A Re-Vision of Information Systems

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Abstract

The theme of the Conference, "Revisioning Information Systems", is examined. A two decades old vision of information systems is reviewed here by its author to establish the groundwork for a re-vision. The original vision, and its prediction, is evaluated, and used as the basis for a re-vision and a new prediction. Some implications of the new prediction, and some impressions gained while arriving at it, are reviewed.

THE CONFERENCE THEME

The theme of this the 7th Australian Conference on Information Systems is *Revisioning Information Systems*. It must be assumed such curious wording was chosen deliberately to provoke, and it is indeed provocative at several levels.

Even the use of the phrase *information systems* is provocative to anyone who is concerned that agreed and legal standards should be upheld. Ian Gould (1972) in reviewing the work that led to the International Standard Vocabulary (ISO 1991) wrote that " it is difficult, if not impossible, to find a concept that could reasonably be called 'information processing'; our machines can surely only process data." So the very popular view that equates an information system with a computer system is, at the very least, non-standard.

Although in one sense this battle for correct terminology is unwinnable, (like the battle to preserve *impact* from synonymy with *effect*), in another sense it must be kept up at least to influence how people see information systems. When the Conference's Call for Papers says " There needs to be a move from a predominantly technological focus . . . to an information based paradigm", a return to the old and well thought out standard definition of information is surely intended, particularly as the Call goes on to say that the move " will seek to contribute to national life at all levels . . .". A wholly laudable ambition.

The word *revisioning* is also provocative, and not just for lexical reasons in this time of Oversight Committees ! The English language is, or should be, a constant delight to its native users at least—consider the difference between telling someone they are a *sight* and telling them they are a *vision*. The Conference, then, is not to be about revising any or all information systems, but about looking at how information systems have been seen and speculating about how they should now be seen.

To re-vision information systems, then, an original vision is needed, and one not of computers, but of what computers are used for. An article entitled *The Major Tasks of Data Processing* published in the 10th Anniversary issue of the Australian Computer Journal (Holmes 1977) provides a useful starting point for such a re-vision because it presents an historical vision of information systems, a vision which was an overt reaction to the then more usual *from reed relay to silicon chip* school of computing history which saw computing in terms of its machinery rather than of the machinery's use.

AN OLD VISION

Major Tasks saw development roughly in decades, starting from an Archaic Period (pre-1950s), moving to a then present (1970s) Data Management decade, before speculating about a 1980s Text Manipulation decade.

Each decade was seen as having a main task, a dominant class of processing, and a secondary task, a new class of processing in development. The tasks of each decade were seen as being made possible by developments in technology in pursuit of a particular objective. This historical vision is very briefly shown in the following table, adapted slightly from that of the original article, in which the *Main Task* refers to the dominant style of processing developed from the *Secondary Task* of the immediately prior decade.

	Decade	**Main Task**	**Secondary Task**	**Developments**	**Objective**
—	Archaic	Tabulation	Computation	Plugged panel	Simplification
1950s	Stored program	Number processing	File processing	Magnetic stores	Automatic computation
1960s	Operating system	Job processing	Transaction processing	Direct access storage	Machine productivity
1970s	Data management	Record processing	Text processing	Terminals	Concurrent services
1980s	Text manipulation	Enquiry processing	Request processing	Networks	Universal services

There is no need to review the early details of this vision. They are given in the original article, which included tables of detail for each of the decades considered, and had the benefit of the clarity of hindsight. However the depiction there of the 1970s (seen from its midstream) and the 1980s (seen in a crystal ball) should be explained so that their sequels can be better understood.

By this account, the *Data Management* decade owed record processing (the processing of transactions of formatted data), to popular adoption of the prior decade's transaction processing, and it owed text processing (the processing of transactions of unformatted data), to development beyond transaction processing. These two major tasks were seen as depending on " the evolution of the operating system" to " taking complete responsibility for all data available to . . . the operating system"—what would now be called integrated database support.

The *Text Manipulation* decade would, it was predicted, owe enquiry processing, " textual, graphic, and even facsimile data communication", to popular adoption of the prior decade's text processing, and it would owe request processing, " [inter]active and manifold", to development beyond text processing to cumulative and interactive data processing. These two major tasks were seen as springing from " pervasiveness of data processing services . . . encouraged by the cheapness of data storage and transmission, and discouraged by the cost of people . . .".

These two explanations display the pattern of development claimed for data processing, and so for information systems, whereby the Main Task of any decade is the popular adoption of the Secondary Task of the prior decade, and the Secondary Task is developed beyond the prior decade. This perhaps Procrustean view emphasises the steady evolution of use of the technology and dismisses revolution as a valid depiction.

HOW GOOD WAS THE OLD VISION ?

Each decade discussed in the *Major Tasks* publication is summed up there in tables with entries under topics such as *Data*, *Programs*, and *Example Applications*. Many of the entries in these two tables now seem quaint, if not somewhat strained. The depiction of the 1970s is probably supportable, but that of the 1980s is somewhat skewed because it supposed the continuing development of networked terminals, and failed to anticipate the widespread adoption of personal computers for the secondary task of the '80s.

For the '80s the items under the main task, *enquiry processing*, were not very far astray, given that corporate computing still hung onto as much control as could be managed, and provided large scale services on mainframe computers to networked dumb terminals (later to be personal computers) to provide both customer services, such as cash withdrawal by ATMs (then, Automatic Teller Machines, at least in this country), and employee services such as electronic mail.

The items under the secondary task, *request processing*, were a bit off target, mainly in their example applications, and because of the popular adoption of personal computers. The next table, in which the items under *Programs* and *Operations* show what is meant here by request processing, is modified from the original along these lines.

1980s: Text Management

Enquiry Processing	Request Processing	Enquiry Processing	Request Processing
• *Data*		• *Operations*	
Stored online	From keyboard	Natural language or formal Q&A	Iterative, cumulative Problem solving
• *Programs*		• *Machinery*	
Input insensitive	Input sensitive	Special purpose terminals	Personal computers
Concentrating on simplifying the human interface	Adaptive Richness of capability Interpreted, with special key and "mouse" control	• *Example Applications*	
Static, modular		Integrated databases	Word processing
		Operational databases	Spread sheets Personal databases

Two questions are pertinent here. *Firstly*, why was the adoption of personal computers not easy to foresee ? *Secondly*, how should the secondary task of the '80s be seen in retrospect, compared to what was foreseen ? As to the first question, perhaps the popular adoption of personal computers should have been foreseen. Certainly there were small specialised word processing systems (like the popular Wang series), and overtly personal computers (like the IBM 5100 series) with spread sheet and database software, quite widely used throughout most of the ’70s. But these were fairly expensive, and were seen as a threat to the traditional data processing departments of the large institutions which could afford them, and which saw their future in centralised control of all computing. Apart from cheapness, what was lacking, it later became obvious, was a good full-screen interactive interface to the main personal use programs.

This gives the answer to the second question—how did the secondary task of the ’80s turn out ?— and the answer is, through adoption of three simple well-interfaced “ killer” applications, of which by far the most used was the word processing application. When surveys of personal computer use were carried out in the ’80s, the result could usually be paraphrased as “ 90% were used only for word processing, and the rest were used for word processing 90% of the time”. No wonder the electric typewriter disappeared overnight, and diskettes and later hard disks flourished.

WHAT NOW ?

The revision for the information systems of the ’80s provides a basis for a vision for those of the ’90s. If the pattern claimed in *Major Tasks* holds, then the main task of the ’90s is a popular adoption of the secondary task of the ’80s, and the secondary task of the ’90s is a development of the secondary task of the ’80s. The next table shows a proposed vision for the ’90s, and demonstrates the claimed pattern.

1990s: Multimedia Support

Publication	**Image Processing**	**Publication**	**Image Processing**
• *Data*		• *Operations*	
Text, tables, graphs	Pictures, sound	WYSIWYG	Graphical
• *Programs*		Fonts and colour	interfaces
Integrated suites	Evolving	• *Machinery*	
Display drivers	and generic	Laser printers	Digital
Multiformat	Time	Scanners	detectors
imbedding	sensitive	LANs	Coders/decoders
Object-oriented	Transformational	• *Example Applications*	
	Special purpose	Desk Top	Video games
		Publishing	Tomography

For the ’90s, the main task is seen as following from the word processing secondary task of the ’90s in a quite straightforward way, leading to what is called Desk Top Publishing when its result is to be put out to a printer, or is called multimedia or hypermedia when put out to a screen, but which is here called *publication* to indicate the formality with which a variety of data—text, tables and graphs from spreadsheet and database processors, and pictures from scanners—can be combined for presentation to a user.

In principle, this re-vision sees main task information systems of the ’90s as offering variety and high quality of presentation through the use of processes which allow the presentation to be inspected as it is being developed by the user. Note well that the major tasks of prior decades persist as background to the major tasks of any decade. Thus, enquiry processing and record processing continue traditionally as background to the two major tasks of the ’90s.

For the ’90s, the secondary task is seen as developing from the text processing of the ’80s by going beyond mere text to the processing of sound and of images. This *image processing* particularly enriches information systems through programmed generation of images. While the main task of the ’90s routinely presents static graphics showing for example scanned static images or tables of numbers graphically presented, the secondary task adds movement to video games and interpretation to scanned stimuli such as otherwise imperceptible X-rays or gamma rays, for which very fast processing is needed.

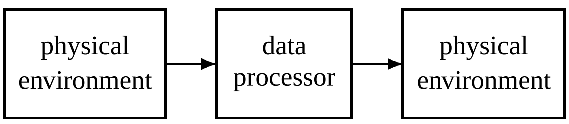
As a background to the major tasks of the ’90s, two developments are particularly significant. First is the popular use of networking, though in the ’90s this is of most significance in coupling personal computers and workstations through Local Area Networks (LANs) to achieve something of the capability of dumb terminals networked to main-frame computers which was so significant in the the ’80s. Second is the adoption of both digital encoding, as for example in the obliteration of analogue encoding in the music industry, and of digital data compression which will make digital TV practical by the end of the ’90s and which will in itself have a dramatic effect on the information systems of the ’00s[1].

What is an Information System ?

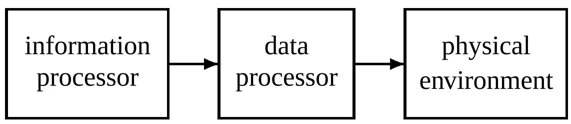
In the ’90s, the variety of computer applications, the proliferation of special purpose processor chips, the adoption of digital techniques seamlessly into a multitude of consumer products, and the onset of the Internet, make a review of what should be meant by the phrase *information systems* timely. Since the standard vocabulary has it that *data* are representations of facts or ideas, whereas *information* is the meaning that people give to data, to abbreviate slightly (from ISO 1991), then data processing is done by machines and information processing by people.

Because people use machines, and not the other way around (at least not yet), then an information system is a combination either of information processors (a social relationship, or, more generally, a society), or of an information processor and a data processor. But, in the latter case, what kind of a combination ?

Data processors take in data from the physical environment (through sensors) *or* from an information processor (a person), and put data out to the physical environment (through effectors) *or* to an information processor (a person). Of course, the *or*s here are not exclusive, but may be treated as such to allow a simple classification of systems which are based on data processors, as shown in the following diagrams.



Servomechanism

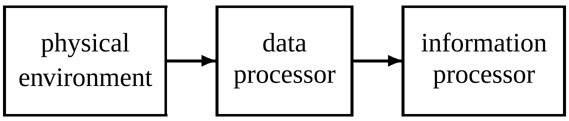


Control System

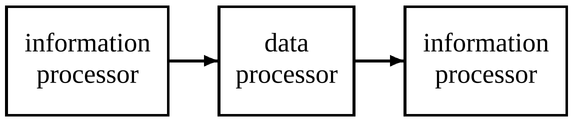
A data processor that merely puts its data out to the physical environment is not thereby the basis of an information system since the data it puts out are not converted to information. Rather, the

[1]The problem of pronouncing *the ’00s* has been discussed in *New Scientist (1996 June 8 p.64)* with no final agreement. Easiest on the tongue is perhaps *the nillies*, or *the willy nillies* if a modicum of prediction is desired.

system is a control system. If such a system is fully automatic with its input data coming only from sensors, then if it is simple it is called a servomechanism (a word derived from the Latin *servus* meaning *a slave*), if it is complex, a robot.



Monitor System



Information System

A data processor that puts its data out to an information processor is not thereby necessarily the basis of an information system. If its input data come from the physical environment automatically through sensors then it is not fully an information system but rather merely a monitor system. If its input data come from an information processor then it must surely be considered the basis of an information system !

If television broadcasters are considered to be data processors, and if what they broadcast is considered to be merely a representation drawn from the the physical environment (which only a complete cynic would aver), then the television industry could be classed as a monitor system for its viewers. By contrast, if the physical telephone system is considered a data processor, then that system together with its information processors must be an information system.

This classification gives a somewhat broader than usual meaning to the term *information system*, as it is normally taken to apply only in government or business, that is, when at least one of the information processors involved is an employee. The greatly accelerating adoption of computers for domestic uses, for example as personal organisers, strongly suggests the unusually wide meaning advocated here. Any prediction for the ’00s is compelled by this popularity of computers to encompass broad social issues.

Only if a clear and accepted distinction is made between *data* and *information*, can a clear and useful distinction be made between people and machines as components of information systems. Any doubts about the validity of this distinction would swiftly be dismissed for anyone reading recent literature on evolutionary psychology (in particular, Baron-Cohen 1995).

Most unfortunately, the two terms are usually taken to be at least partly synonymous. And it is not easy to correct. Questioning in one case revealed that third year computing students who were clearly, emphatically, and repeatedly told of the standard distinction in the first year of their studies, had forgotten it. When pressed, the best distinction one class could make (and only after I strongly pressed them) was that information is data arranged so that they are useful.

One of the most important implications, though, of accepting the standard definitions, and the consequent classification given above, is that professionals and students in the field of information systems should be at least as concerned with information processors as with data processors, which is not typically the case. The formal study of information processors, *cognitive science* (Gardner 1985), should be a salient part of any formal course of study of information systems. I would be happy to provide any enquirers with details of the cognitive science I have been teaching for some years now in my Department’s course offering at Launceston.

WHAT NEXT ?

The most likely criticism of the picture given here for the ’90s is the lack of emphasis on networking. However, there is a good defence to this. Although digital telecommunication already has a long history (Holzmann and Pehrson, 1994; Napoleon built a very effective international digital network reaching to Spain, Italy, Germany and the Netherlands), and although the adoption of optical fibre as a transmission medium has led to enormously increased rates of data transmission, the main social effect of networking will not start to be felt until the ’00s.

There are three reasons for this. *Firstly*, simply connecting data processors gives us nothing new. The transmission of data between components of a computer is much like that between computers. Coupling data processors produces a more powerful data processor. *Secondly*, the wide deployment of optical fibre, as either FTTC (Fibre To The Curb) or FTTH (Fibre To The Home), will not be achieved for quite a few years—in Australia, even Telstra’s HFC (Hybrid Fibre Coax) based FSN (Full Services Network) is only now being planned to supercede its not yet fully completed narrowband FMO (Future Mode of Operation)[2] twisted pair based digital telephony network (Whittle 1996). *Thirdly*, effective exploitation of the capacity of the optical fibre network awaits the adoption and proving of standards for, and the development of equipment for, digital video (Perry 1995) and for the optical switching of its signals (Thylén *et al.* 1996).

But the arrival of cheap digital video and the establishment of optical fibre networks will have two major effects, which may be construed as giving rise to the main task and to the secondary task of the ’00s, as shown in the following table.

2000s: Grand Networking

Reality Processing	**Entertainment**	**Reality Processing**	**Entertainment**
• *Data*		• *Machinery*	
Archived/real-time	Stored video	Broadband networks	Retinal
multimedia	Large models	Client computers	projectors
• *Programs*			Body sensors
Search engines	Simulators	• *Example Applications*	
Archive managers	Image manipulators	Conferencing	Video on demand
• *Operations*		Three dimensional	Virtual reality
Adaptive	Whole body	modelling	Stimulus enhancement
Agentive	Multisensory	Smart rooms	

The main task is the huge enhancement of the image processing of the ’90s through digital video cameras for the capture of images, digital signal processors for modifying those images, vastly greater digital storage capacity to store those images, and optical fibres to transmit them very quickly. Quick transmission will make mediated visual communication the theme of the ’00s, and sensors other than cameras make developments like “ smart rooms” possible (Pentland 1996).

There is an anticipation at present that Internet and its World Wide Web will dominate, if not

[2]The digital telecommunications industry is infested with this kind of abbreviation to a degree beyond the wildest dreams of any data processing jargonist of yore, as a glance at any current telecommunications journal will demonstrate with ghastly clarity.

monopolise, the information systems of the '00s. Without any doubt whatsoever, the general interconnection of the computing systems of the world will remain for the foreseeable future an accompaniment of information systems, and this is the essence of Internet. But the details can be greatly improved—for example, the ASCII character set is a standing disgrace and a grotesque hindrance. In any case the long term prominence of the World Wide Web, at least in its present form, seems doubtful to some at least (Berghel 1995).

The secondary task of the '00s is likely to be the development of participative entertainment on top of the inevitable Video On Demand which its owners hope will justify huge investment in the optical fibre networks such as those already being rolled out in Australia (Whittle 1995).

Since it is likely that the demand for passive video-on-demand will be satiated quickly, developments from that basis will be hustled by its providers, and two lines of development will be sought. *Firstly*, the stimulus provided by the video will need enhancement, and this may well take the form of image projection directly onto the retina (Dagnelie & Massof 1996), if not of extension to stimulation of other sensory modalities. *Secondly*, the passive reception of video will be deemed insufficiently stimulating so participation will be demanded, leading to a convergence of video movies with video games, a technology already being developed. Notice that, while the original video-on-demand systems might not seem to fit within the classification of information systems, participative video certainly does, and here the information processors are not employees but customers.

Of course, other analyses of the prospects for digital technology in the near future are possible. For example, David Messerschmitt (1996), in discussing the future integration of computer and telecommunications systems, contrasts client-server and interpeer applications, giving them a distinct main task/secondary task flavour. Although this would redistribute the applications given in the table above, and although it is rather more sedate, the prospects are much the same in both analyses.

In the analysis given here, however, while the main task of the '00s, reality processing, supports and boosts the richness and expediency of interpersonal communication, and smacks of enabling and extending human capability, the secondary task, entertainment, emphasises a substitution of reality, and smacks of disabling and diminishing human individual and social capability (*passivation* (Hoos 1983)) through gross and artificial satisfaction of the senses—the philosophers' Brain in a Vat come grotesquely true (Collier 1990).

	Decade	**Main Task**	**Secondary Task**	**Developments**	**Objective**
—	Archaic	Tabulation	Computation	Plugged panel	Simplification
1950s	Stored program	Number processing	File processing	Magnetic stores	Automatic computation
1960s	Operating system	Job processing	Transaction processing	Direct access storage	Machine productivity
1970s	Data management	Record processing	Text processing	Terminals	Concurrent services
1980s	Text management	Enquiry processing	Request processing	Personal computers	Personal services
1990s	Multimedia support	Publication	Image processing	Signal processors	Information richness
2000s	Grand networking	Reality processing	Entertainment	Optical fibre	Mass marketing

To see the predictions for the '00s in a proper perspective, it is essential to understand that, for any of the decades shown in the summary table and in particular for the last decade shown, all the main tasks of prior decades persist and are enhanced by the later techniques and technology. The main and secondary tasks of any decade are, in other words, underpinned by the continuation and enlargement of prior main tasks.

SO WHAT ?

Hegel, through Bernard Shaw, gave us perhaps the most memorable historical aphorism: *If there is one thing we learn from history, it is that we learn nothing from history*. Hegel's original remark less memorably asserted "that people and governments never have learned anything from history, or acted on principles deduced from it." If there is one reason for considering the history of information systems, it is to enable us to give the lie to Hegel's assertion.

Western civilisation has been marked by cycles of slow technological development whose eventual popular adoption causes rapid social change if not destruction. This pattern can be seen at various scales both of time and locality. The history of the adoption of printed books in Europe shows a typical slow adoption and élite use, with only late popular use. On the other hand, the recent adoption of the snowmobile by Lappish tribes compressed the slow adoption followed by rapid popular (and socially catastrophic) use into only one decade (Pelto 1972).

The content of this article so far might well convey to the reader an impression that in adopting digital information systems our society is merely continuing the so-called Gutenberg revolution (Birkerts 1992). But during the writing and revising of this article its author, while bemused in his readings by the impression of rapidly accumulating popular use of computers and information systems, and of optimistic if naive attitudes towards them (indeed we *seem* to be going through a WWW-induced global technological euphoria), was being continally reminded of rapidly accumulating pessimistic portents for the very near future of our global society by other readings in even the popular press (some referred to in the following).

It is therefore the final thesis of this paper that, while the technology of information systems displays a pattern like a speeded-up Industrial Evolution (a Digital Evolution), and while its cycle is at present passing from the slow technological development phase to the rapid social change phase, there is very real threat that the Digital Evolution will amplify the social effects of the already only too evident adverse physical effects of the Industrial Evolution. It can well be argued that only a wise use of information systems can prevent those social effects from becoming destructive. It can also be argued that the physical changes forced on us by ordinary technology, and greatly speeded up by the organisational support of that technology through heavy use of information systems, look even more threateningly destructive, and the avoidance of their potentially dire effects depends even more on exploiting modern information systems.

The Past

The Industrial Revolution is a fantasy of popular history[3], as many recent history books are making quite clear (for example, More 1989). Indeed there were, in Europe, many centuries of slow technological development leading to half a century of gross social change which ended in the destruction of the First so-called World War, but we are are still experiencing the Industrial Evolution. The Post-Industrial era is a myth (Cohen & Zysman 1987).

[3]Though not of all popular historians. Lewis Mumford commented as follows in the caption to Plate 26 of his 1966 book, *Technics and Human Development*. "What is usually treated as the technological backwardness of the six centuries before the so-called Industrial Revolution represents in fact a curious backwardness in historical scholarship." Computing historians who ignore the six decades before the electronic computer are just as backward.

Just as there was water power before there was steam power, so there were electromechanical tabulators before there were electronic computers (Norberg 1990). Just as the popular adoption of steam powered machinery led to the industrial cities of Europe, so the popular adoption of digital machinery is about to lead to vast social change for people living in the Digital Society. Compared to the Industrial Evolution, the time scale of the Digital Evolution is compressed say ten fold, but the locality scale is expanded say a thousand fold as it encompasses now all the " developed" nations of a world with vastly greater population than a hundred years ago (Ehrlich & Ehrlich 1991).

Most of the dwellers in the industrial cities of Europe a hundred years ago lived in abject physical poverty, while the owners of the technology lived in luxury. Charles Dickens, and many other writers, depicted this moderately but quite clearly. In our Digital Society the gap between rich and poor is again widening and widening (Thurow 1987, Bassuk 1991, but see Franke & Chasin 1990 for a heartening exception). " Between 1968 and 1994, the Census found, the share of total income going to the top fifth of [United States of] American households increased from 40.5 percent to 46.9 percent. In the previous quarter century, society had been growing more equal." (Kuttner 1996) Between 1968 and 1994, economic development was dominated by the adoption of manufacturing and information systems not available in the previous quarter century.

Just as the Industrial Evolution was originally based in Great Britain and later spread to Europe, North America and Japan, fed by abducting and exploiting other societies, so now the Digital Evolution is spreading from Europe, North America and Japan, and again by exploiting the resources of other nations. Just as the many poor of our Digital Society are growing poorer, so are the poor nations (UNDP 1996). Increasingly so in both cases.

Just as the Industrial Evolution destroyed communities and cultures, so are communities and cultures now being destroyed. The world even now has an enormous social and cultural variety (Irenäus Eibl-Eibesfeldt (1989) shows just how much) that television is already destroying. When the Internet goes video, we will surely be moving towards a monocultural virtual society—well, those of us who can afford to join it.

The Future

" Advanced information technology ... promises to shape the course of future developments as [a] mirror image of the path to the present. The nation-state emerged out of a long struggle between monarchical and feudal power. Virtual feudalism would arise through an inversion of that process." (Mowshowitz 1992) Virtual feudalism is just another name for the Information Society, and the governments of developed countries are planning for this (George *et al.* 1995). The feudal expectation is clear in the projection given above for the '00s. The main use of information systems, which the major task of the '00s merely continues, is for the maintenance, support, and growth of major institutions, whether government or business. In this context, the secondary task of the '00s, high tech entertainment, has a flavour of making the serfs contented in their spare time.

The only problem is that the Medieval feudal barons needed the labour of their serfs, but the digital feudal barons don't much (Van Cott 1985, Hoos 1983). And modern feudalism has both a national and an international reality nowadays. Consider the attitude conveyed by the reported remarks of a representative of a multinational organisation at a conference in Adelaide proclaiming " Sixty five percent of all workers today use some type of information technology on the job." (reported *Launceston Examiner* 1996 Sept. 30 p.2). This is plain evidence of a widely-held attitude of international feudalism—serf countries don't count.

The context of the future for information systems is the world environment. The problems are well-known, and have long been documented. As a direct result of the Industrial Evolution, there will be fewer resources to be shared across a wider gap—Spain, Portugal, Italy, and Greece are fast becoming deserts (Pearce 1996), and the British government is blithely accepting that " in 30 years, the climate of Europe will have moved 150 miles north" apparently happy because it will be " a boost to tourism" ! (Brown 1996) The present abrupt climate change is an effect of the Industrial Evolution and any reversal could only be through a redirecting of the Digital Evolution as a basis for the urgent world-wide coöperation needed to avoid complete catastrophe within less than fifty years. There is a rôle for information system professionals to design ways to spread the information about our global reality, and to underpin the international efforts needed to change it.

But computing and information system professionals also learn little from this history. The literature, both serial (recently, Lewis 1996 and Myers 1996) and monograph (recently, Oakman 1995), is pervaded by views of a future dictated by technological development, particularly digital development, and independent of physical or social reality outside the technological and professional milieu of the authors. The problem we are facing is vast almost beyond imagination, and will require huge effort and world-wide goodwill and collaboration. Such goodwill and collaboration will not be possible without the development of a world-wide information system specifically to support it. " The result [of virtual feudalism] could be a fusion of private (business) and public (national) authority in a non-territorial system which ensures the dignity and political equality of all human beings; or it could be something less appealing. If the errors of ancient Rome are repeated, the outcome is sure to be unappealing for some time to come." (Moshowitz 1992)

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