of an Information Society ecosystem – though this will demand much innovation in the way of micropayments and the like. But we could also see a considerable expansion of gift relationships, motivated in part by the mutual benefits that arise when large numbers of people can effectively rely on each other's IT systems as sources of shared intelligence.

Organisational strategies, and structures, are crucial in the shaping of future phases of Information Society, as they have been in the past. While knowledge and power are very unequally distributed, they are still dispersed across a wide social arena. The practices adopted by any one party, reflect that party's perceptions of the likely costs and benefits confronted by different lines of action will both influence other parties, and be influenced by assessment of these parties' likely actions and responses. Not only corporate actors, but also labour forces, social movements, and governments generate their own strategies (or, often, adapt and adapt those they see others wielding). These are informed by their understanding of the nature of Information Society and the potentials of new IT. The awareness of the potential significance of information and IT strategies is liable to grow for organisations of all sorts – which implies the increasing participation in, and in the shaping of, Information Society, even if the precise approaches that will be adopted are hard to predict.

Since there is every likelihood that technological possibilities will continue to grow at breathtakingly fast speeds, the challenge is for social and organisational innovation – including new political strategies and alliances – that can keep pace with these new potentials. This is necessary both in order to achieve democratic objectives (including limiting social exclusion associated with unequal access to knowledge of the new systems and to the technologies themselves) and to promote technological trajectories that better accommodate user and social requirements. Such social innovations may be instituted at societal level or within specific organisations. In either case, they should go well beyond prototyping and market testing new services, worthy as these may be. They are liable to involve new modes of representation of individual and collective views and interests in technology assessment and social foresight programmes, training and education systems going beyond the slogans of "lifelong learning", and a rethinking of the design of regulatory systems for media, communications, and working life. The agenda is huge; the challenges to which it must rise are huge; all that can be said for certain is that strategies will evolve as Information Society continues to mutate into new forms.

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