Chapter 5

Windows of Opportunity: appropriate technologies or appropriated technologies

This chapter provides a link to the second part of this book which describes facets of a design paradigm with which to develop paths of access from the margins to the central processes of globalisation and development.

It steps backwards, beyond the debates touched on in Chapter 3 concerning the nature of rational modern design, to look at predictive literature from the end of the nineteenth century onwards. This review of the value and pitfalls of prediction is followed by an overview of some emerging forms and paths to inclusion which will be revisited in the concluding chapters. It has been demonstrated that a process of organisational learning is needed to move beyond the technical effects of direct substitution of information technology for manual processes. The nature of this social learning process is examined in the final section of the chapter.

The modern information and communication technologies derived from Second World War innovations are essential to the level of control required over back offices and subsidiary plants located across national boundaries. They are therefore key determinants of the replacement of a spatial hierarchy involving resources, manufacturers and consumers with complex interlocking layers of labour and resource markets.

Private investment can be allocated on the basis of favourable polices on infrastructure provision, taxation and other incentives from competing local governments (Lipietz, 1987).

Inspired by the new organisational relationships made possible by the merging of computer and communication technologies (ICTs), observers such as Negroponte (1995) and Mitchell (1995) argue for the transformative potential of new forms of networked organisation and

"virtual" workplaces. However, the locational strategies which allowed white collar work from the US mainland to be relocated off-shore to the Caribbean as far back as the 1980s have been described already.

Less developed regions find themselves increasingly in competition for such lower value work, and their infrastructure is likely to be developed primarily to support it. At the same time, potential consumers with limited economic resources are less able to influence the direction of development of technologies, artefacts and services. These are targeted at the most lucrative component of global markets but they also determine the nature of access from the less favoured regions.

Across the new networked economy as a whole research and development, raw materials sources and routine manufacturing, final assembly, markets and after-market support, are increasingly co-located. The emergent global system is one of complex inter-penetration of peripheries and cores and these terms now refer to competence in the underpinning information and communication infrastructure, rather than physical location.

These innovative forms appear to alter the relationship between organisational size and performance. The contemporary notion of the "network organisation" and decreasing Internet costs appear to present an opportunity for smaller players to access resources from and to compete within global networks. However, using the reduction on transaction costs delivered by ICTs, larger firms can restructure to enter niche markets yet still draw on their wider resource base. Castells (1996) describes a form of "network enterprise" which presents a formidable challenge to smaller and medium scale players: monolithic large scale planning is being replaced by opportunistic niche infiltration.

Previous chapters pointed out that the growing separation between intellectual capital and physical production has consequences for both core and peripheral economies. Lipietz (1992) argues that the ability to separate production from consumption in these systems signals the end of the "Fordist compromise" which underpinned the Keynsian social-democratic paradigm. Meaningful engagement from the margins requires a means of challenging such approaches to the development and distribution of resources.

Looking Backwards, Looking Ahead: moving into a New Century:

Rosenberg (1982) illustrates the problem of being even partially right in technological forecasting by quoting a late nineteenth century prediction

that ultimately every American city would be provided with a telephone. Webber (1968) cites significant high speed surface and air transport developments, although supersonic transportation and not the sub-sonic wide-bodied jet is mentioned and mass air travel is not discussed. However, improved communications, including public real-time access to computerised databases are identified as potentially critical developments. Toffler's (1970) pro-technology assertions were subsequently given fictional form by science fiction writer John Brunner. However the predicted world of "Shockwave Rider" (Brunner, 1975) in which it was possible to exist in the interstices of massive computerised domestic credit and surveillance systems had been exceeded by Clifford Stoll's factual account from the end of the eighties (Stoll, 1989). Billed as a new kind of detective story, the latter describes the global pursuit of miscreants across several international computer networks, while Brunner's fictional twenty-first century network was confined to the U.S.A.

In many respects the technical component of predictions from the nineteen-sixties were reasonably accurate, what was lacking was any intimation of parallel changes in the institutional settings of those technologies. Large institutions managing large main-frame based resources are the paradigm implicit in the technological forecasting of this era, the desk-top computing revolution and the distributed nature of current resources, and consequently organisations, was not foreseen. The central issue - access to and exclusion from key resources - was not part of the discussion.

In addition, an ethnocentric bias is reflected in formulations of progress and development in which Western (US) urban forms and structures are seen as the end product of a process of social evolution, as noted in the previous chapter.

The question of what leverage is available to small players in terms of influence over the emerging new "techno-economic paradigm" (Dosi, 1986) becomes central to participation in or effective exclusion from a global system of development. Harnessing the key technologies for development beyond Ohmae's dominant triad raises the question of what leverage can be achieved over outcomes. The perspective that is appropriate here is that of the nineteen-seventies "intermediate technology" movement. Forbes and Wield (2001) use examples from Africa and India to show that a variety of strategies can be used to achieve innovation in the face of competition from global leaders.

The prospect of non-place community does not depend on the big technologies, rather on appropriate use of a range of technical opportunities. If local and regional initiatives are to be possible, then the

notion of an intermediate or appropriate entry point to the technology becomes central.

As noted in the preceding chapter, the current situation requires an "appropriated technology" approach rather than the "appropriate technology" approach promoted during the nineteen-seventies. This implies access to the technological core of the global economy. Despite the continually falling costs and growing flexibility of computer technology there is considerable debate over the realisation of its potential benefits by organisations (eg. Hartamis and Lin, 1992; Kling, 1993; Landauer, 1995). Much of the argument is around the way in which the core concerns of computer science should be broadened to encompass the usability and usefulness of its products. The skills required to assess and monitor the practices and requirements of end-users are now recognised as very different from the technical skills required for the development of a technical infrastructure.

Sometimes strategies favourable to national players in the global community may offer an unanticipated advantage to minority users within a local community. Such "windows of opportunity" inadvertently offered by shifts in the dominant technical realm must be recognised and exploited. They can be used to reduce the growing inequities that threaten the prospect of effective participation in a globalising economy.

At each location, relevant aspects of the world economy and corresponding emergent organisational forms must be related both to the developing technical infrastructure. As noted in Chapter 3, this system is often presented as a seamless technological artefact despite the historical and cultural particularities that ensure diversity and friction throughout it.

The emergence of English as a global language emphasises the existence of both cultural and linguistic barriers within the world economy (Crystal, 1997). Key innovations in information technology have succeeded where they were mapped on to existing cultural frameworks. The spreadsheet package became the "killer application" that ensured the commercial success of the micro-computer because it could readily mimic the twenty column analysis paper already in use in Western economies (Kaye and Little, 1998). In East Asia a number of economies have been relatively late adopters of many facets of office automation because of a range of cultural differences, not least their use of non-Roman characters. Shepard (1993), writing from direct experience, sets out the technical complexities of networking in an environment that must move beyond the ASCII standard. Technologies that do not incorporate the requirement of a specific alphabet have been adopted, and Castells and Hall (1994) attribute the refinement and promotion of fax technologies by Japanese companies

as evidence of their need to support logographic text. Rather than attempting to overcome cultural barriers, such users have applied available technologies to more directly relevant areas of advantage. However, in an era of bit-mapped graphics and machine translation, the Chinese script provides a clear advantage through its independence from regional variations in spoken language (Kaye and Little, 1998).

The rapidity of technical development, particularly in ICTs, is constantly reducing entry costs, and rendering obsolete extant technical infrastructures. Such a situation favours later entrants, and permits them some chance of catching up. In many developing countries the colonially oriented communication infrastructures are already obsolete. Current technical developments such as direct satellite mobile communications via large numbers of low earth orbit satellites or wireless fidelity (WiFi) protocols offer unintended advantages to marginal groups marginalised by the current technologies. However, unless the late entrants can find a point of entry, these technologies will be shaped entirely by the interests of users who are already well resourced. Nevertheless, forms of distributed development and pathways to resources are becoming evident.

Emerging Forms, Emerging Strategies

Continuing development in technology and economic scale has led both to the internationalisation of economic activity and to the emergence of environmental consequences beyond the capacity of individual states to manage. Camilleri and Falk (1992) argue that power and authority have become diffused over a considerable period, with national states participating in a variety of multilateral arrangements covering not just trade, production and finance but also increasingly inter-related environmental and security issues.

The potential of computer-based information systems to facilitate or even substitute for organisational structure and standards has been evaluated from a variety of social and organisation theory perspectives. Little (1988) shows how very different strategies may be pursued with the same technology, but that technical development may lag behind organisational ambition. Sproull and Kiesler (1991) emphasise the difference between immediate technical gains from ICTs and the longer term process of social gains for organisations. Specific technologies like computer-aided design may substitute for organisationally enforced standards, while software standards and electronic date interchange are

increasingly presenting organisations with externally derived standards and procedures.

Suchman (1986) has looked at the collective and collaborative use of computer systems by groups of users, breaking with a human-computer interaction research tradition which has emphasised usability of systems in terms of the performance of individuals. The concept of Computer-Supported Collaborative Work (CSCW) subsequently emerged with the move from an individual to a collective view of users in a socially constructed workspace which includes computer-based information systems. Such technically created non-spaces for both work and social activity can be achieved with relatively unsophisticated equipment. Increasingly such non-place workplaces are appearing within the home, as discussed in the previous chapter.

The demonstrations against the World Trade Organisation in Seattle in 1999, and subsequent events in Prague and Stockholm represent one set of reactions to the shifts in employment practices described in the preceding chapters and their impact on communities which derive their identity from economic activities now under threat. They also represent a powerful alternative paradigm for organisation at a global level that will be discussed further.

Kanbur (2001) argues that they also reflect a perception that the activities of the Bretton Woods institutions, including the World Bank and International Monetary Fund, are increasing rather than reducing global poverty and inequality. For Kanbur a Group A mentality on the part of the governments and international institutions clashes with a Group B view of the non-governmental opponents (NGOs). Conflicting views of the appropriate level of aggregation at which to gauge progress, of the appropriate time horizon that should be addressed, and of the nature of markets structures and power relationships ensure that agreement is impossible. NGOs stress the short term effects on actual communities of medium-term focussed policies, while environmentalists stress the much longer term sustainability of policies. Both sides disagree upon the nature and function of market mechanisms, with the NGOs perceiving substantial market power accruing to large scale established players from developed countries.

The real-time management of a sequence of large, international demonstrations shows that the key technologies of the Internet and World Wide Web do offer opportunities for voices and visions from geographically disparate locations to enter the world of global communication. These can build a dynamic between traditional cultural practices and modern communication forms to provide an enrichment of

global symbolic life. Little, Holmes and Grieco (2000) describe a symbiosis between the use of the Internet for e-commerce purposes and the maintenance of living and differentiated cultures, a pattern which is already evident in Canada, Africa and Indonesia. The richness of this medium also allows a challenge to the hierarchical nature of the established global political discourse.

Castells has described "informational politics in action" (Castells 1997 p.333). He is concerned that one aspect of globalisation, the reliance on simplified mass communication, inevitably reduces the complexity of political discourse. However, in the same volume he describes very different and complex forms of electronically mediated communication by dissident minorities: the Zapatista rebels in Mexico and Militia groups in the U.S.A. In both cases movements premised on the championing of the local and specific and a rejection of the global economy are achieving a presence and a voice in a global arena through the appropriation of the technologies of globalisation.

Castells (1997) cites the Zapatista movement in Mexico as an example of an oppositionist response to the exclusion from the benefits of the global economy of those bearing its greatest social and economic costs. Significantly it utilises the very information and communication technologies that facilitates the system under criticism. The image of the laptop and satellite phone in the rain forest is a potent one, however, in regions of less stark contrast between those included and those excluded, similar forms of resistance and opposition can be found. Castells also points out that fundamentalist appeals are not confined to the Muslim world, as evidenced by the rise of the U.S. Militia movements which draw on specific historical precedence, and make an equally significant commitment to the Internet. While the Zapatista example is a well worn one, it is significant that the Mexican Federal Government itself now provides links to independent and critical coverage of events via its own web-site, shifting political discourse into cyberspace and in front of a limitless audience (Little, Holmes and Grieco 2000).

In Japan, the Internet has been widely used for political debate, for example over airport location and development in the Kansai region. The Japan Local Government Centre has set up a site through which it links with local governments globally to explore solutions to new urban problems[1].

On-line electronic petitions systems have been established in Scotland (see Griffin, 2003) and for the UK as a whole. SMS (short message service) text from mobile phones as well as traditional postal voting has

been trialled at local government elections in an attempt to increase voter turnout.

Providing grassroots access to the ICT domain has been identified as a means of reducing the cost of health and educational servicing, as with the current planned expenditure in the U.K. National Health Service (Cross, 2002). However, the channels established for electronic commerce and for top down monitoring of public sector performance create new forms of bargaining. The transaction costs for the least powerful to gain visibility are also greatly reduced.

In California the notion of "community informatics" has been used to justify the provision of access to information previously freely available, but increasingly commercialised (Pitkin 2001). Across Europe city governments are co-operating across national borders through fibre optic technologies and other forms of electronic networking in the identification of municipal problems shared and solutions sought. Similarly within the European Union locations along particular lines of transport communication have begun to co-operate electronically in the management of traffic (Little, Grieco and Holmes, 2001).

Along with U.S. ownership of the strategic components of global communication technology, most particularly the dominance of Microsoft, the emergence of English as a global language is seen as an important element in a flattening of cultural terrain. Such a view cannot be entirely discounted but it ignores many of the new cultural capacities of new forms of global communication. Just as Crystal (1997) argues that the global English language is no longer under the control of its original native speakers, so are the technologies of globalisation appropriated by users at the margins.

New technology can assist the civic empowerment of the individual in relation to the state and also the capability of remote locations to influence the world of global government and global commerce: there are now powerful electronic counterbalances to historical policy remoteness. Networking small states and islands through a combination of new technology and face to face meetings can generate new economic and social structures within global functioning. Miller and Slater (2000) explore the question of local improvisations in the case of Trinidadian diaspora:

> "Indeed the significance of studying the Internet is the degree to which it transcends dualisms such as local against global. It forces us to acknowledge a more complex dialectic through which specificity is a product of generality and vice versa". (Miller and Slater p. 7)

Trinidadians undertake a distinctive set of social activities on the global Internet. What they experience are specific and local practices at a remote location. Malta, with a population of 420,000, the smallest of the candidate states due to join the European Union in 2004 has a much bigger virtual presence as the centre of another diaspora.

The rise of the portal metaphor as an organiser of web access has allowed countries such as Estonia, to provide public access in its own Finno-Ugric language (Abbate, 2000). The use of "front-end" translation software can now overcome the language barrier. Estonians can surf the Internet in their own language from public access kiosks provided by their government.

The portal is a home page which provides structured links into resources appropriate to its users. As an organising device it can reduce search time for newer users. The World Bank recognised the role of knowledge in the 1998-99 "World Development Report" (World Bank, 1998) and subsequently re-branded itself as the Knowledge Bank. Stephen Denning, former Director of Knowledge Management for the Bank has presented this approach as a necessary dialogue between all parties concerned with the development process (Denning and Grieco, 2000). A component of this realignment is the development of a web portal for Global Development Knowledge[2]. The Bank has opened a web-based debate with non-governmental organisations which has inevitably raised the issue of power relationships. These can be seen in the framing of access pathways by the resource rich on behalf of the resource poor. Part III will look at some of the issues raised in this venue.

The emerging global system described in these chapters is far from complete and far from determined, but it has already had a profound impact on social and working life in the regions included within and excluded from it. Information and communication technologies are driving the distributed processes of globalisation. By providing new forms of adjacency they are also providing avenues of engagement for excluded constituencies. They offer a means for entry or challenge and a means of refining and developing and managing the knowledge which has been foregrounded by the new relationships.

The speed of change in markets, competition and technology means that there is a socio-institutional lag as the new paradigm emerges (Dosi, 1986; Perez, 1986). For example, e-commerce is already mutating into m-commerce: mobile delivery of services. Despite the relative inadequacy of current WAP (Wireless Application Protocol) mobile telephony, the combination of low earth orbit (LEO) satellites with Global Positioning Systems (GPS) in proposed systems such as the European Galileo GPS will

allow location-sensitive services to be delivered to individuals and groups on the move (Taplin, 2000). Wireless broadband (WiFi) has been co-opted where fibre-optic infrastructure or even copper wire telephony is not available.

New forms of community of practice may arise, together with a reassessment of the spatial dynamics of knowledge creation and application. With LEO direct satellite systems, the network coverage will of necessity be equally dense and universal across the majority of the planet's surface beneath the hundreds of orbiting satellites. The lag caused by severe problems with the initial business models of the pioneer systems presents an opportunity for a diversity of models and approaches to be discussed and developed by potential users outside those models.

The next section of this book contains four chapters which introduce design as a set of processes which reflect resources, capabilities and context. A design perspective offers a means of identifying opportunities within the complex constraints on development at the centre and participation from the periphery which have been described in this opening section.

Social Learning, Social Networking

Marvin (1988) quotes from the debates and disagreements over the significance of the electrically-based technologies of the second industrial revolution. She notes the time taken for a general understanding of the appropriate social use of the telephone to emerge. It is not surprising that a global consensus on the more recent generation of information and communication technologies underpinning the current wave of globalisation is still to emerge. What is clear is that the necessary paradigm will not emerge on its own. Would-be participants in the development process need some window of opportunity through which to gain influence and access.

Kalpinsky and Posthuma (1992) demonstrate the transferability of organisational technology in the form of Japanese manufacturing practice without high levels of capitalisation. Marginal players, in this case East African manufacturing companies, can make significant improvements in their performance without substantial capital investment. The adoption of the organisational approaches utilised in Japan can transform efficiency and effectiveness in companies in developing economies without the supporting technology usually associated with it. Gains from relatively low-cost reorganisation were achieved through the use of intellectual

resources which had some consonance with the cultural assumptions embedded within the imported techniques. However, to compete directly with developed economies access to similar levels of capital resources is required. Ultimately access to state of the art technology is necessary for full participation in the global economy. However, access to such technology is no guarantee of its appropriate use. The use of technology, rather than the technology itself is the key to appropriateness, and to sustainability but the organisational and cultural segmentation of potential users requires an adequate fit to varying needs and the capacity for adjustment over time. This implies a cultural wrapping for the technical standards. The technology also must be available in a mature and robust form capable of adaptation to specific situations (Kaye and Little, 1996).

Sproull and Kiesler (1991) show how a process of organisational learning is needed to move beyond the technical effects of direct substitution of information technology for manual processes. Unfortunately the direct technical costs and benefits dominate information systems planning and investment. The gains reported by Kaplinsky and Posthuma were achieved through the use of intellectual resources which needed some cultural consonance with the cultural assumptions embedded within the imported techniques. The transformative gains in effectiveness represented by Zuboff's (1988), "informated organisation" will come about in the globalised arena only through an understanding of the need for cultural interoperability at both pre-competitive and competitive stages of development (Kaye and Little, 1996).

Standards are the vehicle used to achieve interoperability and the notion can be applied to each level of interaction within and between organisations. Standards themselves cannot solve the problems confronting actors in the global economy. The cultural dimension of organisational practice impacts on the diffusion and adoption of socio-technical systems across cultural settings. Simply ascribing differences in outcomes to "cultural difference" between adopters offers little guidance for either potential adopters or for policy-makers.

O'Hara-Devereaux and Johansen (1994) argue a distinction between work cultures, both professional and corporate and the primary culture in which an organisation is embedded. For them the synergy between levels is a potential resource, but the tendency towards a convergence determined by the primary culture is seen as an obstacle to cross-cultural working. Culture needs to be de-composed into issues related to the historical, geographical and institutional setting in which organisation and individual must operate. The business recipes and frameworks grounded in these

differences offer a view of "culture" of more direct value to actors (see for example Marceau, 1992).

Chapter 2 introduced Castells (1996) notion of network enterprise which is composed of components of larger corporations, collaborating in specific spatial and temporal circumstances, while the main companies are still pursuing global strategies of direct competition. Japanese companies have demonstrated the value of pre-competitive collaboration and joint development of key technologies. Collaboration between Sony and Phillips over audio media has created global standards for consumer products. The framework of the network organisation appears to offer an opportunity for smaller players to access resources from and to participate in global networks This was illustrated in Chapter 2 with the "virtual village" (Inoue 1998) in which small enterprises are able to form and reform alliances in order to provide high technology services to larger companies. However, it was noted that a dual challenge is provided to smaller firms, since the advantages offered are matched by the ability of some larger firms to de-couple key business units better to target customers and markets traditionally served by much smaller firms.

During the 1980s the Centre Mondial Informatique et Ressources Humaines in Paris promoted the use of state-of-the-art computing technology in Saharan and sub-Saharan Africa (Roper, 1983). While the national basis of the institution might say something about its post-colonial orientation towards Francophone Africa, it deployed the work of Seymour Papert (1980) as evidence of the ability of the new information and communication technologies to short-circuit the learning curve of earlier industrialisation processes. However, it was only at the end of the twentieth century that technical progress offers to solve the chronic infrastructure deficit of less developed regions. The shift from geostationary Earth orbits (GEOs) to medium Earth orbit (MEO) and low Earth orbit (LEO) satellites (Price-Waterhouse, 1998), introduced earlier, has the potential to render the current communications infrastructure largely obsolete. A range of proposed systems will use various combinations of direct inter-satellite communication and a low number of ground-stations. The planned systems target current affluent users of mobile communications, rather than the 3.9billion people judged to have no telephone service available.

The Teledesic system originally proposed a total of 840 broadband LEOs communicating directly with individual personal computers. By 1997 a revised system of 288 satellites was planned. In 2002 this was replaced by a scheme for 30 satellites in Middle Earth Orbit (MEO) reflecting the take over of a failed competitor. In July 2003 Teledesic

surrendered its broadcast frequencies to the U.S. Federal Communication Commission. The Iridium system, re-launched under a new company in 2001 consists of 66 low-earth orbiting (LEO) satellites plus 14 orbiting spare satellites. Following the failure of optimistic business plans which assumes the technology would compete with the existing terrestrial cell phone, the services are now marketed to businesses and workers remote from established communications infrastructure.

The technology to achieve low and middle earth orbit is simpler and more accessible than that for geostationary orbits which is dominated by Ariane and NASA-based launches with a small contribution from Russia, Ukraine and China. In addition, the laws of geophysics ensure equally intensive coverage of all areas below the satellites, regardless of OECD status.

Clearly such shifts in technology offers a window of opportunity for countries and regions disadvantaged by the current distribution of communication infrastructure to make up considerable ground, if not to leapfrog to the forefront. However, the removal of the barrier of physical and technical infrastructure leaves the problem of social and institutional infrastructures.

Windows of Opportunity

The need for peripheral users to utilise features of mainstream technical developments as far as possible is exemplified by a study of the impact of relatively simple bulletin board technology on a group of users with special needs (Earls 1990). Nineteen-eighties bulletin board technology allowed these users to participate in an electronic community which was unaware of their considerable physical disabilities. The features which were of particular advantage to this group, such as the “narrowness” of the communication bandwidth which produced a levelling and bland alphanumeric interface, or the asynchronous nature of communication are those which characterise access to the global communication technologies by those at the margins, reliant on obsolete equipment and relatively poor connections. These features were eliminated in the mainstream push for ever greater sophistication.

The most striking feature of the findings of the study was the contrast between the short term results which reveal no change in attitude over a three month period and the significant changes revealed by a repeated application of the Measurement of Attitude Towards Disabled Persons Test (Yuker, Block and Campbell, 1960) after two years.

Initial results revealed a slight lowering of self image by the board users at the end of the experimental period. After two years, however, case-studies revealed individuals who had become politically active, gained employment (over 50% of the experimental group), taken up further study and begun to live independently. These clear benefits also evoked positive changes in their peer group, structural changes in the organisation and a policy response from government.

These outcomes emphasise the importance of longitudinal studies. Vitalari (1985) argues the need for such an approach in the broader investigation of computing environments and in effect supports Sproull and Kiesler's (1991) call for consideration of both the short and long term implications of the introduction of computer-based communications.

Much of the available data on the impacts of computer-based information systems and communication is cross sectional in nature. Such studies have often presented conflicting findings on, for example, the employment implications of the introduction of word processing (Buchanan and Boddy, 1983) because they have examined organisational relationships which have still been in flux following the deployment of the technology.

In this instance the initial negative results may be interpreted as a reflection of the increasing standards of performance and the wider technical community against which the participants measured themselves and their new skills.

The impact of relatively simple bulletin board technology highlights the need to utilise features of mainstream technical developments as far as possible. The features which were of particular advantage to this group, such as the "narrowness" of the communication bandwidth which produced a levelling and bland alphanumeric interface, or the asynchronous nature of communication might be eliminated in the mainstream push for greater sophistication. Such shifts might not be useful for the particular disabilities examined here although other emerging techniques and technologies might offer similar advantages to different groups and disabilities. The long term, qualitative nature of the benefits suggests that such research methods would be appropriate for the evaluation of more sophisticated computer-based technologies for any group of users. The evaluation of the use and impact of an experimental computer bulletin board on people with disabilities illustrates one paradigm for a diverse range of minority users and their relationship with information technology and the opportunities it affords (a full account of the study in which clients and therapists in an Australian Spastics Centre were linked with computing students for a period of three months is available in Earls, 1990).

Despite the falling costs and growing flexibility of computer technology there remains a need to identify and exploit equivalent windows of opportunity presented by mainstream technology. Considerable sophistication in the evaluation and use of elements of mainstream technology is needed by any group wishing to access the potential benefits of a mainstream solution, in order to minimise the use of low volume, expensive specialised hardware and software. The evidence of the ability of current protest movements to achieve real-time direct access to a global audience through a combination of mobile computing and Word Wide Web technologies is encouraging.

Part II presents a detailed discussion of the nature of design paradigm taken from high technology innovation and design management. An understanding of design and technical development as embedded socio-technical processes is a necessary precondition for engagement with the technical dynamic of the emerging global system.

Notes

1 See http://www.jlgc.org/
2 See http://www.edc.org/GLG/gkd/ for an on-line archive of these contributions and debates.