Appropriate Use of Computing Technology

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1. **As the computing boom gets quieter...**
2. **What benefit is a publicly open system?**
3. **What harm is in computerised systems?**
4. **So – what is appropriate in computing?**

Appropriate computing
or
Computing as if people mattered

1 As the computing boom gets quieter...

Mature computing technology

Computing technology has been applied in many areas of Western civilised life since its commercial start in the early 1950s. There has been unchecked growth in computer power, software size, sales and installed computers through three decades since then, despite wars, peace, booms and recessions in general business – until this near-depression. The newspapers continue to show us that the boom in computing has become quite subdued these days, even if it is not yet a bust. Profits are lower (even at IBM), margins are getting thinner, and it's possible for techies to lose jobs. It appears that in *this* recession computing is not immune.

I take this as a sign that computing technology is maturing in its relation to society. And it's about time: we can now catch our breath. The market for computing technology is getting saturated – or perhaps tired – as in the past other exponentially growing technology-based markets reached unexpected limits (supersonic commercial aircraft, VLCCs (super-tankers), fast trains (still being debated)...). Although society has internalised the idea of computing which is centred in an organisation, it is still catching up with the recent spread of personal and distributed computing systems and wide area networking; and for whatever reasons there is little excitement with the idea.

At the same time the rate of change in computing systems is slowing down. Factors of ten increase in hardware speed are still being delivered every few years, but are dissipated in supporting new versions of the same old software with an effective speed gain of only a factor of two or three. Software change is slower than previously, and open systems standards are on the increase. Which is cause, which the effect? Defining standards is now possible because change has slowed; they have not been accepted for long enough to have themselves slowed software change. We can see this as maturity arriving in computing, or put simply (as when Dave was lobotomising HAL in an apocryphal version of *2001: A Space Odyssey*): "*People do not want computers that can do everything. They just want computers that are [choose a system here] compatible.*" At least we now have a choice of three systems to be compatible with in small computers... so the incompatibilities within one system or another are becoming hot topics of debate, like *which UNIX? what should be in POSIX? which windows? which look-and-feel?*

The benefits...

The general benefits of computing are ubiquitous. They start with general information processing for organisations, providing efficiency and functions that manual processing made impossible in time or at acceptable cost, hence cheaper operation and less fraud. They provide increased knowledge of our economy and environment, from LandSat and SPOT satellite image processing to more detailed economic surveys and statistics. They are in semi-embedded systems for information and control such as taxi and emergency vehicle despatch, machinery, electrical and water supply control and safety management, ABC radio broadcast production (a recent low-key Australian world-leading achievement), telephone switching, weather data management and forecasting support, air traffic control, Automatic Teller machines to replace human bank tellers, and EFTPOS to provide novel services in consumer banking; quietly embedded control systems (car ignition and throttle control, consumer electronics, ovens, dishwashers, aircraft fly-by-wire controls and flight management systems) and noisy embedded systems (video games, virtual reality, wilder and wilder variations of pocket gadgets, smart weapons with pinpoint accuracy on purely military targets, the Star Wars programme's brilliant pebbles). We have gained safer and cheaper aircraft control, cheaper engineering design; more efficient, less polluting car engines; cheaper control functions, new entertainment functions, new control functions.

Some of the benefits have come only recently, with the very obvious computer: the standalone and networkable personal computer. The personal computer has been important not only for what it does (the majority of PCs are sitting in homes, where they are used primarily for games and homework assignments) but in gaining general public acceptance for computers as tools in everyday life.

...and the costs

But the costs of computing have also been growing. With more powerful information processing our society has lost some of its happy ignorance about economic and criminal matters – which has spurred politicians into taking tighter watch, and perhaps tighter control, of our personal financial affairs, and charging more taxes in supposedly unnoticeable small bites. Cheaper information processing has meant inevitably that jobs have been displaced or lost (cheaper *must* mean smaller or fewer wage packets somewhere), and has pushed one side of our society's continuing contest between cheapness and quality – quality of goods and services, and quality of life. Computing has exposed us to new undesirable behaviours: the new addiction to computer video games, and to hacking; and to further decreases in personal responsibility for death-dealing actions, increasing the confusion between war and video games.

We appear to have also exposed ourselves to more intense versions of existing problems. Engineering design has always been subject to honest mistakes, misleading assumptions, and inadequate theories, which become apparent as bridges and buildings falling down (do we really want a software design process that is only as reliable as bridge design? remember Tacoma Narrows, King St, West Gate...). Using computer technology has not relieved the engineer of responsibility, but the computing tools that reduce some of the tedium have removed some of the hands-on feel for the design that guards against previously obvious errors. The risk of over- automation has also become evident in aircraft control and flight management systems, though the inquiries are still out on the continuing series of Airbus 320 crashes (I read in comp.risks that they can all be blamed on "lack of height," but that's a common problem in all aerial activities – it isn't the fall that kills you, it's the contact with the ground). And in nuclear reactor controls (Three Mile Island). And in car throttle controls (Porsche). It is always possible to blame the user when the interface design is at fault, and it is dangerously easy to let new technology determine the interface.

Technology has always provided us with ways of distancing our consciences from the fact that our actions are killing people, and the "smarter" the technology, the more distancing the killing. Smart weapons used in the Gulf War of 1991 provided clear TV images of "surgical" explosions that were almost as good as video games, and coupled with the one-sided weight of casualties, allowed the (other) one-sided media reports to convince us that we had a clean, surgical, war involving only military targets (obviously only bunkers, missile bases, vehicles – soldiers were not reported as killed, let alone civilians, until the reports of rumoured slaughter that gained enough strength to stop the shooting, as we are only recently discovering and squabbling over). There is never a clean way to fight a war, but we were shown the image of one through the surgical precision of smart bombs, and the gee-whizz Hollywood qualities of Patriot anti-missile missiles. Never mind that the majority of explosives used were old-fashioned

blunderbuss dumb "iron" bombs, or that the Patriot missiles had far more morale effect than military effectiveness – as did the Scud missiles they were destroying. Using smart weapons certainly does not make *us* any smarter.

Comparisons of the Gulf War with another recent televised conflict are perhaps informative in pointing up the different attitudes of two countries to military technology. The British used many smart ground-to-air missiles and high-tech bomb guidance systems, but did not dominate the ground by aerial and armoured means alone: the foot soldiers had to yomp across the land that they were fighting to liberate, and came face to face with their enemies at short range, and many of the missiles were hand-held.. Comparatively more soldiers died on the winning side than in the Gulf. And the memory of that war is more horrific in British minds: the people are aware that there is a price to be paid in taking mailitary action, however glorious the result. If we must have wars, then it is better that they should be painful for *both* sides.

For the majority of humankind, where is the benefit from computing? For a small percentage in Sri Lanka, China, and the Phillipines there have been new jobs in low- level assembly of components onto printed circuit boards. If computerised trading on world financial markets has increased the efficiency of world trade to the benefit of undeveloped countries, then there has been a benefit – but it would be hard to argue that such an effect has happened. Personal computers used by locals in agriculture, science, economic management have had some results in the third world; but they are a long way short of having any real impact on poverty, disease, malnutrition, and the symptoms of food and resource shortages: government persecutions of their own people, and civil wars.

Non-networked personal computers are appropriate technology for countries where even voice telephone networks are unreliable, but in many undeveloped countries even this level is difficult outside cities, where the basic infrastructure such as any reliable electricity supply is still lacking. In these cases any effort to provide computing (e.g. via battery-driven laptops) is hardly justified; scarce hard currency can be wasted in the political game of putting computers into up-country schools that have no power, let alone any experienced teachers. (Even Australia had trouble finding teachers to use school computers, for the first two years.) If the university centres can get UNIX and direct satellite connections, is the rest of the country advanced by this? A more appropriate computing technology might be that which leads to direct technology transfer to the rest of the country, such as concentration on personal micros. We have enough trouble in our own relatively developed country transferring students with training on university UNIX systems to the more common working world of Novell-networked PClones. We should not wish such problems, among all the others, on the under-developed countries.

Back at home, advances in networking personal computers are changing this originally useful and acceptable technology before it has hardly been digested. After a few glorious years of users getting control over their own computing environment, however inefficiently (*it sits there on my desk. I can turn it off and turn it on again. I can take the disks away in my pocket. I can see the disks, the printer, the programs.*) we have started to re-impose control: the Network. Network management and shared remote files, electronic mail and shared printing, software upgrades while your back is turned – all much more efficient and up-to-date, but actually more threatening, and weakening the control of users over their own working environment. And at the same time the work now absolutely requires the use of that computing environment.

The near future holds more promises: the paperless office, the universal computer networked society (with information for everyone and from everyone on the bulletin boards, as seen by science fiction seers Orson Scott Card (*Ender's Game*) and David Brin (*Earth*)- perhaps dominated by multinational mega-corporations and nibbled at by cyberpunks, as seen by William Gibson (*Neuromancer*)); rapidly disseminated, electronic magazines and journals, masses of selectable information and advanced knowledge at every person's fingertips. The universal information society depends on commonality and openness of information access, interconnectable communications, mailing systems, and databases, on a few base systems to make software production and upgrading feasible.

2 What benefit is a publicly open system?

The normally recognised benefits of having *open* systems are too well known for me to rehearse here: practical interworking, competition of creators and suppliers, stable platforms for software development

etc etc. These can be summed up as cheaper software systems, hence more powerful or more affordable, or higher quality, information processing. The openness of *access* that is also in prospect, enabled by widespread inter-working computer and communications networks at low cost, has greater social impacts. And such open systems, with widespread and publicly known interfaces, and open access, are also tempting to the invasive hacker.

For the wider community the impact will be in two fields: entertainment and open information. Entertainment continues to dispose of a large proportion of personal incomes in developed countries. Any technology that can be successfully turned to purposes of entertainment has assured sales of millions and enormous market penetration. Virtual reality is painted as a rich interface for the world of models and scientific visualisation, but its justification in the pockets of many may be more direct: technosex! teledildonics!

Integrated networked communications and computing has promised us the paperless office for some time now, but paper consumption is higher than ever – on facsimile transmissions, photocopies of faxes, slick laser-printouts of less carefully written material. The paperless newspaper was supposed to arrive and displace all others, combining interaction and user-driven selectivity with access to all the up-to-the minute information – who needs interaction at breakfast time, or over that first cup of tea in bed? There is a feeling that millions of words written by journalists and released by governments, businesses, and action groups, are editorially cropped from the newspaper that is presented, and lost to the potentially interested reader. However, interactive selection is not what is wanted by many people, whose selectivity is either momentary via a TV channel select, or made by a single choice of newspaper that remains constant thereafter. Life is too short to make lots of decisions about the news! The provision of megabit bandwidth into the home as the norm, expected in the next decade, may change this: but for people now used to information in exciting moving images, mere words are insufficient, however rich and varied the sources; and the cost of producing a TV item from raw video shots is high enough that not every bit of video can be post-produced to be provided for public access. The events chosen for any video coverage are already selected for general interest and general newsworthiness anyway, and much of importance that is happening is not videoworthy. All that we can expect is that more *channels*, such as CNN, will become available here directly.

Telecommuting has made hardly any impact, though sufficient technology is already there at a reasonable price: but the workplace fulfills an essential social function, and most jobs contain essential informal interaction with other workers for office politics, support, stimulus, awareness of other work, romance, promotion or demotion gossip, etc., regardless of how a formal job description might show that the job's inputs and outputs and quality supervision can be delivered by remote electronics. Perhaps again video telephones will modify this.

Only in one country, France, has interaction with public databases been a success as the Minitel system has extended the telephone network. Who is using remote databases and bulletin board systems in other countries? those who need the information on rapidly changing prices for their jobs, where the database is maintained (and its services paid for) on a commercial basis; those with a technical amateur leaning to semi-private modem hook-ups; and a few businesses and semi- government organisations that provide work-related access to the InterNet. One significant exception is the gentle alternative – the peace and green movements, many of whom retain a belief in accurate information underpinning political activism, and are using their own computer-based networks very effectively in keeping the faith and spreading awareness for new campaigns.

Otherwise on the net we have a very low quality interaction, techno-babble, net Babel, as serious contributors are drowned out by the chit-chat of the keyboard happy, who "*remember something like this from college, or from a book I read, but can't remember the reference to it right now, but I think..*" The ideal of a Forum or Agora of electronic debate has perhaps been realised, if the Forum is seen as gossip around the market stalls, with only the occasional orator breaking through the babble. But we have no mechanism for catching the attention of everyone! all communications are equally loud, and equally blandly packaged (no bright clothing, loud voices, cymbals or trumpets - in some ways our current incarnation of cyberspace is very grey and one-dimensional. The only bright spots are the flames, and they are usually very unimaginative and more personal hurt than flights of rhetoric to amuse and persuade the crowd.) Serious public newsgroups with any of the weight of a journal like Byte, let alone of a learned journal, are very few; for protection, the serious work has gone underground into private electronic mailing lists. The amount of babble defeats the original purpose of open information, for who

can keep up with more than a few newsgroups? using the blinkers of prior, fixed, selection of groups is essential to have any time left apart from the net.

3 What harm is in computerised systems?

The costs of having computerised systems are the obvious financial and economic costs, and also the direct, and potential, harmful effects on individual people and on society. Some of the harm is the result of automation, that is, replacing people's jobs by computer processes. Others are the results of changing procedures and uncovering unexpected uncertainties and risks; and some are the result of over-automation. And some is the result of well-intentioned people making use of powerful technology in ways that damage some of the qualities in our way of life.

Jobs: those who were typists, then keyboard operators, word processor operators, are themselves doing other jobs; but a missing generation of typists are now unemployed. Many other jobs have been created in other fields, many requiring higher skills (computer programmers, salespeople) and by multi-skilling higher- level jobs and displacing keyboard specialists, more people are employed at this level to perform the same final amount of work. Many job categories have almost disappeared: telephone operators, telegram deliverers, accounting machine operators, quill-pen clerks... we cannot attribute *all* of these to computing. But there are visible effects elsewhere: smarter manufacturing machinery has obviously displaced labour in general.

The unexpected risks of using computing technology in technical areas have been described earlier. The result of using computing technology, in many areas, has been to remove the human from the decision making and control loop. This leads to decisions that are wrong, even according to the system designers (and frequently blamed on the human whose decision making has been made harder, or based on mi-represented information, by the computer system); to decisions that are correct according to the system designer, but dubious or incorrect, according to the ultimate authority for the system, who may have to operate it at some remove (the generals, pilots and politicians with respect to the smart bombs, or to the Vincennes incident of shooting down a civil airliner; the government's intentions with respect to the SDI (Star Wars) program, threatening to use dangerously unreliable high technology in a system whose deployment would destabilise the nuclear balance, as it was at the time SDI was conceived); and to more homely and immediate example of de-humanising the subjects of the computer, you and me, by reducing our identity to impersonal numbers. The depersonalisation has the attendant risk of errors, where the numerical identification is mistaken for the person themselves and incorrect attributes associated with them. It also permits "computer error" to be blamed for failures in computer procedures that are no longer humanly cross-checked, as in this month's examples of Australian Department of Social Security and Taxation Office letters being scrambled with supposedly confidential personal information going to the wrong people; and for people with bureaucratic authority to apply such erroneous information to the direct disadvantage of actual people, as in numerous, continuing, horror stories.

Stronger detection and control of financial transactions has the benefit of reducing fraudulent claims on government benefits, detecting criminal activities through trailing money, tracking down debtors or defaulting family maintenance payers, directing advertisements at consumers by better knowledge of their purchasing patterns... At some point this merges into intrusion into privacy. Although Australia has little articulated sense of personal rights of privacy (and even less in legislation or constitution) there is evidence that we share a sense of some rights: the strength of feeling against the Australia Card, the idea of "no sticky-beaking" and the reluctance to "dob in your mates", and the existence of restrictions on telephone tapping. Computing technology has eroded this freedom. Cross-matching of data files by the "mean machines" in Australian government departments has become common practice; many of the effects that were attributed to the Australia Card have in fact come to pass a little less efficiently under cross-matching and the existence of tax-file numbers, and the availability of enough computing resources to work around the lack of a single identification key. There are no legal restrictions on monitoring electronic mail and few practical ones: what appears to be a very private medium of communication is in fact as open to snooping as a party-line telephone, or a cellular radio phone. Advice: send electronic love letters encrypted, and beware of traffic analysis!

Of course, we have nothing to fear from legal or illegal availability of computerised information if we have done nothing wrong – do we? What is wrong depends on who knows about it, in most peoples'

lives (our conscience is our own to square our conduct with). But what may be legal behaviour may be personally damaging, and may well become public as a result of invaded privacy. A little love affair, a medical history, a parking offence, a delayed loan repayment, police called to a noisy party or a straying dog... any of this information may have harmful effects in the hands of partners, friends, or employers. The computing technology has opened a hole in some parts of our lives that we have not yet acted to fix, in this country. Aware, whistle-blowing, socially responsible computing professionals please step forward...

4 So – what is appropriate in computing?

This is no plea for Luddism. There are great benefits to humankind from computing, and the potential to apply many more to the developed countries and to the undeveloped countries that have yet to see much appropriate computing technology. It is necessary for us to balnace many things in weighing up what is an appropriate technology in computing as in other areas: balancing organisational and economic efficiency, jobs which provide useful and fulfilling employment, information power, information tyranny, new and increased risks. But we have some immediate problems: the loss of personal power over computing technology to the greater good of the personal computer network, the loss of imagination to the mediocre marketplace in what the wider public access network will provide, the lack of any appropriate computing technology for the majority of humans, in undeveloped countries, and the treat of increasing military, engineering, and bureaucratic control of people via computer systems with too little community vigilance.

This is no plea for Luddism. We should not destroy computing machines, nor cease our efforts to "make machines in the likeness of a human mind" [the commandment of the Butlerian Jihad, according to Frank Herbert's *Dune*]. But this is a plea to the systems and applications designers, who are individually and collectively, responsible for some aspects of the systems that they build and deliver for use. Please *be* responsible – and develop new systems and applications as if people (on both ends of the information processing) mattered.