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“News Briefs from the Computer World” is a regular feature which covers local and overseas developments in the computer industry including new products, interesting techniques, newsworthy projects and other topical events of interest.

WORKSHOP ON DATABASES IN THE NATURAL SCIENCES

The proceedings (231 pages; A4 size) of a database workshop that was sponsored by the CSIRO Division of Computing Research, the CSIRO Division of Soils and the Bureau of Flora and Fauna in September 1983, are now available, prepaid, from CSIRO Division of Computing Research, GPO Box 1800, Canberra, ACT 2601. The price is $15.00.

The workshop covered a wide range of topics and applications including small databases, reference collections for e.g. herbariums and museum and applications in research areas.

Further information may be obtained from Dr J.L. Smith at the above address.

NEW BOOKLET

North-Holland has recently published a booklet entitled “IFIP, its aims and its recent publications”. The brochure presents a detailed description of IFIP (International Federation for Information Processing), as well as full details on 55 books reflecting the interest-sphere of IFIP: Programming, Education, Computer Applications in Technology, Data Communications, System Modelling and Optimization, Information Systems, Computers and Society, Digital Systems Design.

IFIP publications are available to members of national information processing societies at a 25% discount.


1984 ACM COMPUTER SCIENCE CONFERENCE

The Twelfth Annual ACM Computer Science Conference will be held in Philadelphia, PA on 14-16 February 1984 at the Franklin Plaza Hotel. The traditional emphasis on abstracts of current research will be blended with invited papers, panels and refereed papers. The central themes on each of the three days are “Factory of the Future”, “Coping with Small Computers” and “Social and Ethical Implications of Computers”.

In addition to the technical presentations, the Conference features over 50 computer and instructional material exhibits, the finals of the International Student Programming Contest and the annual Employment Register with over 200 employer participants. A Conference Lunch will be held on Thursday, 16 February.

For further information and registration forms, contact Dr Frank Friedman, ACM Computer Science Conference Chairman, Computer and Information Science Department, Temple University, Philadelphia, PA 19122 (215) 787-1912.

The Technical Symposium on Computer Science Education of the ACM Special Interest Group on Computer Science Education (SIGCSE) will be held on 16 and 17 February in conjunction with the 1984 ACM Computer Science Conference. For further information, contact the chairman, Dr Richard H. Austing, Department of Computer Science, University of Maryland, College Park, MD 20742 (301) 454-2004.

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(Continued on page iii, following page 164)

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Special Issue on the Social Consequences of Computing Technology

Guest Editorial

In the past few years we have seen a range of new issues raised in relation to computing technology. Perhaps the first point to be made is that we should now be speaking of "information technology" rather than "computing technology". The convergence of computer, communications and other associated technologies in recent years has blurred the dividing lines between separate technologies, and it is this very marriage of technologies which has given birth to many new concerns. We now have what might be described as an envelope of social concerns wrapped around the technologies and their use. The rate of growth of information technologies and their all pervading spread into every aspect of our daily life, has raised many new issues related to the social, economic and legal implications of the implementation of the technology.

Unfortunately, the computing profession has been very tardy, in fact inexcusably tardy, in giving any attention to these problems. We have continued to apply most of our attention to the technology itself. We failed to recognise the breadth and depth of the impact of the technology on people and on the community. We did not have enough foresight to envisage the very real problems that would either be created or exacerbated by information technology. These include issues such as the informational privacy of the individual, technology-based unemployment, trans-border data flows, information rich and information poor nations, new legal concepts of evidence, radical changes to the nature and structure of the workforce, major changes in the education system, and so on.

Nor did we realise, I think, that these should really be a major facet of our concern. We tended to adopt the attitude that our role was value-free, and it was the responsibility of others to concern themselves with the impact and effects of the technology. I believe this view no longer holds. I should certainly hope it is not a part of our philosophy as computer professionals. The Australian Computer Society certainly does not hold this view. We recognise that it is very much our responsibility to ensure that the technology is developed and used for the benefit of man, and not to exacerbate his misfortunes.

The papers in this issue have been selected from among more than a dozen submitted, that provided several different perspectives on a range of issues within the topic. Making the selection was not an easy task, and I would particularly like to thank again those authors whose papers could not be included. In the final selection two main themes are apparent: changes in the workplace, and implications for the autonomy of individuals. In both of these areas, effects that could only be surmised 20 years ago have now become a reality that is not universally pleasant. There is, and will be, a continuing need for the Australian Computer Society and its members to address such matters.

The Editor of the Journal deserves congratulation for initiating this special issue of the Journal on the social consequences of computing technology. I was delighted to be asked to be the guest editor and have been very pleased with the extremely good response we received to our Call for Papers. As Chairman of the Social and Economic Implications Committee of the Society since the inception of the Committee in 1970 I have been fortunate in being involved in these matters, not only in Australia but internationally, for over a decade. Whilst one might cavil at the failure to produce a special issue prior to this, nevertheless the appearance of this issue is a notable event for the Society. As President of the Society I would also like to say how pleased I am that this issue has appeared during the term of my presidency. It will reinforce, I hope, the commitment that the Society has to do all in its power to bring about the necessary changes and innovations which will reinforce the benefits and minimise the social dislocation which inevitably attend the introduction of such technology.

Ashley Goldsworthy,
Guest Editor

The Australian Computer Journal, Vol. 15, No. 4, November 1983
Perhaps Some Enlightenment and Re-Assurance About Our Jobs

J. I. Warracke* and J. R. Carnegie†

This paper examines the social consequences of the introduction of information technology within the insurance industry. For the purposes of the paper the insurance industry is defined as including companies which conduct life insurance and/or general insurance business. The main thrust of the paper is directed toward examining the employment effects of technology applications within these sectors. Emphasis is placed on how technological change has affected employment levels, the employment structure and the quality of working life for employees.

Our conclusions are essentially negative but for this we make no apology as our assessment is based on empirical evidence and personal observation.

Keywords and phrases: Social consequences of computing, insurance industry computing, working environment, employment decline, job structure, quality of working life.


INTRODUCTION

In the last decade the Australian Insurance Industry has experienced widespread changes in respect to both its organisational structure and its basic mode of operations.

The rationale for such changes stem largely from the very nature of the product provided by the industry, the extraordinary level of competition involved in selling that product to the consumer, and the significant change in consumer preference for the product in question.

Insurance can be broadly defined as a "contract under which one party (the insurer) agrees, in return for a consideration, to indemnify another (the insured) for loss suffered as a result of the occurrence of specified events which cause the destruction, loss or injury of something in which the other party has an interest." (Thomas, 1981)

Essentially, the insurance industry can be broken down into four main sections: life insurance/superannuation; general insurance; health insurance; and services to insurance. In this paper we examine changes to the two largest employment sectors, life insurance/superannuation and general insurance, hereinafter referred to as the life sector and the general sector, respectively.

Until the early 1970's life insurance was the predominant source of consumer saving for retirement purposes and as a consequence the life industry showed a steady, if unremarkable, pattern of growth (Buttrose, 1981).

Changes to taxation, which had previously afforded life companies a considerable competitive advantage over the other savings institutions, increased inflation levels and increased consumer awareness brought an end to this era by the early 1970's. These changes forced the life sector into a situation of direct competition with other savings institutions operating in the capital market. The more aggressive operating style of some of these institutions, notably building societies, merchant banks and money market corporations, offered some stiff competition. To meet the challenge the life sector had to develop new products and a more efficient organisational base.

The general sector of the industry has also been facing difficult economic times since the mid-1970's. In respect to this sector the pressures stemmed not so much from external as internal phenomena. With over 170 authorised general insurers operating in Australia and some 1,000 insurance brokers, competition for business has been intense. Most companies introduced rate-cutting in premiums around 1979 in order to attract new business. At the same time the claims experience of many companies began to rise. As a result companies began to suffer underwriting losses. By 1980-81 over 75% of authorised insurers returned an underwriting loss (Insurance Commissioner, 1981) and a substantial number showed an overall operating loss for this period. In such circumstances, this sector, like the life sector has had to introduce measures to reduce costs and improve customer service.

One such measure in both sectors has been the widespread introduction of information-based technology. This development has hardly been surprising, not only for the economic reasons suggested above but also because of the very nature of the tasks necessary to the underwriting of insurance.

INFORMATION TECHNOLOGY AND THE INSURANCE INDUSTRY

Insurance work basically involves large quantities of routine and repetitious paperwork, considerable arithmetic which has to be performed at periodic but regular intervals, and other interrelated tasks involving the processing and storage of an enormous volume of information.

Any new process or technique which offered the capacity to either simplify these tasks and/or allow more work to be processed was welcomed with open arms. It was basically the largest life offices, companies such as MLC and AMP which pioneered the use of electronic data processing (1958 and 1959 respectively) (MLC, 1978; Korporaal, 1978).

For smaller life offices and almost all general insurers the costs involved in buying and installing these machines were prohibitive. The early mainframes were to be found only in large organisations and were generally locked away in "computer rooms" with specialist staff in attendance. The average insurance worker felt little, if any, concern

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*Victoria College (Prahran Campus), Prahran, Vic., 3181. †Australian Insurance Employees Union, 310 Queen Street, Melbourne, Vic. 3000. Manuscript received June 1983; revised October 1983.

The Australian Computer Journal, Vol. 15, No. 4, November 1983
about the impact of these machines either in his or her workplace or in society generally. While job displacement occurred within this period — the introduction of AMP’s first system displaced some 300 staff — the consequences went largely unnoticed because this job displacement had occurred at a time of near full employment (F-ord, 1979).

The combination of economic pressures, vast advances in the computer hardware and considerable cost reductions in the purchase and installation of EDP equipment greatly increased the adoption of these systems by the mid-1970’s. By this time many life offices had moved from batch mode to on-line systems. With this step a customer’s policy files were linked together logically, either through a customer information file (CIF) or through more generalised Data Base Management System (DBMS) techniques (SRI International, 1981). The Policy Management System (PMS) led to similar developments in the general sector.

For most companies the current process is one of upgrading systems as new developments become cost effective propositions. Microcomputers and other office equipment such as wordprocessors are now widespread at the branch level. Proposed developments include parameter driven systems which will allow non-DP staff to generate required output, portable data terminals for on-the-spot data entry or enquiry via a telephone line, and terminals made available for customer use using the same principle as automatic telling machines.

The direction towards which most advanced technology users in the industry are now heading is one of integrating their word/data processing systems with other office systems to create the “paperless office of the future”.

For the employer in the insurance industry, information-based technology has brought significant economic benefits. Without the use of EDP it is almost impossible to imagine how the volume of business handled could have been processed. Certainly it would have required a workforce many times larger than currently exists. Not only has information technology extended the capacity of companies to gain more business it has also reduced the turn-around time involved in processing that business. This has meant that, for the first time, management can assess the day-to-day economic position of the company. There have also been considerable organisational benefits from the application of technology, as determined by economic criteria, including increased centralisation and control over branch and office functions. In the current economic position facing the insurance industry, management sees the benefits brought about by the application of technology as being a fundamental factor in determining which companies survive and which do not!

The other side of the coin — the human side — is that the application of technology has inextricably altered the working life of all insurance employees from management to life insurance salesmen. While some of the changes have led to improvements in the employee’s working life other changes have clearly had an adverse effect. In the following section we will briefly discuss the nature of this social impact. Although our evaluation is based on subjective criteria it has been determined by factual analysis and observation.

EMPLOYMENT LEVELS AND PARTICIPATION RATES

The effect of technology on employment levels is a vexed question, complicated by the diversity of other factors which must be taken into account in making any value judgement about this issue. In an industry like insurance it is impossible to distinguish the fundamental cause behind changes in employment levels because, combined and in concert with the rapid introduction of information technologies, the industry has witnessed considerable structural re-organisation and rationalisation. Mergers, takeovers, insolvencies, and companies withdrawing from the market have proved all too common occurrences and many jobs have disappeared in these processes.

Rather than attempting to isolate the employment effects of technology application in any given situation, it is more fruitful to see technological change as being in a symbiotic relationship with these other processes.

Rationalisation within the industry is enhanced by the availability of technologies which facilitate the rapid integration of companies or provide inter-company interfaces to handle non-competitive functions such as application and rating information. Similarly the centralisation of the working process and work functions is made possible by the use of communications technology and large data base systems operating in distributed processing networks. From this perspective technology provides the central linking element. Management may choose to attribute job displacement to Organisation and Methods changes (O & M) accompanying the introduction of a new data processing system but without the introduction of that technology such organisational changes would not have eventuated. Thus we can attribute to technology a fundamental role in changing the employment base within the industry.

Just how that employment base has altered is demonstrated by statistics obtained from the Australian Bureau of Statistics (ABS) Census of Population and Housing**.

Although the industry as a whole, as defined by the ABS, showed a 3.8% increase in employment levels for the decade June 1971 to June 1981 this figure must be viewed against a 34% increase in employment levels across all industries for this period. Furthermore, when the figure is broken down into its component parts it is evident that in the industries of life and general insurance, which are the two sectors under consideration in this paper, there has been a net reduction in staff.

Unfortunately, the 1971 census figures cannot be broken down by industry/sector but a comparison of the 1976 and 1981 results shows that, in respect to life insurance, employment fell by 15% over the five year period, inclusive.

The two employment categories to suffer the heaviest losses were the Administrative, Executive, Managerial (18.4%) and Clerical sectors (15.7%). Likewise, the general insurance sector showed a decrease in employment of 11% between 1976 and 1981 and again it was these two occupational categories which showed the most significant decline (20.8% and 13.6%, respectively). The largest occupational grouping within the industry is clerical workers, so this decline in employment has far-reaching ramifications.

** All figures given below were obtained by the authors’ own analysis of Census Data. Specifically the results of 1971, 1976 and 1981 Census of Population and Housing were analysed and compared in respect of Population Aged 15+, Industry by Occupation (Major Groups) by labour force status by sex and the 1981 results were analysed in terms of Population Aged 15+, Industry by Occupation (Occupation Code Minor Groups), by sex.
Broken down by gender, male employment has witnessed the greatest decline. In the Administrative, Executive, Managerial sector this would not be unexpected, given the overwhelming concentration of males employed within this sector (96% in 1981). In respect to clerical workers the decline was evenly balanced between the sexes in the life sector, but a greater proportion of males were adversely affected in the general sector.

It would appear that junior employees have also been at greater risk. The Australian Insurance Employees' Union (AIEU) membership figures show that junior members represented 39.9% of the total membership in December 1979. By June 1981 juniors had dropped to 35.8% of the membership and, as at August 1983, juniors accounted for a mere 17.3% of AIEU's total membership***.

Examining these statistics it is clearly evident that employment is on the downturn although perhaps not as strongly as some observers have suggested. In this context it is important to point out that this decline in employment has occurred at a time when the volume of business handled has risen dramatically. Without the introduction of information technology it seems clear that many more staff would have been required by the industry just in order to maintain existing levels of work throughput (Korporaal, 1978). Technology, in this respect, has directly contributed to the streamlining of existing jobs. As well, it has been the most important factor responsible for the non-creation of jobs.

As we have already seen these adverse employment effects have tended to fall disproportionately on different groups: males, middle management and youth. In fact, the entire employment structure of the industry has been largely overturned in the last decade and one of the major factors responsible for this transformation has been information technology.

Once perceived as a career industry, particularly for males, insurance provided employees with a long-term stable employment future. Such a state has long since past into mythology. Today, the office junior is an uncommon sight and it is more than likely that “she” will be employed in keyboard tasks and other jobs without a career future. (75% of AIEU junior members are female.)

The 50% decline in junior recruitment evident in the last two years suggests that insurance employers have embarked on a deliberate policy of reducing their overall labour requirements over time. While closing the doors on junior employment in the industry has had measurable financial benefits for employers, it has significantly contributed to the current crisis in youth unemployment. Like the banks, insurance companies were regarded as an important source of employment for school-leavers in the expanding tertiary sector of the 1960's. This has evidently ceased to be the case.

The ABS figures also showed a significant decrease in male clerical employees, a symptom of the demise of the old career structure. Many jobs once performed by clerks have been rendered obsolete by technology and these employees have found themselves either made redundant or reduced to occupying jobs with little or no promotional prospects. In such cases employees are forced to seek employment elsewhere or wait out this period for an early retirement. For many of these individuals whose whole life has been centred around developing a career within the industry, the emotional impact of such a situation is devastating. The Australian Insurance Employees' Union has documented evidence of many members who have found it extremely difficult to cope with the changes to their work and career brought about by technological change.

Many employers have chosen to employ women to fill the clerical jobs that remain. Female employees, as a proportion of the total number of employees, have shown a 5% increase over their male counterparts in the decade 1971-1981. This trend towards feminisation of the workforce has gone hand in hand with automation of work functions. Women are employed in large numbers to undertake clerical tasks of limited responsibility and keyboard functions: jobs with no career or advancement prospects. The authors would argue that this shift towards female employment has been a deliberate policy pursued by insurance employers for very clear organisational reasons, namely to increase the number of short-term employees within the industry. Thus while labour is still required for many tasks, these will be reduced in number as more and more functions are integrated into an automated office system. A basic assumption still held and even reinforced by insurance management practices, is that young adult women will only remain in the workforce for a limited period. Certainly, female labour turnover is high, but very little encouragement is given to women to go on with their careers. Many companies use this turnover to reduce the total number of jobs over time and, in this way, are able to regulate employment levels.

The other main occupational group adversely affected in their employment have been lower and middle management. Many tasks previously undertaken by this group have been adapted or redesigned to fit the organisational requirements of a technology-based work process. As a consequence, promotional opportunities in many areas of insurance work have all but disappeared. It is particularly employees at the supervisory level who have been at risk. As more and more office tasks have been automated the need for office supervision has diminished accordingly.

The traditional insurance manager whose experience and training has not kept pace with the changes around him has also found himself being asked to move sideways or to take early retirement. While it is understood that insurance companies must develop a highly educated management base if they are to succeed in today's competitive environment it is cold comfort to those who have been made redundant after spending ten to twenty years of their working lives in a company which they had assumed would provide their lifetime career employment.

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*** These last figures are taken from AIEU Membership records held at the Union's Federal Office, Melbourne. By way of explanation in respect of the validity of these figures as an indicator of junior employment it is pointed out that AIEU has had a compulsory unionism agreement with the Australian Employers' Industry Association (El A) since 1974. The IEIA is an industry body representing some 300 of the largest life and general insurance companies, which between them employ some 32,000 employees. This represents approximately 82% of the industry's total employment in respect of the three Occupational Groupings: Professional, Technical and Related; Administrative, Executive and Managerial; and Clerical. The Agreement makes Union membership a condition of employment for all employees whose salary falls within the Award range, that is up to $17,508 (effective September 1983). Given that these large companies are, ipso facto, the largest employers of junior labour and given the reality that very few employees below 21 years of age receive salaries above $17,000, we can say that AIEU membership provides an indicator of at least 80% of total junior employment within these two major sectors.

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Lack of skills and training in other than insurance makes further employment for this group in any other sector most unlikely and the financial and emotional hardship of forced early retirement or unemployment which follows can prove a heavy burden to bear.

Associated with professional management, the group which appears to have benefitted most in real terms in the last five years is the technical and related groups, in particular statisticians, computer programmers and system analysts. Since 1976 this group has shown a 38% increase in the life sector and a 53% increase in general insurance. Such trends are hardly surprising in the context of the rapid application of technologies especially in the general sector. While it may appear that the creation of these jobs has opened up new and exciting employment opportunities, the fact is that such job creation is matched by job destruction in the clerical, administration and managerial sectors by a factor of 5:1 in the life sector and, nearly 7:1 in the general sector. As companies move towards more sophisticated technology applications, these employment trends can be expected to continue.

EMPLOYMENT STRUCTURE AND WORKING ENVIRONMENT

In ascertaining the social impact of technological change in a given situation it is necessary to examine not only the effects on employment levels but also the effects on the employment structure and the work environment. Some of these effects have already been referred to in the previous section: the reduction in promotional opportunities and breakdown in career structure, impact on certain categories of jobs, centralisation of job functions etc. In this section we assess these changes in more depth.

1. Career Structure and Job Definition

The traditional view of an insurance company’s job structure was one of vertical progression, i.e. for male employees, with the residual of non-career tasks performed primarily by females. The introduction of information and communication-based technologies has fundamentally altered this structure by eliminating or redesigning those jobs which provided the base for this vertical movement. Most clerical tasks and specialised insurance tasks through which employees gained a knowledge of the industry necessary for career progression are now performed by computers and the clerical work which remains has been redesigned to correspond to the requirements of the technology. In other words there is little scope for upwards progression and, as the ABS statistics indicated, a fundamental shift has occurred in the sexual division of labour with the development of this trend.

Emerging in place of the traditional insurance industry career structure is a three-tiered structure:

- in the first tier are the vast mass of jobs—lower level clerical jobs and keyboard jobs such as VDU operation, word processing, typing and cashiering—performed, by and large, by women;
- in the second tier are an increasing range of technical and professional jobs generally filled by outside appointment; and
- in the third tier are management and executive personnel who, while decreasing in absolute numbers, are becoming more professional and better trained in keeping with the increasing pressures within the industry.

Movement between these tiers is severely limited and almost non-existent for those relegated to the first tier. The lack of employment opportunities offered within the insurance industry is a matter of great concern to these female employees. A recent survey conducted by the AIEU in conjunction with Melbourne University found that while 66% of the respondents considered their career prospects and promotion opportunities as being important aspects of their job, only 31% believed that their current career prospects were good (AIEU, 1983a).

Many tasks at this level have been imposed by computing technology; task definition has been narrowed and increased work pace and control over task performance has followed. In addition some deskilling has occurred, especially in respect of stenographers who are being replaced by word processor operators. Many of the redefined jobs performed by employees are essentially machine-minding and/or machine feeding in nature and, in this respect, vary little from the factory machine-line jobs of their blue-collar counterparts.

2. The Quality of Working Life

Essentially, this catch-phrase encompasses all those individual aspects of a job, which, when combined, help to determine the desirability of one career over another. An essential element in determining the quality of working life is job satisfaction. This concept is difficult to quantify and will be determined by reference to various factors which will differ in intensity from one employee to another. Four standard variables which provide a common yardstick are:

- (i) the individual initiative required to perform a task;
- (ii) interaction with co-workers;
- (iii) rewards both implicit and explicit;
- (iv) future prospects.

For the average insurance worker in the first tier none of these variables are substantially fulfilled and in respect to all four, the introduction of technology has played a negative role.

(i) Worker Initiative

Although an initial response of many employees to the introduction of a computerised work system is relief that many boring repetitive tasks have been removed from their daily workload and replaced with new interesting tasks, the relief experienced is short lived. Once the initial interest has worn off employees find that the new tasks offer even less scope for individual initiative. Modifications to a system may reduce opportunities even further.

A by-product of computing technology is greatly increased control over worker productivity. The meticulous and continuous monitoring of performance, the advent of machine paced work, the constant drive to increase speed and the stress caused by the absolute accuracy required for input data all combine to enhance administrative procedures for the company while destroying the possibility of a palatable interface between worker and machine.

Employees feel they are unable to alter the situation personally, therefore they persevere with the consequences of decisions made by others. From the authors’ own experience of the industry the all too common approach of insurance employers when introducing a new task or system to a worker is to say “from tomorrow your job will be done this way”. Of course some companies have approached the subject in a more enlightened manner, involving their em-
employees from the outset, but consultation and communication is all too often lacking in the introduction of technology to the work process.

(ii) Interaction with Co-workers

Interaction and communication between employees is also affected not only because work is directed by and through a machine but because it significantly disrupts the establishment of networks between employees. Communication of information between work stations will be reduced further to task information only with the introduction of electronic mail systems and unless care is taken employees will become isolated and dependent on machines for "human contact". This same communication technology can be used to achieve greater communication between employees if the system is so configured and utilised but again this is dependent upon the manner of introduction.

(iii) Explicit Rewards

The salaries of insurance workers in the clerical/key-board groupings, while generally comparable with other private sector employees working in the occupations at the base level, provide a fairly basic level of monetary reward for many years of service. While an employee may start his/her career as a clerk on $12,793 (September 1983) per annum, after 14 years of service his award salary will only be $17,500 and a woman employed in a keyboard function ceases to receive any further incremental increase in her award salary after seven years of service.

While technology can hardly be held responsible for the existing salary structure in the insurance industry, its introduction will ensure that the majority of employees have only limited scope to go beyond this level of monetary reward because the opportunities for promotion which would automatically lead to a higher salary are simply no longer available.

Implicit Rewards

More specifically, the introduction of technology alters the relationship between supervisors and employees. As supervision of the work process is taken over by machine, work output is monitored only by reference to a set goal or target, e.g. the number of keystrokes per hour. Not only does measurement of human performance by machine increase mental and physical stress, the lack of human contact itself has deleterious effects on the employee's perception of his or her worth. A machine cannot measure effort, only output and in this respect a human function ceases to exist.

(iv) Job Prospects

In essence, this variable has been covered under career structure and as made clear in that context, technology has directly contributed to the lowering of career prospects for most employees. In addition, one must take into account the fear and uncertainty which many employees now feel as more and more work functions are assumed by technology. As one employee, a 22 year old female clerk employed by a Life Insurance Company for two years, has expressed it, "We are still not quite sure to what extent computers have changed our lives. Perhaps some enlightenment and reassurance about our jobs would partly answer the question." (AIEU, private communication, 1983.)

This expression of uncertainty is widely shared as employees see changes occurring around them. The threat of redundancy and its after-effects — retrenchment or relocation — is high and instances of such actions are not isolated. Since 1980 the following companies have been "forced into" retrenching significant numbers of employees for "organisational" reasons:

- National and General Insurance Company Ltd 39
- Mercantile Mutual Holdings Ltd 62
- QBE Insurance Group Ltd 30-40
- Norwich Winterthur Insurance (Australia) Ltd 34
- Royal Insurance Australia Ltd 180
- New Zealand Insurance Ltd 137

The lack of job security within the industry has altered the perceptions of employees about their employers. Once extremely loyal, because they believed that diligence would secure a permanent future, many employees now demonstrate a markedly negative or neutral attitude to their employers and to their work. This will have ramifications for the employers not only in terms of productivity loss but also increased union militancy.

Another important variable to be considered in determining the quality of working life is the working environment. In this respect, also, the application of technology has had fundamental ramifications. The issue is not merely one of replacing desks and paper work with computer terminals. More specifically it concerns the methods used to achieve this transformation and the level of consultation and planning which has taken place around this process. While many insurance companies willingly spend hundreds of thousands of dollars on hardware and peripherals, little or no attention is given to where this equipment will be placed and how employees will be trained to use and accept it. There are some exceptions in the life sector and in some of the larger general insurers but these are all too few. The more common reaction of insurance management is to find a space and literally shove the terminal or word processor into it without regard to placement, space, lighting, noise levels, temperature and so on.

In such conditions, employees face increased health and safety risks. Stress, fatigue, visual problems and repetition injuries can result. The incidence of such risks are well-documented (e.g. Busch, 1976; Cole, 1979; Ardnt, 1979; Zaret, 1981; Cumpston, 1981; NH & MRC, 1982). A recent voluntary questionnaire by the Australian Insurance Employees' Union on repetition strain injuries showed that this appears to be a growing problem area within the industry. The Union received over 100 replies from employees indicating that they had suffered from various repetition injury symptoms and of these nearly a half had been to see a doctor at their own expense (AIEU, 1983b). Given the ad hoc nature of this survey, AIEU, believes that this number represents only a fraction of those who have suffered from these injuries. An earlier survey conducted in 1981 also indicated that muscular fatigue and eye problems are widespread (AIEU, 1981).

CONCLUSIONS

Drawing together all the effects of technology application on these variables, it is the opinion of the authors that, in overall terms, the quality of working life has declined for the majority of employees working in the insurance industry.

The reduction in employment levels and the changes to the employment structure referred to in the previous section further compound the negative effects of technology for this labour force.
In this context we must look beyond this industry and examine the effects of technology on the entire labour, force and ultimately the society in which we live. Optimum gain from micro-electronics will only occur when human and social considerations are taken into account along side technical and economic criteria. Technology promises the capacity to improve standards of living and increase human wealth but whether such benefits occur will be largely determined by how the technology is used and for whom. If the example of the insurance industry is any guide the prospects for realising our human potential through technology and for re-distributing the economic gains made by this advance appear very grim, indeed.

REFERENCES

BIOGRAPHICAL NOTES
Ms. Jane Carnegie received a Bachelor of Arts (Hons) Degree from Melbourne University in 1978 and has almost completed a Graduate Diploma in Industrial Relations from Footscray Institute of Technology. On finishing her first degree she gained employment in the Department of Employment and Industrial Relations. She has been employed as a Research Officer with the Australian Insurance Employees' Union for the last three years.
Ms. Jan Warracke is currently a final year student at Victoria College (Prahran Campus). She is completing a Bachelor of Business majoring in computing. Prior to this her career included four years working in the Insurance Industry at various levels. Her current interests include technology and its effects on society, and raising the level of computer literacy.
Tradition in Transition: 
Technological Change and Employment 
In Australian Trading Banks†

S. Macdonald and D. Lamberton*

There is currently much concern among bank employees about employment levels in banking, a concern which seems to emanate partly from technological change and partly from organisational change thought likely to occur within the industry. This paper explores the essential connection between technological change and organisation in banking and concludes that employment levels are dependent on the ability of banks to adapt to technological change, rather than to any direct impact of the technology. Australian trading banks, however, are not accustomed to rapid and radical adaptation; nor would it seem from the results of a large survey of branch employees in Queensland, are bank employees well equipped for the change to electronic banking. The result, particularly in the wake of the Davidson and Campbell Reports and amidst more rapid change in some other sectors of the finance industry and of the economy as a whole, is a high degree of uncertainty that seems to benefit no one.

Keywords and phrases: banking, technological change, employment, organisational change, innovation.

CR categories: K.4.2, K.6.1, K.6.m.

INTRODUCTION

Australian banking is in a state of unwonted and uncomfortable flux. For many years the major Australian trading banks enjoyed a comfortable, co-operative and protected existence, disturbed only by the annoyance of government regulation and occasional complaints that their efforts to best serve the Australian economy also put them very near the top of the list of the world’s most profitable banks.† There has recently been major change in the structure of the industry and much more is threatened. The merger of the Bank of New South Wales and the Commercial Bank of Australia to become Westpac, and of the National Bank and the Commercial Banking Company of Sydney to become the National Australia Bank has reduced the number of major trading banks from six to four. Of greater significance would be implementation of those recommendations of the Campbell Report requiring deregulation of the banks and the entry to the Australian market of foreign trading banks.‡ Within this uncertain milieu is technological change, interacting with other factors and increasing the uncertainty. This paper is primarily concerned with technological change and employment in banking, and, using survey evidence from Queensland bank branches, reaches the conclusion that little is to be discovered in a search for a direct impact of technological change on employment. Of much greater importance for banking employment is the interaction between technological change and banking organisation. The success with which Australian trading banks adopt, and adapt to, technological change is much more relevant to banking employment than the technology itself. The traditions of Australian banking present grounds for doubt that the organisational flexibility exists to allow adaptation sufficient to protect employment.

THE BANKING INDUSTRY

The current major trading banks in Australia are survivors. They are the companies which have endured the vicissitudes of 19th and early 20th century banking in Australia and have, through fortitude, mergers and a degree of good fortune, established for themselves positions as major pillars of the financial establishment of Australia. The merger activity of 1981 was designed to fortify that structure rather than to effect radical change in its architecture. § Recent activity and aspirations of the new Australian Bank — the first new Australian bank since the Bank of China was allowed to open a Sydney branch in 1942 — suggest that there may be scope for new banking activity in Australia that does not involve prodigious branch overheads, and it may be that a large network of branches is no longer a sine qua non of successful modern trading bank activity.  

The Campbell Report has recommended significant de-regulation of Australian trading banks, allowing them easier access to new financial markets. Certainly there is every indication that other, less-regulated, financial institutions — notably the building societies and the credit unions — have made inroads in areas formerly the preserve of the banks. Table 1 compares asset growth of the trading banks over the last two decades with that experienced by
some other financial institutions; trading bank growth has not been particularly dynamic. The expansion of other financial institutions has seen the banks' share of the Australian financial sector drop from 52% in 1953 to 38% in 1978. Increasing involvement in non-bank financial services has compensated for about a third of the decline. Whether this broader market necessarily makes the trading banks more competitive is unclear. The banks have been criticised for using their protected position to be both inefficient and uncompetitive,7 and there is some indication that they feel this protection should also apply to their non-bank activities. For example, there have been complaints that the trading banks use their banking status to the benefit of their finance companies,8 and the banks have been vociferous in their objections to what they see as unfair competition with their travel companies.9 Certainly there is little evidence of price competition among the trading banks: for example, until the passage of the Trade Practices Act in 1974, the banks had a uniform system of charges for cheque accounts. The co-operation which occurred when Bankcard was established would probably now be illegal.10 Industry policy can still be decided by the banks in concert: for example, the decision by each trading bank not to co-operate with this study was apparently taken at a meeting of the Australian Bankers' Association on 21 April 1980.11 What competition there is among trading banks seems to take the form of heavy advertising stressing customer services offered. Much press comment suggests that there is considerable customer dissatisfaction with bank services that, in Australia, is not reflected in customer mobility.12 Bank branches currently play a fundamental role in promotional activity as the banks' shop windows and the outlets by which the banks market a whole range of services well beyond the regulated confines of traditional banking. One bank apparently offers no fewer than 187 distinct services available throughout its branch system.13 Trading bank activity in such areas as travel, insurance and investment services has increased greatly in recent years and is relevant to this study in that much recent diversification of bank activity appears to have been facilitated, and perhaps encouraged, by technological change adopted by the banks. Bankcard, for example, is as much a product of the banks' technological capability as of the banks' desire to offer a lucrative new service.

Table 2 gives some indication of the change in business emphasis that has occurred among the major trading banks over the last two decades. In 1963, only 7% of consolidated operating profit came from finance companies: in 1978 that figure was 37%. In that same year, bank ownership accounted for 42% of total assets of Australian finance companies and general financiers, and about 12% of assets of money market corporations.14 In the travel business, the National Bank was recently Australia's largest retail travel operator and the Bank of New South Wales was thought to be the second largest.15

What happens in the trading bank branches is crucial to banking employment, for most of the workforce is in those branches. There has been considerable discussion of branch banking in Australia, much of which concludes that Australia is over-banked.16 In 1977, there was one trading bank branch for every 2,750 people in the country.17 Yet there has been an increase in the number of branches through the seventies. That growth seems to have halted, except in the branches of the two overseas trading banks, and there is much discussion by the major trading banks of the need for branch rationalisation.18 A more subtle change has occurred in the location of branches; branch numbers have increased in metropolitan areas and have been gradually declining elsewhere in the country. Rationalisation may mean the acceleration of this process. It is not impossible that branch numbers may follow the pattern of trading bank agency numbers, which dropped from 1580 in 1970 to 1009 in 1980.19

Branch rationalisation, however, should not be viewed as a policy divorced from the general business strategy of the banks.20 Employment levels and conditions in banking will be related to that strategy and to its success much more than to any rationalisation programme. The banks seek to attract customers and market services through the branches while offering at least some of those services elsewhere. They seek to protect their traditional banking business from aggressive interlopers while they themselves invade the market of other financial institutions. Naturally enough, the banks will use whatever resources they possess to further their plans, and these resources include their branch networks, their existing staff and new technology. Only by assessing the impact of technological innovation upon the structure of the banking industry and upon the business of the banks, and then relating those changes to employment, is it possible to gain any real appreciation of the impact of technological change on employment in banking.

**TECHNOLOGICAL CHANGE IN BANKING**

The key to technological change in banking is electronic data processing. To function at all, a trading bank must keep accounts, and computer technology has, for at least two decades, offered a way of dealing with vast numbers of tedious and repetitive transactions that offers obvious advantages over traditional manual methods. Indeed, the banks argue that their volume of business is

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Source: Reserve Bank, Submission to the Committee of Inquiry into the Australian Financial System, 1979, Chapter 3, p. 32.
now so great that there is no way that it could be handled without use of electronic data processing, and that the computer has been absolutely essential to the continued growth of the banking sector. Their view is that if the computer is essential for banking business and banking business is essential for banking jobs, then the computer must be essential for those jobs. There is sense in that point of view and it has been largely, if tacitly, accepted by the banking unions for what has become established, long-standing computer use by the banks. However, the banks now seek to extend that principle to all technological change in banking, and the unions have been much more reluctant to accept the argument that what technology is good for banking is also inevitably good for bank employment. The banks argue further that the most major technological changes have already taken place in banking, that recent change is of a minor nature, and that what little technological change takes place in the future will be slow and gradual. By the banks do not see technological change as an important factor in influencing banking employment levels, but rather blame general economic conditions, the regulation’s under which the trading banks have to operate in Australia, and what is euphemistically termed "the structural change in participation rates in the workforce", by which it must be supposed is meant the increased proportion of women in the workforce. The banking unions have not accepted these latter arguments and, in a climate in which there is some concern about the impact of technological change on employment, that is hardly surprising.

The recent history of technological change in banking in Australia sheds some light on why the banks believe that, despite the rapidity of change in some other sectors, future technological change in banking will be slow and measured. Technological change in banking has been gradual; early banking computing of the sixties was little more than an extension of the mechanical accounting of the fifties brought about by a growing volume of transactions and mounting pressure on space. The first bank to install a computer was not one of the major trading banks, but the State Savings Bank of Victoria in 1962. The adoption of computers was slow throughout the sixties and generally restricted to the metropolitan centres, where the machines tackled the most obvious and pressing accounting work and handled staff payroll. Not until 1973 were all the major trading banks using computers. Even this gradual change brought problems, particularly the expense and delay associated with moving paper from outlying branches to the computer centres. Further technological change was required to cope with the problems produced by earlier technological change and it became necessary to locate computer terminals in the branches to give immediate access to the computer. There are plans for all branches of all the major trading banks soon to be on-line; the cost in terminals alone of putting every branch on-line has been estimated at $40 million and at $100 million if every teller is to be on-line. While on-line terminals give the banks the opportunity to transfer a much greater variety of information between branch and computer centre and to re-locate some decision making, the banks are still constrained by their legal obligation to transfer physically at least some of the paper they handle.

The adoption of technological change in banking over the last two decades exhibits a pattern similar to that uncovered in other studies of computer adoption. These suggest that initial adoption is slow and that the computer is introduced to perform only a few of the most obvious and pressing tasks. By 1970, there were still only 15 computers in the Australian banking sector: by 1976, no fewer than 134 had been purchased, mainly from IBM, Honeywell and Burroughs. With growing experience of what the technology can do, its use is extended to other existing tasks and often to new ones altogether. It is a characteristic of the adoption of major new technology that organisational change gradually accompanies technological change in order to facilitate the widening use of the technology. The ability of the organisation to adapt to its new technology seems to be a crucial factor in successful innovation, and one that is often ignored. Technological change is likely to exert pressure for other change, which may be technological, organisational or social. It is a grave mistake to treat technological change as an independent variable the effects of which can be easily isolated for assessment. Technological innovation is a catalyst, inducing rather than merely introducing change.

**EMPLOYMENT IN BANKING**

The traditional view of employment in banking is of a white collar career with its rewards increasing with length of service. The stability of bank employment reflected the image of the banks themselves — sound, dependable and secure. It would seem that this traditional view may have been more justified in the past than in recent years. The Australian Bank Employees’ Union now argues that banking is, in fact, an industry of young, poorly-paid workers who do not intend to make a life-long career in banking, and that they are not encouraged to do so by their employers.

Employment statistics covering the period to the mid-seventies have been used extensively in arguments presented recently by the banks and the Australian Bankers’ Association. They illustrate the high rate of growth in banking employment during 1954 and 1974 in comparison with employment growth in other sectors of the economy. In the Commonwealth Bank, for example, the average annual rate of full-time employment growth between 1964 and 1974 was 4.3%. So great has past employment growth in banking been, that the banks have occasionally succumbed to the temptation to overlook the drastic decline in that growth during the second half of the seventies in their presentation of aggregate employment figures covering the whole post-war period.

There is, however, little disaggregation of the employment statistics before 1975. The figures that are published have been supplied by the banks and are not sufficiently detailed for extensive analysis. The banks refused to supply this study with any employment statistics at all for the post-1975 period, and these had to be obtained from the two banking unions, the Australian Bank Employees’ Union (ABEU) and the Commonwealth Bank Officers’ Association (CBOA). It really is difficult to sympathise with the Chairman of the Australian Bankers’ Association, who finds it “disappointing that banks should be subject to criticisms which are generally based on misconceptions...”. When the ABA itself refuses to provide even the most basic information. The private banks have supplied the ABEU with reasonably detailed employment statistics since 1975, but not until 1977 did the CBOA obtain comparable figures from the Commonwealth Bank. Even these figures are scarcely adequate, especially as they do not cover data centres and head offices, but no better are available.
In the late seventies, recruitment was reduced to little more than half the level of 1975.\(^3\) As most recruits to banking are school leavers - 89% of recruits to the Commonwealth Bank in 1978-79 were under 19\(^3\) - the consequence has been some ageing of bank staff. A further change has been the growing proportion of women in the bank workforce. Though most bank employees are male, since 1975 nearly three-quarters of recruits under 18 have been female.\(^6\) By 1979, women comprised 45% of bank employees compared with 42% in 1975, about 33% in 1960 and only 21% in 1947.\(^7\)

Despite the ageing of bank staff caused by reduced recruitment and exacerbated by lower exit rates since 1975,\(^8\) bank employees are still predominantly young. Even in 1979, 58% of male staff and 95% of female staff were no older than 30. Most female bank employees will not remain in banking long: only 6% of female staff in the old Bank of NSW remained beyond ten years' service.\(^9\)

Since 1975 there have been two major changes in the age structure of bank employees. There are now very many more women in their twenties still working in the banks, and relatively fewer men in their early twenties, a group that still seems to be experiencing considerable wastage.\(^10\)

As might be expected, the female resignation rate is higher than the male: twice as many women as men resigned from the National Bank in 1977-78.\(^11\) Most women occupy clerical or telling positions and, from past experience, very few are likely ever to hold a position higher than full-time teller. In the 650 Queensland branches of the five private major trading banks and the Bank of Queensland in 1980, there were 23 female accountants and only three female managers.\(^12\) Most banking jobs created in data centres are held by women and it has been observed that these are routine jobs offering few career opportunities.\(^13\) Over 5% of the Queensland banking workforce (excluding Commonwealth Bank staff) is employed in data centres,\(^14\) and the Bank of NSW employed a similar proportion of its Australian workforce in such centres in 1979.\(^15\)

The numbers engaged in part-time work in the private banks have grown from 471 in 1978 to 1086 in 1980. Under the terms of the 1974 Award, all had to be female and be tellers, and their numbers could not exceed 3% of the total bank workforce. The Commonwealth Bank was not bound by the Award and had 1100 part-time workers in 1980, none of whom undertook telling duties. Neither was the Bankcard company, Charge Card Services, bound by the Award and 128 of its 684 staff in 1980 worked part-time.\(^16\) Although the ABEU remains opposed to the expansion of the part-time workforce, it has been willing to concede ground to achieve shorter working hour concessions. An Award of December 1982 fixed the proportion of part-time workers at 7% of the full-time workforce, rising to 11% by January 1984, and possibly to 15% by June of that year. For those engaged in EDP or administration work, the level is already 15%. No longer need part-time workers be female and they may undertake any task up to that of teller.\(^17\) It is strange that the ABEU sees part-time employment as a threat to full-time employment and consequently seeks to discourage it, while British banking unions take precisely the opposite view and do what they can to promote part-time employment.

### Education

Most bank employees joined the bank upon leaving school and very few hold tertiary qualifications. This may have been of little consequence as long as it was the policy of the banks to offer a career for life and to promote from within. Technological change may be one important reason why the banks feel they can no longer do this and must look outside the banking system for the particular skills they require. Indeed, the banks' traditional policy of encouraging staff to be competent generalists and of not permitting individuals to become specialised has made more necessary the search for skills outside banking.\(^18\) It is thought by some bank managers that what is called the 'two-tier' system, in which there is a top career grade occupied by graduates and a lower grade occupied by those with few prospects of advancement, will become a dominant feature of Australian banking.\(^19\) Most senior management in the present banking employment structure have worked their way up from more menial employment in the branches. It is doubtful whether senior management in the future will have forged a career in this fashion. That situation will not be welcomed by those who have already started what they had assumed would be a banking career which, with perseverance, would lead to the top. Table 3, although restricted to ABEU membership and covering less than half of total Australian bank staff, shows very clearly that women dominate the junior positions and men the senior in branch banking.

It has been observed elsewhere that a characteristic of the adoption of technological change is not normally a reduction in employment levels, but rather an increase in the adopting organisation's ability to perform more work with existing staff levels.\(^20\) This is likely to have been happening in the banks, particularly with the redeployment of staff within the organisation. In 1975, 19.3% of the branch workforce was employed as juniors performing back office functions: by 1979, this had fallen to 11.7%\(^21\). Similarly, as Table 4 shows, there has been a large reduction in the proportion of ABEU branch staff filling junior positions, and a corresponding increase in the proportion occupying more senior employment categories.

The employment pattern in banking is changing and that change seems to have accelerated during the second

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Table 3. Duties of Private Bank Branch Workforce by Sex, 1979.

<table>
<thead>
<tr>
<th>Group</th>
<th>Total</th>
<th>Male</th>
<th>% of Male Employees</th>
<th>Female</th>
<th>% of Female Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junior Clerical, Trainee</td>
<td>4820</td>
<td>2212</td>
<td>9.6</td>
<td>2608</td>
<td>14.5</td>
</tr>
<tr>
<td>Enquiry Clerk</td>
<td>1933</td>
<td>55</td>
<td>0.2</td>
<td>1878</td>
<td>10.4</td>
</tr>
<tr>
<td>Typist, Typist/Clerk, Stenographer</td>
<td>2505</td>
<td>—</td>
<td>—</td>
<td>2505</td>
<td>13.9</td>
</tr>
<tr>
<td>Ledger Examining/Supervising</td>
<td>4125</td>
<td>897</td>
<td>3.9</td>
<td>3228</td>
<td>17.9</td>
</tr>
<tr>
<td>Teller/Junior Clerical</td>
<td>2317</td>
<td>978</td>
<td>4.2</td>
<td>1339</td>
<td>7.4</td>
</tr>
<tr>
<td>Sole or Full-Time Teller</td>
<td>6442</td>
<td>3054</td>
<td>13.2</td>
<td>3388</td>
<td>18.8</td>
</tr>
<tr>
<td>Teller/Senior Clerical, General Clerk</td>
<td>2259</td>
<td>1817</td>
<td>7.9</td>
<td>442</td>
<td>2.5</td>
</tr>
<tr>
<td>Senior and/or Specialised Clerk</td>
<td>5201</td>
<td>4637</td>
<td>20.1</td>
<td>564</td>
<td>3.1</td>
</tr>
<tr>
<td>Accountants</td>
<td>3039</td>
<td>3015</td>
<td>13.1</td>
<td>24</td>
<td>0.1</td>
</tr>
<tr>
<td>Managers and Assistant Managers</td>
<td>4217</td>
<td>4213</td>
<td>18.2</td>
<td>4</td>
<td>—</td>
</tr>
<tr>
<td>Other</td>
<td>4318</td>
<td>2223</td>
<td>9.6</td>
<td>2065</td>
<td>11.4</td>
</tr>
<tr>
<td>Total</td>
<td>41176</td>
<td>23101</td>
<td>100.0</td>
<td>18075</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: ABEU.
half of the seventies. This is a normal part of, or response to, organisational change in firms in most industries, but employment in banking has been rather different from employment in most industries. Banking has traditionally offered training and a career for life for its male employees, and at least temporary employment for its female employees. This latter group is now close to becoming a majority of bank employees, and the former group, largely because of its limited experience and poor educational qualifications, is likely to have great difficulty becoming the specialised and dynamic workforce banks may require in the future.

**THE QUEENSLAND SURVEY**

The refusal of the major trading banks and of the Australian Bankers’ Association to co-operate in any way with our study both made a survey the more necessary and also dictated that the survey be conducted through the unions rather than the employers. The survey was ultimately confined to private banks in order to achieve compatibility with the superior employment data of the ABEU, and was restricted to Queensland because of funding limitations. The ABEU had 8,413 full-time and part-time members in Queensland in June 1980, comprising 3,971 females (47%) and 4,442 males (53%) and representing 90% of the private bank workforce in the State. A list of these members was made available and a sample of 2,000 was obtained by selecting every fourth name, discarding the names of those who did not work for one of the five private major trading banks or the Bank of Queensland. The questionnaire was discussed with officers of the ABEU, and was also considered by its union committee, which suggested some minor amendments. Following pilot testing, the questionnaire was dispatched on 26 September 1980. By the middle of November 1980, 957 replies had been received, a response of 48%. Of the replies, 949 were usable.

**Educational Qualifications**

The vast majority of respondents left school after Year 10 or 12, but very few went on to achieve higher educational qualifications. Of the 949 respondents, just 70 have some sort of tertiary qualification: 11 respondents have a degree, 12 a diploma, 38 some sort of commercial qualifications and 18 have Banking Institute qualifications. The concept of career advancement through banking experience is obviously still valid for the majority of employees, most of whom would have joined the bank straight from school and have remained with the same bank. Of our respondents, 90% have worked with the same bank throughout their employment in the banking industry. Of the 43 respondents enrolled at a tertiary institution for a course specifically related to their job in banking, 41 are male. The two females enrolled—one a computer operator and the other an accountant—both feel they have a career in banking and that they are already launched on that career. The differences in attitude to work, and potential for career advancement, between males and females is very marked in banking employment.

It has often been suggested that female bank employees perform the more mundane jobs and advance more slowly than men into higher job categories. An analysis of the 15-20 age group working in branches in Queensland seems to support this view (Table 5). There are roughly equal numbers of males and females and over 50% of

<table>
<thead>
<tr>
<th>Job Category</th>
<th>Male</th>
<th>Female</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trainee</td>
<td>32</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Machine Operator</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Typist</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ledger Examiner</td>
<td>23</td>
<td>2</td>
<td>-13</td>
</tr>
<tr>
<td>Junior Clerk</td>
<td>34</td>
<td>8</td>
<td>-16</td>
</tr>
<tr>
<td>Sole Teller</td>
<td>13</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>General Clerk</td>
<td>15</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>Senior Clerk</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Accountant</td>
<td>0</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Manager</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>123</td>
<td>156</td>
<td>94</td>
</tr>
</tbody>
</table>

Source: Questionnaire

**Table 6. Opinion by Sex of Whether Employee has a Job or a Career in Banking.**

<table>
<thead>
<tr>
<th>Job Category</th>
<th>Male</th>
<th>Career</th>
<th>Total</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>41.6%</td>
<td>58.4%</td>
<td>100%</td>
<td>570</td>
</tr>
<tr>
<td>Female</td>
<td>71.4%</td>
<td>28.6%</td>
<td>100%</td>
<td>357</td>
</tr>
<tr>
<td>Male and Female</td>
<td>55.1%</td>
<td>46.9%</td>
<td>100%</td>
<td>927</td>
</tr>
</tbody>
</table>

Source: Questionnaire.

females are employed as machine operators and typists: the figure for males is only 1%. In the higher job categories—from ledger examiner to general clerk—there are twice as many males as females.

Banking is obviously not a career for the majority of women bank employees. Not surprisingly, women are found to have different career expectations from men; 71% of all female respondents feel they have a job rather than a career in banking compared with 42% of all males (Table 6). It is interesting that such a large minority of men also feel they have a job in banking rather than a career. The tradition of banking employment, for men if not for women, has long been one of a secure and dependable career.

**Tradition in Transition**

The Australian Computer Journal, Vol. 15, No. 4, November 1983
Contact with New Technologies

About half of all respondents work in the Brisbane area and some 26% in rural parts of Queensland. Given this heavy urban emphasis, it was expected that most bank employees would have contact with such new technologies as word processors. As the banks have declared that all branches will be on-line by 1983, it was also expected that many staff would have encountered on-line computers. It was, therefore, surprising to find how little contact most of the respondents have with new technology, particularly as so much public attention has been given to technological change in banking. Respondents were asked if they had any contact with such technology as word processors, on-line and off-line facilities, mini-computers, and computerised transaction systems such as CEMTEX and SWIFT. The new technology most likely to be encountered by respondents is on-line terminals. 32% of respondents frequently come into contact with them and 6% occasionally, but the majority never encounter them. Off-line terminals are used by even fewer employees, just 10%. The vast majority of respondents have not come into direct contact with CEMTEX, mini-computers or even word processors, or, as yet, with SWIFT. These results strongly suggest that the simple money transaction process dominates banking and that it is in this process that the majority of employees are engaged.

Although hardly any respondents have actually encountered the technologies in question, the majority of respondents chose to express an opinion about the effect of new technology on their work. Very few bank employees think that new technology makes no difference to their work, but it is not easy determining precisely what that difference may be. Employees are quite certain that new technology makes their work easier, and disagree totally with the suggestion that it makes employment more secure. They are divided, though, on whether work becomes more skilled, more responsible, or more satisfying. For many employees, new technology seems to make work both more interesting and more repetitive.

Table 7 illustrates very clearly that the vast majority of respondents (615) feel that the new technology introduced by the banks has not improved their career prospects. The difference in response is much more marked for age than for sex, younger employees being more likely to be uncertain or to feel that technology has improved their career prospects. Those over 21 are very decidedly of the opinion that new technology has not benefited their careers.

When the response was broken down by job category in the branches (Table 8), trainees and machine operators emerged as the groups least certain that career prospects are not improved. More senior staff are decidedly of the opinion that prospects are not improved, and accountants seem to envisage an especially bleak future.

Bank employees were also asked what effect they thought specific new technological developments would have on their job or career prospects. The new developments chosen included those that are likely in the very near future (complete on-line facilities), those whose introduction has only recently begun (ATMs), and those about which a considerable amount has been written but which do not look likely to appear in Australia in the next five years (point of sale terminals and telephone banking).

Considerable controversy has surrounded the recent introduction of ATMs by the banks. The unions have been opposed to them, seeing them as a means of cutting costs by replacing human tellers with machines. They have conducted a nationwide campaign to inform both their members and the public about the likely effects of these machines, and have adopted the slogan 'Banking is people not machines'. The banks have countered with the argument that ATMs will create, not destroy, jobs. Though there are now ATMs operational in Queensland, no bank in Queensland had installed an ATM at the time this survey was conducted. Table 9, therefore, gives some indication of which of the protagonists had been the more persuasive. Most bank staff think that ATMs will have an adverse effect on their jobs or careers. Young people, those who might expect to become tellers in the near future, are particularly concerned. Women of all ages perceive an adverse effect, but older men, who would probably be senior clerks, accountants and managers, see little personal threat. Very few employees perceive any benefits from the introduction of ATMs.

New Banking Services Facilitated by Technological Change

Although the major trading banks have long engaged in the provision of services peripheral to their traditional banking function, new technology has enabled them to...
extend many such services in recent years. Employees were asked how much of their time was spent providing some of these activities, and most of those work in head offices. Clearly, though, many staff deal with these areas as part of their normal duties, and in a sense, these new activities rather than more traditional banking activities account for over 20% of bank employment.

Branch employees were asked how they thought such new services had influenced their work. There was strong agreement by both males and females of all age groups that new services give them more interest in their job. They also think that new services have called for more skill, but men are more positive about that than women. Branch employees are adamant that new services have increased customer contact. Even among the trainee group 72% think that contact has been increased, and no less than 87% of managers are of that opinion. Many comments were offered stressing the importance of employee-customer contact, and it would seem that new services are instrumental in strengthening this contact. Such comments tended to suggest that the adoption of new technology would reduce customer contact to the detriment of banking, and there was no indication of any awareness that new technology has facilitated the extension of new services which, apparently, has greatly increased customer contact.

TECHNOLOGICAL CHANGE AND EMPLOYMENT IN BANKING

Employment levels in banking and the characteristics of that employment are likely to be much more influenced by what the banks do than by how they do it. We have argued elsewhere that the indirect effect of technology on employment is much greater than the direct effect and, even more strongly, that the adoption of technological change promotes and requires concomitant change in the adopting organisation. Large organisations in particular are unlikely to be aware of the magnitude of change necessitated by technological innovation. In Australia, it is still possible for the Chief Economist of the ANZ Bank to consider the changing structure of the banking industry and to list major innovations in the banking system over the last two decades without even mentioning technological change. Employment levels and conditions will be more a product of organisational response to technological change than of the technology itself.

Yet, the banking unions — and, strangely enough, the banks themselves — clearly think in terms of displacement ratios, of how many staff will be directly displaced by each piece of technological hardware. The Bank of NSW estimated that in the 181 branches converted to computer processing up to 1970, 300 staff positions were saved, and the Commonwealth Bank has calculated that total staff savings of 2,000 positions were attributable to computerisation up to 1979. Similarly, the CBOA estimated in 1980 that the Commonwealth Bank’s workforce of 28,000 would have been over 32,000 without EDP. The ABEU has sponsored an advertising campaign in which it was asserted that one ATM replaces 3 tellers, and bans have sometimes been placed on the new technology. In response, the banks have claimed that the new technology does not, in fact, threaten employment levels and that ATMs will be responsible for increased employment in banking because additional staff will be required to service the machines.

This is a sterile dispute likely to have no outcome except the confusion of bank employees. That confusion is evident in the Queensland study results; bank employees who often saw their job or career as having benefited from previous adoption of new technology were alarmed about future technological innovation. Similarly, while bank employees welcomed their increased involvement with new services offered by the banks, they made no connection between those new services and the technological change which made the services possible. At this level of appreciation of the process of technological change, no solution to the problem of the relationship between technological change and employment is possible. That is not to say that it is consequently necessary to resort directly to the abstractions of theory. The facile reasoning of the Myers Report — that if there are reductions in employment levels caused by technological change in certain industries, there will be automatic compensation through increased real income generating new jobs in other industries — is not only trying to the faith of even hard-nosed economists, but is cold comfort to the employee embarked on what he had believed was a career in banking. It should be possible to explore what has actually been happening in Australian banking and to reach more useful, if tentative, conclusions about the relationship between technological change and employment.

The major Australian trading banks are huge business concerns for which — no less and no more than for other Australian business — continuing profit is a prerequisite for

<table>
<thead>
<tr>
<th>Table 9. Employees' Opinion of How ATMs Would Effect Job/Career Prospects (%)</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adversely</td>
<td>(926)</td>
<td>(130)</td>
<td>(178)</td>
</tr>
<tr>
<td>Not at all</td>
<td>52 75 56 34 18 28 15 62 65 52 50 0 33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beneficially</td>
<td>7 9 5 4 15 6 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don't know</td>
<td>8 11 8 8 8 5 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100 100 100 100 100 100 100</td>
<td>100 100 100 100 100 100 100</td>
<td></td>
</tr>
</tbody>
</table>

Source: Questionnaire.

<table>
<thead>
<tr>
<th>Table 10. Proportion of Employee Work Time Spent Providing Traditional and New Banking Services.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bankcard</td>
<td>6.6</td>
</tr>
<tr>
<td>Travel</td>
<td>3.4</td>
</tr>
<tr>
<td>Finance company/Insurance</td>
<td>6.3</td>
</tr>
<tr>
<td>Corporate investment</td>
<td>3.8</td>
</tr>
<tr>
<td>All other banking activities</td>
<td>79.6</td>
</tr>
<tr>
<td>(Number)</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Questionnaire.

The Australian Computer Journal, Vol. 15, No. 4, November 1983
Continuing existence. The banks do not exist to create employment or to make employees happy in their work, though some would argue that this should be the case, and more that liberal treatment of what so many annual reports call ‘the company’s greatest asset’ makes a positive contribution to increased profitability.63 Employment is part of the means by which the banks reach their end; it is not in itself the objective. Consequently, technological change, in that it is adopted by the banks to achieve certain ends, is primarily directed towards those ends and not towards creating an impact on employment. The distinction is important, because no assessment of the employment impact of technological change is likely to be terribly useful if it misunderstands the reasons for adoption and if, by concentrating on a side effect, it neglects altogether the impact of the innovation on the employing organisation.

The banks may choose to increase profits — or whatever else they might want to increase — by reducing costs. It is important to remember that this is not an inevitable business strategy; increased profits can be associated with increased, rather than reduced, costs if, for example, a company alters the scope of its business or changes its internal organisation. We will argue later that just such changes have occurred within banking, that they are associated with technological change, and that their impact on banking employment would seem to be much greater than the impact of technology introduced to reduce costs. If the banks intend reducing costs, then their branches and the employment in those branches would seem to be obvious areas on which to concentrate. The Bank of New South Wales estimated that 72% of its 1978 operating costs were attributable to its branches and data centres.64 The majority of Australian bank staff work in branches; for example, in the Commonwealth Bank 67% and in the old Bank of New South Wales 80%.65 As has been shown, there is much feeling that Australia has too many bank branches. While there has been some relocation of branches from rural areas to metropolitan centres in recent years, and closure of some smaller branches, total branch numbers — unlike total agency numbers — have changed little during the seventies. Yet the banks have stated quite categorically that the survival of branches is dependent on their profit potential.66

New technology is relevant to the survival of the branches in several ways. First, much of the branch assessment exercise is dependent on information from the branches, made rapidly and conveniently available to head office by computer systems.67 Second, it may be that new technology — such as ATMs — offers an alternative to branch closure, as, indeed, it might offer an alternative to the opening of a new branch. Third, and by far the most important, new technology has facilitated the means by which banks have diversified their business interests. For example, the Commonwealth Bank uses its branch network and computer technology to handle transactions between travel agents and airlines for the whole of Australia.68 While branches have always played an important role in attracting customers to use the full range of services offered by the entire banking group and have not been expected to function as discrete profit-making entities, increasing diversification has made the ‘shop window’ function of the branches more important. In the banking of the eighties, anticipated profits are much more likely to come from widespread customer use of the range of services provided by the banks than from an expanded deposit base.69 The branches play an essential role in attracting the customer, and technology is vital to the provision of the services he may buy.

The Queensland survey indicated not only that a considerable proportion of bank staff time is spent on the provision of new services, but also that most staff welcome the sort of duties involved, think that they improve job or career prospects, and particularly valued the customer contact they necessitate. There would appear to be a strong nexus of technological change, branches and customer contact which would seem likely to mitigate against radical programmes of branch closure by the banks. That does not mean that drastic rationalisation will not occur.

All banks have vastly extended their range of services since the sixties and have diversified by increasing their interests in such areas as travel, insurance, finance companies, and corporate finance.70 As services become more diversified and specialised, the branch becomes both more important as the means by which customers are attracted to the service and also less important as the unit providing the service. Most branches are still small — of the 749 branches of the old National Bank, two-thirds had fewer than nine staff in 1979.71 Of a total of about 3,800 private trading bank branches in 1979, 55% were staffed by fewer than eight people.72 It is impractical to expect such a small working unit to be the repository for a great deal of specialised knowledge and to make a variety of informed decisions. The problem, therefore, is to offer a diversity of services without distancing those services from the customer. One possible solution is that attempted by the ANZ Bank. Its area banking concept, reminiscent of the satellite banking system of the Midland Bank in the UK, allows customers to by-pass local branch bank managers to contact specialists in an area branch or head office.73 Unfortunately, that solution is inadequate for the much greater problem new services pose for branch employees.74

The Queensland survey gave an interesting indication of the educational qualifications of bank employees. They are not high. While 6.7% of the total Australian workforce has a degree, only 1.2% of the Queensland bank workforce appears to be similarly qualified.75 It is unnecessary to argue here that formal education is useful for decision-making in a variety of complex and specialised areas. It is sufficient to note that the banks have the option of leaving such decisions in the hands of generalists in the branches or of hiring specialists with formal qualifications from outside the world of branch banking.76 Increasingly, the banks are taking the latter course and are allowing educational institutions to bear the costs of training and to screen potential specialist employees.77 The result is what has been referred to as the ‘two-tier’ system, whereby branch employees remain just that and there is little progression to the upper tier. Again, the role of technological change is evident for it was the banks’ desperation to acquire EDP professionals which set a precedent for substantial recruitment of employees with no experience of branch banking. It is no longer unusual to find highly-educated and probably highly-ambitious employees among the ranks of middle management in banking. Such employees have little experience of branch banking and little desire to obtain any.78 While most of the present senior bank management has risen through the ranks in the branches, that will probably not be the case with senior management in the near future. It is a matter of conjecture whether the change will be accompanied by a more aggressive use of the technology available to banking.
Tradition in Transition

In branches, the adoption of new technology is increasing the strain on what gives every impression of being an anachronistic and paternalistic employment structure. Salaries of unclassified staff are still related to age rather than aptitude. Salaries of managers are related to 'hands' in the branch rather than the work performed. Promotion is largely a function of endurance and sex, and there is virtually no inter-industry or even inter-bank employee mobility. In July 1981, the managing directors of the Bank of NSW, the ANZ, the National Bank, the CBA and the CBC had all worked for their company for between 40 and 42 years. About half the banking workforce is now female and yet the industry offers no real career prospects for the majority of this group. Tight restrictions on part-time employment further reduce the flexibility of the bank workforce. In any industry seeking to co-ordinate with rapid and widespread technological change in the rest of the economy, such an employment structure would be a grave disadvantage. In an industry which is itself likely to undergo further extensive technological change, such characteristics give all the more cause for concern. If effective impediments to technological innovation do exist within the employment structure of the banking industry, the consequence is likely to be not the slow rate of adoption envisaged by the banks and desired by the unions, but an sequence is likely to be not the slow rate of adoption envisaged by the banks and desired by the unions, but an uncertainty as much as possible, it is probable that the banks will do what they can to delay the adoption of new technology — and so avoid that uncertainty — until conditions are more settled. It may be, of course, that the strategies of competitors will permit no such delay or that the apparent advantages of certain technological changes are so great that adoption becomes irresistible.

It is almost a truism to say that the traditional business of the major trading banks is dependent upon achieving economies of scale. Much of the incentive of banks for the adoption of early computer systems was the sheer bulk of repetitive work. The importance of economies of scale may be rather less in those new areas into which the banks have increasingly diversified, though, as was revealed in the Queensland survey, the overheads and the technology of these new services are shared with traditional banking activities. However, the pioneers in the introduction of at least some technological change in the financial sector have been relatively small building societies and credit unions rather than the banks. It is a characteristic of any technology so dependent on semiconductor electronics as computers that improved performance is associated with rapid price decline. Consequently, very small financial organisations have been able to use new technology to overcome some of the advantages of economies of scale held by the banks. That will not always be possible. Indeed, the Bankcard experience shows very clearly how vital economies of scale still are and how powerful a group can be that is big enough to provide a huge customer base and the technology to provide those customers with a new service. Most other technological change the banks might conceivably introduce seems to be both dependent on economies of scale for its introduction and likely to intensify the importance of economies of scale in its utilisation. Both the building societies and the credit unions, early and successful users of smaller systems, seem to realise this in their recent attempts to form loose but larger groupings. Economies of scale are particularly important for the several technological changes leading ultimately to an electronic funds transfer system (EFT).

Like the electronic office, EFT is not going to be introduced quickly. EFT is a complex of systems rather than a single system, and it will require not only the widespread diffusion of a whole range of technologies, but also concomitant change within many organisations and in the linkages which bind those organisations together. The introduction of appropriate technological hardware, such as ATMs and point of sale terminals and even of minor systems such as Bankcard, is only the prelude to much more radical change by which common financial transactions will be effected electronically and detailed information concerning those transactions will become essential to all levels of economic activity. The technology to achieve this exists now and there appears to be an awareness among some organisations of the benefits inherent in EFT. Calculating those benefits and relating them to the massive costs — including the cost of uncertainty — is hardly possible. Indeed, the exercise may seem scarcely worthwhile as long as, for example, many workers still insist on being paid in cash and legislation demands the physical movement of paper vouchers.

However, if it is accepted that the economy will eventually be dependent on electronic funds transfer, it is clearly to the advantage of some organisations to become involved in such systems as soon as possible, either because...
they feel they will themselves benefit from using EFT or because they perceive it may be in their interests to supply a service to others. The banks are clearly among those organisations, but they are far from alone. Large retailing and insurance organisations also appear to be keenly interested and they are not unaware that their scale of operations may permit them to venture beyond being users of EFT to being suppliers of EFT services for others. In other words, EFT may allow non-bank organisations to enter what have been traditional banking areas: it is less likely that the banks will enter, say, general retailing or insurance. Indeed, it is conceivable that a sophisticated EFT complex of systems would allow consumers so much ease and control of financial transactions that the bank account would hardly be required. At the moment, a bank account serves as a collection point where funds are mustered before being spent. EFT, in combination with institutions willing to accept immediate deposits and withdrawals, provides the potential for instant mustering and is a long-term, but very serious, threat to the position of the banks.91

Enormous investment is required to take even the first tentative steps towards EFT. Even the vast scale on which most banks handle existing transactions may be insufficiently grand to justify EFT on cost grounds. It is far from clear what traditional cheque transaction costs are — especially when cheque account fees are subsidised by charges for other services92 — but one American study has suggested 40 cents per transaction in 197793 and another 5 cents in 1980.94 Using an ATM or POS may make transactions rather more costly; one American study reckons between 20 cents and 85 cents per transaction.95 and another $1.25.96 Reduced operating costs, then, are unlikely to be attracting the banks to EFT in the United States.97 What may be is the prospect of achieving massive economies of scale in the very long term by assuring a large customer base as soon as possible. It would seem that there is some customer resistance to EFT which takes time to overcome;98 much of that resistance would no doubt evaporate if bank charges for cheque transactions were made to reflect real costs.99 The pricing tool may be a powerful weapon in promoting the rapid diffusion of EFT systems. However, the banks may find difficulty justifying passing on to the customer the real costs of cheque transactions while they themselves continue to enjoy the benefits of interest-free money in cheque accounts,100 particularly as the use of new technology has already allowed the banks to increase transaction speed and so reduce the unprofitable float.101

The main consequences for banking employment of the growth of EFT will be determined by the extent of the trading banks’ involvement in the new systems complex. The large market share and tradition of co-operation of the Australian trading banks suggest that EFT in Australia will eventually be introduced by the banks rather than by other organisations.102 Four Australian banks have now franchised the Chemical Bank’s Banklink computer system to allow corporate customers immediate access through a terminal to information about their domestic and overseas accounts.103 The same system can eventually be used to effect transfers. However, certain non-bank organisations — for example, the unfortunate Myer Emporium104 — have recently shown more energetic interest than the banks in aspects of EFT systems. Myer’s videotex developments have recently been taken over by Westpac. Although the Telecom monopoly over the transmission of information is now little threatened by the Davidson Report, Telecom may be encouraged to accelerate the development of systems for the transmission of data by business enterprise.105 Such systems would be quite capable of executing financial transactions. It is likely, however, that these developments will be more gradual left to a monopolist rather than competing suppliers of telecommunications services.106

Technological change has already exposed the existing Australian trading banks to a degree of competition from other institutions and there has been some response; for example, in extended trading hours. Exactly the same thing has happened in Britain.107 In the United States, de-regulation has increased competition and has encouraged financial institutions other than banks to offer a wide range of innovative financial services, including easy access for depositors to money market interest rates.108 Of the Australian trading banks, only the new Australian Bank does this.109 The entry of licensed foreign trading banks to Australia should accelerate the rate of innovation in the Australian trading banks, but even without foreign trading banks technological change will allow increasing competition from existing financial and other organisations. Neither the Banque Nationale de Paris nor the Bank of New Zealand — the two foreign banks which have long held Australian trading bank licences — has shown any urgent desire to exploit its position. New foreign trading banks, perhaps devoid of branch networks, would not necessarily be any more aggressive, nor would they necessarily offer competition in retail banking, the area where there is most potential for eventual radical change,110 and immediate demand for the cash management services the new technology permits.111

If the Australian trading banks do manage to establish a key role for themselves in EFT systems, the banks’ employment levels will be secure, though the locations of employment may change and the sort of work performed may tend increasingly to resemble that currently offered in data centres. If other organisations come to dominate EFT in Australia, banking employment levels are likely to fall, though the sort of work offered may be more interesting and challenging.112 In such a scenario, the banks might be imagined paying increasing attention to the provision of what have been referred to as new services, and to their financial consultancy role. Either way, technological change will have much more impact on banking in the future than it has had in the past. The nature of that impact and the eventual consequences for banking employment will depend very largely on whether the major trading banks prove flexible enough to create and adapt to a new financial regime.

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BIOGNPHICAL NOTES

Stuart Macdonald is a Senior Lecturer in the Information Research Unit, Department of Economics, University of Queensland. He is interested in the process of change and particularly the role of information and organisation in the process of technological change. Publications are in the areas of science policy, microelectronics, manpower planning and employment, and agricultural history. The second edition of his book with Ernest Braun, The History and Impact of Semiconductor Electronics, was published last year by Cambridge University Press.

Don Lambertson is Professor of Economics in the Information Research Unit at the University of Queensland. In addition to his teaching duties, Professor Lambertson serves as a member of the Technological Change Committee of ASTEC, the Industrial Property Advisory Committee, and the Australian Commission for Unesco General Information Program Committee, and is Chairman of the Pacific Science Association Scientific Committee for Economics.
Computers and Industrial Relations: The New Zealand Experience

C. E. Beardon*

To ensure that society receives the maximum benefit we need to study the detailed interaction between the introduction of new technology and social institutions. A detailed examination of the way new technology has been handled by the industrial relations system in New Zealand reveals many attitudes and procedures that give little ground for optimism. It is suggested that professionals need to go beyond a purely passive role in responding to this situation.

Keywords and phrases: industrial relations, technology agreements, legal implications, trade unions, New Zealand.
CR categories: K4.2, K4.3, K5.2.

It has often been said that those who are concerned with the social aspects of computing are divided into the two camps of optimists and pessimists. In truth there is probably a little of both positions in each of us. We can all see that technology could be used in ways that would be beneficial to humanity, but we can also see that society does not always achieve what it could or should. In our optimistic moments we can see a future in which computerised systems provide timely and relevant information and replace people in dangerous and unpleasant jobs; in our pessimistic moments the same systems are seen as supporting vast impersonal bureaucracies and resulting in massive unemployment. Whilst we can all see a desirable future on the horizon, it is not easy to see the paths that will lead us to this goal through the labyrinth of social, economic, legal and political processes that constrain every step.

For example, with greater trade union involvement in technological change the best intentions of computer professionals may increasingly run foul of industrial relations procedures. This may be because they are unaware of formal procedures, or it may be a matter of attitude. Bjorn-Andersen (1979) shows that computer professionals often have stereotyped views of what the ultimate users of their systems are like. Too often the participation of the workforce is seen as restrictive and negative and to be avoided at all costs. In reality, workers are usually positive about the introduction of new technology and welcome it as getting rid of boring jobs and preserving the viability of the enterprise (see Griffin, 1982). This situation deteriorates when the workforce is misled or information is hidden from it (see Fleck and Scarbrough, 1982) or when redundancies are likely to occur.

Before 1980 this issue received little attention because computer systems were thought of as having little to do with the technologies of production, and awareness of the implications was generally lower than it is today. Since 1980, however, there have been several publications on the situation in Australia, including a significant section of the Report of the Committee of Inquiry into Technological Change (1980, pp. 118-142), a discussion of the effect in a white-collar area (Griffin, 1982) and a discussion of redundancies in manufacturing and transport industries (Deery, 1982). The New Zealand situation has been described briefly by Beardon and Duignan (1981).

WHO IS 'THE USER'?

It is of the utmost importance that computer professionals think of social issues in realistic terms and avoid mystifications. For example, a number of recent conferences have taken “The User” as their theme. In discussion at the 7th New Zealand Computer Conference held in 1981 various possibilities were suggested as to who “The User” actually was:

(a) the top management or shareholders of the client organisation,
(b) the customers or users of the organisation,
(c) the middle management of the organisation,
(d) those members of the workforce whose work depends upon the information processed.

The one group who, in my opinion, had the best prima facie claim — those operators who physically used the system — were considered only briefly and then dismissed as being generally rather uninteresting.

On reflection I believe that this concentration upon “The User”, whilst expressing a noble sentiment on the part of computer professionals, causes much confusion. We are invited to think of the relationship of computer systems to an organisation in terms of a single individual — a kind of platonic ideal whose satisfaction should be our highest priority.

Our society has become very adept at creating such entities out of thin air. What is in reality a complex set of relations is fragmented and reconstructed as an object. Perhaps the most obvious example of this is the notion of “The Economy” which is presented as some sort of vital organ of the state whose well-being demands almost any sacrifice. Just as there is no “Economy”, only a complex set of economic relations, so there is no “User” either, only a complex set of relations between a new system and the organisation. The danger of this way of thinking is that we are invited to think of a single user with a single set of values and expectations that need to be satisfied. The

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*The author is with Department of Computer Science, University of Waikato, Hamilton, New Zealand. Manuscript received June, 1983; revised September, 1983.
realities, however, is a complex set of relations involving a plurality of users often with competing interests.

ASPECTS OF AN ORGANISATION

K. Nygaard (1980) has analysed the internal operations of an organisation in terms of five interacting systems:
(a) A system of work tasks.
(b) An information system.
(c) A decision system.
(d) A power system.
(e) A social system.

The introduction of a computerised system, or in fact any organisational change, is likely to affect all these systems. For example, it was traditional in many enterprises that senior "blue-collar" workers not only exercised managerial control over that section of the workforce but also had significant, though perhaps informal, impact upon decision-making at high levels in the organisation. With the introduction of a computerised system, however, the nature of management decision-making tended to change. The increasing influence of tertiary-trained managers with a more technical approach led to a decline in the influence of "blue-collar" management. In such a way the introduction of a new information system can have a significant effect upon both the decision system and the power system within an organisation.

In addition, a new information system may introduce a system of work tasks that results in tedious, alienating jobs and breaks up traditional groupings of workers. The experience of Mumford and Henshall (1979) shows that the working people most involved may have a different attitude towards appropriate work tasks from that of the information systems designer. The social system at work may also be affected, and as Nygaard has illustrated (Nygaard, 1980) the social system provides a necessary channel for unstructured information sharing. Such information sharing is often significant for the smooth operation of the enterprise and is usually ignored by the formalised information system.

Commentators generally agree that computer-based systems are going to have a very profound effect upon working life. The general notion that "those who use a computer system should be involved in the design and implementation of the system", is a truism that would probably raise no opposition. Any attempt to clarify what we mean by "involvement" would almost certainly lead to strong disagreement. If we wish to clarify the matter we need to address three questions:

1. How do we make computer professionals aware of the impact of the systems they design upon the complex structures within an organisation?
2. How do we educate those people who are likely to be affected by organisational change so that they can make positive contributions to the design process?
3. How do we proceed in those areas where there are conflicting views held by different sections of the organisation (typically, management and employees)?

It is questions such as these that we need to address if we are to begin to make progress.

INDUSTRIAL RELATIONS IN NEW ZEALAND

In New Zealand, as in Australia, industrial relations are normally carried out within a structure built around an Arbitration Court which has the power to register unions, register awards and agreements, and arbitrate in cases of dispute over either the terms of awards or their interpretation in particular cases. In New Zealand the Court was first set up by an Act of Parliament in 1894 and, despite several changes, exists today in much the same form.

About 40% of New Zealand's 1.3 million workers are organised in unions registered with the Arbitration Court and there are several significant unions and associations that are not so registered. The size and scope of the 265 registered unions varies enormously, from the large national unions (e.g. Engineers, Clerical Workers) with anything up to 50,000 members, to the very small local unions, often covering only a single site. Some of the small unions have as few as ten members.

The issue of participation in the design and implementation of computer-based systems first came to the attention of the Arbitration Court in July 1980 when it heard a dispute between the Clerical Workers Union and Wellington Law Practitioners. (For a detailed account of issues raised by this case see Joseph and Hughes, 1981). The dispute concerned the planned introduction of a number of word processing machines by solicitors in the Wellington area, but it quickly developed into a test case with both the New Zealand Employers Federation and the New Zealand Federation of Labour appearing.

The central issue was the extent to which the introduction of new technology could be handled within existing industrial relations practices. The Union argued that the introduction of such technology was an "industrial matter" within the meaning of the Industrial Relations Act 1973, and hence they had a right to bargain over its introduction. On this basis they argued that the entire process of the introduction of new technology was one in which they had a legitimate role to play. The Employer's Federation did not agree, and whilst expressing the belief that there should be discussion and consultation concerning the introduction of new technology, expressed fears that "the aim is 'participation' which in turn implies 'control'". The employer's view was that any discussions should be limited to avoid the danger that they would "stifle or veto" the introduction of the technology.

In considering the matter, the Court appears influenced by an Australian ruling:

"Whilst it is a truism that both industrial disputes and awards made in their settlement may consequently have an impact upon the management of an enterprise and upon otherwise unfettered managerial decisions, the management of the enterprise is not itself a subject matter of dispute." (quoted in Joseph and Hughes, 1981, p. 133).

The implication of this ruling is that matters are to be finely divided between "industrial matters" which are the legitimate concern of unions and the Court, and "management matters" which are not. The essence of the Law Practitioners case therefore centred on the attempt to define where, in the course of introducing a system employing new technology, that line was crossed.

The Act in question defines the concept as follows:

"'Industrial matters' means all matters affecting or relating to work done or to be done by workers, or the privileges, rights, and duties of employers or workers in any industry, . . . "

By tradition, in both Australia and New Zealand, this has been interpreted narrowly as referring only to the work actually provided by the employer, i.e. it does not cover the
quantity of work offered. By concentrating on the labour replacement aspects of the technology, the Court was able to rule that the decision to introduce the technology affected the quantity of work provided and therefore was properly a "management matter". However, in so far as its actual introduction affected the conditions of workers, (i.e., it made them redundant), then the union had a right to be involved after the event.

Thus the Court, in a majority ruling, inserted three clauses into the award. These are (essentially):

(a) When an employer is considering the introduction of new computer technology ... the employees likely to be affected ... will first be advised.

(b) When an employer had decided to introduce such technology the employer concerned shall consult fully with the employees concerned and the representative of the union.

(c) When the introduction of such technology will result in redundancies, the employer concerned shall notify the union to enable discussions on redundancy to take place ...

The ruling was seen as a major victory for the employers who emerged with no obligation to consult the workforce before the initial decision was taken; were not required to give any specific notice; were not obliged to reach agreement; and were not bound to take the matter through a disputes procedure. In addition, the ruling of the Court that the introduction of new technology was not, in itself, an "industrial matter" meant that it is questionable whether the Court will agree to accept jurisdiction in cases concerning the introduction of new technology and, furthermore, that unions or workers taking industrial action over such introduction could be liable to fines and a claim for damages under the Commerce Amendment Act 1976.

THE EXTENT OF TECHNOLOGY AGREEMENTS IN NEW ZEALAND

The introduction of a 12-month Wage and Price Freeze in New Zealand in June 1982, since extended by a further nine months, has led to a virtual halt in the registration of new awards and agreements with the Arbitration Court, with the exception of a few large composite agreements covering construction projects and a number of specific redundancy agreements. Furthermore, a supplementary regulation prevents formal negotiations on other aspects of terms and conditions of employment, including technology agreements. Purely by chance this has made it possible to compile reasonably accurate data on the extent of technology clauses in the currently registered documents and to draw conclusions as to the coverage they afford to various groups of workers in the country. A database has recently been created at the University of Waikato containing details of each award, the industry or industries it refers to, the craft or crafts involved and the unions which are signatories to it. As well as indicating whether the award has any specific clauses relating to new technology there is also the facility for indicating, by means of keywords, the content of any such clauses. At present the database covers only technology clauses, though it is envisaged at a later date to include other topics of interest to researchers.

Table 1. Extent of Technology Agreements in the NZ Workforce

<table>
<thead>
<tr>
<th>Industry</th>
<th>No. workers</th>
<th>% age of total workforce</th>
<th>No. Registered Unions</th>
<th>% age in Registered Unions</th>
<th>No. Registered Awards</th>
<th>No. Registered Awards with Technology Clauses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary, Construction and Power</td>
<td>250,000</td>
<td>20%</td>
<td>22</td>
<td>24%</td>
<td>130</td>
<td>3</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>300,000</td>
<td>24%</td>
<td>108</td>
<td>59%</td>
<td>625</td>
<td>46</td>
</tr>
<tr>
<td>Transport</td>
<td>110,000</td>
<td>9%</td>
<td>48</td>
<td>47%</td>
<td>181</td>
<td>9</td>
</tr>
<tr>
<td>Retail and Wholesale</td>
<td>230,000</td>
<td>18%</td>
<td>30</td>
<td>44%</td>
<td>71</td>
<td>4</td>
</tr>
<tr>
<td>Clerical, Technical and Professional</td>
<td>370,000</td>
<td>29%</td>
<td>57</td>
<td>33%</td>
<td>303</td>
<td>53</td>
</tr>
<tr>
<td>All New Zealand</td>
<td>1,260,000</td>
<td>100%</td>
<td>265</td>
<td>40%</td>
<td>887</td>
<td>87</td>
</tr>
</tbody>
</table>

As at 8 June 1983 the database contains details of 887 awards and agreements registered since 1 January 1982. As awards are traditionally registered annually it contains most awards currently active. However the introduction of the Wage and Price Freeze Regulations has meant that it has not always been necessary for an award to be re-registered. Some awards registered before 1 January 1982 are therefore still in effect. It is estimated that the database currently contains about 75% of all active awards, and contains all the important awards registered with the Court. A number of awards contain clauses that are supplementary to a more general award and apply, in conjunction with the conditions of the main award, to a specific group of workers. There are 188 of these supplementary awards as opposed to 699 main awards.

Of the 887 awards in the database only 87 were found to contain specific clauses relating to the introduction of new technology. Of these, 85 were main awards while only two were supplementary awards. The details of the industries to which the awards referred can be found in Table 1.

A few comments on the contents of Table 1 are required. The three awards in the primary, construction and power industries, the nine awards in the transport industry and 15 of the awards in the manufacturing industry all refer to clerical workers, or technicians, or storepersons and packers working in that industry. Therefore there are no groups of "core" workers in either the primary, construction, power supply or transport industries who are covered by any sort of technology agreement, and
very few workers in either manufacturing, wholesale or retail are so covered. Most of the coverage is afforded to the clerical and technical staff and the national Clerical Workers award, which contains the same clauses as were inserted in the Law Practitioners Award, has very wide coverage among unionised workers. It should be remembered, though, that only one-third of clerical workers are unionised.

The extremely low number of wholesale and retail employees who are covered by technology agreements also requires some comment. It is probably due in part to the policy of the various shop employees' unions to achieve total membership in every retail outlet, rather than the accepted practice overseas of concentrating on large chainstores. This emphasis of the unions on small employers not only requires considerable union resources, but also tends to determine the priorities of the union.

**THE NATURE OF TECHNOLOGY CLAUSES**

The detail of technology agreements is significant for two reasons. Firstly because it contains the specific arrangements for the introduction of new technology, and secondly because it indicates the sort of issues that are considered important between the parties. The clauses contained in agreements generally fall into five categories:

(a) **The employer shall advise or give notice**

Forty-nine awards have clauses to this effect. The most common is that inserted in the Law Practitioners Award, stating merely that the employer should advise the employees likely to be affected when they are considering the introduction of new technology. In five cases a specific period of notice is stipulated, normally being six months.

(b) **There shall be consultation, negotiation or agreement**

Seventy-two awards contain clauses to the effect that discussions should take place. In six awards the only clause is a rather weak one, merely saying that the union may discuss the matter with the employer. In a further 50 awards the clause inserted in the Law Practitioners Award is repeated, stating that when the decision has been taken consultations shall take place. The remaining 18 awards have more specific provisions that ensure that the agreement refers retrospectively to equipment considered before the agreement came into effect; that a disputes procedure is agreed upon in case of disagreement; and that regular meetings shall take place to monitor the implementation.

(c) **That training shall be given and health and safety aspects monitored**

Only 15 awards have clauses concerning this aspect, and only 11 have specific provisions stating that operators should be properly trained. Eight awards have quite extensive provisions in the area of health and safety, working environment and provision for workers who are medically unfit to operate the equipment. These awards are those covering journalists and specific groups of clerical workers. The Public Service Association is also currently negotiating an extensive award in this area.

(d) **Redundancy and Redeployment**

Thirty-five awards have the standard clause as inserted in the Law Practitioners Award, stating that if redundancies are to occur then the union shall be notified so that discussions can take place. Twelve awards adopt a more positive approach, 10 containing clauses requiring displaced staff to be retrained for other jobs in the same industry and two guaranteeing redeployment for displaced staff.

(e) **Employer’s Rights**

Three awards contain only a single clause that asserts that the employer has the right to use whatever technology he (sic) thinks fit in the running of his (sic) business.

**INFORMAL AGREEMENTS**

One of the effects of the Court's ruling that the introduction of new technology is not an "industrial matter" has been that technology agreements arrived at outside the scope of the Law Practitioners ruling may not have been registered as the Court's willingness to accept jurisdiction in the future is in question. The status of these informal agreements is that they are completely voluntary and not enforceable in law. However, this does not mean that they are insignificant. The reality of industrial relations on a day-to-day basis proceeds by informal and often unwritten agreements and the formal decisions of the Courts are more like landmarks around which the parties have to navigate, than a formal structure that imposes conformity.

One informal agreement, between the Hawkes Bay Farmers' Meat Company and the Freezing Industry Clerical Officers' Union, goes beyond most formal agreements in stating that the employer will agree to collective bargaining on new technology and goes on to state:

"The Union and Union members at the workplace will be involved in the type of equipment to be introduced and on how their work is to be organised, designed and controlled as a result of the new technology or system." (Hawkes Bay Farmers Meat Co/ NZ Freezing Works Clerical Officers, New Systems and Technology Agreement, 10 April 1981, Clause 6)

The new technology agreement between AFFCO Ltd and the Federation of Labour arose out of the company's intention to introduce pelting machines, but in fact covers any introduction of new technology. It specifies that 26 weeks before the proposed introduction of any new technology or system full information is to be made available to the unions. Eight weeks later there shall be full negotiations between the parties, and these negotiations may address the need for changes to take place at all. A joint committee shall then be set up to carry out the task of consultation and formulation of a plant plan.

Before we get too enthusiastic about the positive aspects of these agreements, we had better place them in perspective. They are local voluntary agreements, and, whilst they remain in effect, negotiations for a national agreement covering the introduction of new technology in the freezing industry have opened in a very negative way. The employers, whilst agreeing to the holding of talks, have announced in advance that if agreement is not reached then they intend to introduce the new technology without agreement.

**ISSUES FOR COMPUTER PROFESSIONALS**

I listed above three questions that we need to address, and it is now appropriate to review them. Firstly, the education of computer professionals concerning the detailed implications of their work is an on-going activity, but one to which I hope this paper has been a small contribution. Secondly, the education of those who are affected by change is not a matter I have addressed here, though
it would seem that the more enlightened clauses in agreements require the training of staff, not just to carry out their particular jobs but also to participate constructively in the design process. It has been my experience that education for this latter purpose is a new challenge for our professional educators. A traditional, technical education is not appropriate but we have yet to develop courses which can explain the significant aspects of computerisation in terms that are relevant from the perspective of the workplace. The only development I am aware of is a programme developed by a Swedish white-collar union, a summary of which has appeared in English (TCO and TBV, 1982).

The third question concerned the appropriate action for a professional to take when a conflict of interest is involved. I see no reason why a professional should object to the notice, public inspection and negotiations that would be involved in agreements along the lines of the AFFCO—Federation of Labour Agreement quoted above. In fact it would serve to clarify the professional's obligations to both the client and society and should lead to better systems. The success of such a scheme ultimately depends on the success of union-based educational programs and the availability of suitable technical advisers to unions. Whilst we, as computer professionals, may be prepared to hire our services to either side of industry, it will always be for a fee. The reality of the situation is that employers usually have the means to obtain the expert advice they require, whereas trade unions, at least in New Zealand, are financially weak and could not hope to employ the technical advisers necessary for their active participation. It may be appropriate for professionals to investigate ways in which their services can be made reasonably available to all who need them.

On the surface the decision of the Arbitration Court and the attitude of some employers has meant that for those of us in New Zealand concerned to see greater participation by all relevant sections of the workforce in systems design, there is little to be optimistic about. Nevertheless there are some more hopeful aspects to the situation. For one thing New Zealand is a country which has a strong tradition of conciliation in industrial matters and despite recent government intervention, there is a strong belief that the parties should be able to reach reasonable agreement on such matters. For another, the ruling of the Arbitration Court was based upon the premise that the introduction of new technology was a specific event and was not a constant feature of working life. In many industries it will soon become apparent that this is not the case and so a more permanent and regular structure for the monitoring of changes to technology and work processes will become necessary. At this stage the Arbitration Court may be asked for another ruling. Finally, the Arbitration Court did not set a clear precedent in that the Court “does not regard itself as bound by any factual precedent in matters of arbitration” and recognises that “different approaches may need to be adopted for other industries as further technological changes occur” (see Joseph and Hughes, 1981, p. 136). There is scope, therefore, for the Court to refine its view if presented with further cases.

Ultimately, though, it is the author's belief that computer professionals themselves should become involved in a more far-reaching look at the effect of industrial relations upon the introduction of new technology, and the impact of new technology upon the industrial relations system. If we would prefer to see computer technology introduced in a more constructive and co-operative atmosphere of industrial relations, such as one may find in Scandinavia or elsewhere, then we have a part to play in the creation of that atmosphere. All sides of industry will require our advice and opinions if they are to successfully negotiate the transformation to a high-technology society. If the paths to this particular goal on the horizon are not already in existence then we have a duty to be part of the process of building them. The alternative is that the worst fears of the pessimists will be realised.

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BIOGRAPHICAL NOTE

Colin Beardon has been working with computers since 1965. He obtained a Doctorate in Artificial Intelligence at the University of Essex in 1976, and spent three years in Australia, lecturing at the NSF Institute of Technology. He is currently a Senior Lecturer in Computer Science at the University of Waitakaro in New Zealand and is a member of IFIP TC9 (Computers and Society).
Privacy Legislation and the Right of Access

J. A. Thom and P. G. Thorne*

The right of individuals to access information concerning them is an element of virtually all privacy legislation. This right is generally regarded as a prime safeguard of personal privacy. This paper raises issues fundamental to the definition, implementation and enforcement of the "right of access" principle. As a consequence of developments in database technology compliance with this principle may, in many cases, be infeasible.

Keywords and phrases: right of access, privacy, data protection, freedom of information, deductive databases, PROLOG.

CR categories: K.4.1, K.5.2, I.2.3.

1. INTRODUCTION

A common element of virtually all privacy legislation, enacted or proposed, is the right of access by an individual to the information held concerning that individual.

Hoffman (1980) proposes that the research agenda for "Computers and Privacy" should include the continuous assessment of new technological developments. This paper analyses the implications for the "right of access" principle of recent developments in the design of database systems. It will be shown that the definition of "the information held concerning a particular individual" is no longer clear and widely differing definitions are possible.

Early database systems evolved from the manual systems which they replaced, accessed just by a single primary key in somewhat the same manner as accessing a filing cabinet without an index. Thus the earliest database systems were based on a hierarchical model. Endeavours to protect privacy appear to have been initiated on the basis of such simple models. However, development of more sophisticated database systems, including those based on the relational and more recently the deductive model, have led to much more sophisticated systems in which information can be stored in very diffuse form.

A distinction must be made between information which is stored explicitly in one or more records and information which is stored implicitly across a number of records. Explicit information can be retrieved by accessing the records in which it is directly stored, whereas implicit information may be retrieved only by accessing and combining the information held in different records, possibly using rules which may also be stored in the database. Information which is stored explicitly in a manual system may be very difficult to extract. Primitive computer database systems generally had a limited capability to retrieve implicit information. However, in more advanced systems including deductive database systems, the stored rules enable information which is stored implicitly in the database to be accessed readily.

2. RIGHT OF ACCESS

The Australian Computer Society (1982) asserts that the individual has the following basic rights:

1. The right to know who is keeping records about him in an information system.
2. The right to be informed of the record-keeper's information practices sufficient to allow him to make an informed judgement on whether or not to provide the personal information which is sought from him.
3. The right of reasonable access to all data relating to him held in an information system.
4. The right to have made available to him at regular intervals, or whenever a change is made, the details of all data relating to him and how it is used.
5. The right to challenge the validity or relevance of data related to him and to add explanatory information.
6. The right to have erased from the information system information which cannot be proved to be true, accurate or relevant, the onus of proof to be on the record-keeper. Such a right should also provide for the automatic removal of information after a lapse of time.
7. The right to restrict and control the release of private information by the organisation responsible for its original collection from him. Disclosures which violate the individual's reasonable expectation of privacy should only be permitted where there is a significant countervailing public interest.
8. The right to obtain legal redress (e.g. by way of injunction or damages) if any of the above rights are infringed.

These are similar to principles enunciated by many others. In Australia these include reports by Morison (1973) and the Privacy Committee (1980) in New South Wales, a government report in Western Australia (1976), a report of the South Australian Law Reform Committee (1980), and a discussion paper of the Australian Law Reform Commission (1980). Overseas these include reports by the Younger (1972) and Lindop (1978) committees in the United Kingdom, and the United States Department of Health, Education and Welfare (1973).

Many countries have enacted privacy or data protection legislation based on principles similar to those given above, including Austria (1978), Canada (1977), Denmark...

Also international agreements have been made, based on principles common to most existing privacy (or data protection) legislation. For instance the conventions of the Council of Europe (1980), and the Organisation for Economic Co-operation and Development (1980). Both these international agreements include the right of individuals to access data relating to themselves.

Although Australia does not at present have any general privacy legislation as such, freedom of information legislation has been passed at both Federal (Australia, 1982) and State (Victoria, 1982) level which provides some protection of personal privacy in relation to government records. Also in New South Wales (1975) legislation was passed establishing a Privacy Committee (1980) which (amongst other things) investigates complaints of unjustifiable invasions of privacy.

The Australian Law Reform Commission (1980) states that "the right of access" principle "is generally regarded as perhaps the most important privacy protection safeguard". The Commission refers to "the individual participation principle"; the right of an individual to have communicated to him, "data relating to him" and to be able to challenge "data relating to him".

Although the right of access is an important principle, it should be remembered that it is only one of a number of rights which attempt to give the individual control over his or her personal information. This paper is primarily concerned with the definition of the right of access, and does not address general criticisms of the right of access such as the following:

1. The right of access is workable only if a relatively small proportion of people exercise their right, and it is unlikely that all people will have equal opportunity to exercise this right.
2. The right of access does not overcome the nature of power relationship between large institutional data-keepers and individual data-subjects. Institutions control the technology; and the right of access, in itself, does not prevent them from maintaining an excessive amount of information on individuals (Rule, McAdam, Stearns and Uglow, 1980).
3. In practice the right of access principle, as enacted in most countries, inevitably seems to contain a number of exemptions; including information collected in the name of "national security".

3. DATABASE MODELS

Various database models exist, for instance the hierarchical, network and relational models described by Date (1981). The hierarchical and network models rely on defining linkages connecting different types of records (facts) when a database is set up. These linkages must be set up in a tree (hierarchical) or graph (network) structure.

The following sections will consider only the relational model and an extension to it, called the deductive model, distinguishing between implicit and explicit information. The other two models are similar to the relational model to the extent that explicit facts can be stored within the database and that implicit information, in general, can be accessed only by the construction of more complex queries. In the relational and deductive models logic can be used to represent both the contents of a database and queries about the information stored in the database (Lloyd 1983). Thus formal logic is used as both a data definition language and a data manipulation language. Logic programming (the use of logic as a programming language) is described by Kowalski (1982), Clocksin and Mellish (1981) and Sammut and Sammut (1983).

3.1 Relational Database Model

A logic program (as defined in the Appendix) which consists only of facts is a relational database. Consider the following facts in a simple database

married(jenny,karl)
married(laura,paul)
married(eleanor,edward)
son(edgar,jenny,karl)
daughter(laura,jenny,karl)
daughter(eleanor,jenny,karl)

which represents the family tree in Figure 1.

![Family tree](image)

This database may be interrogated using queries such as

\[ \text{WIFE = jenny} \]

This query merely retrieved information which was stored explicitly as a fact in the database. However queries can be generated which retrieve information which is stored only implicitly in the database. For example the query

\[ \text{married(WIFE,karl) & daughter(WIFE,MOTHER-IN-LAW,FATHER-IN-LAW)} \]

determines Paul's parents-in-law with the answer

\[ \text{MOTHER-IN-LAW = jenny} \]
\[ \text{FATHER-IN-LAW = karl} \]

Simple logic programs follow the relational database model. In a relational database the facts are usually referred to as tuples.

3.2 Deductive Database Model

The deductive database model is an extension of the relational model. A deductive database is a logic program which contains rules as well as facts. For example, if the rules

\[ \text{parents-in-law(MOTHER-IN-LAW,FATHER-IN-LAW,PERSON) :- married(PERSON, X) & son(X,MOTHER-IN-LAW,FATHER-IN-LAW)} \]

\[ \text{parents-in-law(MOTHER-IN-LAW,FATHER-IN-LAW,PERSON) :- married(X,PARENT) & daughter(X,MOTHER-IN-LAW,FATHER-IN-LAW)} \]

are added to the facts listed in the previous section, then a deductive database has been created. Similarly queries about information stored explicitly or implicitly in the database can be made. For example the query

\[ \text{parents-in-law(MOTHER-IN-LAW,FATHER-IN-LAW,paul) with the answer} \]
\[ \text{MOTHER-IN-LAW = jenny} \]
\[ \text{FATHER-IN-LAW = karl} \]

extracts information which is not explicitly stored in the database.

General purpose deductive database systems have
been implemented in recent years, for instance those described by Dahl (1982) and Debenham and McGrath (1983). A deductive database based on PROLOG has been implemented at The University of Melbourne. PROLOG is used both as a data definition and data manipulation language. The first author contributed to development of this database facility and to its application as a database system containing information about all the students in the Computer Science department.

The power of a deductive database lies in the ability of its users to extract information, which is implicitly stored in the database in the form of rules and facts, as though it were explicitly stored as a fact. A user of such a database may be unable to determine whether the information accessed by a particular query was implicitly or explicitly stored in the database.

The facts in the "family tree" relational database described in the previous section could be presented in a form understandable to "the person in the street" as shown on the left side of Figure 2. These are the only facts which are stored explicitly in the relational database. To access the implicit information on the right side of Figure 2 would require more complex queries.

When rules are added to create a deductive database, much more information about each person will become available; including information which is stored implicitly in the database. For example, if rules about these relationships

\begin{itemize}
  \item brother
  \item sister
  \item mother-in-law
  \item father-in-law
  \item brother-in-law
  \item sister-in-law
\end{itemize}

were added to the database then all the information in Figure 2 could be obtained using simple queries. More complex queries would still be needed to extract implicit information about relationships for which there are no rules, such as sister-in-law's husband.

Thus with deductive databases it is necessary to distinguish between two types of implicit information:

1. Implicit information which can be derived from the database using the stored rules and a single predicate query, and
2. Implicit information which can be accessed only by the use of more complex queries and some external rules which are not stored as part of the database.

4. **WHAT IS DATA RELATING TO AN INDIVIDUAL?**

The previous discussion regarding relational and deductive databases raises a fundamental issue — what constitutes "the information held concerning an individual". Let F be the facts in the database P and N be a particular person. At least three definitions of "information concerning an individual" are possible.

Consider the "family tree" database described in the previous section and the information held concerning Paul. This simple example will illustrate the problems of defining what constitutes "the information concerning an individual". In real systems it is possible for a very large number of facts and rules to be involved, including many complex combinations. In practice the sheer volume of information will be one of the major problems in providing an individual with the "right of access".

The following definitions should be considered in conjunction with another "right" namely the right to know how data has been used; that is, what information has been accessed and used in the past. The first definition represents information which is actually stored in the database whereas the second and third definitions include information which is not explicitly stored in the database but may nevertheless be generated.

<table>
<thead>
<tr>
<th>EXPLICIT INFORMATION</th>
<th>IMPLICIT INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facts about Jenny</td>
<td></td>
</tr>
<tr>
<td>Husband is Karl</td>
<td>Sons-in-law are Paul and Edward</td>
</tr>
<tr>
<td>Son is Edgar</td>
<td></td>
</tr>
<tr>
<td>Daughters are Laura</td>
<td></td>
</tr>
<tr>
<td>and Eleanor</td>
<td></td>
</tr>
<tr>
<td>Facts about Karl</td>
<td></td>
</tr>
<tr>
<td>Wife is Jenny</td>
<td>Sons-in-law are Paul and Edward</td>
</tr>
<tr>
<td>Son is Edgar</td>
<td></td>
</tr>
<tr>
<td>Daughters are Laura</td>
<td></td>
</tr>
<tr>
<td>and Eleanor</td>
<td></td>
</tr>
<tr>
<td>Facts about Edgar</td>
<td></td>
</tr>
<tr>
<td>Mother is Jenny</td>
<td>Sisters are Laura and Eleanor</td>
</tr>
<tr>
<td>Father is Karl</td>
<td>Brother-in-law are Paul and Edward</td>
</tr>
<tr>
<td>Husband is Paul</td>
<td></td>
</tr>
<tr>
<td>Facts about Laura</td>
<td></td>
</tr>
<tr>
<td>Mother is Jenny</td>
<td>Brother is Edgar</td>
</tr>
<tr>
<td>Father is Karl</td>
<td>Sister is Eleanor</td>
</tr>
<tr>
<td>Husband is Paul</td>
<td>Brother-in-law is Edward</td>
</tr>
<tr>
<td>Facts about Eleanor</td>
<td></td>
</tr>
<tr>
<td>Mother is Jenny</td>
<td>Brother is Edgar</td>
</tr>
<tr>
<td>Father is Karl</td>
<td>Sister is Laura</td>
</tr>
<tr>
<td>Husband is Edward</td>
<td>Brother-in-law is Paul</td>
</tr>
<tr>
<td>Facts about Paul</td>
<td></td>
</tr>
<tr>
<td>Wife is Laura</td>
<td>Mother-in-law is Jenny</td>
</tr>
<tr>
<td>Brother-in-law is Karl</td>
<td></td>
</tr>
<tr>
<td>Facts about Edward</td>
<td></td>
</tr>
<tr>
<td>Wife is Eleanor</td>
<td>Brother-in-law is Edward</td>
</tr>
<tr>
<td>Sister-in-law is Laura</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2. Explicit and implicit facts in the "family tree" database.
where the success set is the set of facts which are logical consequences of the database (success set is defined in the appendix).

In the example the additional information would be that Paul's mother-in-law is Jenny, father-in-law is Karl, sister-in-law is Eleanor and brother-in-law is Edgar.

The relationship between these two definitions is shown in Figure 3. The Herbrand Base is the set of all "possible" facts including those facts which are not logical consequences of the database (the Herbrand Base is defined in the appendix).

![Figure 3. Explicit and derivable facts.](image)

$$\text{EF}_N = \text{explicit facts about the individual } N$$

$$\text{DF}_N = \text{derivable facts about the individual } N$$

$$\text{P} = \text{facts and rules in database}$$

$$\text{B(P)} = \text{Herbrand base of P}$$

**Figure 3.** Explicit and derivable facts.

### 4.3 Attributable Facts

In the broadest sense, information concerning an individual could be defined as any information in the entire database which might be utilised in making judgements or analyses, or drawing conclusions regarding a particular individual. This includes all information covered in the previous definition and also any information which could be accessed by constructing queries of any complexity; that is, it includes information which could be retrieved by adding new rules.

The attributable facts may include facts which are outside the Herbrand Base $\text{B(P)}$ because new predicates may be introduced. In the example, this would include information such as Paul's sister-in-law's husband is Edward. This information is not explicitly stored nor is it derivable by applying the rules stored in the database. It can only be attributed to Paul by use of a new "rule" about the relationship "sister-in-law's husband".

### 5. PRIVACY PROTECTION

Sophisticated database systems present problems which are significantly different from those which occur when a "simple" database is accessed and humans make decisions upon the accessed data (according to working rules), because:

1. The imbedded rules in a deductive database may be more difficult to determine or to challenge.
2. The responsibility of individuals in the formulation and implementation of rules may be diffused and delegated to systems analysts, programmers and semi-automatic techniques — including such techniques as deriving rules from a statistical analysis of the database itself.

### 6. CONCLUSION

Although current and proposed privacy legislation places considerable dependence upon the right of individuals to access data held about them, it is likely that increasing sophistication of database systems will render this regulatory mechanism ineffective. It is difficult to see how the problems outlined above can be solved. However, it
seems reasonable that privacy legislation should endeavour to define "data relating to the individual" in such a way as to include both information which is stored explicitly in the database and information which is stored implicitly.

There is a conflict between the right of the individual to know about information stored on that individual and the rights of others to their own privacy. Even if they have the motivation and initiative to invoke their right of access, individuals may well be denied access to material relevant to them as a consequence of the need to preserve the privacy of others.

7. ACKNOWLEDGEMENT

The authors wish to thank John Lloyd for his useful suggestions for improving earlier drafts of this paper.

APPENDIX – LOGIC PROGRAMMING

A logic program can provide both a specification (its declarative semantics) and an answer (its procedural semantics) to a given problem. At present, logic programming languages, such as PROLOG (Clocksin and Mellish, 1981; Sammut and Sammut, 1983), use a subset of formal logic formulae called Horn clauses.

A Horn clause is a first order logic formula of the form

\[ H \leftarrow B_1 \land \ldots \land B_k \]

where \( H, B_1, \ldots, B_k \) are atoms. The head \( (H) \) is separated from the body \( (B_1 \land \ldots \land B_k) \) by the logical implication symbol \( \leftarrow \). Each atom in the body is separated by the logical conjunction symbol \( \land \). (Note, most PROLOG systems use \( :- \) and \( \cdot \) for \( \leftarrow \) and \& \( \land \), respectively)

An atom has the form

\[ p(t_1, \ldots, t_m) \]

where

\( p \) is a predicate, which is an \( m \)-ary mapping from \( D_1 \times \ldots \times D_m \) onto the set \{true, false\} where \( D_i \) is the domain of \( t_i \), \( t_1, \ldots, t_m \) are terms.

A term is either

1. a variable, which we shall represent by words in upper-case,
2. a constant, which we shall represent by words in lower-case or by numbers in the special case of integers,
3. a function with form

\[ f(t_1, \ldots, t_n) \]

where \( f \) is an \( n \)-ary function and \( t_1, \ldots, t_n \) are terms.

The following is an example of a Horn clause which defines a predicate called "does" as true if a person, whose first name is FNAME and surname is SNAME, is enrolled in the unit numbered UNIT.

\[ \text{does(FNAME, SNAME, UNIT)} \leftarrow \text{student(ENUM, FNAME, SNAME)} \land \text{unit(ENUM, UNIT)} \]

A Horn clause, such as this example, which contains both a non-empty head and non-empty body, is called a rule.

A fact is a Horn clause without a body in which case the "\( \leftarrow \)" is usually omitted. Some examples of facts are

\[ \text{unit(839999,101)} \]
\[ \text{unit(839999,102)} \]

which in English reads that Fred Smith's enrolment number is 839999 and he is doing the units 101 and 102.

A query is a Horn clause without a head. There are two kinds of queries, open queries and closed queries. A closed query contains no variables and requires a yes/no answer. For example a query which asks whether Fred is doing the unit 101

\[ \text{does(fred,smith,101)} \]

would receive the answer "yes". An open query on the other hand contains at least one variable and has zero or more answers. For example the query

\[ \text{does(fred,smith,X)} \]

is asking what unit or units is Fred Smith enrolled in and would receive the answers

\[ X = 101 \]
\[ X = 102 \]

A logic program \( P \), can be defined as a set of Horn clauses with non-empty heads (that is facts and rules) which can be run by a query \( Q \).

A logic program \( P \) has a Herbrand Base, denoted \( B(P) \), which consists of the set of all ground atoms (that is, atoms which contain no variables) which can be formed using predicates and constants from \( P \). \( B(P) \) is typically very large and represents, in a sense, all possible "facts" using predicates from \( P \).

Consider the program containing clauses of the form

\[ \text{unit(Enr_no, Unit_no),} \]

the Herbrand Base would be the set

\[ \{ \text{unit(N,M)} : N \in D_1, M \in D_2 \} \]

where \( D_1 \) is of the domain of enrolment numbers and \( D_2 \) is the domain of unit numbers.

Those elements of \( B(P) \), which represents statements which are logical consequences of the program \( P \), form a subset of \( B(P) \) called the success set of \( P \).

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BIOGRAPHICAL NOTES

James Thom, senior tutor in the Department of Computer Science at The University of Melbourne, obtained his BSc honours degree from The University of Melbourne in 1980. His research interests include databases and social implications of computers.

Peter Thorne, senior lecturer and Deputy Chairman of the Department of Computer Science at The University of Melbourne, received his PhD in 1967 and a Diploma in Public Policy in 1980 (both from The University of Melbourne). His research interests include computer architecture, computers in education and social implications of technology.

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Privacy Versus Policy, Precedent and Expediency

C. J. Bushell*

The South Australian Cabinet issued a directive to State Government agencies which appeared contrary to the guidelines which exist on privacy. The Government then attempted to justify this action on the grounds of policy, precedent and expediency. This paper discusses the case and the position of the ACS in such situations.

Keywords and phrases: privacy, privacy guidelines, use limitation principle, purpose of specification principle, professional ethics.

CR Categories: K.4.1, K.5.2, K.7.m.

BACKGROUND

Early in 1983, the South Australian Cabinet issued a directive to Heads of State Government agencies requiring them to provide trade unions on a quarterly basis with lists of employees who did not have trade union subscriptions deducted from their pay. The existence of this directive was not public knowledge until the Leader of the State Opposition raised the matter in Parliament. The exchange which took place related to whether or not this was tantamount to compulsory unionism. The Premier denied that it was and said that this action was compatible with the Government's policy on preference to unionists. He said this policy was a legitimate part of the overall policies on employment which were substantially similar to those applying for many years when in office previously. No further public outcry occurred except for a few letters in the press again relating the directive to compulsory unionism.

PRIVACY

However, within the Australian Computer Society (ACS) a number of members were very concerned. This is not a unionism matter at all. This is a matter of privacy. Information gathered about individuals and held in a personal data system must be collected for a specific purpose or purposes and should not be used thereafter for purposes other than originally intended. This principle is contained in all the Guidelines that exist:

"Personal data should only be accessed consistently with the system's socially acceptable uses and for additional uses by consent or by law."
— Guideline 5 of Guidelines for the Operation of Personal Data Systems, NSW Privacy Commission

9. The purpose for which personal data are collected should be specified not later than the time of data collection.

10. Personal data should not be disclosed or otherwise used for purposes other than those specified in accordance with paragraph 9 except:
(a) with the consent of the data subject; and
(b) by the authority of law."
— Guidelines on the Protection of Privacy and Transborder Flows of Personal Data, OECD

"The purposes for which personal data are collected should be specified to the individual at the time of data collection. Subsequent use should be limited to the fulfilment of those purposes or such others as are not incompatible with those purposes and as are specified on each occasion of change of purpose."
— Position Paper No. 1 — Privacy, Australian Computer Society.

INTERPRETATION OF THE GUIDELINES

This particular directive clearly requires the use of data for purposes other than originally intended. The fact that an individual is a member of a trade union, superannuation fund or medical benefit fund is recorded so that deductions can be made from income by the employer. This is a necessary and accepted part of the main objective of such a system — to pay people. It is also acceptable for reports to be produced for trade unions, superannuation funds and medical benefit funds listing people for whom deductions have been made. This is no disclosure of personal data because organisations are already aware of their members and contributors. Such organisations need to know for whom they are receiving payments and this is compatible with the system's objective.

The disclosure of who is not a member of an organisation is another matter entirely. This is totally incompatible with the system objective and it does breach the confidentiality an individual has a fundamental right to expect.

In the Guidelines there are two caveats which make this kind of action acceptable. The first is the agreement of the data subject. In other words every individual listed finds the action acceptable. In this situation this is hardly likely to be the case and the Government has taken no action to establish whether it was the case. It is amusing to observe something of a dilemma here. To poll the people concerned it would be necessary to list them and so apparently breach

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*Senior Lecturer, School of Mathematics and Computer Studies, South Australian Institute of Technology, Ingle Farm, SA, 5098. Manuscript received July 1983.
the guidelines. In fact this would not be so because the intention would be reasonable and the data would remain undisclosed.

The second caveat is where provision of such information is required by law. Government directives do not constitute the law. It would be perfectly proper for the SA Government to withdraw the directive and introduce a bill through Parliament to make provision of such information a legal requirement. There is little doubt that it would be passed by the Lower House but one would hope that would not be the case in the Upper House which is a house of review. One would assume that members of all political persuasions would see the danger in expressly legalising a universally accepted malpractice. But whatever happened, that would be an acceptable course of action and if it were passed, everyone would have to accept the decision.

A MORAL DILEMMA

Now we come to the moral dilemma faced by members of the ACS who are employees of the State Government. They are aware, or should be aware, of the ACS Position Paper and the other Guidelines that exist on privacy. How should they behave when requested to facilitate compliance with the directive?

"7.1 A member shall have proper regard for the health, privacy, safety and general welfare of the public in the performance of his professional duties. In case of conflict between the general welfare of the public and the performance of his professional duties the interest of the public shall be put first."

— The ACS Code of Ethics Instrument 1979

That seems perfectly clear. Compliance with the directive is unethical. Non-compliance is not likely to generate the employer’s whole-hearted happiness!

OUR RESPONSIBILITIES

Privacy is not solely a computing matter. The reason that privacy has become a matter of great concern in recent years is because of what is possible using computers. The Guidelines which exist apply just as much to personal data systems which do not utilise computers and, for example, is recognised in the Scope section of the OECD Guidelines:

"These Guidelines should not be interpreted as preventing... the application of the Guidelines only to automatic processing of personal data."

(This is a spectacularly bad piece of English but if it means anything, I assume it means what I think it means!)

It does seem to be true that computer professionals have been more involved with the recent privacy debate than any other professional group. This is natural since we are the ones who understand the possible abuses of computers. Therefore the responsibility of monitoring privacy matters and exposing the right to privacy falls to us by default, arguably even where computers are not involved. One problem is that many computer professionals, mostly not members of the ACS one would hope, have taken no interest in the privacy debate. It is clear too that despite all our attempts thus far at exposure, the general public is still not aware of the ramifications of privacy. It even appears that members of Governments do not understand the problem.

It is clearly our responsibility to give the privacy question the widest possible exposure.

THE POLITICAL VIEW

Recognising the danger in the directive issued by the South Australian Government, a number of ACS members wrote letters to the Premier highlighting the problem. The response was heartening in that he agreed with the general concern about the protection of individual privacy and foreshadowed a thorough examination of all aspects of privacy followed by legislation if deemed necessary.

However, he went on to say that the directive would stand on three grounds:

1. Expediency — No information was being disclosed that trade unions could not find out for themselves.
2. Precedent — This policy has been applied under previous Labor Administrations.
3. Policy — The action was compatible with legitimate policy on preference to unionists.

There is some merit in these justifications but a thorough analysis of them might be as follows:

1. Expediency

It is true that if the trade unions have access to full staff lists of Government Departments and if they have lists of their members they can indeed deduce a list of non-members of their union. This however is not what they are to be provided with. They are to be provided with lists of individuals who are not members of any union. To achieve that, in absence of the directive, would require additional co-operation between all the unions concerned. Perhaps unions do exchange membership lists and the above might constitute a specious argument.

That is a minor point, the major point here is — should something be ethical simply because it is possible? If the unions could deduce this information for themselves does that make it acceptable to supply it? If that were the case why is expediency not given as a third caveat in the extracts at the beginning of this paper?

It is important, again, to note that privacy became an issue in parallel with the spread of use of computers because of the realisation of what is possible using computers. Nevertheless the guidelines are agreed to apply whether or not computers are used. This has to be the case, otherwise one can justify any action on the grounds of expediency.

2. Precedent

The precedent argument is very hard to sustain. Community standards do change over time. A mining company would have grave difficulty employing children for underground mining simply because this was done hundreds of years ago. I wonder how the Breathalizer Squad would react if you told them you drove drunk long before they came into being.

For computer or other personal data systems developed before the guidelines came into existence it would clearly be unacceptable to add additional purposes incompatible with the guidelines after the guidelines came into existence. Additional such purposes added after the system’s design and before the guidelines appeared are harder to deal with.

Part of the South Australian Government’s argument appears to be that their systems came into existence before
the guidelines and thus the guidelines cannot apply to those systems retrospectively.

Retrospective activity of any kind seems to be frowned upon in Australia and this is the one point where I would concede that the South Australian Government can partially justify its actions.

However the ground is treacherous. If that point is acceptable now, it will present severe difficulties at the time when legislation is introduced. No existing systems could be subject to the law.

3. Policy

The policy of preference to unionists is of no concern to us. The ACS has no stated policy on unionism within the profession or without. Indeed the ACS can be regarded as pro-union since it has a history of strongly supporting attempts to form a union for computer professionals.

An unacceptable action cannot be justified solely because it is compatible with legitimate Government policy. We have a Police Force and a Taxation Department but there are limitations on their powers and methods. In this particular case the action is considered socially unacceptable.

It is interesting to note that the SA Ombudsman has expressed reservations about the Government's policy on preference for unionists on the grounds that it is incompatible with the spirit of the equal opportunity legislation. But that is another story . . .

GOVERNMENT ACTION

The Government announced on 30 May that a Committee was to be formed to look at the privacy question. On 17 June the Data Processing Board issued a set of interim principles for the fair and secure treatment of data on individuals for use in all South Australian Government agencies. These guidelines are as follows:

"Data which relate to individuals and which are collected, stored, or used in Government agency information systems should be:

- Accurate
- Up-to-date
- Complete
- Relevant for the purpose for which collected and stored.

"Information relating to individuals should not be used for purposes other than the stated purpose for which it is collected without notification to the individual.

"Access to or disclosure of such data, whether for verification, reference, research, checking, or normal Government operational purposes should be covered by consistent, clearly described and authorised policies."

The unfortunate thing about these guidelines is that they are very much weaker than the guidelines earlier in this paper. The agreement of the individual or the force of law is not required when using personal data for purposes other than originally intended. It is only necessary to notify the individual and have an authorising policy.

Certainly these guidelines are better than nothing. Despite the weakness of these guidelines the Government is still in breach of them since it has not notified the individuals concerned, unless we accept the exchange in Parliament or the directive itself as notification.

When notifying the ACS of these guidelines the Premier stated that "these principles parallel quite closely the broad principles which have been developed within the OECD . . .". While this may be an honestly held opinion, it is not my opinion.

If the Government believes that the OECD Guidelines are desirable why not adopt them as the interim guidelines?

CONCLUSION

After all the exposure given to the question of privacy and the various privacy guidelines by the ACS and the Law Reform Commission, it is depressing that such a situation could develop. Having taken a decision, it is not surprising that a Government should attempt to defend that decision. Did they realise the privacy implications at the time of making the decision? It is hard to know.

What is clear is that we must continue the process of developing public awareness. We should now regard ourselves as the guardians of privacy and object vehemently when we see privacy eroded. It is not acceptable for the ACS to retain a low profile. That the South Australian Government is now to consider the matter fully and promptly is hopefully due in part to ACS lobbying.

But the most important conclusion that we can reach is that legislation is required urgently. We know that the Law Reform Commission is developing legislation for the Federal Government. It is to be hoped that this will occur soon and be followed by compatible legislation by the States.

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BIOGRAPHICAL NOTES

Chris Bushell received his BSc degree in Mathematics from the University of Manchester in 1965. He worked for nine years for ICL writing Operating Systems and Data Base Management Systems. In 1974 he was appointed Senior Lecturer in Computer Studies at the South Australian Institute of Technology. His main interests are systems analysis, systems design, operating systems and the social implications of computing.

He is a past chairman of the South Australian branch of the ACS, was for many years a National Councillor and has served on the ACS National Careers and Education Committee and the National Social and Economics Implications Committee.
Book Reviews


This textbook is for the professional database analyst, designer, database administrator, and application programmer. The stated purpose is to establish a consistent framework for multi-level database design, to define a workable methodology; and to describe a set of general principles, tools, and techniques for database design at each level. The content covers database design methodology down to field access methods and ranges through such topics as requirements formulation, conceptual design, entity formulation, implementation design, physical design and file organization. The approach is applicable to relational, network, and hierarchical database management systems.

The style of the book, like the approach it advocates, is essentially top-down with each aspect of database design covered in reasonable depth. The first three chapters leading up to requirements analysis (a view of setting up a database based on following tried and tested pre-database approaches) are somewhat vague, but that again is akin to the topic. The next three chapters concern conceptual design, high deals with information independent of any actual implementation, and such aspects as entity formulation and analysis are covered. These chapters are designed to be practical guidelines for database design following the needs of the users, and they serve to concretize otherwise vague stabs at what is required. Unfortunately the presentation is somewhat dull, and the specific¬ness is not completely convincing, although it does raise issues that may otherwise escape consideration.

Undoubtedly the forte of the book is physical design with eight chapters, numerous formulæ and lots of good material. Primary access methods (linked lists, hashing, B-trees and more) and secondary access methods (multilists and inverted files to expedite quick searches for target records) are presented in a simple, and yet fairly complete, style.

The book concludes with special design issue overview files and distributed database considerations) and an appendix of exercises for the enterprising reader. The overviews are brief and pertinent: the exercises are non-trivial and challenging.

Except for the shortcoming mentioned previously the book meets the stated purpose. It contains many good features and should find a place on your shelves next to your other database books.

J. Pollard, AAE, Lucas Heights Research Laboratories


This book is volume 98 in a series of proceedings from meetings of the NATO Advanced Studies Institute, and contains papers from a meeting in Portugal during June 1981. 

Unfortunately the title is quite misleading; the papers concentrate upon the specification, design and analysis of information systems, with only peripheral reference to database management (and even then with much more emphasis on applications than "theory").

The content of the book is more accurately presented by the major section headings:
- conceptual data modelling and logical database design;
- building application systems;
- decision support systems for application builders; and
- applying and evaluating decision support systems.

The value of the book is diminished by a great variation in the quality of the papers, some of which provide an excellent overview of their subject matter with large numbers of supplementary references, whilst others present an unsubstantiated and unconvincing resume of the author's views.

It is difficult to identify the potential market, since the book is probably unsuitable as a text, of little immediate use to a practitioner and unlikely to find acceptance amongst researchers in the field.

Ken J. McDonell, Monash University


This book follows a currently common practice of publishing the papers of a small conference on a specialist topic in book form. However it could not be used as a text because it lacks any framework on the subject. Indeed with such a title it is not surprising to find a diverse collection of research papers. They largely address formatted databases (as opposed to graphic, geographic, image or text databases). The papers would only be of interest to database researchers or for study in graduate courses, and the book should be considered for purchase only by computer science libraries.

The need to improve database usability and responsiveness could be felt towards every major function of database management. These I categorise as (1) database design, (2) data dictionary/ directory, (3) data entry and validation, (4) integrity, (5) host languages, (6) interactive interfaces, (7) commit and recovery, (8) analysis and report generation, (9) maintenance and evolution, (10) security, (11) concurrency control, and (12) communications. The majority of the papers in the book relate to functions 1 and 6, with others related to functions 4 and 11. There are 21 papers in all of which six describe interactive interfaces, four describe conceptual design models and definition, and nine describe techniques associated with distributed control, relational joins, indexing, hashing or translation. There is an overview of an experimental distributed system called R* and a paper on reliability measurement.

The most coherent set of papers are those on interactive interfaces and they illustrate some of the alternatives being explored for user-friendly interfaces. They include a forms oriented query system, a dialog method of constructing queries, a graphic method, and an experimental system which displays video pictures to assist the user generate a query. For researchers interested in those papers with a significant formal data or control model there are two on distributed control, two on relational joins and three on conceptual models. Another paper describes a hashing technique used to handle spelling errors in text words.

John Smith, CSIRO Division of Computing Research


This is the proceedings of a conference organised by IFIP Working Group 2.5 and held at Boulder, Colorado in August, 1981. The purpose of the conference was to bring together specialists in numerical software and in programming languages. As a result, there is much in the proceedings of interest to anyone involved in the development of numerical software or the design of programming languages. Topics covered include:
- arithmetic, (the IEEE floating point standard, control of precision, etc);
- symbolic mathematics;
- data structures;
- parallelism;
- numerical programming with Ada; and
- the proposed new Fortran standard.

A nice feature of the volume is the inclusion of an edited version of the discussion following each paper. In some cases, e.g. discussion of various "features" of the new Fortran standard and of the IEEE floating point arithmetic standard, the discussion was quite lively with many interesting issues raised (although not always resolved).

The developers of numerical software are often criticised for their conservatism in falling to quickly adopt new programming languages (Pascal, Ada, . . .). The papers in this volume will help to explain the reasons for this conservatism and illustrate that the "ideal" language (or programming environment) for the development of robust, portable and efficient numerical software is still a long way off.

Overall, this is an excellent reference which should be read by anyone interested in the topics mentioned above. The reviewer
confesses that he was fortunate enough to be able to attend the conference, and had already ordered a copy of the proceedings for his bookshelf before the review copy arrived.

R.P. Brent, Australian National University


This is a collection of papers presented at a conference held at the Technical University Braunschweig, West Germany in April 1982. While the general quality of the articles in the book is excellent, it also has a Jekyll and Hyde quality.

The book is not really for beginners in this field but is really aimed at the person who is already conversant at a sophisticated mathematical level with computer-aided geometric design, i.e. that aspect of computational geometry which is concerned with the representation and manipulation by computers of shape information for design purposes. However, for this intended audience, the book is a must. The paper by Barmhill is also very good and could really be regarded as a state of the art address, going into a thorough survey of the means of representing 3D surfaces, primarily through the rectangular and triangular Coons' patches, and Bezier methods. There are some articles by Barmhill on recent work with a unified mathematical treatment, unlike many of the original sources of this information in journals which tend to use obscure or incomplete mathematics.

The opinions in a slightly permuted order:
- Computer Aided Surface Representation and Design;
- Surface Construction Based upon Triangulations;
- Contiuity of Curvature between Adjacent Bezier Patches;
- Convex Combination Surfaces;
- Generating the Bezier Points of Triangular Splines;
- Dual Bezier Curves and Surfaces;
- Design and Fairing of Ship Surfaces;
- Smooth Interpolation to Scattered 3D Data;
- Fitting Scattered Surface Data with Large Gaps; and
- Surface Approximation with Impounded Conditions.

The general quality of the articles is lowered by a few trite papers by people describing basically their company's computer system for CAD and trying to make it respectable by adding a few equations and here and there some editorial errors. The worst here is a cross reference to a paper in the same book that unfortunately does not exist there — although the person referred to was actually in attendance at the conference. Considering the quality of the articles, more effort in organizing the order of the papers within the book could almost make it into a standard reference in the field. Carrying that further, adding a few papers covering a few other topics, could have made it into the reference in the field.

As a book itself, there are several anomalies. It is certainly a beautifully bound, hard covered book of some 200 pages, which would grace anyone's bookshelf. However, after a well-decorated hard cover and nice title pages, one is confronted with merely reproductions of the individual author's typewritten notes in most cases. They do not all use the same typeface or font, and in some cases, awkward symbols or even all the mathematics are merely handwritten. Considering the effort on the front cover artwork, and the astronomical price tag (approximately $US25 per page) one wonders if the cost of having every article retyped onto a typesetting system would have added all that much to the book's cost. Also, the wisdom of using hardcover and fancy artwork instead of a simple softcover could be queried. It is not really the sort of book which people buy simply because they are swayed by a flashy covering in a bookshop.

In summary, from a technical viewpoint, for someone working in the field, the book should be a mandatory component for their library and could even be considered as a reference, if not almost a text, for a postgraduate study course in the subject. And, because some of the information collected together in this one volume is very new, perhaps this book is not quite as extraneous as it seems to be — or maybe the buyer has no other choice.

Damon McGuirk, University of New South Wales


I expected that this book might be yet another introduction to probability and statistics, differing only perhaps in its use of different types of IC chips rather than coloured balls in examples, I was pleasantly surprised to find a detailed coverage of more material than I have ever presented as part of a course based around a novel sequence. As well as an introduction to probability and statistics, the book covers reliability analysis, analysis of computer operations using probability and queueing theory, and probabilistic analysis of computer programs. This blend of topics is of interest to computer scientists and engineers, and is a natural collection because of dependence on the same basic theory.

The book is clearly aimed at students in computing science. A certain mathematical maturity is required, and some examples will be comprehended only by those who know Pascal and have an understanding of computer hardware and software. It covers analytical techniques in probability and statistics, and in application areas related to computing. This is done in a concise manner, with relatively few words between equations, but with a large number of worked examples. This means that in a book of this size a vast amount of material is covered.

A major shortcoming of the book is that it does not assist the reader with the more subjective decisions which must be made when applying the material. For example: there is little help given in choosing a probability distribution if there are no clear candidates on a priori grounds; there is no advice given on when one should use analytical techniques in preference to simulation or experiment; nor is any mention made of the debate on the usefulness of queueing theory. This means that the book must be supplemented by other material when used as a text.

The author has boldly departed from traditional sequencing and grouping of this material. For example, the concept of expectation is treated after, rather than before, a detailed discussion of common probability distributions. Furthermore, many topics (for example, reliability analysis) which are often covered completely in a separate set of chapters (or a separate book), have been sprinkled throughout the book. I am impressed by the care with which this has been done; the concepts of reliability (and other topics) are introduced gradually and illustrate various aspects of probability theory as they arise. Unfortunately, the price for this unusual sequencing is that it makes the book a poor reference work. A hunt may be required to find some fact concerning reliability, since that fact may not be in a section headed "reliability". Similar problems exist with other topics. Not all of the information for any given probability distribution is to be found in the one place.

The concepts of probability and statistics are not easy to grasp, and because this book has such a concise presentation, it is not well suited as a first introduction to these concepts. The book is a good text book for those who already have some knowledge of probability and statistics and wish to extend this to one or more of the application areas. Those readers in this category should be prepared to read the book from the start. Once the book has been read, and the structure understood, it will serve as a useful reference book.

Graham Smith, University of New South Wales


This book contains the published proceedings of the International Symposium on Current Issues of Requirements Engineering held in Kyoto, Japan in September 1982. This was sponsored by the Liaison Committee of Requirements Specification Techniques in Japan which was initially a JISDOS users' group but is now a committee organised from members who have an interest in requirements engineering in computer manufacturers, universities and the Information Technology Promotion Agency.

The book is divided into four main sections: (a) Specification Techniques, (b) Requirements Specification Support Systems, (c) Design and Support, and (d) Requirements Specification for Real Time Systems. There is an introduction in the form of a keynote address delivered by Harlan Mills of structured programming fame entitled "The Intellectual Control of Computers".

I found the proceedings rather disappointing and at the recommended price, not particularly good value. Admittedly my
view is somewhat prejudiced by the fact that the keynote address is only a reprint of an article by Mills on software development, published in the IEEE Transactions on Software Engineering Vol. SE-2 No. 4 in December 1976. Some of the papers were quite interesting, for example “SWIFT — Requirements Specification System for Software” by G. Kampen of Boeing Computer Services describes a system being constructed to overcome some of the disadvantages of PSL/PSA and SREM, two of the more widely used and important specification systems in use today. Other papers were simply accounts about how these systems are being used in practice. About one half of the papers were by Japanese authors. Although the text of these was in English, in some cases the examples were given in Japanese, which made understanding by someone like myself, with no facility in the language, exceedingly difficult. Perhaps this is a foretaste of the future. As the Japanese continue their thrust to dominate the field of information processing, we may all have to acquire some fluency with that language, just as they have had to master English, merely to keep up with the literature.

One section of the proceedings, which is perhaps worth a second look, is that on specification techniques which comprises four papers, each based on a different formalism for specification. The first reports on a technique for the formal definition of a distributed system based on a model which consists of several information structures and a set of consistency constraints; the second describes the use of the Vienna Development Method to produce a specification of an interactive application system; the third presents a deductive approach to information system specification and design while the last paper proposes the use of a functional language for software development. These papers are indicative of the current trend towards a more theoretical and formal approach to the specification of complex software systems. Some such approach will supplant, in the future, the informal methods which are widely used today. It is interesting to observe that the Japanese who have embarked on such ambitious projects as the design of the fifth generation computer are sponsoring conferences in the field of requirements engineering.

Peter C. Poole,
University of Melbourne


A book title containing more than one piece of jargon requires translation. Structured things of all kinds exist these days, but specifically “structured systems” refers to the ideas originally extolled by Stevens et al. (1974), Myers (1978) and, in Australia, by Yourdon’s various seminars. The general idea is that software systems should be built from component modules that are highly cohesive within themselves and as independent as possible from each other.

“It vertical Migration” concerns moving modules towards the hardware that forms the innermost layer of a system. The idea is well described in Stockenberg (1978). A well structured and formal levels representing layers of modules providing more and more powerful and generalised functions, each level building on the levels below it. For example operating systems have at least two levels corresponding to the firmware/hardware level and the system call level (e.g. SVC’s in IBM System 370 style machines). The concept can be extended to application systems. Very significant performance improvements can be gained by simplifying functions at higher levels and moving them down towards the hardware.

Performance improvements of an order of magnitude in a given function are cited by Stankovic which in one example translated to an improvement of 50% in an entire application system using the function. The extensive use of the Vertical Migration technique is dependent on how the various functions within a system are used. Unfortunately systems are typically skimpy. They relate to one system only, the Brown University Graphics System (BUGS). This is an indication of the real difficulty of collecting comprehensive experimental evidence in this complex and expensive science.

Nevertheless given that operating systems consume at least 50% of system CPU resources, the book provides important insight into how performance enhancement is possible. These days manufacturers sell both functional and performance improvements to their machines without changing the basic underlying hardware.

I liked Stankovic’s development of the Vertical Migration model to an object oriented system. The methodology emphasises modules which abstract actions (“functional” modules) or abstract data and its operators (“informational” modules). These kinds of system components reduce complexity by reducing module interconnections. The Vertical Migration technique compensates for performance losses caused by putting global or common data with their appropriate operators inside informational modules.

The book is a research monograph rather than a useful text. It is interesting. However it has no references later than 1979 and at $US50.00 for 141 pages is quite over-priced. Most of the ideas can be gleaned from Stockenberg (1978), Stevens et al. (1974) and recent research articles on information hiding modules or object oriented systems.

REFERENCES


C.N.G. Dampney,
Macquarie University


This very topical book about living with information technology is a collection of papers by eminent UK journalists, professionals, businessmen and educationalists, in a similar vein to the “Technological Change: Impact of Information Technology” books printed in Australia in conjunction with Information Technology Week over the past five years. Such texts often suffer from duplication and discontinuity between sections, which has been largely avoided in this case.

“Brave New World?” is a brief review of major developments in information technology, and seems especially relevant to small business managers and technical specialists seeking to broaden their awareness of the application and impact of IT in such areas as:

- Finance
- Retailing
- Engineering
- Manufacturing
- Education
- Employment
- Mass Communication
- Industrial Relations

It is very readable and particularly interesting as numerous practical examples are given of the application of various information technologies such as computers, robots, electronic mail, optic fibres, LANs, electronic printing, CAD/CAM and others.

The book includes a glossary, and a handy section giving a briefing on each chapter, making future reference particularly easy. However, there are no references given to other publications. The last section includes advice on acquiring a small computer and a list of sources of help; such as magazines, papers, books and relevant organisations. Like the rest of the book, these have a UK focus.

Would I buy it myself? Probably, as it is well-written and reasonably priced. However, those seeking comparable Australian material may prefer “Sleepers, Wake” by Barry Jones. Those looking for material specifically for computerists should try the proceedings of 10ACC, or the ACS (SA) booklet on “Human Aspects”.

REFERENCES


Andy Bennett,
Ministry of Technology, South Australia

The Australian Computer Journal, Vol. 15, No. 4, November 1983
This book is confusing since, in spite of its title, it presents a conglomeration of papers on international communications and open systems standards; formal description techniques and modelling of protocols; network simulations and tools; and network infrastructures for simulations in areas other than networks, communications or protocols.

The 13 papers covering this spectrum, are grouped into: foundations (of standards, reference models and formal description techniques); simulation in networking; and networking in simulation.

The quality of the papers range from the very general (which are out of place in a high cost technical reference work), the optimistic (given over more to polemic and wish-listing than actual technical content), and the remaining kernel of useful technical papers fitting uncomfortably into the three categories mentioned above.

Papers on 'Foundations'
1. 'Introductory Remarks on CCITT: Use of Computers for Network Planning and Circuit Group Dimensioning' by F. Bigi. This author is not mentioned in the section 'The Authors', so that the reader is left uncertain as to his credentials. The introductory remarks on CCITT are out of place, being a very brief overview of CCITT modus operandi (why not ISO, ANSI, IEEE etc.?) The main paper on the use of computers for network planning, is not a technical paper at all, but a summary of the deliberations of the CCITT study group XIII from 1969 until 1976, when it was disbanded. The conclusion of the paper is that computers can be useful in planning as a means of storing data and that 'the CCITT could study any of the technical problems which may arise in the future but does not recommend continuance of the question at this time.' The paper gives no references except to FASCICLE II.5 of the CCITT Yellow Book. In summary, the paper has a very low interest or relevance value.

2. 'A "Reference Model" for the Formal Description of Entities Which Perform Protocols' by L.G. Moli. The author is careful to distinguish between what he is describing as a 'reference' model . . . or semantic model . . . and a Formal Description Model. After reading this careful paper on what can be called 'COLLOQUY' theory, and its seeking after precision, the reviewer was curious about the equivalence of this model to the ISO Open Systems Interconnection (OSI) reference model. They are equivalent, and the author provides an appendix showing the equivalences between the two. Neither are models in the scientific sense of 'model'. They make no predictions and are not empirically testable. They are a means of 'description', and both are equally 'powerful' at this stage. Moli's paper is paired with a very brief paper, 'Formal Description Techniques of Protocols and Services in View of the Theory of Colloquy' by A. Faro, which simply provides a review of possible formal description techniques, that are more adequately dealt with by the next paper.

3. 'Formal Modelling of Communication Protocols' by C.A. Sunshine. This author is well known in the world of standards (IFIP, ISO and ANSI) and is the chairman of ACM's Communications SIG. The paper provides a useful review of approaches to the formalisation of systems and protocols: finite state automata, abstract machine models, formal languages, sequencing expressions, Petri nets, buffer histories, abstract data types and programs (based on PASCAL). He then covers verification techniques, such as state exploration, symbolic execution and structural induction. As a review paper and a general introduction to the field, it is excellent with a good bibliography. Many of these papers have now been collected into the single volume listed at the end of this review.

Papers on 'Simulation in Networking'
There are eight papers in this section ranging from the very general and introductory to the useful and technical:

1. 'A Review of Simulation' by S. Schneemaker. This very general paper was unnecessary in a book of this kind since it is very general and elementary and aimed at the complete novice.

2. 'Simulation Techniques in Network Design' by A. Remes. This gives a more technical overview of simulation techniques, with examples given for a point-point line simulation and a multipoint system. The treatment of the subject is very general and the bibliography is very poor.

3. 'Simulation of Packet Switched Data Communications Networks' by A. Gieseler. This is a more useful paper, with interesting examples and a useful bibliography.

4. 'Simulation of Protocol Layers of Communications in Computer Networks' by B. Wolfinger and O. Drobnik. This paper describes a generalised modelling system, MOSAIC (Modelling System to simulate Arbitrary Information flows in Computer networks). After an analysis of the layered model of protocols, a la ISO/CCITT, it is applied to the analysis of the BERNET network, Berlin, which consists of several large host computers interconnected by special network entry processors (NEPs) to BERPEX, an X.25 based subnetwork. The results of the model and simulation are not described in the paper, but detailed references are given, the most interesting one being in German.

5. 'Modelling and Evaluation of Communication Protocols' by R.R. Razouk and G. Estrin. The paper describes the development of an international Communications Protocol Model by R.R. Razouk and G. Estrin. The paper describes UCLA's SARA (System ARchitect's Apprentice) computer-aided design system and its use in the evaluation of protocols. CCITT's X.21 is used as a case study, and considerations are then made of simulating X.25 without any work on this protocol being actually described in the paper. The paper ends with a useful bibliography.

6. 'Simulation of a Hierarchically Connected Computer Network' by W.L. Price. The author describes the simulation of a very large network carried out at the National Physical Laboratory, Teddington, UK. The results of the simulation are reported, and the light they threw on the problems of flow-control and routing are discussed. The conclusions from the simulation are well presented, followed by a good bibliography.

7. 'TETRASIM: A program system for the simulation of telephone networks' by T. Rogeberg. TETRASIM (TEIe-TRAffic SIMulation) is based on SIMULA and the paper describes the program followed by results of its applications and a discussion of the practical implications. This is a good technical paper.

8. 'The Communication Environment Generator' by D.E. Cronin. This paper describes a system produced by LOGICA, UK, as a result of a contract for the Central Computer and Telecommunications Agency (CCTA) of the UK Government. The system is a multiprocessor-based simulation system for the generation of a scripted telecommunications load. The generator simulates the activities of a number of terminals according to user defined scripts. The computer system being tested operates normally under this simulated communications environment. No references are given for the paper. It is mainly a product description.

Papers on 'Networking in Simulation'
There are two papers in this section:

1. 'Electronic Communication for Interactive Group Modelling', by H. Lupinski and R. Adler. This paper describes the HUB teleconferencing system developed by the authors at the Institute for the Future, Menlo Park, California. The network allows conferencing, store and forward inter-user message processing and interactive graphics. As a paper on the HUB system and on its usefulness for group interaction, teleconferencing, think-tanking, gaming, etc. it is excellent and well referenced.

2. GLOSAS Project (GLOBAL Systems Analysis and Simulation) by T. Utsumi and J. DeVita. This is essentially a wish-list paper, proposing the development of an international interactive engine of energy resources and environment systems to provide decision-makers with comprehensive information. There is extensive verbiage in this paper (47 pages) with an extensive bibliography to match.

REFERENCE

G.L. Wolfendale, Integrated Computer Services, Canberra, ACT

The Australian Computer Journal, Vol. 15, No. 4, November 1983
The following list has been provided by Professor J.M. Bennett of the University of Sydney. It consolidates Ph.D. and Masters thesis lists for the period 1978-81 which have been provided by computer science and associated departments of Australian universities and CAEs, and supplements the list published previously (this journal, Vol. 10, No. 1, pp. 37-39, February 1978).

<table>
<thead>
<tr>
<th>UNIVERSITY</th>
<th>TITLE</th>
<th>AUTHOR</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Adelaide</td>
<td>Design and evaluation of data access paths.</td>
<td>C.B. Keen</td>
<td>1978</td>
</tr>
<tr>
<td>Ph.D. Theses</td>
<td>Coroutines: A programming methodology, a language design and an implementation.</td>
<td>C.D. Marlin</td>
<td>1979</td>
</tr>
<tr>
<td></td>
<td>Evaluation by simulation of queueing networks models of multiprogrammed computer systems.</td>
<td>L.N. Lester</td>
<td>1980</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australian National University</td>
<td>Sequential algorithms in non-linear programming.</td>
<td>K. Jittorntrum</td>
<td>1978</td>
</tr>
<tr>
<td>Ph.D. Theses</td>
<td>The application of a learning technique for the identification of speaker characteristics in continuous speech.</td>
<td>M. Wagner</td>
<td>1978</td>
</tr>
<tr>
<td></td>
<td>Superconvergence of numerical solution to second kind integral equations.</td>
<td>G.A. Chandler</td>
<td>1980</td>
</tr>
<tr>
<td></td>
<td>An axiomatic semantics for expression languages.</td>
<td>P.A. Pritchard</td>
<td>1980</td>
</tr>
<tr>
<td></td>
<td>Newton’s method at singularities.</td>
<td>A.O. Griewank</td>
<td>1980</td>
</tr>
<tr>
<td></td>
<td>Regularisation of linear operator equations.</td>
<td>M.A. Lukas</td>
<td>1981</td>
</tr>
<tr>
<td>M.Sc. Theses</td>
<td>A size and modularity measure for programs.</td>
<td>K. Cox</td>
<td>1978</td>
</tr>
<tr>
<td></td>
<td>Virtual memory for mini-computers.</td>
<td>W. Ginn</td>
<td>1978</td>
</tr>
<tr>
<td></td>
<td>Implementing a relational database system.</td>
<td>H.G. Mackenzie</td>
<td>1980</td>
</tr>
<tr>
<td></td>
<td>The design and implementation of Modula for the Burroughs B1700 computer.</td>
<td>G.N. Justusson</td>
<td>1981</td>
</tr>
<tr>
<td>James Cook University of North Queensland</td>
<td>A solution technique for the cane railway routing and scheduling problem.</td>
<td>D.J. Abel</td>
<td>1978</td>
</tr>
<tr>
<td>La Trobe University</td>
<td>SYMBOR: An application of macroprocessing to microprocessor software development.</td>
<td>R.F. Francis</td>
<td>1980</td>
</tr>
<tr>
<td>University of Newcastle</td>
<td>Some problems on combinational arrays.</td>
<td>K.A. Heinrich</td>
<td>1979</td>
</tr>
<tr>
<td>(List supplied by the Department of Mathematics, now the Department of Mathematics, Statistics and Computer Science.)</td>
<td>Aggregation of states in Markov chains.</td>
<td>H.M. Lewis</td>
<td>1980</td>
</tr>
<tr>
<td>Ph.D. Theses</td>
<td>Some problems in the enumeration of labelled graphs.</td>
<td>N.C. Wormald</td>
<td>1980</td>
</tr>
<tr>
<td></td>
<td>Construction and resolution of quadruple systems.</td>
<td>A. Hartman</td>
<td>1981</td>
</tr>
<tr>
<td>M.Math. Theses</td>
<td>School timetabling algorithms.</td>
<td>T.B. Scott</td>
<td>1978</td>
</tr>
<tr>
<td></td>
<td>Hadamard matrix construction by difference methods.</td>
<td>J. Milas</td>
<td>1980</td>
</tr>
<tr>
<td></td>
<td>Construction for balanced, incomplete block designs.</td>
<td>G.W. Southern</td>
<td>1981</td>
</tr>
<tr>
<td>University of Melbourne</td>
<td>Numerical initial value problems in stiff ordinary differential equations.</td>
<td>R. Sacks-Davis</td>
<td>1977</td>
</tr>
<tr>
<td>Ph.D. Theses</td>
<td>A distributed logic computer.</td>
<td>P.A. Dunn</td>
<td>1978</td>
</tr>
<tr>
<td></td>
<td>A shortest path algorithm for partitioned grid graphs.</td>
<td>K. Kanachanasutt</td>
<td>1980</td>
</tr>
</tbody>
</table>
Monash University

Ph.D. Theses
Global register allocation in high-level microprogramming language translation.
ARK — a general problem solving system with learning.
An information measure comparative analysis of megalithic geometries.
The concept of a hardware kernel.
C.J. Coles 1978
P.C. Cheeseman 1979
J.D. Patrick 1979
J. Rosenberg 1979

M.Sc. Theses
Relational and network data base management on a mini-computer.
Implementation of INTERSLIP on the B6700.
An automated file design and performance evaluation package.
A detailed study of relational algebra.
G.T. Bentley 1978
S.J. Westfold 1978
D.J. Hubbard 1979
L. Ho-Cheung 1979

New South Wales Institute of Technology

M.Sc. Theses
The uses of a software library — supported data management systems as an engineering tool and construction resource in the automation of information systems engineering.
Application of a microprocessor to teleprocessing — the evaluation of its specific use as a 'store-and-forward' concentrator.
D.H. Smiley 1977
C.P. Cavallo 1981

University of New South Wales

Ph.D. Theses
Computer graphics — the recovery of descriptions in graphical communication.
Extendible contractible translators.
A study of algorithms for industrial scheduling.
A theory of structural concept formation and pattern recognition.
Automatic program synthesis.
A multiple processor, personal computer system.
Primal search tree algorithms for the general job shop problem.
A system for digital hardware description and simulation.
R.B. Stanton 1970
A. Yezerski 1971
G.B. McMahon 1972
B.L. Cohen 1978
R. Follett 1980
J.M. Tobias 1981
J.R. Barker 1981
G.R. Hellestrand 1981

University of Queensland

Ph.D. Thesis
The semantics of computer drafting languages.
M.J. McLean 1978

M.Sc. Theses
An analysis of the performance of a generalised data based management system.
A comparative study of some aspects of computer systems using queueing models.
A.B. Tickle 1978
R. Cheeseman 1981

University of Sydney

Ph.D. Theses
Parallel programming without synchronisation.
Parallel parsing algorithms.
Portable code generators and the BCPL compiler.
Counters: a tool for process synchronisation.
J. Kay 1977
P.A. Greenfield 1979
L.N. Plotskoi 1979
B.G. McNair 1979
B.G. Rowswell 1978

M.Sc. Theses
Development of an heuristic program for the solution of a word puzzle.
BCPL storage architecture.
Image enhancement using a visual model.
A language for notating human movement.
A.E. Marlow 1977
P.A. Greenfield 1979
L.N. Plotskoi 1979
B.G. McNair 1979
B.G. Rowswell 1978

M.Eng.Sc. Thesis
The high speed interconnection of dissimilar computers.

University of Tasmania

M.Sc. Thesis
The translation of high level languages to other high level languages.
R.A. Freak 1979
1. **INTRODUCTION**

With the increased availability of colour printers and plotters, many programmers are beginning to recognise the value of colour to convey more information than would normally be available in monotone graphics. It is not intended to enter any controversy about the perception of colour, but to provide a simple method of automatic allocation of a colour to an object. Given a set of objects with some defined relative similarities, the aim of the technique is to represent objects that are deemed relatively similar to have similar colours while objects viewed as being relatively different, have colours that are perceived as different (see Figure 1).

In the method described below, this correspondence is achieved by defining a colour space of three dimensions and summarising the interrelationships among the objects from a multi-dimensional character space also into a three dimensional space. These two 'spaces' are then aligned to enable the colour code of a particular object to be extracted.

2. **THE THREE DIMENSIONAL COLOUR SPACE**

Several techniques have been developed to classify colours by representing them in one, two or three dimensional space, the simplest being the spectral scale, a one dimensional representation using the wavelength of light between approximately 400 and 750 nanometres (millimicrons).

Current colour applications such as printing or colour television make use of a discovery made by Maxwell in 1861 who showed that any colour could be produced using three 'primary' colours. A primary colour is one which cannot be created by the addition or subtraction of any other colour. There are in fact a set of primary additive colours and a set of primary subtractive colours. The additive colours are those used in colour video tubes where the addition of red, blue and green produces white against a 'black' background. The subtractive colours are used when plotting on white paper; here the primary colours are yellow, magenta and cyan, the addition of which will produce black. In these systems, the colour 'solid' is represented as a cube. The origin is located at one corner of the cube or the centre of the sphere and the three orthogonal axes represent the three primary colours. Any point in this space, represented by three (positive) co-ordinates, corresponds to a different colour.

3. **THE THREE DIMENSIONAL SPACE OF OBJECTS TO BE COLOURED**

The field of Numerical Classification or Numerical Taxonomy is concerned with the elucidation of structure in a data matrix. Many such techniques consider the objects as points in a space whose axes (dimensions) are defined by the set of variables describing the objects. Principal Component Analysis (see Cooley and LOHNE, 1971) is a method that attempts to condense the maximum information (variance) within a dataset into as few dimensions as possible; this presents a logical method for colour association. If three dimensions can be used to display a considerable proportion of the structure in the data, a direct mapping procedure can then be used to translate the co-ordinates (principal co-ordinates) of the objects into co-ordinates (colour values) in the colour space.

The mapping procedure aligns the first three principal component axes with three primary colour axes (either additive or subtractive primaries) and then scales each component in one of two ways. The direct approach involves scaling the maximum of the first component to the maximum of the first colour axis and then scaling subsequent components in proportion to the variance accounted for. This will, of necessity, limit the volume of the colour cube available in proportion to the ratio of the variance of each component. For example, if the variance of the first three components were 60%, 20% and 10% respectively, then the second axis would be scaled to 33% of the second colour axis, while the third component would be scaled to 17% of the third colour axis. The advantage of this method, is that the distances between objects in component space is faithfully reproduced in the colour space. The disadvantage is that colour differentiation between objects may not be possible given the resolution of the colour space. In the
example above, 5% of the potential colour volume is used. The alternative is to scale each of the three components independently to the maximum colour saturation on each colour axis. Resolution is gained at the expense of the enhancement (distortion) of the second and third components. Both methods could be used.

The new co-ordinates of the points define a colour and so indicate the relative similarities among the objects as well as define the position of the objects in an optimal three dimensional space. The usefulness of the technique for presenting results in Exploratory Data Analysis or Numerical Taxonomy is readily apparent.

4. EXAMPLE

Data presented by Rummell (1967) for a number of United Nations member nations (Table 1) have been analysed by NTP, the Numerical Taxonomy Package developed in the Division of Water and Land Resources, CSIRO. In the example, a variant on principal component analysis termed principal co-ordinate analysis (Gower, 1967) was used. Whereas principal component analysis requires the use of a variance/co-variance or correlation matrix between objects, principal co-ordinate analysis will accept alternate, and in this case, more appropriate measures of pairwise association between the objects. Clifford and Stephenson (1975) and Sneath and Sokal (1973) present an introduction to various measures for pairwise association and their attributes. It seemed appropriate here to use the Gower metric (Gower, 1968). This measure is defined as:

\[
\text{Dissimilarity} = \sum |X_{ik} - X_{ij}| / \text{Range}_k
\]

where

- \( i = \text{country} i \)
- \( j = \text{country} j \)
- \( k = \text{variable (attribute)} \)

A routine GCOL was used to re-scale the principal co-ordinate vectors of the United Nations' data into a three dimensional colour space for the Division's APPLICON colour ink jet plotter. This unit can colour up to 25 pixels per square millimetre with the three primary (subtractive) colours — yellow, magenta and cyan, each with a range of integer values 0 to 16 where 0 represents no colour and 16
Table 1. Data from Rummell (1967)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Country</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>G  : Gross national product per capita</td>
<td>BRAZIL</td>
<td>91</td>
<td>2729</td>
<td>7</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>69.1</td>
<td>148</td>
<td>2.8</td>
<td>0</td>
</tr>
<tr>
<td>T  : Trade (million $)</td>
<td>BURMA</td>
<td>51</td>
<td>407</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>-9.5</td>
<td>74</td>
<td>6.9</td>
<td>0</td>
</tr>
<tr>
<td>P  : Power ranking based = population * energy production</td>
<td>CHINA</td>
<td>58</td>
<td>349</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>-41.7</td>
<td>3054</td>
<td>8.7</td>
<td>0</td>
</tr>
<tr>
<td>S  : General stability</td>
<td>CUBA</td>
<td>359</td>
<td>1169</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>64.3</td>
<td>53</td>
<td>2.4</td>
<td>0</td>
</tr>
<tr>
<td>F  : 0 = purges, riots, strikes, guerilla warfare, coups</td>
<td>EGYPT</td>
<td>134</td>
<td>923</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-15.4</td>
<td>158</td>
<td>6.0</td>
<td>1</td>
</tr>
<tr>
<td>C  : 1 = stable</td>
<td>INDIA</td>
<td>70</td>
<td>2689</td>
<td>10</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>-28.6</td>
<td>410</td>
<td>1.9</td>
<td>1</td>
</tr>
<tr>
<td>VOTE : Voting agreement with USA in 10th session UN</td>
<td>INDONES.</td>
<td>129</td>
<td>1601</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>-21.4</td>
<td>267</td>
<td>6.7</td>
<td>0</td>
</tr>
<tr>
<td>D  : Defence budget (millions $)</td>
<td>ISRAEL</td>
<td>515</td>
<td>415</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>42.9</td>
<td>33</td>
<td>2.7</td>
<td>1</td>
</tr>
<tr>
<td>E  : Acceptance of International Law</td>
<td>JORDAN</td>
<td>70</td>
<td>83</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>8.3</td>
<td>29</td>
<td>25.7</td>
<td>0</td>
</tr>
<tr>
<td>@ : 0 = does not subscribe</td>
<td>NETHERL.</td>
<td>707</td>
<td>5395</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>52.8</td>
<td>468</td>
<td>6.1</td>
<td>1</td>
</tr>
<tr>
<td>E  : 1 = subscribes with reservations</td>
<td>POLAND</td>
<td>468</td>
<td>1852</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>-41.7</td>
<td>220</td>
<td>1.5</td>
<td>0</td>
</tr>
<tr>
<td>D  : 0 = little if any</td>
<td>USSR</td>
<td>749</td>
<td>6530</td>
<td>13</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>-41.7</td>
<td>34000</td>
<td>20.4</td>
<td>0</td>
</tr>
<tr>
<td>E  : 1 = extensive</td>
<td>UK</td>
<td>998</td>
<td>18677</td>
<td>12</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>69.0</td>
<td>3934</td>
<td>7.8</td>
<td>0</td>
</tr>
<tr>
<td>T  : 2 = unrestricted opposition</td>
<td>US</td>
<td>2334</td>
<td>26836</td>
<td>14</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>100.0</td>
<td>40641</td>
<td>12.2</td>
<td>1</td>
</tr>
</tbody>
</table>

represents complete saturation (Applicon, 1979). If the principal co-ordinate vectors of the data are roughly equal, the maximum volume of the colour space will be utilised. If the contribution is disparate, the reduction in the volume of the colour space available for plotting will lead to a reduction in colour discrimination. If each component is scaled so as to use the maximum range of the colour space in that dimension, discrimination is enhanced, but the contribution of the second and third principal coordinates is inflated. The analyst must consider which approach is most appropriate given the number of objects and the resolution on the colour space available. In the example, the three principal co-ordinate axes were treated as equally important and the axes were therefore scaled to the maximum. The principal co-ordinate analysis and the resulting colour transformation are presented in Table 2.

The example clearly demonstrates the strength of the mapping procedure. Each of the 14 countries has been allocated a separate colour that enables complete discrimination on the 17 unit APPLICON colour space. Countries with similar features have been graded as chromatically close, while those exhibiting opposite polarities have been allocated as colour extremes. For example, Burma and Indonesia show similar patterns in the data which are reflected by the total difference in colour amounting to 3 units (a 1 unit difference on magenta and a two unit difference on cyan). The USA on the other hand is different to Indonesia in terms of most data attributes and the 23 unit difference on the colour scale reflects this (16 units on yellow, 3 units on magenta and 4 units on cyan). If an interpretation is attempted on the meaning of the colours, it appears that increasing saturation of yellow (larger loadings on PCA 1) may reflect an increase in stability and GNP of the countries. Increased saturation of magenta (larger loadings on PCA 2) reflects increase in freedom and voting agreement with the USA, while increased saturation of cyan (larger loadings on PCA 3) reflects a decrease in power.

To determine how well the colour represents the information in the original data, a correlation between the original attributes and the derived colour coding (new attributes) was performed. The Gower metric, originally used for the pairwise comparison of countries on original attributes, was also used to determine the level of association between the countries based only on the derived colour code. Pearson's Product Moment Correlation Coefficient (r) was then employed to compute the relationship between these two association matrices. A value of r = 0.7485 was obtained. Considering that only three principal co-ordinate axes were used and that a better correlation could have been attained by using a finer colour...
## Table 2. Principal Co-ordinate Analysis and Colour Transformation of Data from Rummell (1967)

### PART A

<table>
<thead>
<tr>
<th>Country</th>
<th>PRINCIPAL CO-ORDINATES</th>
<th>COLOUR SATURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>BRAZIL</td>
<td>-0.286</td>
<td>0.327</td>
</tr>
<tr>
<td>BURMA</td>
<td>-0.409</td>
<td>0.044</td>
</tr>
<tr>
<td>CHINA</td>
<td>-0.108</td>
<td>-0.434</td>
</tr>
<tr>
<td>CUBA</td>
<td>-0.293</td>
<td>0.178</td>
</tr>
<tr>
<td>EGYPT</td>
<td>0.133</td>
<td>-0.095</td>
</tr>
<tr>
<td>INDIA</td>
<td>-0.328</td>
<td>0.134</td>
</tr>
<tr>
<td>INDONES.</td>
<td>-0.365</td>
<td>-0.009</td>
</tr>
<tr>
<td>ISRAEL</td>
<td>0.150</td>
<td>0.146</td>
</tr>
<tr>
<td>JORDAN</td>
<td>-0.155</td>
<td>-0.254</td>
</tr>
<tr>
<td>NETHERL.</td>
<td>0.126</td>
<td>0.414</td>
</tr>
<tr>
<td>POLAND</td>
<td>-0.111</td>
<td>-0.381</td>
</tr>
<tr>
<td>USSR</td>
<td>0.458</td>
<td>-0.429</td>
</tr>
<tr>
<td>UK</td>
<td>0.417</td>
<td>0.187</td>
</tr>
<tr>
<td>US</td>
<td>0.771</td>
<td>0.173</td>
</tr>
</tbody>
</table>

### PART B

<table>
<thead>
<tr>
<th>Number</th>
<th>Eigenvalue</th>
<th>% Variance</th>
<th>Cum. % Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.7080</td>
<td>33.8397</td>
<td>33.8397</td>
</tr>
<tr>
<td>2</td>
<td>1.1466</td>
<td>22.7164</td>
<td>56.5561</td>
</tr>
<tr>
<td>3</td>
<td>0.5809</td>
<td>11.5086</td>
<td>68.0647</td>
</tr>
<tr>
<td>4</td>
<td>0.4339</td>
<td>8.5973</td>
<td>76.6620</td>
</tr>
<tr>
<td>5</td>
<td>0.3310</td>
<td>6.2018</td>
<td>82.8638</td>
</tr>
<tr>
<td>6</td>
<td>0.2887</td>
<td>5.7207</td>
<td>88.5456</td>
</tr>
<tr>
<td>7</td>
<td>0.1852</td>
<td>3.6693</td>
<td>92.2538</td>
</tr>
<tr>
<td>8</td>
<td>0.1568</td>
<td>3.1059</td>
<td>95.3597</td>
</tr>
<tr>
<td>9</td>
<td>0.0637</td>
<td>1.2614</td>
<td>96.6211</td>
</tr>
<tr>
<td>10</td>
<td>0.0554</td>
<td>1.0972</td>
<td>97.7183</td>
</tr>
<tr>
<td>11</td>
<td>0.0528</td>
<td>1.0469</td>
<td>98.7652</td>
</tr>
<tr>
<td>12</td>
<td>0.0373</td>
<td>0.7399</td>
<td>99.5051</td>
</tr>
<tr>
<td>13</td>
<td>0.0250</td>
<td>0.4949</td>
<td>100.0001</td>
</tr>
<tr>
<td>14</td>
<td>0.0000</td>
<td>-0.0001</td>
<td>100.0000</td>
</tr>
</tbody>
</table>

This is a pleasing result. The differences in colour attributed to the countries do indeed reflect the differences among the countries in the original data. The technique is therefore appropriate when it is useful to be able to summarise by the use of colour, the interrelationships between a set of objects being coded for three or more attributes. Other ordinating techniques such as correspondence analysis (reciprocal averaging) and multidimensional scaling that aim to provide a summary in a reduced dimensional space should also provide a base for objective colour assignment. Some care in interpretation is required, however, when the first three components account for a small proportion of the variance.

### 5. REFERENCES


**BIOGRAPHICAL NOTES**

Lee Belbin received a BSc in geology at the University of New South Wales in 1970 and worked as a geological consultant in Canada and Australia until 1972. At this time he took up a post in the Department of Geology of the Australian National University. He received a Graduate Diploma in Computing Studies from the Canberra CAE in 1978 and moved to the Division of Water and Land Resources CSIRO in 1979. He is currently involved in research and consulting in Numerical Taxonomy.

Charles Marshall is currently completing his BSc honours in Zoology at the Australian National University. After completing his BSc in Applied Mathematics in 1982 he spent six months with the Numerical Taxonomy Group of the CSIRO Division of Water and Land Resources.

Daniel P. Faith received his BA in Mathematics at the University of Chicago in 1973 and a PhD in Ecology and Evolution from the State University of New York and Stonybrook in 1979. He is currently involved in research in Numerical Taxonomy in the Division of Water and Land Resources, CSIRO.
Letters to the Editor

COMMENT ON PROFESSIONALISM PAPER

I write to congratulate Messrs. T.R. Earle and E.P. Fitzgerald on their excellent article, "Professionalism—Its Educational Aspects". I believe it raises the relevant issues and deals with them fairly. Rather than debate the details of the article may I record the following comments about their recommendations.

(a) Agree: This is being done. But computing knowledge is re-doubling every 5 years so rapid increase in credentialism must be expected.

(b) Agree: But it is almost impossible, as reference to IBM and Urwick International and other recent surveys will show (see Computer World, page 3, August 1983).

(c) Agree: Why don't you lay down some guidelines?

(d) Agree: The problem is the concept of what constitutes 'Computing' is changing. What would you say about epistemology and semantics?

(e) Agree: Actually the major personalities in the ACS Membership Standards Committees are heavily involved in course accreditation through their professional (rather than ACS) affiliations.

(f) Agree: This is something I propose to contribute towards in the near future.

REFERENCE


A.Y. Montgomery,
Department of Computing,
Royal Melbourne Institute of Technology

COMMENT ON STUDENT SELECTION

The paper by D. Woodhouse (1983) is a sensible effort at identifying predictors of student performance in a diploma level Computer Science curriculum. This is even more laudable in an era of still inadequate tertiary funding and scarce resources. However, several points of caution need to be raised in reference to this paper and the more general practice of student selection.

In the paper it would have been much more desirable to perform a stepwise multiple analysis using the total course score as the criterion variable and the remaining variables as predictors. This would be a more informative use of the data because this technique includes variables in the regression equation in the order of their utility as predictors. This is a more systematic way of identifying good predictors than by simple inspection of correlations (significant or not). The second advantage of the technique is that it provides an estimate of the amount of variance in the criterion variable that is explained by the predictors. Hence, a small subset of the predictors can be selected for future use, which explains more of the criterion variable variance than the single best predictor.

Woodhouse however opts to use the CPAB as the major (in conjunction with academic record) selection device, despite the possibility of the RAPM and WG tests being able to provide additional significant predictive power in conjunction with the CPAB. From the results presented, the correlation between the CPAB alone and total course performance never exceeds 0.73 and thus almost half of the variation in course performance is not explained by CPAB scores.

One could also object to the separate analyses carried out for the years 1977-1980. Collapsing the data across years would provide much more reliable data and more stable correlation coefficients. Since one is concerned with finding predictors of success in a particular course, one should be little concerned with year by year comparisons (unless the course is changed somewhat).

In pursuing student selection procedures, one should also pause to consider the cost and benefits involved. From the general field of signal detection theory there can be four categories of events in these circumstances: an applicant actually has the ability to succeed and is identified as such (hit); an applicant has the ability to succeed and is not identified by the selection procedure (miss); an applicant does not have the ability and is identified as such (correct rejection); and the applicant does not have the ability but is not identified as such (false alarm). It is in the categories of hit and correct rejection that the system produces benefits, but in the categories of miss and false alarm it incurs costs. Moreover, if the discriminatory power of the selection procedure remains constant, but one wishes to include as many hits as possible and minimise the number of misses, then the cut-off must be dropped. However, this also increases the number of false alarms and decreases the number of correct rejections. If the reverse is done then the number of false alarms decreases, and the number of misses increases but, in turn, the number of hits decreases and the number of correct rejections increases. Hence in deciding on cut-off scores, one must contrast the cost of selecting ‘duds’, and misidentifying talented students, against the benefits of screening out the duds and providing opportunity for the talented. The values ascribed to the costs and benefits must be decided by the selectors themselves.

REFERENCE


P.J. Morrison,
Department of Psychology,
University of New England
PERKIN-ELMER'S WAGERING SUCCESS WITH AUSTRALIAN EXPERTISE

Perkin-Elmer Computers have had a long history of association with computerised wagering systems in this country. The fact that they were the first 32-bit mini-computer in the world made them an ideal early choice for such things as on-course tote applications where processing power was vital. Also the extreme reliability of the Perkin-Elmer hardware enhanced their credibility as a vehicle for providing such a public and sensitive service, where system failure can quickly become a very visible issue.

Perkin-Elmer Computers are continuing their penetration of the wagering scene with systems, sourced from Australia, being now sold overseas. The combination is now so cost effective that it is becoming viable for the smaller provincial race clubs. Even though the software was developed in Australia, Perkin-Elmer's partner in this activity is the subsidiary of an international company that also incorporates the world's largest supplier of computerised wagering terminals and systems. But, the philosophy of the Australian subsidiary towards wagering is vastly different to that taken by the sister company, and is a direct result of the pioneering work done by a local software group that is now affiliated with the US giant.

The international company is the General Instrument Corporation, operating in areas of high technology like broadband communications, semiconductor products and data systems. Their area of expertise pertinent to the local subsidiary, and Perkin-Elmer, is computerised wagering, and it is here that they joined forces with an Australian organisation, RT Wagering.

PROJECT PAVES WAY FOR THE PAPERLESS OFFICE

New computer technology which dramatically improves the flow and processing of information in the "paperless office" has been the focus of an intensive study project at the University of Sydney's Warren Centre for Advanced Engineering.

The project started on 22 August and ended with a two-day symposium on 25 and 26 October.

Entitled "Local Area Networks", it looked at new technology with particular reference to office automation. It involved more than twenty Australian technologists drawn from industry, government and universities and was led by Dr John Limb, a senior member of the research staff of Bell Laboratories, who was invited to Australia as the project's visiting Fellow.

"Local Area Networks" is the second intensive study project to be organised by the Warren Centre, which was set up this year with industry support of more than two million dollars to speed the introduction of new high-technology industries to Australia, and to increase interaction between practising engineers and university teachers and researchers.

The members of the study project were grouped in four teams, each concentrating on different aspects of local area networks and office automation. The four aspects were: survey of current and projected technology; scope for Australian manufacturing involvement; "human factors" ranging from office design through to the social implications of changing work patterns; and case studies of operating networks to test their performance and provide design information.
ACEMA RESPONSE TO FEDERAL BUDGET

Primary policy and responsibility for Australia's high technology industry should remain with Mr Jones, the Minister of Science and Technology, who, according to Acema, understands the issues and is doing a "most commendable job".

The Minister foreshadowed recently a substantial tax incentive scheme to encourage investment in new technology growth areas, which is welcomed by Acema. And Acema is extremely pleased with other initiatives of Mr Jones and the department of science and technology.

"However, the Budget, which included really very little for the local high technology industry, illustrated what can happen to good initiatives when Treasury and the Prime Minister's departments get hold of them," Acema's vice president Graham Cole said.

Mr Cole said that at its board meeting in Melbourne the day following the Keating budget, local computer manufacturers expressed concern about the outcome of the budget.

According to Acema there is a substantial difference between proposals for the industry foreshadowed some time ago and the Budget outcome.

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with whom applications close on 25 November, 1983.

"Whilst we welcome the increased allocations to both AIRDIB and the AIDC there was literally no reference whatever to a tax incentive scheme which we have been discussing positively with government at all levels for some time," Mr Cole said.

He said that it was particularly frustrating to Acema, as no doubt it must be personally to Barry Jones, that the prestigious Espie committee findings and experience in both the USA and Japan were not reflected in the Federal budget.

The Espie committee had found that "no country has succeeded in establishing a climate for investment in high technology enterprises without the government taking positive action and, at a minimum, adopting a catalytic role".

Acema said it would be a great tragedy if creative leadership was to be effectively blocked by officials espousing economic theories which cannot be empirically verified and who are not required to suffer the consequences of their advice.

A recent edition of the American publication, Business Week, referred in a feature story to "A new weapon against Japan: R & D partnerships". The story referred to the venture capital scheme operable now in America which allows US corporations to co-operate on high tech research.

Business Week, referring to the 10,000 start-up companies which have been spawned in recent years, said that "by raising private venture capital from limited partnerships looking for tax advantages, big corporations can band together to fund massive, high risk research efforts like the target projects of Japan's ministry of international trade and industry".

The most appealing aspect of the partnership scheme, according to Business Week, is that it all can be done by private enterprise.

Business Week says that it is the highest-leverage investment government can make, and it isn't interventionist. It says that it is a very "socially acceptable thing", particularly when compared with the cost (to government) of other tax-avoidance schemes.

Mr Cole said that Acema represented Australian computer manufacturers.

Since its formation Acema board members have spent a great deal of time and effort in putting the views of the local industry to Federal Government ministers and senior government officials.

CROYDON FIRM WINS DATA CONTRACT

Telecom has awarded a $3.1 million contract to the Croydon (Victoria) firm of Datacraft (Aust) Pty Ltd for the supply of data modems over the next three years.

Mr Mel Ward, Telecom's General Manager — Commercial Services, said that the modems were needed to match the demand for data services which is currently growing at over 20 per cent per annum.

The modems which will have 55 per cent Australian content will handle data transmission at speeds ranging from 2400 to 9600 bits per second. They will be used on Telecom's datel service principally on intrastate and intercapital routes.

Telecom's total purchases of data equipment during 1983-84 would amount to over $50 million, Mr Ward said, to cover the range of data services which Telecom can offer to its customers.
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