Reminiscences – Simon Buxton
IT Application Development over 40 a year period

Introduction

My intention in writing these notes is to record something about my IT career and describe some examples of computer applications development over a 40 year period. Despite enormous advances in hardware, software and communications in this time, there has been less change in the management and implementation of applications and the associated hardware. Successive generations of management fail to heed lessons of the past with incorrect decisions leading to the wrong choice of equipment, poor software acquisition processes, cost overruns and lack of benefit achievement. These mistakes were still being made up to my retirement in 2003.

Morgan Crucible Co Ltd 1964-1970

The Company

The Morgan Crucible Company, my first employer in the IT field, was founded in 1858 and still exists as a public company. Its main product lines consisting of crucibles, electric motor brushes, mechanical carbon products and quality refractories have changed little over the years, though various management teams have attempted to grow by acquisition. This growth did not prove very successful with most acquired businesses being re-sold after a number of years. Over the past 30 years the company has seen little overall growth. A few years ago its performance was so poor that it no longer paid dividends. Following changes to the board, it is now improving with more manufacturing being transferred to lower cost countries and selling off acquired businesses.

Until the mid 1970s, its main factory and head office was located on the south side of the River Thames at Battersea in London. Other factories were acquired or built elsewhere in the UK at various times and finally the Battersea site was sold for river front housing development. In my time all major computing activities took place at Battersea, though the odd subsidiary elsewhere had small machines. The company had a large export business with subsidiaries and agents throughout the world. At one time there was even a factory in Russia but it was closed down at the time of the 1917 revolution.

The Battersea site, with its Victorian buildings, was very dusty from the processing and machining of fine graphite and handling of refractory materials, so was not a good location for electronic equipment.

Around 2000 people were employed at Battersea in the batch production of goods using kilns, machine shops and dry processing of powdered materials. The main carbon workshops had some 6000 orders in progress at any one time, many being small job lots.

One unusual feature of the company was its use of the week number rather than actual

dates to define accounting, scheduling and reporting periods. Thus “months” were of 4 or 5 weeks duration and always ended on a Friday and financial years were of 52 or 53 weeks. This made any type of work scheduling much easier, so that month end computer runs, for example, could always be correlated with weekly reports and be carried out over a weekend. One exception was the payroll for office staff which followed calendar months.

Another quirk was its “staff initial” system. This allocated everyone on the office staff in UK sites, a two to four letter set of initials that defined the position rather than the incumbent. The first letter defined the division (and its general manager), the second the department (and its manager) with the third and sometimes fourth letter for others lower in the hierarchy. When I joined the crucible division in 1959, E was the general manager, EY was the technical applications manager and I was EYB as a member of his department. I have never seen this sort of system elsewhere and it was very effective for addressing internal correspondence and for references on mail. It had no data processing significance though.

Another interesting aspect of the company was its encouragement for eligible employees to buy its shares. These were a special class of ordinary share, equivalent to the public shares, but could not be traded on the stock exchange. A fixed number had been issued which could be traded once a year, at the time of the AGM. The pool available were those being sold and eligible employees could request a number of shares which they may or may not receive in full. The price was determined by the auditors and was about half that of the public stock. The dividends were treated by the inland revenue as “earned” income which, in the 1960s, was taxed at a lower rate than “unearned” income such as interest and dividends. In the early 1970s there was a falling demand for the shares and the scheme was wound up with the shares converted to marketable stock – a useful capital windfall for those who still retained them.

The HEC-4 / ICT 1201 Computer

In the 1955-1970 period the company was a UK leader in applying computers and information technology (IT) in a commercial manufacturing environment. At a time when people were forecasting that a few dozen machines would satisfy the UK's total computing needs, Morgans, who had been big users of punched card equipment, in 1955 felt that industry could use computers to take over much statistical work as well as doing similar work to rented punched card tabulators but at lower overall cost.

The British Tabulating Machine Company had developed the HEC-4, later known as the ICT 1201 when the company became International Computers and Tabulators (ICT), and Morgans became its first business customer and indeed was said to be the first UK commercial company to purchase a computer. A few other businesses had developed and built their own computers including English Electric, Elliots, Ferranti and Lyons Tea Shops.

The HEC-4 processor was housed in a large cabinet and used about 2000 valves with the circuits contained on plug-in modules. These modules were the reason that the computer ultimately became almost unserviceable. The plugs and sockets used had silver plated contacts and over time in a hot environment, the silver migrated to form short circuits between the pins. These days, gold plated contacts are generally used for computer

connections.

The operating console was desk sized and could display registers and memory locations in binary form. The memory unit, housed in the console, was a drum store with 1k x 40 bit word capacity. All programming was carried out in machine code and either entered at the console and punched out or sometimes hand punched. Program cards were coded in binary, where each of the 80 x 12 positions represented one bit.

Because the work on the computer would largely duplicate tabulator functions, there was little commercial risk so that in the event of breakdown, tabulators could be used, albeit more slowly, with the statistics produced when the computer was back in service. For this reason work could be transferred to the computer over a period of time.

Master and transaction files were held on 80 column punched cards, some, especially those used in factory production control, requiring many thousands of cards which were moved around the factory on large trolleys.

One peripheral was a combined printer and card reader, essentially a converted tabulator, which could print 26 letters and 10 numbers using a total of 32 characters. This was achieved by allocating 2 characters to some symbols (e.g. 6 & G, o & 0, i & 1 were the same symbol). No computer processing was done using alpha characters, just read and print. The other peripheral was a card punch for file output. This was essentially a converted card reproducer.

As much processing as possible was carried out off-line due to the limitations of the machine as well as available computer time. This included mechanical card sorting and collating, reproducing cards, printing some reports on tabulators and interpreting cards (i.e. printing legible characters across the top). A reproducer was used for “turn around” cards, an example being the time cards for hourly paid employees where the previous week's card was copied without the piecework and time-work hours, distributed to factory areas and returned the next week to the punch room with the hours written on for punching. Another use was to copy cards for back up of card data or program sets. Thus quite a number of staff were needed to punch, process, distribute and collect cards.

There was a Lampson pneumatic tube system covering much of the works. The carriers could accommodate small numbers of punch cards and but use of the system was strongly discouraged by data processing operations staff, since all too often cards were never clearly identified as to what they were.

A couple of contemporary articles, originally published in the "Electronic Engineers Reference Book" for 1958, one by the company's controller justifying the purchase and the other describing the HEC4 can be found on my web site at http://www.vk2bv.org/sb/hec4.htm.

A typical Application

One of the applications of the 1201 was to assist the various progress (Production Control)

offices in the factory areas.

In the carbon brush and mechanical carbon factories (No 1 and No 2) products were made on machine tools and required some 4 – 8 operations each carried out by a different machine section and operator. When orders were received, the progress office would write out the sections through which the order must be routed (coded 1 - 99) together with the expected date (expressed as week numbers 1 - 53). The punch room would then punch a set of cards comprising a header and one for each operation which were sent back to the progress office.

The header card was retained in the office and the rest went to the shop floor with the order and drawing with the relevant card being returned on completion of a job step with the set up and machining time entered. The office would transfer the hours to the employee's time record and send the card on to the computer department (known as “Hollerith” from its punched card days) for punching and management reporting of factory output and hours worked. To respond to customer enquiries about order progress, runners had to be sent from the progress office to locate the order and report back. The header card was returned to Hollerith when the order had been completed to produce a list of completed orders. Much of the reporting could be done by sorters and tabulators without the computer being involved.

Of course the system was a lot more complex in detail, especially in the payment area as allowance had to be made for multiple operators working on the same order, orders being sent outside the factory area, urgent orders split over two operations, batch operations with multiple orders processed together and so on.

Selecting a replacement computer

By 1964, the 1201 was getting increasingly hard to maintain and becoming obsolete while the company wanted to upgrade and expand applications. Computers were becoming faster and more reliable with solid state components, the introduction of high capacity magnetic tape storage and larger core memory. Assembly languages were now normal, though each manufacturer had its own. Although Fortran was available for scientific work, Cobol was very new and both required far more machine resources than the use of assembler.

Unlike service industries such as banks and insurance companies, Morgans was used to purchasing machinery and used this experience in selecting a new computer. The project was managed by Martin Ludlow, the computer department manager. A number of suppliers were approached for proposals, with offerings including the IBM 1401 and Univac 1050. None of these was very satisfactory with lack of an upgrade path without complete re-programming of applications and IBM only offered expensive rental terms, which limited the company's future options.

The 1050 was selected as the best choice and decision to purchase it was about to be approved when the company was approached by ICT with the information that a new computer range, the 1900 series, was under development following their merger with Ferranti's computer division. At this stage only a prototype existed. The machine was attractive since it was British made and there was to be a range of sizes. Although the

operating system, known then as the “executive”, varied between the different machines including the larger multi-programming models, the identical executable programs would run unchanged on all variants. This provided an upgrade path as well making a back up machine easier to arrange. Morgans decided that the improvements offered by the 1900 range greatly outweighed the risks in an unproven product and were the first company to order one, and chose the single program 1902 model.

The configuration initially chosen was 16k of 24bit words of core memory, a 1200 line a minute printer, a 960 card a minute reader, a 250 card a minute punch and 4 x 20k cps tape decks. There was also a control console with a teleprinter for machine control and activity logging. At a later stage the memory was doubled to 32k words and a hardware multiply and divide unit installed to allow the company's scientific research staff to run FORTRAN programs. The machine needed an air-conditioned environment, mainly to keep out dust from the factory. In addition a motor generator was installed to smooth the electricity supply from voltage surges when factory equipment such as electric kilns were started and stopped. The estimated time for the computer room to be completed and the machine delivered was about a year and the machine cost was about .£20,000.

Three years later, in 1967, applications had expanded to the extent that there was a need for additional computer capacity. This was met through the purchase of a second-hand 16k memory 1901 from Alexander Stephens, a Clydeside shipbuilding firm that was merging with Upper Clyde Shipbuilders. The machine was a little slower than the 1902 but was capable of running all Morgan's non-scientific work, so it effectively doubled capacity at minimal cost.

As an aside, a few years later one of Morgan's subsidiary companies that had installed a basic 1901 wanted to buy increased memory. After a few weeks ICL, as it was by then, was contacted by the computer manager, as no engineer had turned up to install the extra memory, despite payment being made. Didn't the sales rep leave a new copy of your “executive” program he was asked? Yes he did, was the response. Well ICL said, just use that. Apparently extra memory was always installed during production because the basic 8k was never enough and customers always asked for more. The new executive program allowed applications to access the extra memory!

To assist covering the computer's cost until the full range of applications had been developed, the company offered a bureau service to other organisations. The major customer was Radio Rentals, a TV hire firm. There was one unfortunate occasion when this company's data was almost totally lost. One week their brought forward tape master file could not be read. Back up copies were of course retained, and so the tapes were brought in to rerun the previous week's update. These tapes too could not be read. This presented a real problem, as there was now only one more master file remaining. A decision was taken to process the final set of tapes offsite at ICL, which was done successfully. It turned out that one of the Morgan tape units had a fault that resulted in the tape having so much tension applied that it stretched, rendering it unreadable.

Transferring HEC-4 Applications to the ICT 1902

I joined the computer department in 1964 after 5 years with the company as a technical applications metallurgist in the crucible division. This was the stage when purchase of the 1902 had been decided. The company were seeking systems developers for the new machine and existing staff were encouraged to apply for transfer if they had an aptitude, since there were few experienced programmers on the market and none for the proposed machine, being a new model. It was deemed easier to train suitable staff in systems development techniques, including programming, than to try to teach newcomers about the company's business. In those days there were of course no IT graduates. It must be remembered, too, that each make and often model of machine had its own programming language. Training consisted of a programming course of around four weeks given by ICT.

Only one HEC-4 programmer, Vic Wilson, remained at this time and the four of us, I think it was, undertook a programming course in the 1900 language, PLAN (Programming LAnguage Nineteen hundred). Following this, our next task was to convert the first batch of existing applications from the HEC-4, taking advantage of the 1900's improved hardware but with no major functional changes. These improvements included the availability of magnetic tape for sorting and data storage plus additional memory. These applications allowed us to undertake parallel run testing and also enabled us to become familiar with the machine before embarking on systems requiring major redesign.

Another task we had as part of conversion, was to recode card files from the 32 character Hollerith code set to the 64 character codes of the 1900 series. This was done as part of the initial file transfer programs from card to tape.

Those who had programmed in machine code warmly embraced the PLAN language as there was no more keeping track of physical memory locations – names could be used instead, with alphabetic mnemonics used for instructions and the compiler would sort it all out.

Despite all the hype, over the years it seems to me that even using 3 and 4 G/Ls it takes just as long to produce a working program as it did in PLAN. Perhaps this is because most of the work is in the design and later debugging the logic and business rules rather than the act of coding!

The initial applications chosen for conversion were mainly accounting systems and consisted of Payroll, General Ledger, Sales Analysis and Debtors Ledger. These were systems that used the HEC-4, whilst others, such as most factory functions that were mainly processed on punched card machinery, could be left for later.

I was allocated Payroll and Vic Wilson, the General Ledger, whilst the others had the remaining two applications. There were in fact two completely separate payrolls; one for hourly paid factory employees run weekly and the other for monthly paid office staff.

My task included familiarisation with the corresponding HEC-4 systems and on occasions to help with minor ongoing program changes such as updating the tax tables. I had to flowchart the systems, liaise with users for clarification of requirements, design the application, write all the programs and finally to do the physical test runs and documentation. I think there were about 20 programs involved in each system including

reports. Initial program compilation and testing was carried out at ICT's Putney installation. Having one person doing the complete system makes for rapid development, though I think today's management would be a bit wary about the lack of back up staff. Apart from the steps mentioned, I had to be able to operate ancillary equipment such as card sorters.

The steps in writing a program for the 1900 were

1. draw a flowchart of the program logic
2. write the program code on to PLAN 80 column coding sheets
3. submit to the punch room for card punching in 1900 code (not HEC-4)
4. operate the computer (before production started) to compile and list the program from cards
5. check for compiler, punching and logic errors (at least on early runs)
6. when clean, punch executable program cards from the computer
7. test run the program

To fix errors we generally hand punched new source cards. If there were too many to fit in the available gaps in the sequence numbers, one could insert a “branch to end of program” where the new cards were added and finish with a return back to label! If the error was minor we occasionally used to update these cards. This was done by filling the incorrect holes with a piece of card chad and punching the new holes! Later one would re-number them using a card reproducer. Card sequence numbering was essential to avoid the very time-consuming task of of hand re-sequencing a dropped deck!

The executable program cards consisted of the binary code punched in 64 bit character format with 4 columns used to hold a 24 bit word. Executable programs, for both production and testing were always held on cards as it was quicker to read a few hundred cards than load and unload the limited number of tape decks. They were reproduced when getting a bit worn and tatty.

If we had any programming problems, especially with peripheral reading or writing, we were able to contact the actual writers of the compiler or peripheral sub-routines at Putney for help. Try that today with companies such as Microsoft!

The 1201 was decommissioned once all systems using it had been transferred to the 1902.

Subsequent Applications

No 1 Factory Pacer

Following successful implementation of the two payroll systems, I became responsible for factory production control and costing systems. In these areas there was much scope for improved systems over those running on the 1201 and card equipment.

Most attention was paid to the Carbon Division, which became a separate company, Morganite Carbon, about this time, since this is where the high value work was done and there was the greatest need for improved information. There were three main factories in

the carbon area producing different products based on carbon and graphite.

The production sequence commenced with the Feeder Factory which produced the blocks and cylinders from which all the finished products were machined. These were made by mixing and pressing various grades of carbon bonded with tar into cylindrical or block stock in various sizes with no bigger dimension than 6". They were then processed in continuous graphitising furnaces at temperatures to suit the different grades of carbon. Some grades, such as those for heavy duty electric motor brushes, were later impregnated with molten copper through a vacuum/pressure process in the Theta plant. The output of the Feeder factory was supplied to both the two finishing factories and exported round the world. Because of the limited range of products produced, none of which were sold to external customers, this was the last area to receive an order progressing system, but the first to benefit from a new cost accounting system.

The carbon brush factory (No 1 Factory) was mostly a jobbing business that supplied carbon brushes to customer drawings or samples. These were mainly electric motor manufacturers or spare parts suppliers and covered a wide range of applications including automotive, aircraft, rail and general engineering. There was also a small order shop making replacement brushes for older equipment, where a single operator carried out all the operations on an order. Few brushes were made for stock.

A new computer system was considered important to improve customer service. The progress office received dozens of calls a day from customers enquiring when to expect their order, so a new system had to be able to provide the information to respond immediately. Fortunately the factory staff were quite used to data processing so obtaining requirements wasn't as hard as it might have been.

I began working on this system, named "No 1 (Factory) PACER", once the initial payrolls were into the test phase when time became available while waiting for test turnaround. The system designed was quite simple. The progress office scheduled the machine sections that each order required by week number according to the planned work load produced the previous week and gave a priority code. After punching, the order was added to the 1900 tape master file and a set of progress cards punched, one for each operation. These cards followed the order and after each step the relevant card was returned with the completed week number added together with any quantity discrepancy from spoilage or rejection and used to update the master file.

Three days a week all orders were listed by number with one line for each showing current location and the remaining the steps yet to be completed and the revised estimate of completion. This enabled the office to answer order status queries with some accuracy and if need be chase an order on the shop floor. A weekly list was printed by section so each was able to see orders that were running late and take action. Weekly statistics were provided on orders in hand, overdue and completed together with the forward loading by section. It wasn't considered worth the trouble to estimate the man hours for each section as brush making is a reasonably standard process with order quantity determining the load. Large orders were broken down into several parts if necessary.

Some orders such as those for aircraft needed extra tests, but the usual steps were

1. Draw blocks from feeder stock and cut into the correct size and chamfer

2. Drill the carbon brush body, insert the braid, tamp in with copper powder and cut
3. Crimp or solder the terminal fitting to the braid
4. Inspect, pack and despatch

Other Applications

Outside of my own responsibilities, others had completed and implemented the General and Debtors Ledgers and Sales Analysis systems. Customer invoicing was not seen as an area where the computer would be useful. This is because we were not selling stock items at a standard price, with each order being separately costed and quoted. Invoicing was a responsibility of the relevant home or export sales unit and generally had to include some sort of delivery cost.

One copy of each invoice was sent for punching summary data for sales and debtors ledger processing.

Each system tended to be designed and run separately though there was some integration through the output and transfer of summary cards. One example was payroll summary data by department passed to the general ledger.

Factory staff had to be paid in cash in those days as few had bank accounts and also as a relic of the Truck Acts of the 1830s which prevented some earlier practices of payment in other forms, such as goods or credit in the company store. This meant that one of the outputs of the payroll was a coin analysis showing the exact numbers of each note and coin to be drawn from the bank to make up the pay packets.

Monthly staff were paid through bank deposits, which were carried out by providing the company's bank with a covering cheque and a list of employees banks and account numbers.

In those days there were no application programs provided by suppliers other than the utilities for sorting and peripheral control. Nor was there software on the open market. As a result, at the time of buying the 1900 and of course earlier, the only source of applications systems was to write them in house! One of our first programmers, Tom Barnard, had the idea of designing a general purpose report writing program for producing simple lists and tabulations from a few parameter cards rather than having to write and compile a PLAN program.

The concept was based the plugboard programming of a tabulator whereby wires mapped the card columns to the printer columns, identifying those that were totalled.

His program initially called LITA (LIst & Tabulate) required a header card giving the report and column names and data source (cards or tape) and one or more cards defining the input field types, length and position. Alpha field positions were identified using A – H with some values indicating control breaks, numeric fields used 1 – 9 with decimal point

identified and which fields were to be totalled. A set of output cards gave the field codes and their location. Reserved symbols defined the location of current date and page number. Unless the data was pre-sorted a memory sort was used if the data volume was small, otherwise tapes were used.

This program was extremely useful and enabled simple reports to be set up very quickly and saved much programmer time. Its use was mainly limited to ad hoc jobs rather than regular report runs.

In those days Morgan's did not consider it unethical for programmers to take software developed by them and resell it! So when Tom left the company, he took the program and marketed it initially to other 1900 installations and later, after rewriting, for other machines such as the IBM 360 series.

No 2 Factory Pacer

On completion of No 1 PACER, a second system was developed for the mechanical carbon factory (No 2 Factory). This was more advanced in so far as it was based on each pattern produced having a product code and associated master file with production steps including machine set-up and production hours per 100 with standard costs. This made for increased work in setting up the product details before processing an order, but there were more standard items than in the brush factory. In addition it was necessary to include similar pattern details for the raw material stock from the Feeder factory.

Fortunately there were only two levels of “assembly”, in the feeder and finishing factories, which obviated the need for complex parts explosion procedures. A two pass costing, one for the Feeder factory and the other for No2 factory sufficed to update the master file on a change of cost rates or products. The purpose of the product master file was to provide for easier quoting for orders and in the future to feed back actual hours worked for management information and to update costings.

Most processes were machining operations with one man working on a single order at a time, however there were a few processes that raised interesting costing calculations. Defining these became important for any later systems that collected piecework and time-work hours for payroll purposes. Examples included continuous tunnel kilns with unfired blocks going in at one end and graphitised carbon coming out the other. Process operators were paid on time-work but there were batch processes such as the Theta copper impregnation plant that had gangs of four people on a common piecework rate and with 24 hour shift working. Another complication for the system was coping for expected and actual production rejects.

Again I carried out all the analysis, specification and design work, but by this time, in 1968, I had some assistance in programming as we now employed staff without business experience as full time programmers and Bill Spence, with previous 1900 experience, had joined us as chief programmer.

To digress, Bill's previous employer, the Church Commissioners, had stretched his

creativeness in the design of the national clerical payroll. Although some clergy were paid from the church's general income, the sources of funds for paying many livings could vary by diocese and individual living, making for enormous complexity.

Other Projects

One different project that I got involved with as a sideline was PERT (Project Evaluation and Review Technique) a form of CPM (Critical Path Methodology). PERT was a new system devised in the US for managing major projects such as setting up a new factory or building a ship. ICL had developed software to analyse and evaluate the network of tasks. In principle each task was linked in a dependency network with best, worst and expected times and resources being estimated and then updated as these were changed or tasks were completed. The software provided reports to project staff and in particular identified the critical path upon which completion was most dependent. It proved overly complex for use with our systems development projects or indeed Morgan's capital works projects of any type. It was thus never used in practice.

Another responsibility was to keep a watching brief on hardware developments. One of these was the “visible record computer”, which was essentially an electronic accounting machine that used strips of magnetic tape attached to a card for each account on which the transactions were printed. I don't think we found a use for these.

We also trialled machines that keyed directly to magnetic tape rather than cards. Again I don't think we used these in production since to be effective they needed input data that consisted wholly of punching sheets for the one application in some quantity. Most of the bulk input consisted of turn-around cards where extra data had been written on the card.

Following the bedding down of the PACER systems, plans were developing to move production from the Battersea site. Crucible and furnace departments were to go to the existing Suprex crucible factory at Norton near Worcester whilst the carbon production would move to a green field site at Morriston near Swansea. This of course impacted system development.

By this time Martin Ludlow had moved to a more senior position and the computer department was now headed by John Seymour, a new recruit. The development staff had increased from four in 1964 to around 10, most being programmers.

Computers were becoming more common in industry towards the late 1960s with quite a number of companies now advertising for experienced staff at salaries well above the normal office type rates that Morgans were paying. As a result a few of us were tempted to apply for outside jobs.

One job that I applied for was with Johnson Matthey, the precious metal refiners, as it combined my metallurgical background with systems development. I was offered the job at a considerable salary increase but my application obviously was seen by their Ian Matthey a director. It happened that he was also a director of Morgans so the upshot was that wearing that hat, Morgans realised the unsatisfactory salary situation and I received a

large increase to discourage a move.

Over the next two years, 1969 and 70, I was involved more in planning future developments than in producing actual systems, though I was still responsible for the maintenance of the existing factory systems. Future plans involved a number of experiments with emerging requirements and technology.

One experiment involved electronic data transfer between the new factory at Swansea and the computer at Battersea. By the 1960s, electronic text transfer was available on a dial up basis to most business organisations of any size. The system was called Telex and used teleprinters, many of which were equipped with paper tape readers and punches, to communicate with a dialled remote site. Paper tape was used for longer messages since it could be prepared off-line and so minimise expensive transmission time.

Telex proved rather unsatisfactory as it was based on 5 track tape allowing for 32 characters, similar to the HEC-4 coding, but had no error checking and retransmission procedure. This meant that data accuracy was rather poor with errors very difficult to identify and remedy. Instead we ended up using postal services for paper or punched cards until a computer had been installed at Morriston.

Writing about Telex reminds me that few people seem to realise that email has been around in various forms for over 150 years. I regard email as transmission of written material electronically rather than physically. For the first 50 years messages were telegraphed over cable, but after that, wireless was also used. Of course for the first 100 years users did not have access from their premises but needed to go to a Post Office to send a telegram which at the receiving end needed manual delivery over “the last mile” to the recipient. After WWII, following development of automatic exchange equipment, most larger businesses had in house Telex teleprinter facilities. The next major electronic development came in the 1980s with FAX. Although common in business, it never had much penetration domestically. It is only over the past 10 years that the internet has brought costs down to the extent that most office workers and many homes have direct access to email.

My next project was to investigate shop floor data collection that would enable factory staff to enter and transmit both fixed and variable data, thus obviating the cost and time in having data punched by the girls (never men) in the punch room. The intention was to collect both the current PACER type data and at the same time payroll data for factory staff.

At that time VDU terminals were not generally available, however Morgans had been approached by a company, Feedback Ltd, who were making data collection terminals that might satisfy our needs. The terminals were capable of reading an 80 column punched card, such as we were using in our factories, a punched plastic badge like a small card that could be used to identify the operator or terminal user and also the ability to enter 12 variable digits with rotating wheels. This data would be transmitted by the terminal to a special receiver in the computer area that added the time and input station details before output to paper tape.

There were concerns that the terminals would be prone to problems arising from the graphite dust in the factories, however the test units appeared to work well. I developed a draft specification in February 1970 for the mechanical carbon factory (No 2) since this unit was already collecting the necessary master pattern data for No 2 PACER. The document described the business rules, the programs required and the design of the shop floor job cards and employee badges. I still have a copy of this document. Equipment cost was estimated at £17,000 with additional cost for factory wiring.

The target was to complete the design and get approval by August. The system was never developed, however, because of the impending move to Swansea. At the same time I left Battersea to move to the company's Australian subsidiary as covered in the next section.

Summary

Up to the time I left to join Morganite Australia, the company had been an innovative and successful user of data processing facilities. The reasons for this included a far sighted management, experience with capital intensive equipment and the use of in-house staff with experience of the business rather than outside consultants for systems development. Being a non-government organisation, they were able to avoid the restrictive and time consuming tender process.

This situation led to the choice of the most suitable equipment and the fast building of effective applications.

Morganite Australia 1970-1975

In 1970 Morganite Australia was and still is the Australian subsidiary of Morgan Crucible and at that time handled nearly all the group's sales in the country as well as doing some manufacturing. The company also owned a few largely independent businesses away from the main site, for example in the refractory and fuse making fields. Items manufactured were mainly those required locally in small quantities or urgently and included electric motor brushes, mechanical carbon parts, crucibles and resistors with other items and raw materials being imported. The manufacture of resistors and crucibles ceased many years ago. The main factory and head office at that time was in Alexandria, south of Sydney city centre and employed about 200 people. Since that time, with manufacturing being reduced, it has moved operations elsewhere. The company used a 40 column Powers Samas punched card system for data processing.

The finance director, Robert Corbridge, and company secretary, Harry Goodman, came over to the UK in 1970 to look at our experience as they were keen to buy their first computer. Their commercial needs were somewhat different to those at Battersea, so that using the UK software wasn't a consideration. As a result they purchased a Honeywell H-115 disk based machine. I was involved in liaising with the Australian visitors and as a result got invited to spend 2 years in Sydney as computer manager to oversee the initial set up.

The H-115 had 24k bytes of memory and used large 20mb exchangeable disks on 3 floor mounted drives. A disk based system was selected as costs had come down at that time

and it allowed the use of random access and indexed sequential file systems that enabled updating and look up validation without a preceding sort, passing a large tape master file or program incorporation of validation tables. Disks cost about $200 each so careful planning was needed for systems design and back up procedures. The staff payroll was deemed specially confidential so the current disk was kept in the managing director's safe with access strictly controlled by his secretary. There was no room for the back up copies in the safe so these were kept in the computer room and accessible to any operator. She was never told about the need or existence of these!

A new air-conditioned computer room was needed and the hardware had to be shipped from the US, taking about a year in all. System development commenced well before arrival of the machine with testing of the initial applications on a supplier's machine.

Some applications software was offered by Honeywell and we decided to use and modify their debtors and creditors ledger packages, assuming the requirements to be very similar throughout the world. In hindsight this was a bad decision since a huge amount of effort went into working out how the programs operated and then changing them, since there was no documentation apart from the actual source code.

Cobol was now a mainstream language that was relatively machine independent so we used it for all development. An experienced programmer, Heather Berry, and a systems analyst, Colin Peretti were recruited. The development team later grew to 4 people as we trained a couple more programmers. As with Morgans in the UK, all software development, apart from the ledger packages, was done in house. I also got involved in some programming to meet deadlines and despite my own experience in Cobol being limited to a short introductory course, I was able to pick up the language by copying the basic structure from other programs and then filling in the detail!

When my two years were up, I offered to stay on for various reasons.

After 5 years I left the company and moved on as the machine, with a good range of commercial applications running successfully, had settled in with a good development and operating team. Management wasn't really my interest, as I preferred hands on application development and the technical side of the business.

IDAPS Computer Sciences 1975-1980

The Company

IDAPS was a small public company founded around 1970 that provided a bureau service including applications systems to the General Insurance Industry. It also serviced a few clients in other fields. The founders were mainly ex-IBM employees that had been involved with the insurance industry.

When I joined as a systems analyst, the main insurance product was GIS (General Insurance System). This was a magnetic tape based batch system that processed policy

and claim details for clients as well as providing statistical, management and statutory reports. Input was provided daily by clients on cards or tape. Monthly and quarterly reports were produced on paper plus full details of all claims and policies on microfiche.

It was in general a well designed system with some nice features but at the time I joined, the system was no longer a common package because each client's system was customised to meet their individual needs. New customers were supplied with the existing customer's system that was closest to their requirements, which was then modified to suit their special needs. System updates were made at each customer's request and billed accordingly.

By this time the company had several major insurers as customers including MLC, NZI, FAI, MMI, N&G and Scandia as well as the odd small life office. This meant that it was now becoming a very profitable business.

One client, MMI, employed their own programmer, Ray Wise, for some work. Ray was a retired MMI sales agent who took up programming as a part time job. Because his company was charged by IDAPS for every program compilation, Ray checked his work very carefully before submitting it. As a result nearly all his programs were error free on the first run, something almost unknown with in-house programmers. I remember celebrating his 70th birthday at MMI with a good bottle of French champagne, since Ray was a connoisseur of fine wines.

One of my largest tasks at IDAPS was working with MMI on designing a re-insurance sub-system.

Haymarket

For most of my time with IDAPS, my job was to identify and document customer's detailed requirements, write the specifications of changes for each program and arrange the test runs, usually with client supplied data. At a later stage, when IADPS had acquired a report writer, I wrote ad hoc reports without programmers needing to be involved. IDAPS was very professional regarding system documentation. In the case of system modifications, the changes were appended to the specification as well as the body of the document being updated. Clients were always given copies, which additionally served as off-site back up. Program listings were signed off by the analyst before being used in production.

The main computer was an IBM 370/145, chosen in part because the company's founders were from IBM and also because IBM equipment was common in finance and other service industries. The reason for this was that service industries had been unfamiliar with purchasing capital equipment, so IBM sales staff targeted the highest level management with their pitches, rather than those familiar with the detailed requirements of the organisation. This resulted in the saying that “you will never be sacked for choosing IBM”and so the brand became ubiquitous with such businesses.

Apart from high purchase or rental prices, the main disadvantages of IBM computers at that time were that on site operators were needed at all times; that any upgrade of the

computer or its operating system needed a huge amount of work to implement and finally that all jobs run needed a set of Job Control Cards (JCL) that had be checked and usually updated every time there was a run. As a result a significant proportion of IDAPS staff were operators and JCL clerks.

During my time at IDAPS, the operating systems were updated from OS to MVS on the existing equipment. This took about a year to implement with most of the work being the updating of the JCL cards!

Most customer processing was carried out overnight, which meant that many of us were on call and had to go in during the night to investigate any application problems.

At the time I joined, there were around 50 employees, split between sales, administration, development and operations with the premises located in the Haymarket area of Sydney. We all worked closely together and often on Friday evenings the managing director, Jeff Scott, would pick up the tab for a Chinese dinner for 15 or more of us.

In those days long lunches with clients were common place and often the client was the host.

Another difference I found after working in an industrial company was the number of amorous relationships formed or changed between the staff, whether married or not. Maybe it was a reflection of a younger average age!

Aetna Tower

About 1978 the business needed larger premises so moved to a new building taking 3 floors in the Aetna Tower near Town Hall, owned of course by Aetna Life one of IDAPS' clients. This included a recreation area with billiard table and bar, which was mainly used on Friday nights.

Being split over 3 floors with elaborate security access, there was less socialising between the different groups of staff. Jeff Scott had retired as managing director and John Cooper joined as General Manager.

Around this time a major effort was going into updating the GIS system to provide clients with more modern systems and up to date data. The aim was to provide terminals located in their offices that were updated on an overnight basis. IBM offered their 3790 unit that essentially consisted of a keyboard, VDU and mini-computer with a disk drive.

Unfortunately this began the start of the company's path to failure. The new system had virtually been written and tested, using an early version of the 3790, when IBM announced that they would not be putting the unit into full production due to lack of demand.

Thus all the development work by IDAPS had to be written off and an alternative solution was sought that could be implemented over a short time period.

The company's reaction was to look at the US market for packaged insurance industry

systems that provided on-line access. A product, PMS (Policy Management System), was found and IDAPS became its Australian agent.

Closer examination revealed that extensive modification would be needed for the Australian market. Many of the data fields were different which would affect all screens and the database structure. Other changes were due to the need to cater for charges on policies such as stamp duty and fire service levies as well as the need to handle special Australian types of insurance such as Workers Compensation. Virtually all monthly reporting was different so it was decided to write a conversion routine and retain the old GIS reporting suite of programs.

At the same time there were local competitors entering the market that developed systems based on an updated GIS concept. By 1980, the conversion cost had risen to around two million dollars, some of which was paid by PMS.

At this time I and a few others left the company as redundant as we were still supporting GIS which was seen to be on its way out with the PMS area growing.

PMS was never financially successful and the company was taken over shortly afterwards by Paxus of New Zealand. It too survived for only a few years.

Summary

IDAPS was a success for the first 10 years of its life as a result of its enthusiastic and competent staff creating a good product and service at the right time. Although the IBM equipment may not have been the most economical, it was probably the correct choice bearing in mind the expertise of its founders and its common use in the financial services sector.

With hindsight the 3790 terminal concept was a bit of an oddity that never got off the ground and the use of VDUs connected directly to the IDAPS machine might have been a better line of development. Even after the 3790 debacle, writing a disk based on-line front end to GIS would have been more successful than trying to modify a complex overseas package. This would have let IDAPS reshape itself as the leading general insurance software house and allow clients to move processing to in-house computers and at the same time the software could be extended to support the larger insurance brokers.

I believe in the end most clients did move GIS processing onto their own hardware, sometimes with ex-IDAPS staff to support it, and then either continued developing in-house or else bought software from another vendor.

The modification of overseas packages for commercial systems has never been a success for regulated industries that operate in a different manner to their US counterparts. Even in the 1990s and beyond when ERP (Enterprise Resource and Planning) packages became popular, they were never very successful outside of accounting, sales, personnel, inventory control and manufacturing areas.

NSW Health Department 1980-1997

The organisation

I joined the NSW Health Department, then called the NSW Health Commission in 1980. It was the arm of the NSW State government responsible for the financing and oversight of public health in the state. Its prime responsibilities are the 200 or so public hospitals together with a number of other related organisations including the ambulance service, the morgue at Glebe, the state analytical laboratories and the prison medical service. In addition it had responsibility for many areas of public health from food quality to the registration of medically related personnel and organisations. General practitioners and hospital doctors treating patients privately are for the most part the responsibility of the Federal government via their funding of patient insurance through the Medicare scheme. The budget for the department was around 3 billion dollars a year. The department was located in the MacKell building close to Sydney's Central railway station.

At the time I joined, the use of electronic data processing was confined to a few big teaching hospitals such as Royal Prince Alfred (RPA), Royal North Shore (RNS) and the the recently opened Westmead, where each had independently developed systems. There was also a common application in the biochemistry testing field. Hospital payrolls were outsourced to a bureau service under the auspices of the department. In addition the state government data processing facility was used by the department itself for payroll and accounting.

Common Hardware & Software State wide

By 1980 it was realised that the department should co-ordinate data processing in the public hospital arena, as all hospitals had similar general needs. This meant that there must be standardisation of hardware used and common software developed and supplied at no direct cost to users. Richard Dixon Hughes had recently been appointed as Director of the Computer Division to implement this policy.

I joined the commission at an early stage of the plan as a senior systems officer. During the first 2 years I was involved in a variety of projects including determining user requirements for the new common systems as well as assisting with ongoing activities. These included involvement with tenders for such items as visual display units, helping out at RPA with developing a system to handle the newly introduced requirement for billing outpatients and the outsourcing a debtors ledger bureau service for all hospitals that needed it. Many of the other staff were looking at hardware and software needs for the proposed common systems.

With regard to hardware, the first decision was to choose between a large centralised facility or independent hospital installations. The choice was made for separate hospital facilities because

1. There was virtually no data sharing between hospitals
2. Data transfer to the department was low volume statistics and not urgent
3. At that time data transmission was expensive, slow and not very reliable

4. Most applications were real time systems that needed fast response
5. It was considered lower risk to make each hospital site independent
6. It gave hospitals more control over their IT operation

Having made this decision, a tender was issued for a range of computers of different sizes that were capable of running identical operating systems and compiled versions of applications software. On-line operation of all systems was required with background operation for batch work. Another important requirement was the ability for the computers to run unattended by operators. These requirements ruled out some major suppliers including IBM.

The successful tenderer was Digital Equipment Corporation (DEC, although the company discouraged the use of the abbreviation), who offered their VAX range using the VMS operating system. A range of ancillary equipment was also covered.

Patient Administration Systems

As the enlarged Computer Division, including the necessary computer facilities, could not be accommodated in the MacKell building, one of the staff was delegated to search for alternative accommodation that by government policy had to be outside the Sydney Central Business District (CBD). Ultimately three floors were found in an office building in Foveaux Street, the other side of the station, a few minutes walk away and about 100 metres outside the CBD.

Now that the hardware had been selected work began on writing the systems. At this stage additional staff were taken on, including a few contract employees. Cobol was to be the standard language for all except for the pre-existing clinical systems which were written in VAX Basic.

I wrote most of the user requirements for the Patient Administration System (HOSPAS) which included a master index (PMI) of all patients who had attended a hospital and been allocated a Medical Record Number (MRN) and an Admissions, Transfers and Separations (ATS) subsystem covering inpatients which recorded which ward and bed a patient occupied and their bed days. The system was largely based on that of RPA who were already using a VAX computer for a similar system.

I extended the HOSPAS requirements to cover outpatient booking and scheduling which had very complex business rules as to when doctors held clinics and to ensuring that patients attending more than one could do so in a reasonable time frame and in the correct order. This extension was never written during my time in the department.

We had a bit of spare time between writing requirements and being able to start system development. By then a standard range of Cromemco micro-computers were being introduced to the department and hospitals in parallel with the VAX systems. I used a few weeks of this time to write a complete patient administration system for a small hospital using dBase II to run on the little C10 which had 2 x 5” floppy drives and 64k of memory. It included outpatient booking but without the complex scheduling rules. The package worked satisfactorily at Hawkesbury hospital for a couple of years but wasn't developed any further. It really wasn't flexible enough or sufficiently robust for general release.

Until the late 1980s, micro-computers were free standing units with no access the the main VAX applications. With the introduction of VAX terminal emulation software and the newer Microsoft driven desktop machines, users that needed to were able to run office and VAX applications on the one machine. Over the next few years the free standing VAX terminals were superseded by micro-computers within the department.

I wasn't further involved with HOSPAS but around 1983 was allocated the patient billing system (HOSBIL) to design and specify. The system covered both inpatients and outpatients, but now that full outpatient billing had ceased, these consisted of private inpatients and compensable patients (i.e. Those where an insurer would pay, generally covering motor and workplace accidents). Public patients were not charged but private inpatients were billed a daily bed rate which was usually covered by health insurance. In addition they were invoiced by all and any specialist doctor who had anything to do with their treatment. These specialist fees were not covered by private health insurance at that time, but patients were recompensed a fixed proportion of the government standard fee for each procedure through the Medicare scheme covering all doctors, including GPs. Many privately insured patients got a nasty surprise when they discovered how many bills were raised, especially those for every diagnostic procedure. In addition the fees of top specialists were considerably in excess of the standard fee. Some tests were very complex to bill as the charge could vary depending on the number of items actually requested on a standard test that in fact measured many parameters. For example the automated biochemistry blood or urine tests would carry out about 20 different measurements, but the bill could only cover the number actually requested. The HOSBIL system also included a debtors ledger function.

I was told that the HOSBIL system had to be designed to make use of Digital's new network database management system (DBMS), though my preference was to use standard RMS indexed files for efficiency. In a network database every record carries a link to the prior and next record at each key field level, with data access done by following the relevant links. During the development phase of HOSBIL I also carried out the database administration (DBA function).which required a significant amount of work whenever the schema changed.

DBMS seemed a reasonable product during the design and testing phase when usually only one or two testing users were accessing it at any time, but once it got out into the field, performance was poor with record locking a real problem. Whenever a record was retrieved for possible updating, it locked every record linked with it, thus preventing a large number of records being updated by others. By the time this was discovered, I had moved on to my next project, but I believe the next DBA was able to effect some improvement. In fact record locking in a database is almost unnecessary since the chance of more than one person updating a record at the same time is very rare. Instead a much better design approach is to have no locking and instead check when writing an update whether anything relevant has changed and if so only then reject the update. This is called a “change/verify” procedure and rarely causes a rejection. DBMS was never used again by the department and after returning to basic file types, later systems used relational databases, including VAX RDb, that were far more satisfactory.

By now, some five years on, many hospitals had computers and were using the new common systems. User committees were involved in providing feedback and requesting

changes which were usually incorporated into quarterly releases which included automatic procedures to rebuild files or databases that had changed format.

Clinical Systems

Following the resignation of the analyst in charge of the clinical systems section, I attended a course on medical terminology and took over his job. I was probably selected on account of having a science degree!

This section was responsible for maintaining the biochemistry reporting system used in many of the larger hospitals.

My first task was to coordinate and design a very small and simple system to identify state wide vacant neonatal intensive care cots. The idea was proposed by Dr Andrew Berry of the Royal Alexandra Hospital for Children, one of about eight hospitals with such facilities. Before this system became available, doctors from other hospitals wishing to have patients transferred to a cot usually had to phone most of the units before finding a vacancy due to the high occupancy rates. The system kept a simple table of cots for each unit showing numbers free and occupied which was updated daily by each unit. After that it was usually only necessary to contact one unit who could advise where the empty cots were and the availability of a specialised recovery team to transfer the infant.

The main task confronting me in the clinical field was development of a new system (HOSREP) to assist text reporting in a number of specialities, mostly in the diagnostic field, including histopathology, radiology and nuclear medicine. A requirements specification had been written by a doctor who was part of our team. The benefits of the system were to be simpler production of reports using word processing and making them available immediately to wards via computer terminals.

The main part of the system was written in Cobol, and following the experience with DBMS, there was no difficulty in reverting to the use standard RMS indexed files. Unlike microcomputers, there was no word processing program on the VAX. Instead there was VAX TPU (Text Processing Utility) software that could be used to write a purpose built word processor that could include such features as special keystrokes, a spell checker for medical terms and a library of standard phrases for each department (e g “No abnormalities detected” in radiology). Being of a technical bent, I allocated this part of the development to myself as there was no-one experienced in TPU, and someone had to learn! I had also written most of the program specifications, with the aim of using OCR (Optical Character Recognition) for some histopathology examinations.

The system underwent pilot trials at Liverpool Hospital and turned out to be moderately successful. This application, with few specialised national requirements, was one where purchased packages could do a better job than four of us in house. A few year's later, when such software became available, the system was superseded.

New Hospital Software

About the time that HOSREP was undergoing pilot tests in 1987, some hospitals, including Royal North Shore, were looking to improve management reporting. Including relating expenditure on food, pharmaceuticals, theatre and other costs to particular patients,

treatments and diagnoses. These requirements were never covered by the systems that we had developed as there was no pressing need to record them as billable patients were invoiced a fixed charge per day covering all except specialist services.

As a consequence, management consultants from a large multi-national accounting firm were asked to prepare recommendations and a strategy for the next generation of hospital software. The project was carried out using the the Computer Division's planning group to do the data gathering and analysis. Those involved had excellent data analysis skills but little experience of hospital systems or software application development.

The first part of the task was to select a typical large hospital, in this case Westmead a relatively modern hospital, map the organisation structure, record the data originating in each unit and its volume and flow between all the other units. This task occupied some four people for at least 6 months, with much time spent on site at Westmead, and resulted in many dozens of pages of data analysis diagrams and tables. At that time there really wasn't any good software or methodology available, so most were hand drawn. Once all departments had been documented, it still needed two people full time to keep up with the continual changes occurring in such a large organisation.

My thought at the time was that the exercise was a complete waste of effort and far too detailed. But then it wasn't my responsibility and the consultant from the accounting firm was being very well paid to do the job. To use it as a basis of system design ignored that

1. Requirements would change during development of such a huge system
2. It was not practical to devote the two full time staff to its ongoing maintenance
3. Other hospitals would have differing needs which would have to be taken into account
4. It was not possible to devote enough staff to developing the complete system at one time

After the consultant's report, I believe the whole analysis was dropped and never used.

The main recommendations by the consultant were that

1. The hospital system with a budget by then of only $5 billion per year was too small a business to support in-house system development
2. That external packages should be purchased and tailored by the supplier
3. US hospitals were already doing detailed patient accounting so their systems would meet the new costing needs
4. There were packages available from the US
5. Maintenance of the existing systems should be contracted to an outside organisation as they would be superseded within a short period
6. Staff currently engaged in maintenance should be transferred to the contractor so that they would have continuity of employment through other work

Surprisingly, in my view, these recommendations were accepted and followed. By this time I had moved to my next project so was not personally affected or directly involved in hospital systems during my remaining 8 years with the department.

So what was the outcome – a multi million dollar fiasco that ultimately failed and never received a mention in the department's annual reports or the press.

Tenders for packages were requested and one from the US accepted. A great deal of money was then spent on modifying it for use by NSW hospitals with the billing and statuary reporting components omitted as unsuitable and our own HOSBIL system retained.

Maintenance of the legacy systems was contracted to CSA and the relevant staff transferred. These systems were then updated annually rather than quarterly and included only essential and budgeted modifications.

The new patient administration package was trialled in three major hospitals, St Vincents, Royal North Shore and Fairfield. At the end of a two year period, these hospitals rejected the new systems as being far less satisfactory than those they replaced. They reverted to use of the legacy systems.

The old systems, having been outsourced, continued to be maintained by CSA, at high cost and reduced service levels, during the time I remained with the department.

So what went wrong?

1. At that time the only packages on the market were for very small US hospitals, of a similar size to smaller Australian private hospitals and did not cover the complex needs of a large teaching hospital.
2. The systems were inflexible, and unlike our in-house systems, were very costly to update on a regular basis
3. The collection of costing data was included because these items were billed to patients in the US, rather than to assist management control
4. For the size and special needs of NSW hospitals, in-house development was both cost effective and met user needs more closely.
5. There were so many business requirements peculiar to Australia, in particular government Medical Benefit and statistical requirements, that the cost of modification was extremely high. This mirrored what IDAPS had discovered 10 years earlier by trying to adapt a US package in the insurance field.
6. Departmental staff, such as myself, were well aware of these pitfalls, but what was our voice compared with a prestigious multi-national consulting firm with a bevy of analysts

I believe that some 7 or 8 years later further outsourcing was examined and by that time had perhaps became more practical, with systems written for the Australian market. However the department had lost its development staff and expertise, rendering reversion to in-house system building very difficult.

Departmental Reporting

In 1988 the department wanted to redesign the statistical and financial reporting procedures that hospitals used to keep the department informed of costs and activities. This would cover both the data collection as well as the reports themselves. In addition the

software would assist with the annual budget allocations for all government health units units including the department itself. As is common with government departments, reorganisation was a regular occurrence. Hospitals were re-grouped for administrative purposes in different ways at various times. When I first joined, they were divided into Regions, each under control of a departmental office. Later the metropolitan hospitals were re-organised into Area Health Services each with its own local board. Country hospitals followed later with boundary changes from time to time. I mention this as it affected the complexity of the requirements when issuing reports comparing year with year.

This system was intended mainly for the department itself therefore had not been included in the transfer to CSA. The acronym DOHRS was adopted (Department Of Health Reporting System).

I was appointed as Project Manager when the project had become bogged down. At this stage the tender requirements for software had been written and issued to potential suppliers. Generally the products tendered by suppliers covered only the production of reports from an existing database and were just report writers.

These were quite useless as the needs included all the data input functions to maintain a new database as well as the operational function of budget distribution to Area Health Services and their hospitals. In other words a complete system development tool including database software was required, preferably using a high level language.

Had this been realised, it would probably have been developed in house using the existing tools available. As it happened, one tenderer, Information Builders, offered their Focus composite relational and hierarchical database and 4 G/L programming language. This tender was recommended since it was the only possible one that met the actual requirements. This was despite there being only one very small VAX user of the software in Australia, Focus being mainly used by financial service industries based on IBM equipment.

Our team of about 6 built the initial system in 6 months with the help of a Focus consultant, Peter Jolley and close cooperation of user departments. Peter did all the programmer training and wrote some of the more complex procedures. The system did its job well, with ongoing changes being swiftly implemented as the requirements altered or extended. These included the addition of capital works projects and hospital waiting lists, many ad hoc reports and the building of interfaces with other systems for data capture.

During the development phase, I had a terminal and modem installed at home to access the central system. On some days, my schoolboy son used the terminal under supervision as a bit of computer familiarisation to “talk” to the night-shift operators. This reached the ears of the senior production manager and I was told in no uncertain terms that this contravened the policy that outsiders must not access confidential departmental data!

One of the extensions to DOHRS was to report on waiting lists for elective surgery, which had, and still has, a high political profile. Obviously hospitals and the department wanted to show a favourable picture of waiting lists, but there were some data entry problems that made matters worse. One important field was the date the patient entered the waiting list, and where this was in error or omitted, the date defaulted to 1/1/1900! Thus the average waiting time was increased so much that, in such a case, we were asked to change the

default to a two year period! Hospitals were said to adopt various doubtful practices to reduce their lists. One large regional hospital was rumoured to have offered to treat surgical patients on the list over the Christmas and New Year holiday break. Virtually all refused and so were dropped from the list and then re-entered as new additions!

After 6 years I was due to retire and was by then the only person still involved in maintenance of the system.

Because the system was the only one using the Focus product, it was decided to rewrite it using the Powerhouse 4G/L and Rdb which by then had become the more commonly used development tools in the department. I stayed for a further 18 months as a contractor to assist in specification and testing.

Although the Focus product turned out to be very suitable, allowing fast development, use of the tender process and the ultimate rewriting as an orphan language, marred what was otherwise a viewed as a very successful project by all users.

I think this project was an example of the risk of going to tender. Unless the person writing the tender has a very clear idea of the requirements and has gained familiarity with the available products, the best solution will not be selected.

Odds and Ends

The introduction of personal computers

During the early 1990s personal computers were introduced to normal office staff within the department and a major effort had to be made to ensure that our VAX applications would run using PCs. In the interim development staff needed both VAX terminals as well as PCs and there was a huge increase in support staff required. Email was seen as a boon, but as with other organisations it was never controlled. There were quite a few occasions when the email system ground to a halt when the odd clerk decided to forward a large message to “all staff”. I think later this option was removed from all except a few key people.

Until I retired about 10 years later, the general use of email and word processors caused huge loss of information in government organisations as well as requiring increasing amounts of disc storage space. This happened because so much data was held on “personal” disc space which was not properly indexed or accessible by others and system administration could never tell what could be deleted, even where staff left the organisation.

Development of early Pointing Devices

Thinking of PCs and in particular “pointing devices” such as mice, reminds me that when I was working at the Marconi Company's research laboratory in Chelmsford as a temporary job prior to university in 1956 we were building prototype equipment that did the same thing. Its purpose was not directly related to computing, but it generated a small circle on a radar screen that the operator could control with a joystick to identify a particular target echo and follow it.

Introduction of Internet

Our relationship with Information Builders was the trigger for me to request that the

department subscribe to a dial up network service in 1991. This resulted in approval to access the Compuserve network via a 14 kbs modem at a cost of $14 per hour. The main benefit of the service was to be able to email consultants at Information Builders in New York and get an overnight response to technical problems.

Later on other a few other members of our group wanted to use the account and Compuserve by then provided access to the general internet. This was fine until I noticed a lot of emails arriving apparently addressed to a student and a steep rise in the monthly account. I was able to trace this usage to one of the senior IT staff who had allowed his son access from home!

I had some difficulty with this individual as he tended to be very autocratic and would not accept ideas from anyone he considered junior to himself. He was from an Asian background and later one of his compatriots explained that he was from a warrior caste and therefore expected unquestioning obedience from all those not senior to him. At the same time he would always obey instructions from his superiors. From then on, if there was anything where I wanted him to change his mind, it was a simple matter of asking one of my more senior users to make the request. It always worked! In addition he treated any female staff as serfs and was universally loathed by them, many of whom refused to work with him.

Summary

Unlike private enterprise, government departments generally operate as a unique type of business within their jurisdiction, and will differ significantly from similar organisations elsewhere due to scope, cultural and legislative variations. As a consequence, seeking complete package solutions to operational systems is almost certainly doomed to failure.

Even outsourcing the customisation of a package or developing a system through the tender process is generally unsatisfactory. If you have experienced enough user and IT people to provide bidders with the necessary correct and fully detailed requirements specification, then you can probably develop in-house more quickly and effectively.

The NSW Health Department made few serious errors under the direction of Richard Dixon Hughes but after he left in 1989, senior IT management people tended to be career administrators with less experience in creating practical operational application systems. This led to led to unsatisfactory systems acquisition and loss of experienced technical staff.

NSW WorkCover Authority 1998-2003

The Organisation

When I joined WorkCover in early 1998, it had only been in existence in its present form for less than 10 years with no legacy systems inherited from earlier organisations. Thus all computer systems were fairly modern, being based on Unix machines and Windows PCs and servers.

The authority had two distinct operational functions. The first was the funding and management of the Workers Compensation Insurance scheme, with commercial insurers acting as agents for the collection of premiums and management of claims. The scheme had lost money for many years and so was the target of many proposed and actual legislative changes to overcome the problem. Thus systems in this area required high maintenance activity. Staff in this area were primarily administrators, with only a small number of operational staff handling claims directly.

The second area of responsibility covered the Occupational Health & Safety (OHS) responsibilities of the authority and was its major operational function. The bulk of the authority's staff were employed in this division, including around 260 field inspectors. Responsibilities included recommending legislative changes, the investigation of workplace safety complaints and serious accidents together with various licensing responsibilities covering personnel to operate machinery, the storage of dangerous goods, the operation of fairground machines, firework displays and so on.

The authority was not directly funded by the NSW state government as were other departments, but through a percentage of the insurance premiums raised, although the employees were still public servants.

Perhaps because of this funding arrangement, two unsatisfactory procedures in the information technology area became possible during my time. One was the employment of far more IT contractors than permanent staff, sometimes including senior positions. The other was the capitalisation of not only all new systems but major maintenance work as well which included projects such as system changes to cover insurance legislation and handling the Y2K transition. Few, if any, system developments resulted in a cost saving within the WorkCover but were aimed at benefiting the community at large through a reduction in workplace accidents and a more viable insurance scheme.

The effect of this culture was that numbers and cost of actual IT staff were hidden from public scrutiny and the resulting high costs were spread over a number of years.

The Security Tender

At the end of 1997, general management had decided that the contractor regime had to cease and got rid of all IT contractors except a few key staff working on the INSITE insurance system still undergoing development. A new Information Management (IM) Director, Judy Holmes and Applications Development Manager, Wayne Parker were taken on and subsequently a number of permanent staff were recruited, including myself as a project manager.

On my first day I was handed responsibility for evaluating responses to a tender for computer security software that was currently open and introduced to Colin Kennedy from the State Contracts Control Board (SCCB) who looked after procedural aspects of tenders. Apparently there were no contractors left to handle it from the computers operations section who had requested the tender.

Although computer security did not fall into my area of expertise, I was determined to do my best. For the next few days I studied the tender requirements, read some specifications of products on the market and tried to set up a points system for evaluation.

Having done this, I found the tender so badly written that it was impossible to evaluate. For example, several requirements were listed as both essential and desirable, so it wasn't clear what was actually meant nor how tenderers would interpret this. Additionally, description of some of the required features seemed to have been copied directly from one supplier's brochure, using his sales jargon.

Both the Applications Development manager and the director were out of state at a conference for the next few days, so naturally I turned to Colin Kennedy of the SCCB for advice as to what I should do, since he was part of the team. The result was that SCCB immediately withdrew the tender and I scored my first black mark with the director for not approaching her first! I was unable to find out who had actually written the tender specification, though soon after I was approached by an IT consultant, Jim Peach, who had survived the purge and seemed very interested and concerned about the situation. The upshot was that I had to rewrite the tender, but was able to get some assistance from an outside computer security expert.

This next version of the tender was completed satisfactorily and the recommended product purchased. However I don't believe it was ever used by the operations group.

The Insurance System

To digress, I had a look at the design documentation of the insurance system (INSITE) for familiarisation while settling in, although not part of my responsibilities. The system was a large database fed primarily by our insurance company agencies on a monthly batch basis with some WorkCover input covering internally handled claims. Its purpose was to provide WorkCover staff access to the policy and claims experience of employers and to produce voluminous monthly and quarterly statistics. Apart from the statistics, it was more of a reference system accessed from time to time rather than an operational application. The database design was theoretically excellent with relational tables for every possible entity. The statistics were produced by a separate sub-system using the SASS package. Unfortunately the database wasn't “de-normalised” for a realistic practical application which made it very slow in use.

Another problem was the need to copy and rebuild the whole database in a format suited to SASS for monthly and quarterly statistical reports, rather than transfer new data which could take several days at which time the system was not available. A carefully designed data warehouse approach, where only new transactions or journal updates are transferred, might have worked despite old claims sometimes reopened many years later. This would be similar to an accounting system.

The OH&S System

Information technology in the OHS division at that time consisted of dozens of small PC based systems, some merely spreadsheets, each set up to perform one function. Examples included a separate systems for many licensing types, a job allocation sheet at each office, databases of enforcement notices issued to employers, dangerous goods location mapping.

WorkCover management had long seen the need for an integrated system giving the total

picture for each employer or workplace that had any interaction with the authority, ideally with a subset of data held on inspectors laptop computers. This new system would become the main operational system for the organisation and be extended later to include a summary of premium and claims experience.

The cost justification was that by combining all interactions with a work site or employer into one system, WorkCover would be able to direct compliance efforts by its inspectors more effectively and so in the longer term reduce the number and cost of workplace accidents. Accident reduction was used to justify some other systems developments, but without explaining how this was to be achieved other than saying “through better information”. More on this later.

I was fortunate enough to be given IT management of the project and relished the job of designing a major system from the ground up in conjunction with an enthusiastic group of users. The project was kicked off with a 3 day off site Joint Application Development (JAD) session for about 35 OHS and IT people facilitated by an outside organisation. This served to document what was currently done throughout the division and allowed people to identify shortcomings as well as producing a wish list of what they would like to see.

From the JAD information, I started preliminary design work and collecting some of the detailed information with the aid of an excellent business analyst, Dalibor Ivkovic. This being a system without parallel elsewhere, I was assuming we would build it completely in-house. This was not to be so, and I was informed by the IM director that the current policy was to go to tender for an “OHS Package” and that in-house development was not even to be considered for comparison. I believe that this policy was driven in part by the experience with the insurance system and its ever increasing cost and complexity and partly by consultants who would benefit from government outsourcing IT development.

The OHS application was now named WSMS, an acronym for “Workplace Services Management System”, selected to avoid any confusion through using “OHS” in the description. Our next move was to investigate the availability of packages. The only “OHS packages” found were small systems for workplaces to keep their claim and accident records – nothing like what we wanted to do. We also approached other similar organisations to see how they managed, including sister authorities in Victoria and Western Australia and even the UK Health & Safety people. All had a different range of responsibilities to us and used purpose written software which would not have been feasible to obtain and modify.

I then had a look at Customer Relationship Management Systems (CRM) which were commonly used by sales organisations in a commercial environment. These seem to cover types of business processes not too dissimilar to ours, though the terminology was quite different – we had inspectors, not sales reps; we issued notices for breaches of regulations, not quotations; we wanted records of complaints, not sales enquiries; we recorded prosecutions, not sales orders and so on.

Our “customer” structure could be awkward to handle. Accidents and safety problems happen at “workplaces” which could be owned by a “customer” (eg a factory or shop), but on the other hand they could occur at a building site or at a customer of the worker's firm. The aim was to create statistical data both by workplace and by employer which could give rise to a “many to many” relationship. There was also a time element when a workplace or

company changed owners or in the case of a building site, was completed.

A number of the better packages were able to be customised by users to give redesigned screens, new database tables and fields, so this seemed the way to go to comply with our stated outsourcing policy.

I then prepared a tender specification for a CRM package covering ease of customisation, data requirements, ability to use Microsoft equipment and Sequel Server database, portable operation and so on. Based on my experience and that of potential suppliers, I had assumed that our own staff would carry out the customisation. The tender document was presented to the IM director for approval whereupon I was asked where the customisation specifications were!

The project had taken 6 months so far and instead of drawing up the detailed specifications in parallel with tender evaluation, as I had planned, they had to be done first and tenderers asked to quote for implementing them! Apart from losing another 6 months, I knew this wasn't the best approach. It is very hard to specify every detail of a major on-line system at the start of the project. Implementation is usually staged with numerous changes being made all the time in the light of unclear user needs (eg “Oh, we forgot to tell you that this sometimes happens and the system must handle it”) and experience using the system. This is especially true of interactive systems in a novel field. Even with precise specifications there is a large element of guesswork by tenderers resulting in hugely variable quotations.

Anyway we went ahead and included customisation with quite detailed specifications and 6 months later when tenders were evaluated we found differences in the order of 10 to 1 in customisation costs whilst the basic packages were much as expected and more closely matched. As a consequence, the recommended tender effectively had to be selected on the customisation cost rather than the suitability of the software. We were very fortunate the Pivotal “Relationship” product that we had thought the most attractive during the preliminary investigation phase, came out with the lowest cost.

Having recommended a tender, the next task was to have it approved by senior management and in particular by SCCB, the contracts board. Again It was submitted to the IM director for action. Initially I was told there would a couple of weeks delay due to “issues with another tender” and later on that the problem lay with the WorkCover General Manager who was having difficulties with SCCB. After another couple of weeks I phoned the assistant to the GM to see if these difficulties were likely to be resolved. I was told that he knew of no problem and word got back to the director that I had been enquiring and she forbade me to contact any of the senior executive except by going through her. Something very odd appeared to be going on. I continued to advise contacts at my level in OHS Division that I was doing everything possible to progress the tender and idly wondered whether senior management in their division were also aware of the delays. The OHS Assistant General Manager, Michelle Patterson, must have asked our director about the delays so I was taken task for contacting her without approval. No, I said, I had restricted my contacts to lower level staff who had asked me directly about the delay.

It later turned out that the problem with SCCB had been with another IT tender relating to a proposed new insurance system over which SCCB had some reservations about the tendering procedure. SCCB had then been advised that WorkCover would proceed without

their assistance. Ultimately relations were resumed with SCCB in respect of our tender, but a different SCCB officer was assigned to the job. During contract negotiations over the next few weeks, I was instructed to refer legal queries to a private firm of solicitors rather than SCCB as would normally be done. Some 8 months following our tender recommendation, the contract was signed in April 2000 and work commenced.

Oddly enough a short while later, the IM director Judy Holmes and her superior, Stephanie Garland, the Assistant General Manager, Corporate Governance suddenly left without notice as did one or two in the Applications Development Group associated with the problem tender which had been ultimately been scrapped.

As it happened our contractors used very little of the native Pivotal CRM functionality, and treated it mainly as a high level development tool, so that nearly all business functions were written from scratch. The package approach, as I had seen in NSW Health with the hospital systems and in IDAPS with insurance systems, again proved unsatisfactory in a unique government application.

Work on the project proceeded quite fast with each stage tested and approved by users, but by the end of the year the contractor went into liquidation, though not necessarily through under-quoting this project. The work was then sub-contracted to another Pivotal reseller who brought the development to its first implementation in 2001 with the Building & Construction team of the OHS division selected as the test group due to the enthusiasm of their staff.

The initial implementation was limited to the processing of complaint and accident investigations including allocation of jobs to inspectors and the progressing and reporting of the investigation. The system showed immediate operational benefits now that job allocation could be centrally supervised and controlled. Previously each of the 28 branch offices processed all work in its geographical area with inspectors selecting an available job and on completion returning to the office to pick up the next. This resulted in a lot of travel time with some offices having a greater backlog than others. The new system allowed inspectors to be allocated several jobs in the same area each morning and, when occasion demanded, for inspectors to temporarily carry out assignments outside their normal branch coverage. Thus efficiency was improved as the same number of inspectors were able to carry out more site visits.

Attempts were made to convert data and transfer it from some of the existing systems, especially those for compliance notices, but in the end this proved impossible due to the wide variety of differences in a workplace's name and address (each notice had been separately hand written and entered in its entirety) with no link to an employer company or branch master record. As a result the new system had to accumulate data from scratch. The client structure had master records for employers and workplaces to which transactions were linked.

During the data conversion attempts an amusing incident occurred. We required the co-operation of the Records Management team of our IM department who were responsible for running the old systems and this required paperwork for approval to be exchanged. There was a delay and on enquiring, I noticed an unusual reluctance from their staff to explain why. It wasn't until the Applications Development manager, Wayne Parker, passed me the file, unread, to follow it up, that the reason came to light. I had referred some of

their staff as “protagonists” of a particular course of action. In the file was a memo to Wayne from the head of Records Management stating that this term was considered insulting to her staff and official action should be taken against me. I immediately drew the memo to Wayne's attention and after a laugh, we agreed that a satisfactory outcome would result if I wrote an apology stating that I had the highest regard for her staff and had no idea that my words would be interpreted as derogatory. A photocopy of the dictionary entry was attached. Officially I was reprimanded in writing by Wayne for using words that might give rise to mis-interpretation. Nothing further was heard on the matter!

During 2001 a new IM director, Peter Hole, was been appointed to replace Judy Holmes. One of his first initiatives seemed to be to ensure that permanent Application Development staff were all relegated to maintenance work, with all new systems being developed by contractors. I assumed the reason for this was to ensure as much work as possible could be hidden in the accounts through being capitalised, as permanent staff were considered a recurrent expense. I went on leave for a few weeks to come back and find that I had been taken off the OHS project and transferred to run the system maintenance group where the contractor running it had resigned. The IT project management of the OHS system, WSMS, given to a new contractor. There was no suggestion that my work had been inadequate in any respect.

The OHS project continued satisfactorily, with customisation gradually transferred to WorkCover, albeit staffed almost entirely by contract personnel. The use of contractors, which had been cut right down when I joined was now starting to build up seriously again.

Other WorkCover Systems

For the next 6 months I was part of the maintenance group, a job that essentially involved liaising with out client departments, allocating work to programmers and prioritising and progressing it. Not something that I found very interesting, though it did give me some experience of the multiplicity of systems currently running at WorkCover. We still had some contractors in the maintenance group due to the specialised expertise required in some areas including the very complex insurance system and its statistical subsystem (SASS).

One interesting system we had was that developed for internal paperless work flow. It was developed in house and I am not sure how it managed to escape the “outsource everything” approach pursued by the previous IM director. The greatest number of forms flowing throughout the organisation related to the approval of staff leave of various types where at least four people were normally involved. There were many other types of paperwork processed including annual reviews of staff members. The system proved a great success and was popular with staff.

About this time, a consultant, Pedro Harris, was contracted to review the IT operational systems employed within WorkCover and come up with a development plan covering the next 5 years. The recommended plan envisaged a completely multi-million dollar new system covering all insurance system processing and much of the OHS work in the licensing area, which had already started to be incorporated into the new WSMS system. Even the successful new WSMS system itself was to be included in the new development, though fortunately this requirement was later dropped. It was to include a data warehouse

and be built using the new Microsoft dot Net architecture with browser type user interfacing.

A completely new project progressing and documentation system was introduced and used for this and all other projects. Essentially it was based on check lists of areas to be covered with examples that could be modified. It generated large amounts of documentation that I am not sure were entirely beneficial. The dot Net project was planned to employ dozens of contractors and so required the temporary lease of a complete floor of another building for the Applications Development group as the main offices had insufficient space.

Also at this time, the end of 2001, the planned move of the bulk of WorkCover staff from the city to Gosford was well advanced and would take place within the next 12 months. I had indicated that I didn't intend to transfer there and this may have been one reason that I was taken off the maintenance section and from then on allocated a variety of small projects with some spare time to assist the dot Net project.

The new project was roughly divided between the planning and requirements group, those defining the technical architecture and another group to write the first application, that of consolidating the multitude of licensing functions. There was no early benefits analysis other than the vague statement that “better information would lead to improved workplace safety”. Thus the new system appeared to be based on new technology with no real idea on the exact nature of the benefits to the business beyond a common IT platform. Later when a benefits analysis was being prepared by a contractor for the licensing component that was currently under development, I was able to give some assistance. His first draft stated that the rewritten licensing systems would result in a 10% reduction in the 400 staff, he had been advised, that used the system and would effectively pay for its development. I had to explain that there were only 20 staff in the licensing unit and that the remaining 380 users were the inspectors and others who might look up something once or twice a month!

By the time I left the organisation early in 2003, there were some 30 – 40 contractors employed on the new system which still appeared to offer no substantial benefits. I later heard that after two years there was a new IM director who cancelled the whole project after several million dollars had been spent. I doubt that this write off ever appeared in an annual report.

The first minor project I had was to progress a study by the Gartner consulting group commissioned by WorkCover some four years earlier but never completed. The study was intended to compare WorkCover's application development and maintenance environment with those of similar organisations in Australia and overseas. I think the original expectation of WorkCover's IT management was that it would justify the outsourcing of most development work. The work remaining on the project involved completion of forms covering user departments' impressions of development services and pressing Gartner to finish the report. Their report was completed some 6 months later and in essence stated that WorkCover was fortunate to have systems developed on few platforms over the past 10 years that could easily be maintained rather than legacy applications going back far longer. Their main criticism was the extremely high cost of maintenance due to the reliance on contractors rather than staff.

For my final project with WorkCover, I was asked to investigate Enterprise Resource

Planning (ERP) systems such as SAP, Oracle and PeopleSoft and see how these might benefit WorkCover's internal administration covering functions such as Payroll, Human Resources, Work flow and General Ledger. My approach involved identifying existing functions of our current systems and adding those that users would like and compare them to the various ERP suppliers' offerings and ideas they might have. Rough estimates of the cost of purchasing and customisation were also obtained.

My recommendation was that our existing systems met our current needs and in some cases, such as work flow management, were superior to the ERP offerings. There could have been some advantages through integration of the different areas with a more modern interface, but the cost of any package plus the huge customisation needed rendered their use totally uneconomic. Any user improvements required could have been done in-house at lower cost.

I suspect this was not the result hoped for, as to accept the “status quo” rather than making significant changes, however costly, doesn't look good on management's list of achievements!

Summary

At the time I joined the main systems groups varied in effectiveness. The administrative area was quite well served apart from records management and work flow and both these areas were addressed during my time. The TRIM package was implemented for records management and an efficient home built work flow system was written.

The insurance system was quite new but overly complex and time consuming to run. It was however reasonably functional and well maintained albeit using expensive contractors.

The multiplicity of OHS systems was gradually being replaced by WSMS, the new integrated system, though the flawed acquisition process had led to increases in cost and delays. Some of this was due to the novel nature of the application resulting in many changes having to be made as experience in its use developed. These changes were hard for users to foresee in the specification process but the staged implementation allowed updating to be accommodated.

The mammoth redesign of the technical platform and planned integration of many systems that occurred during my last 2 years with the organisation was begun with no real cost benefit study and I understand was cancelled after nearly 3 years of work by many people. I don't think either that the sort of conversion problems we had found with the OHS application had been considered seriously. This project was to some extent a repeat of the building of the INSITE system a few years earlier in so far as it was a theoretical “tour de force” but based on little practical design experience or business benefit and again almost entirely contractor driven. There was virtually no input from permanent IM staff nor training of them in the new dot Net technology.

A Few Final Comments

During the final ten years of my career, the use of email and personal computers was becoming more and more essential to the operation of a business. It was rather worrying

to see that that little or nothing had been done to catalogue or control the ever growing amount of material building up in the form of emails and files on personal disk space. At WorkCover, systems did begin to cover formal documents through the TRIM system but huge amounts slipped through the gaps, much due to staff turnover. Paper files are cumbersome but relatively easy to find and use, but electronic files, like e-books, are difficult to browse and read and may never become easily managed and used. A new document control system based on international rather than proprietary standards is long awaited.

One particular problem that applies not only to IT but to engineering and other technical disciplines is that good experienced staff are held in low esteem. This is in part due to the fact that few top grade technical people are good at or wish to be in sales or management positions. This results in those responsible for running large organisations following a technical path put forward by the most persuasive or senior persons involved. Several of the disasters I have mentioned have resulted from recommendations by salesmen, management consultants or internal management with a particular brand of snake oil to sell. In these cases, experienced in-house staff who have the technical and business knowledge are seldom heard – they have less polished communications skills and in fact may never be asked for their opinions.

Of the employers I have worked for, only Morgans in the 1960s seemed to avoid this trap by having technical staff involved in all major decisions.