

Business Computing: the Second 50 Years

**The Guildhall conference for business
leaders**

The Guildhall, London

5 and 6 November 2001



**Business
Computing**

NCC prize paper entry

**This paper was submitted to the competition for the best paper on
"The World and Business Computing in 2051"**

Philip Virgo

Eurim

LEO

© The LEO Foundation 2001

This paper may be freely reproduced for non-commercial purposes. For other uses please contact Business Computing 50 Conference Committee, LSE Department of Information Systems, Houghton Street, London WC2A 2AE, United Kingdom

Envisioning the Global Information Society: The World and Business Computing in 2051

Philip Virgo

Introduction

Over the past fifty years business computers have evolved from clever, stand-alone, processing engines to “mere nodes and peripherals” in the worlds largest machine - the global communications network. That network has itself been evolving for over 150 years and we have been doing business electronically (telegraph, phone, telex, fax and electronic data interchange) for most of that period. Even if we define the Internet as packet switched data it took around forty years (not four) to get from the National Physical Laboratory to consumer markets. The technologies which will underpin business computing and the global information society in fifty years time are almost certainly already in the laboratories of today. The forecasts in this paper are based on the interplay of trends in technology platforms, the way they are packaged for use and the way business is conducted. It is, however, assumed that the long-term driving force is human nature and neither the dreams of enthusiasts nor the nightmares of politicians.

The Digital Kondratieff Wave will have matured, the Optical Wave will be under way.

Nicolai Kondratieff was not the first to analyse the “long” economic cycle but he was the first to publish predictions and died in lonely exile in Siberia for not only forecasting the Great Depression but also the recovery of capitalism on the next cycle.

Analogies between Computing and the Motor Car were popular during the seemingly inexorable rise of the personal computer. More recently we have seen comparisons between the computing and communications boom-bust of 2000 - 2002 and the automobile and radio boom-bust of 1926- 28. The timelag from the first business computer to the dotcom boom is almost exactly the same as that from when Karl Benz built his first two stroke engine (1879) to when Henry Ford built the last Model T (1926). Ford’s new model had all parts machined to a much higher specification but nonetheless capable of being fitted to his “installed base” as “fully compatible upgrades”.

During the Great Depression the car and the radio changed the world in ways that few of the enthusiasts of the 1920s had predicted but it took twenty years for the stock prices of General Motors and RCA to recover to their 1926 level and over fifty years before automobiles routinely incorporated technologies that had not been overhyped during the boom before the crash.

We might therefore take the analogy with the motor car a little further and say that the next fifty years will see a slow and painful recovery followed by the ultimate flowering of the technologies that have been overhyped over the past few years. However, the consequences will be very different to those being predicted a few years ago.

The Visual Information Society

Opto-electronics and quantum computing may well usher in a new age of analogue computing using technologies sufficiently reliable for digital error correction to be unnecessary, but the more profound changes will be in how the processing power and communications bandwidth are used.

One hundred and fifty years of communications and fifty years of computing development has been enabled by flowering of mathematics and engineering and has, in turn, enabled new ways of thought, presentation and communication. However, visual processing occupies far more of the human brain than speech while written, let alone mathematical, notation was very much a minority occupation until barely a century ago. A picture is worth a thousand words. It is a symphony with all parts conveyed at once, in parallel. In the brain the linear elements of story telling are wired below those for language.

The ability to recall, imagine and mime time based sequences of events probably came many millenia before the naked ape could describe them in words.

Mankind built castles, cathedrals and cities for several millenia, sailed round the world in complex sailing ships for several centuries and built steam engines and railways for several decades before the widespread adoption of mathematics as a notation for complex thought. The rise of mathematics parallels the rise of electrical engineering yet much of it is based on working out the ideas of men like Faraday, who could not master mathematics at all, or Einstein, whose mental productivity tailed off as his mastery of mathematics grew.

Many of the worlds most original minds thought visually before they expressed their thoughts in words let alone mathematics. Leonardo da Vinci, James Clerk Maxwell and Nikola Tesla thought first in images, which were then converted to drawings, models and mathematical notation. The drawings of Leonardo da Vinci incorporate an understanding of stress and dynamic forces that was not expressed mathematically until late in the 19th Century. Today you only learn how to draw if you attend art class. Stephenson did not learn how to read and write until his multiplicity of railway projects grew too complex for him to negotiate and supervise personally. It was not until the 1950s that we fully understood why some of Brunel's finer bridges carry their own weight, let alone that of the trains.

The Final Flowering of the Age of Mathematics

Words and mathematics are emphasised throughout our education system. Yet the final flowering of "the age of mathematics" may well be the production of complex computer-based analytical tools to enable the multi-dimensional visual modelling of problems too complex to comprehend, let alone explain, mathematically. Today the Computer Graphics group of the ACM (the main US Computer Society) is larger and more active than the rest of the ACM added together as they try to master the use of computers to generate multi-dimensional images in motion. Sophisticated graphics and multi-media can be used to convey very complex information, such as how storms build up - with multiplicities of complex mathematical models represented in both series and parallel using juxtapositions of visual presentation techniques. As visual processing and broadband communications enable us once again to agree transactions and brainstorm problems without the need for printed records and mathematical formulae we face a transformation in business methods as well as in government and education, Meanwhile research councils and the academic rat-race could face a lingering death akin to that of the introverted world of medieval scholasticism.

Logical reasoning, "what any decently programmed computer can do", may lose status as did literacy when even the plebs could read and write. If so, not only will current educational hierarchies be overturned but status may pass to those personal service tasks which no computer system can master. Thus nursing an incontinent cripple may have higher status than diagnosing a cancer, "what we use expert systems for". Many of the current problems of the digital divide and social exclusion will be overcome by a reversion to visual communication - with the added ability to convey, over distance and time, much more complex thoughts than could be represented by diagrams and models, let alone drawings in the sand or stories round the fire.

Western "civilisation" has been around for barely a couple of millenia, compared to 3 - 5 for older civilisations (eg Persia, India and China). Today it is also less deep-rooted and more vulnerable to change. More-over times of uncertainty lead to a resurgence rather than a weakening, of old ideologies and certainties. Chinese scripts, based on stylised pictures, are considerably easier for most children to master than the western use of alphabets to represent the sound of words.

A resurgence of visual thinking favours the East, with many cultures and languages based on picture writing. It weakens Arab cultures, the inventors of mathematical notation with a deep-seated religious taboo on images, as well as the West.

The Pacific rim, from Hollywood to Hong Kong (and further west to Bollywood) is already leapfrogging the Atlantic rim as the centre of visually based infotainment but the implications for the way we do business are even more far-reaching. We can produce a "landscape" of a market, millions of transactions rippling like a field of corn so that a dealer can "see" the patterns. But the seductive impact of such display techniques can rapidly mislead users unless systems are designed around what they wish to examine, why, how, when - and how quickly. When timescales for decision may be measured in seconds rather than minutes, the psychological impact of the means used to display results is a major issue.

How will we be able to believe what we see?

One can see the evolution of Western Culture since the Renaissance as an attempt to achieve ever increasing exactitude of representation of all forms of experience: the camera, the mathematics of perspective, shorthand, sound recording, were all phases of this. The achievement of visual reproduction, through many technologies, is one dimension of a vast collective project. The process of reproduction, from photography onwards, stemmed from a desire to capture, (possess), experience but the irony was that progressive attempts to achieve realism in the cinema, from 3D and Omnimax to Cinemascope, have actually been a voyage of improvement in animated delusion. Analogue technologies produced a "print" of reality, albeit airbrushed to remove the unwanted face or blemish. The digitised "transcript" can now be "cleaned" and "edited" to whatever image of perfection or fantasy desired by the producer.

Virtual reality is to imagination as the hammer is to the hand. The optimistic view is that the more familiar we are with the way the image is created the more able we are to see through it. The consequence of using improved visualisation techniques in the media is that we now believe less and less of what we see. But the political and regulatory implications of the impossibility of telling electronically edited truth from fiction are profound.

Should we strive to preserve organisations like the BBC with a reputation for impartiality? Or is that reputation itself merely a fitting tribute to the propaganda skills that the BBC demonstrated to the world in 1940, editing unwelcome reality into sustainable mythology. Hitler used his mastery of the hypnotic power of radio based oratory to reinforce the mass emotion of his rallies relayed by film and newsreel to every cinema. Meanwhile the BBC showed how the illusion of honest candour could be used to equally mislead those to whom such raw emotion and crowd psychology was supposedly anathema. How can we prevent those with equal mastery of the inter-active multi-media of tomorrow from exercising similar power over the imaginations of their target audiences, including the sceptical and well educated who are vulnerable because they think they understand how they are being manipulated?

The development and use of trusted technologies, which provide an unalterable record of what happened for use as evidence, will be essential. Once they are in widespread use the way in which we record transactions and agreements will also change. We will be able to play back a trusted

record of what was done or agreed. The police electronic notebook, an unalterable record of what the officer or surveillance system saw and heard, will transform the legal process. Lawyers will then create a new world of obfuscation about what it meant.

Before then we may have to pass through a period when parchment, vellum and physical witnesses may be the only truly "trusted" record. Encryption techniques will come and go as their flaws, more likely to be of management and application than of mathematics, are found and exploited. By 2051 verifiable, write once, read many technologies recording at the place of transaction will be essential to enable the evidence to be admissible.

Industrial and Social Convergence?

Computers are already being embedded into a growing variety of devices and editing and recording machines let alone controls. Over the next fifty years they will be as ubiquitous as the electric motor or fuse, all but vanishing into business and domestic products and services hanging off the networks. After they have recovered from the shock of recession investors will focus on providers of value-added transmission services (including of censorship and tax collection under the control of government, suppliers or users according to the local market rules), on creators and publishers of content (from research and education to news and entertainment), on the impact on the marketing and distribution of physical goods and on the effects on travel and financial services.

Meanwhile those expected to plan the way forward are crippled by information overload now that delayering has removed the information filters of middle management and the communication filters of secretaries and personal assistants. The anywhere office and martini (any time, any place, any where) communications today paralyse those who dare not use the "off" button. Over the next fifty years we will have to take back control in order to survive.

Tomorrow, the virtual reality helmet will not merely be the tool for flying the plane when the controls become too complex for the time to respond but also the display for browsing the net. We will leave the office by taking off the business helmet. Rightly or wrongly, we will no longer trust the filters embedded in even our favourite information providers. Our helmets (or rather visors, so that we can simultaneously see the unfiltered outside world) will contain our personal information filters, editing our image for the outside world (perhaps removing flab and wrinkles) as well as rationing what we see and organising end-over-end verification when we receive what is claimed to be an unedited transmission of reality.

The way we use communications technology will also have matured as products and services move from "raw commodity", geared to improving raw efficiency (lower cost, faster speed), to "rich in selectivity and usability" and fit for the real purposes of communication. Once "rich" communication has taken place, low volume text may be all that is needed for most business communications. It may also be all that is desired by a pre-occupied recipient, filtering and rationing his or her inputs.

Video conferencing will be commonplace but what value do talking heads add? Can you have a truly productive video-conference (team bonding, shared access to high resolution data, maps and diagrams that are amended and annotated by participants as they talk etc), with more than the four or five heads round a map (whether drawn in the sand, written on paper or displayed on the electronic plot) that has characterised winning military teams for millennia. Can humans truly inter-work electronically if they have never met?

One of the characteristics of the most productive network-based research programmes seems to be that the participants commonly meet physically (whether in bar or boardroom) at least once or twice a year. At one level the need for travel will be reduced and changed to where participants would like to meet, the City with the best climate or the night life at this time of year. At another it will be increased as business centres, vulnerable to terrorism and transport disruption, are dispersed over networks of neighbourhood offices and local and global conference centres.

Will global communications and increased understanding lead to more or to less conflict? Will images of plenty distributed over ever more powerful media increase hope among the masses? If so, will that lead to self-help and growth or help-yourself and war? Will China and India and continue to feed themselves or will they become major importers of food as their economies grow? Will the United States, with its massive investment in genetic engineering to increase crop yields be the bread-basket of the world or will we have agreed that life cannot be patented?

Technology is often said to be neutral in its political effects. Broadcasts can be used to whip up conflict (as in Bosnia or Rwanda) or to call for calm and reconciliation. But what editor ever voluntarily chose "keep calm and be reconciled" for a headline or lead story!

Those in business believe in the importance of market forces. But will the global corporate alliances of the future make more money by promoting global brands with common visual images or by segmenting their brands with culturally specific visual images? Their choice of brand strategies are, perhaps, better seen as global weathervanes than as determinants.

We can see powerful forces driving consolidation among network providers, because of the scale of infrastructure investment needed, and among mass market content providers, because of the degree of product risk. But it is most unlikely that governments will permit the resultant trend towards monopolies and cartels. Open standards should lead to more open competition among software providers while hardware is commoditised (like rice). Meanwhile content publishing will evolve around new ways of establishing and policing intellectual property rights and distributing the royalties in a world where the pace and nature of change and creativity has rendered copyright and patent obsolete but rewarding genuine creativity is one of the keys to economic progress.

The Global Bazaar

We have been doing business internationally in a variety of languages and under a variety of laws for several millennia. There are well established conventions for both. What is new is that small firms and individuals are also being expected to do business both electronically and internationally. More-over it is expected that they will do so cheaply and easily, using legal frameworks and routines which have yet to be agreed, developed and tested. The current routines for cross-border transactions are the result of the inability of Governments to agree or enforce anything better, despite many attempts at harmonisation (from the Romans and the Hanseatic League to the League of Nations and the World Trade Organisation). The pressure for change is coming mainly from those who wish to see global free trade over the Internet. The changes they wish to see require the resolution of debates where agreement may be no more in realistic prospect in 2001 than it was in 1901 or 1801.

From Petty France to Old Jewry, from Lombard Street to Russia Court, London has been a multicultural community as well as an international trading centre for nearly a thousand years. Meanwhile most of those who talk of the Global Information Society of the future appear to assume the infrastructure will be an extension of the US-Centric Internet. They expect the language to be American, the values those of Hollywood, CNN and the Star Ship Enterprise and the legal framework that of the United States of America under its Federal Constitution. Meanwhile the majority of the world's population does not speak English, does not know how to use Windows, does not wish its electronic commerce, education and entertainment to be policed by American lawyers and does not have a reliable power supply, let alone a phone line.

The Latin American, Indian and Chinese and Moslems worlds will jump direct to battery-powered, mobile communications with satellite-based international trunking. They will leapfrog the world of Windows and Internet browsers into a world of mobile electronic commerce accessed by GSM phones, with smart cards and zapper controls triggering audio-visual responses based on local language and pictograms. If they need a bigger screen it will be provided by Digital TV not a personal computer.

A crude analysis suggests that in 2051 the main languages of the Information Society will be (in order) English, Mandarin, Arabic, Gujerati, Spanish, Russian and German. Those wishing to sell premium-added-value to some of the world's wealthiest communities will also need to handle many more languages - from Finnish to Hebrew. The Global Electronic Market place is likely to have the feel of an oriental bazaar rather than a western shopping mall. Business is as likely to be conducted under Chinese, Indian or Islamic Law as it is under common or Roman Law. Any encryption or security

routines must be as acceptable to the Chinese, Indian or Iranian Governments as to the Americans or HMG.

Trade will migrate over time, as in the past, to those markets and jurisdictions which are reliable and efficient, with trusted routines for disputes resolution. Global trade will be dominated by those city states which have been left to run themselves in return for collecting and remitting taxes on the e-commerce services they police to their regional power. London, New York, San Francisco, Singapore, Hong Kong, the Hague and Zurich will be among the centres where you can do business under whatever law and in whatever language you wish. Frankfurt, Tokyo, Cairo and Bombay will be centres for trading under particular jurisdictions or within specific cultures. There will be niche services such as MacTrust, originally for the Scots diaspora but also to those wanting to transact in English under Roman Law, adjudicated in Edinburgh or Calgary. Adjudicated in London, in whatever language, under whatever law you choose, will be a more credible trustmark than regulated by Her Majesties Government, let alone the Commission of the European Communities. But London will be a virtual centre at least as much as a physical location. Those using the Corporation of London trustmark, policed by Lloyd's Register, Den Norsk Veritas and its other "regulators", will be based around the world, in at least as many jurisdictions as currently have Lloyds or DNV agents.

The Privatisation of Electronic Law Enforcement

By 2051 governments will have tried and failed to resolve most of the issues to do with the regulation of the Internet. Law and order will, in consequence, have been brought to the web in the same way that it was brought to the Wild West - with little or no help from government. In the 1870s Alan Pinkerton and his competitors employed shotgun wielding ex-soldiers to ambush train and bank robbers and shoot to kill. The Sheriffs and Marshals could then pick up the survivors. Today a large corporation under assault might turn its firewall into a mirror, responding to each fraudulent enquiry with a mounting series of questions, using all information available to route them back to the originator, until transmissions cease.

Over the decades ahead Telcos and ISPs will spend billions to upgrade the Internet to provide prioritised, secure and authenticated communications (not just bandwidth) for those who want them. At the same time the banks and credit card companies will spend billions to provide on-line authentication services to their customers linked to "guaranteed" payment and delivery. Anonymity on the web will mean that you have no credit. Those who underwrite your payment may not know your real name but will know your biometric identifiers. E-impersonation will be the most feared e-crime. And e-law enforcement will be by global credit black-listing: e-death.

There is no political or industry consensus yet in sight as to who will run the cross-border disputes resolutions and the international track and trace activities necessary to restore confidence in the public Internet as a place for the innocent to learn or to shop. Fifty years on Governments will still be arguing over whether the applicable law is that of country of origin or of the destination.

The handful of players who provide the core structures of the commercial Internet, from server farms and peering centres through pipes to access software will promote secure walled gardens governed by contract law for the moral majority. The forensic accounting arm of Price-Anderson-Young and the investigations arm of Control Risks will be paid by Banks and Telcos to track, trace and e-eliminate those who prey on them or on their customers. Networks of industry self-regulators working across frontiers will provide the credibility and flexibility of response and redress that governments cannot. Those government agencies which have the necessary skills and resources will make the transition to democratically accountable law enforcement on a global basis.

The Internet will have polarised between regulated walled gardens connected by secure highways and a libertarian cyberjungle, home to predators and free-thinkers alike. Democracies will have come to different conclusions depending on whether voters are more concerned over abuse by criminals, by businesses or by government agencies and their employees. Dictatorships will have come to different

conclusions according to whether they are more concerned to attract business or control the choices available to their subjects. Meanwhile the inefficiencies and vulnerabilities of over complex software and systems will have led to a backlash against tightly integrated services. The interlocking systems and networks of the Information Society will be both joined and separated at every level by filters and cut-outs to prevent any form of domino effect.

The side effects will include choice of regulation and legislation for products and services which can be electronically transmitted and, to a lesser degree, for those which can be delivered by air-mail. Regional legislation will still, however, apply to the rest, that majority of transactions which will still require local distribution and delivery, however they are ordered and paid.

Government as a competitive market

The power of centralised nation states will be crumbling. Federal Governments will be devolving power before they lose it. Most will be competing for jobs which could be located anywhere in the world. They will be bidding to attract multinationals who tend to base core functions in the most attractive places to live, to source transactions from those with the lowest sales taxes, to take profits in those with the most attractive corporate tax regimes, to base knowledge operations in those with the most attractive intellectual property rights and so on. They will be bidding to provide good quality education, law and order and social services to be a location of choice where key staff and high taxpayers will be happy to bring up their families and the corporation can recruit the skills it needs.

Education and training will be based on local access, including teaching support, to networked materials and support in a world where providers, including examining bodies and universities, are competing world-wide for paying students and customers. Content production and publishing facilities will be located under jurisdictions which provide attractive regimes for creating and protecting, licensing and exploiting Intellectual Property Rights issues in a world where materials and research may be networked or pirated world-wide. Global communications hubs will be based in locations where regulation is transparent, predictable and trusted. The growing vulnerability of large, network-dependent, centralised organisations such as banks, brokers and retailers to sudden and catastrophic collapse, whether from system failure, fraud, terrorism or “mere” market panic, will mean that these will devolved and backed-up across resilient networks of dispersed and protected hubs, from Guantanamo to Gibraltar.

All previous technology shifts (canals, railways, cars etc) have been accompanied by major population movements. Increasingly these have become international and not just local. High tax localities and governments could be left looking after the unemployed, uneducated and disabled on a declining revenue base. Part of the solution to such catastrophic social exclusion will have been to find ways of skilling and employing the underclasses to provide partnership life-styles to attract “wealth-creators” who will employ and support ancillary and service workers. Part of the solution will have been updated versions of the local self-help partnerships that predate the modern welfare state. Solutions based solely on traditional socialist or capitalist values will have been shown to be irrelevant or dangerously unstable. The falling cost of transmission and improvement in access to information sources will have had an impact on the prestige and life-style of the chattering classes akin to that which the printing press had on those of medieval scholars. The knowledge workers of Guangdong and Bollywood will undercut those of Guildford and Borehamwood.

One of the biggest obstacles to prosperity will have been the inability of Governments to respond to fundamental change and the inability of politicians to recognise that getting out of the way may be their most constructive contribution. At the end of the Eighteenth Century the French ruling classes tried to regulate and plan their way through a period of unprecedented technological and social change. They were guillotined for their pains as the economy collapsed under the weight of cheap imports from Britain. The British had gone for the opposite policy. They had decided on a bonfire of taxes and regulations using local initiative, the poor law unions, to pick up the pieces. That decision was no accident. Edward Gibbon had been a member of the Board of Trade under Lord North. The Decline

and Fall of the Roman Empire may no longer be read as widely as Adam Smith's Wealth of Nations or Thomas Paine's Rights of Man, it is far longer for a start, but, in its day, it was the most powerful political tract ever written. Its influence permeated the political and economic thinking of the ruling classes and educational establishment of Britain for half a century.

The next fifty years will see a similar period of change. A bonfire of regulation, planning and control may again be the only way of stimulating the growth in new and alternative employment that is necessary to avoid widespread social pain and disorder as traditional jobs and careers are destroyed throughout the private sector and falling tax revenues will no longer fund the national co-ordination overheads for services which can be run far cheaper locally. The survival of the nation states, let alone the prosperity of their citizens will have depended on a return to the presumption that social needs vary and are better organised and funded locally. Welfare states will have survived by recreating a kaleidoscope of partnerships, co-operatives and municipal enterprise, akin to that which ran most of the UK infrastructure before the post-war nationalisation, centralisation and standardisation of the utilities, health and social services and education system.

Information Technology will undoubtedly be used to greatly reduce the cost and improve the quality of government (such as the merging of income tax, national insurance and social security into a single intelligible system) but good quality welfare for an ageing population will have been achieved only by using technology to support local services based on partnerships between professionals and volunteers (many themselves pensioners or those previously viewed as disabled) across the public-private divide.

The Opening of the Educational Ghettos

Multi-career lives will be increasingly the norm and not the exception, with most of population needing to master the basics of another discipline or profession to short notice, several times in their working lives. Lifelong Learning will not just be a sub-set of Further Education. It will be the core which links all sectors of education. The Oxbridge Colleges will be among the first to realise the opportunities to regain financial independence and academic freedom on the back of "courses" targeted at corporately sponsored students or those with healthy pensions - a new generation of "commoners", who will finance the life styles of scholars and fellows well beyond the current imaginations of those who currently dominate University or Research Council politics.

Local learning centres will run franchised open learning centres for business, accessing the Microsoft or IBM global learning networks, alongside the Saga Certificate in Rural Religious and Secular Architecture (with weekly coach tours for pensioners to the Churches and Pubs of Surrey and Kent) and the William Hill Certificate in Statistical Probability (in-college betting facilities and 10% discount off admission to the local Race Course or Dog Track).

Many city schools still need to be fortresses of learning, like the old LCC Board schools, with high walls and broken glass to keep the children in and the parents out. But in 2051 they will provide round-the-clock on-line study facilities for all ages (so they are never left empty for the vandals to pillage) to bring hope to the hopeless and jobs to the unemployable. They will draw in funds from those learning for work or leisure, paid for by themselves or by their employers, as well as from those paid for by the taxpayer, through whatever route the funds trickle.

But that future is in our hands

The future is what we work together to achieve or leave to others to decide. Time is not on our side. If we are not going to be a ghetto of paupers on the edge of the global village, a latter day Cannery Row, surfing the cybercrud for snippets, we must enable our citizens and their children to acquire the skills to survive and prosper. We must provide the skilled and talented with the legal, fiscal and social climate incentives to stay, and use those skills and talents here, not across the Atlantic. We must take charge of the politics of the Information Society.

Only then will our children and grandchildren be willing and able, in a village of global mobility, to fund our pensions, yours and mine – because some of us (if not necessarily the judges who read this) will still be around, in frail, technology supported, dotage.