ORGANISATIONAL IMPLICATIONS CAUSED BY THE FOURTH GENERATION ENVIRONMENT

Simon Holloway
Principal Consultant
DCE Information Management Consultancy
Vice Chairman, BCS Data Management Specialist Group

1. INTRODUCTION

Every person involved in the system development life-cycle will be affected by the increasing level of automation and support. Some traditional data processing roles will be radically altered, while some will become obsolete. With the adoption of automated methods, the concentration of human effort will be in the planning, analysis and design stages. New skills will need to be acquired by the programmers of today if they are to adapt to the changing environment. Although the development of an organisation's major data and processing architectures may still involve large teams, much of the subsequent application systems development will be achieved by small teams or by individuals.

At the time of the first Unicom Seminar on the subject of Fourth Generation Tools, two of the UK's leading independent consultgants had seperately looked at what were the possible areas of impact of Fourth Generation Tools on an Organisation.

David Gradwell [1] felt that there were three major areas of impact on organisational requirements due to new application development tools, be they 4th generation systems or Design Aids or whatever. The organisational structure would need to evolve to meet these new needs. He stated that the three were as follows:-

- The distinction between programmers and analysts will weaken and then disappear.
- The importance of strategic analysis is increased. Data administration will become essential. Cross project planning and cross user department planning will become essential.
- End users will need support in their use of decision support software. This will further emphasise the need for a data administration function.

Roger Tagg [2] believed that there were three areas of change needed for an organisation to successfully use Fourth Generation systems:-

- The demarcation lines between programmers and analysts become less valid.
- The position of data processing within the organisation will change, with the necessary change in the sort of person who is manager of the area - more a business manager.
- The involvement of end users in actually developing solutions to their own problems.

As can be seen, they agreed on only two aspects, namely the distinction between programmers and anlysts, and the involvement of end-users. Since thiat time, the Institute of Data Processing Management have issued a report [3], which has suggested that

organisations who have purchased Fourth Generation tools have not been successful as they expected. It is prehaps unfortunate, that no real reasons for this situation, were discussed in the report. My own feelings are that this situationis due to 2 main factors :-

- Firstly, the size of the sample of organisation who were involve in the survey, was not representsative of all the products

- Secondly, and of far greater importance, the organisations had not thought about changing their methodology for developing systems, the new software and it associated new techniques, as well as catering for the new problems that the software causes.

In this paper, I shall put forward my ideas for changes to the orgabisation that need to be considered to take full advantage of Fourth Generation Tools and to prepare for the coming Fifth Generation products. The areas I shall cover are as follows :-

- Application Developers
- Data Administration
- Database Administration
- Project Management
- Security Administration
- End User Involvement

2. APPLICATION DEVELOPERS - NOT ANALYST OR PROGRAMMER

Fourth generation products have been designed to shield developers from some of the major time-consumming environmental elements they have had to deal with in the past; such as operating system, JCL, TP monitor, etc. This liberates time which the developer can use in concentrating upon the organisation - the actual business problem being addressed - and improves communication between data processing and users. Figure 1 illustrates this point.

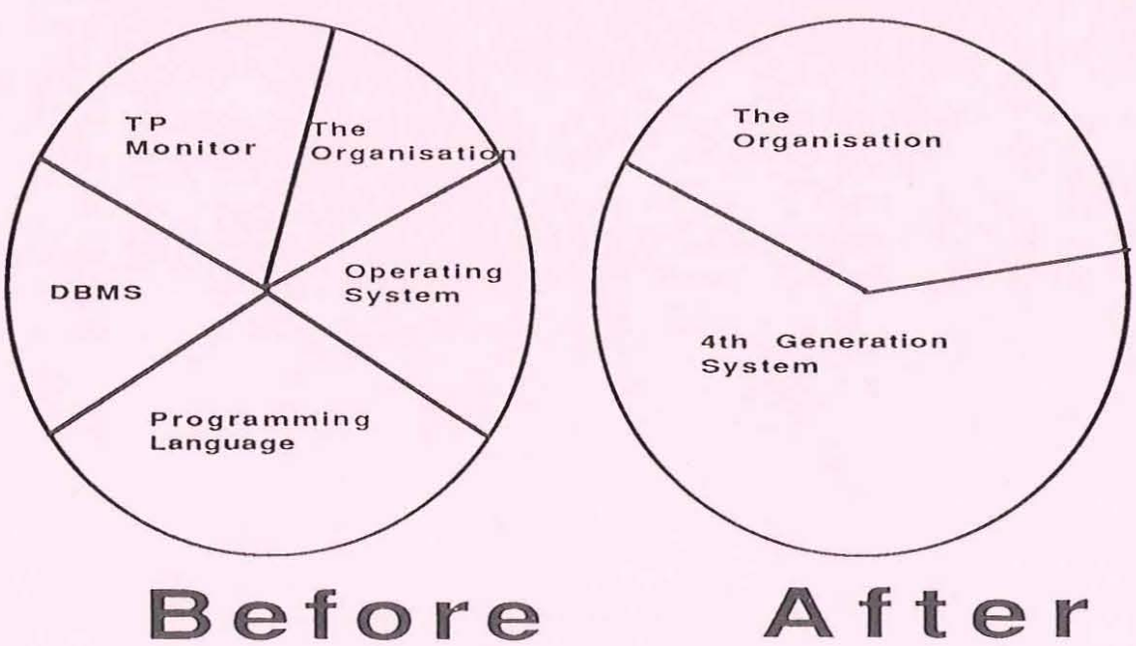

Figure 1. : Fourth Generation Software impact on Developers

Fourth generation products also enable developers and end-users to develop applications

much faster than with conventional languages. The developer can often create programs that have a tenth of the number of instructions that COBOL would require, and in a tenth of the time. The end-user is helped by Fourth Generation languages by being able to specify what he/she wants the computer to do, and not how to do it. This has led to a new problem , that of the overworked analyst.

David Gradwell at VLDB in Brighton [4] felt that Fourth Generation products in the main did help in the following areas :-

- Productivity gains in program coding and testing
- Reduction in the need to understand TP monitors and Database Management Systems
- Easier end-user access to data

On the other hand, he saw that Fourth Generation tools had led to overloaded development machines as well as giving no real support to the analysis phase of the development of a system. In addition the majority of Fourth Generation products had tow major failings :-

- No support for word processing and text management
- Little or no version control

He went onto talk about the arrival of CASE tools, and stated his belief that there was a collision between these two sets of products. It is my beleif that we need both sets of tools to be able to fully develop and maintain applications. The current way in which certain CASE toools have reverted to generate COBOL, and their rigidity in making changes, I feel is a backward step. When working for Applied Data Research, earlier this year, I found that it was their beleif that you needed both sets of tools need to co-exist ,not only for ease of maintenance, but also to evolve rather than revolutionise application development .

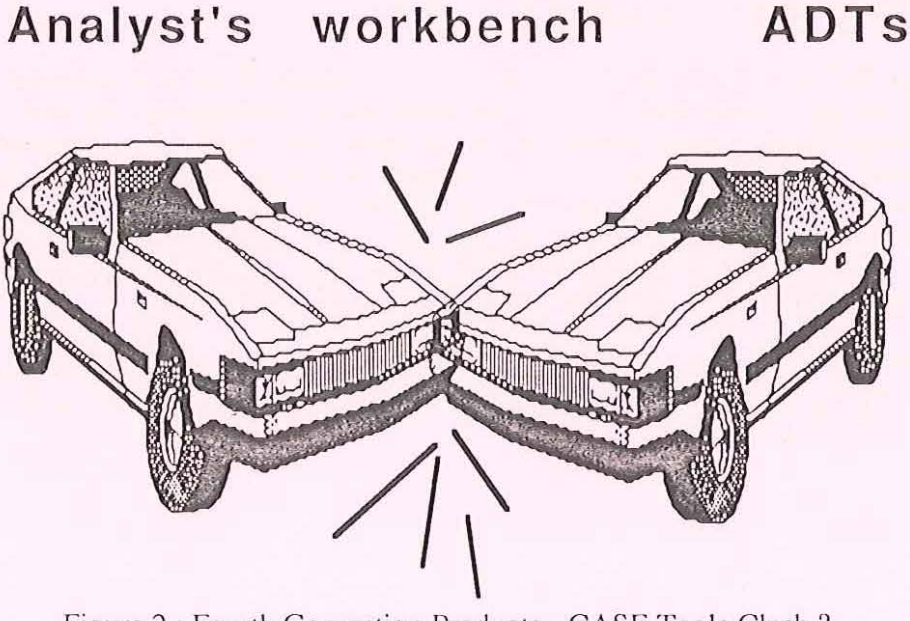

Figure 2 : Fourth Generation Products - CASE Tools Clash ?

As far as systems development careers are concerned, the demand for data processing expertise will continue. End users will not want to manage large scale "production" applications themselves, and Information Centres will not be used for this purpose. However, there will be a trend for data processing professionals to specialise in a certain industry. The background of an individual in banking, insurance, or manufacturing will

become more and more important as compared to experience with this or that operating system or programming language. Also, personal communication skills will become a major factor in job placement and advancement. The data processing community must learn to speak the language of the user, not expect the user to learn data processing jargon. Again, fourth generation languages have the goal of expressing a program in business terms rather than data processing terms. Using a common language will improve communication skills, we will see the ascendancy of information centre specialists. These are individuals with high communication skills who are well trained in the usage of information centre products. They serve as a resource to assist end-users in developing their own applications in the information centre.

In a combination of CASE and Fourth Generation tools, data processing will have a two-edged sword that will speed the phases of an application life-cycle. At the same time, they will radically effect the working practices, not only of developers and analysts, but also the end-user must contribute more to the analysis and design process.

3 PROJECT MANAGEMENT

Without a project manager, bad systems are implemented late and over budget. Sometimes there is no doubt that this happens with a project manager, but the single most over-riding characteristics of a project manager is he/she achieves goals, reaches targets and delivers on time. Expected to manage technology, people and the change process, the project manager can face the following potential difficulties even before the development process for a new system has begun:

- dissatisfaction of users with previously developed computer-based systems;
- project management methods and organisation structures inappropriate for new systems development;
- inadequately skilled systems development staff;
- poorly developed systems planning mechanisms.

The project manager will need to be technically competent so as to choose the technical computing strategies most appropriate for the application development. He will need to be an effective planned, a good controller of his team and sensitive to the problems of implementing change. He will need to be a good manager of his team and capable of training members to discharge their duties efficiently. Part of his success will depend on the organisational relationships between himself and the rest of the organisation. It is important for the project manager to establish a firm base in the organisational hierarchy and, in particular, to be sure of his own upward reporting mechanism.

The role of the project manager can be divided into 5 components, as shown in Figure 3. It is likely that the project manager will need to review and constantly modify the business justification for the project.

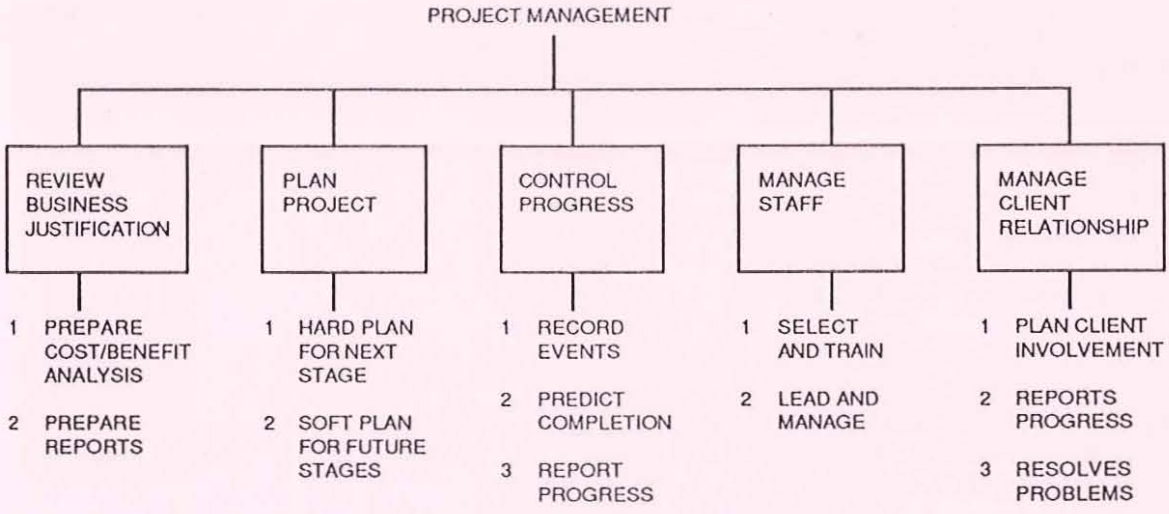

Figure 3: Five Components of Project Management

During the project development cycle, there is a constant need for everyone in the team to reinforce the benefits of the work being done. Short and long term plans will need to be prepared in detail, justified and costed out; and the preparation of hard plans for the next stage and soft plans for future stages will be an important part of the project manager's job. This is because there are always deviations from the plan which, when identified, will cause re-planning to be done. Controlling progress means monitoring the work of others and hence there is a need to manage staff. The project manager is also responsible for managing the relationships between the team and the client. This means many things from:

- influencing the attitudes of the client staff;
- controlling and motivating his own people to present a positive and helpful attitude towards the client;
- selling new ideas;
- reporting progress.

In a modern 4th Generation environment, the notion of creating or establishing an application system and application programs is an activity, which is distinct from writing the application program. While in some organisations the same person might do both tasks, in other organisations the task of establishing applications and their assigned resources may be accomplished by an "Application Administrator", who may be a Project Leader, Data Administrator, Chief Programmer or Developer. This person determines the specific application programs which are going to be built and assigns to the specific dataviews, panels, reports and other programs. This role is a distinct role from writing the application program.

4. ORGANISATIONAL IMPLICATIONS OF DATA ADMINISTRATION

The positions of the Data Administrator and the Database Administrator are relatively new to data processing environments. Traditionally, their functions and responsibilities are handled by various people participating in individual projects or departments within the processing environment. However, the database environment makes it necessary to centralise control and management under one administrative group.

Data Administration, according to the British Computer Society Data Administration Working Party (DAWP) [5], will primarily have a co-ordinating role, and will otherwise play a controlling role, related to the use of data. A more active role that this should only be adopted when necessary to advise, train, or co-ordinate to achieve specific longer term goals. There are areas where guidelines need to be drawn. Outside these areas, data administration will rarely have authority or responsibility, but as general rule, inside them data administration will be involved at a level that reflects the level of existing or potential data related problems. Data administration is not responsible for actual data values of the data of the organisation, but will be concerned with the meaning of the data. A definition derived by DAWP [6] for data administration is as follows:

Data Administration is the corporate service which assists the provision of information systems by controlling and/or co-ordinating the definitions [format and characteristics] the usage of reliable and relevant data. Data that is internal to an organisation can be controlled, whilst data from external sources [eg. tax rates, independent marketing surveys] that is used by an organisation can only be co-ordinated.

Data administration is primarily concerned with problems that cross company organisational boundaries. It follows that the relationship between data administration and the organisational structure is the crux of data administration.

Data administration is as concerned with the way the company is organised as it is with the data - someone with a mathematical bent might define data administration as the intersection of data and the organisational structure.

In order to have successful data administration - that is to have good data - a company must be prepared to pay the necessary price. This price is not so much in terms of money and resources, but in terms of organisational willingness to adapt, co-operate and spend time and effort helping to set up and carry out successful data administration. There are companies where the different parts and functions are not prepared to co-operate with each other, where any issue crossing organisational boundaries is seized on purely as an opportunity for political in-fighting. There is virtually no chance of making data administration work in such companies. Attempts to set up data administration will fail, and can be of value solely in showing up this intrinsic weakness within the company.

The scope of the Data Administration function must be as wide as is needed by a particular organisation, in order to achieve the aims of cost effective use of the data of the organisation. A Data Administration function will always perform a service role, and will be involved in the identification and solution of the data aspects of the problems of the organisation. Data Administration does not directly control data, except data about the data of the organisation and data about its own function.

4.1 Resposibilities of Data Administration

There are a number of areas in which the Data Administrator should have responsibilities assigned to him. These breakdown into roughly 14 major task areas:

- Data Administration Policy - the establishment of the principles of data management which in their turn determine the responsibilities of Data Administration.

- Identification of Corporate Information requirements - The determination and the obtaining of acceptance of the policies for the identification of corporate requirements.

- Generating a corporate awareness of data - The education of the company of the importance of data. An awareness of the value of data as a company asset has to be created. In addition, the knowledge of what data exists and for what purpose the data is used must be communicated.

- Data Analysis - The selection of the data analysis methods in conjunction with the development of procedures for its use. Assistance with the production of business data models and the monitoring of the consistency of the results.

- Data definition - The establishment of standards for the definition of data and the medium for the recording and communication of the definitions.

- Data Dictionary control - The establishment of the requirements for procedures for data dictionary control.

- Problems related to data.

- Physical Data Models - in that Database Administration [5], provides technical support for data administration: Performing database design and development, being responsible for organising and defining the logical view of data, providing education on database technology, and providing support to users in operational database related activities.

- Impact assessment - assessing the impact of data changes.

- Data Access - The design and gaining acceptance of access authorisation rules for an organisation. The arbitration of disputes that arise from requests for access to data.

- Privacy, Security and Integrity - The implementation and the ensuring of compliance within the company of aspects of the Data Protection Act. The establishment of the strategy for specifying the requirements for privacy of data. The determination of the strategy ensurement that the requirements for data integrity, data security and privacy are addressed during physical systems design.

- Data Duplication - The promotion of a policy for a single source of data and the encouraging of the sharing of data across applications.

- Data Archiving - The establishment of a strategy for archiving data.

- Monitoring usage of data - Monitoring live runnning to ensure that the strategies for data integrity, data security and privacy are being followed. Monitoring the use and the content of the data dictionary to ensure compliance with the established rules.

The responsibilities of the Data Administrator will vary from company to company. The responsibilities will vary both in areas covered and the degree of responsibilities involved. Thus the Data Administrator may control, manage, advise, audit, plan, set standards - or any combination. It would be wrong and dangerous to try to specify a set of exact responsibilities that will suit all companies. The right set of responsibilities for the individual company will depend on the particular nature, business and history of the company. There are however, certain factors that will strongly affect the responsibilities of the Data Administrator:

- homogenity or complexity of company structure;

- company policy on centralisation and decentralisation;

- use of Database Management System;

- system inconsistencies;

- data protection legislation;

- corporate business plans.

5. THE CHANGING ROLE OF THE DATABASE ADMINISTRATOR

The Database Administrator is primarily responsible for the technical implementation of the database environment, the day-to-day operations of the database, and the policies governing its everyday use. The Database Administrator's responsibilities include:

- Establishing technical standards and guidelines: Makes sure that all he data are defined, organised, and represented in such a way that multiple uses and applications are allowed, and that end-users, programmers, and analysts have specific, standard guidelines by which data may be input, updated or accessed.

- Supporting policies and conventions of management: Makes sure that the users maintain the policies and conventions determined by management, including the Data Administrator, governing the use and evolution of the database.

- Reviewing application system candidates: Determines whether conform to the design requirements of the database or whether they need to be modified before they are converted to the database system.

- Database design: Analyses the needs of the users on a priority basis and employs the most cost-effective techniques for the design of the database to ensure that the immediate and future requirements of the users are met effectively.

- Control of the database environment: Continues monitoring and control of the database environment after the system is in full operation, including data dictionary maintenance, system additions or extensions, and documentation.

- Technical implementation of data integrity requirements: Implements the necessary data locks and restriction, conducts periodic security audits, supervises the authorisation of access to specific data, and investigates all known security breaches to protect the integrity of the data in the database.

- Training for the database environment: Holds responsibility for the education and training of the users in the principles and policies of database use which includes making current documentation available to the users.

The Database Administrator is a clearing house, a central agency for the collection, classification, and distribution of the information and skills necessary to the success and maximum benefit of the database system.

The Database Administrator's primary functions have lain in the areas of design, control, and evolution.

5.1 Design

The Database Administrator designs the database to reflect the immediate needs of the users and accommodate their future needs. Some of the general responsibilities of the Database Administrator in the design of the database include the definition of the content and the organisation of the database [data structure], the definition of the access to the database [including the logical and physical reference paths and methods], and the allocation of physical storage in the database[s]. The database design not only should reflect the users' needs at the time of the design, but it should also provide the means for incremental growth throughout its life cycle to meet the future needs of the users. Therefore, the design effort is extremely important to the overall success of the database system.

There are two major impacts on the way in which this role has to evolve, namely Foyrth generation tools and CASE tools. With the former, there is need to be able to adapt current physical design techniques to work with prototyping systems. To gain the maximum benefits, the underlying Database management Systems must, Ibeleive be relational, so as to take advatage of flexibility and of ease of use. Both Applied Data Research [7] and Cincom [8] have done something in this area. The second impact form Fourth Generation Systems on design is the ability to exploit tuning possibilities effectively. This normally seems only to be possible within a fully integrated environment, ie. the database management system and Fourth Generation product are supplied by the same supplier. In the case of CASE tools, as they progress further down the line of first generation of physical model from conceptual model, the black art of design for a particular database management system disappears. This is the area where Expert systems are really starting to get a hold, for the vast majority of design techniques can be implemented as sets of rules. The role of the Database Administrator will therefore lessen in this area of design.

5.2 Control

After the database system is in full operation, the Database Administrator initiates control techniques to assure the consistent and effective performance of the system.

Through testing and acceptance procedures, the Database Administrator is satisfied that the design of the database is fulfilling the immediate requirements of the system, and that it is evolving properly to conform to the future requirements of the system. By monitoring the inputs and outputs of data through edit and validation rules, data checking, and access controls, the Database Administrator identifies any inconsistencies in data integrity.

The Database Administrator also reviews all existing application systems for their consistency with the data definition and usage standards, so the systems can be effectively converted to the database environment without major revisions. The Database Administrator makes sure that the development of new application systems effectively meet the users' requirements as well. The Database Administrator monitors the use of the database through access statistics and request/response statistics to assure the maximum efficiency of the system.

In this area, once again Database management System suppliers are working to automate the tuning process, through the use of Expert system technology.

5.3 Evolution

The Database Administrator determines the specifications and design of the extensions, services, and utilities for the database environment. The Database Administrator also documents the evolution of the environment via the data dictionary. The Database Administrator maintains the system development life cycle and the procedures for security, privacy, integrity, and recovery. This helps to assure that the system remains effective in meeting both the current and future needs of the users.

This role is still needed . It is very difficult to envisaged there being no human involvement in the sort of tasks descibed.

6. SECURITY ADMINISTRATION

The issues of privacy, security and integrity within the database environment are important in database design, performance and maintenance. Privacy, security and integrity are all closely related concepts, but, in fact, the differences among the three are substantial. The specific definition of each of the concepts are as follows:

Privacy	the right of individuals or institutions to control the collection and dissemination of personal information
Security	the protection of the computer resources from accidental or intentional destruction, modification, or disclosure
Integrity	the correctness, accuracy, and timeliness of data within a certain level of appropriateness

The Data Administrator and the Database Administrator are responsible for the privacy, security, and integrity within the database environment including all data and processing. Security of the database includes the protection of data from deliverate or inadvertent disclosure, modification or destruction. System integrity is the consistency, completeness, adherence to specifications, freedom from intrusion, and predictability of a system.

6.1 Computer Security Issues

One might ask at this point, "Why do we need security?" The answer is not a simple one. One of the primary reasons is the growing realisation that data is an asset of a company. Because computer professionals have done such a good job of establishing computer resources in the business environment, many businesses today would not survive beyond a week to ten days if they could not process their data. For example, imagine how long a bank or department store would stay in business without its computerised data of the ability to process it.

Many years ago when data processing was a purely 'batch' process, security and control were implemented through external, physical measures. The exposure was low because much of a company's vital information was not stored on the computer. As data processing has matured, almost all of a company's data has moved to the computer. Storage of all records on computers means that highly sensitive information about company planning strategies or personnel is now stored electronically rather than in someone's locked filing cabinet.

As we make advances in computing technology, the exposures associated with potential loss of integrity in our computing environment also increases. The development of large shared databases, increased ability to access this data online, and the proliferation of remote terminals is no longer restricted to computing professionals. For instance, consider the growth of Automated Teller Machines, Point of Sale Terminals, grocery checkout scanners and the increased use of electronic transfer of funds, all of which have directly affected the general public.

Of course, this increased impact of computers on the general public has also enhanced public awareness of security issues. The public is rapidly becoming aware that the data is now owned by the bank or the credit service bureau, but that the data is really theirs. So the need for accuracy and integrity of data is coming closer to home for the general public. Anyone who has ever had a personal loan request refused because of information supplied by one of the many credit agencies has certainly felt the impact of the need for data accuracy.

Another item of increased public awareness is the publication from time to time of incidents of the use of computers to perpetrate fraud or embezzle money. While only the largest cases receive widespread notoriety, each insurance funding scandal or misappropriation of funds through the misuse of computers plans yet another seed of doubt in the mind of the public.

The last and perhaps most important incentive for the establishment of computing security is the increased interest by legislative bodies in accounting controls and individual privacy. Legislation is now in force in the following countries:

- USA
- France
- West Germany
- Sweden
- Canada
- UK

6.2 What to Secure?

What we have to ask ourselves is what should we be protecting:-

- Is it the data itself?
- Is it access to the data?
- Is it access to the physical storage devices on which the data is stored?
- Or is it some combination of the above?

To answer this question we must look at the objectives of Security Administration which are as follows:-

- To implement the Security Policy of your organisation, using the security facilities that are available on the market place that are the most cost effective.
- To maintain the security details appertaining to your organisation.

Therefore Security in my view, should be based on data and data content, and not on storage device and terminal access. What sort of facilities have you available in your 4th Generation Environment? Well beside OEM access control packages, such as RACF and ACF II, certain 4GE products have facilities in built in them to protect the data of your organisation and access to it. This is normally implemented by the use of facilities in the underlying dictionary and/or database management system.

7. END USER INVOLVEMENT AND SUPPORT

The watchword of the Eighties and the Nineties is user involvement. The end user will be involved in every aspect of data processing, including design, development and testing. Singer [9] states that the demand for this involvement has come from factors which operated in the late Sixties and the Seventies :-

- A strong feeling that data processing technology was so complicated that accountants, managers, etc. could not possibly understand it. As a result, organisations consistently found that computer systems did not meet the basic needs of the users.
- The rising cost of complicated systems was another factor. the time taken to develop systems is longer, and in addition requires more people to work on it. The hardware cost per CPU cycle may have dropped, but the cost in development time has risen dramatically.
- The consideration of purchased software packages as being a valid alternative to in-house development, is a third factor. the selection of a good package requires experts not only from data processing but also from the end user groups.
- The growing awareness of end users that the data they need to perform their jobs

can be obtained from the computer.

If the trend towards direct user involvement is to be successful, data processing managers should take the lead in developing a planned, realistic approach to working with end users, Too often a combined team of data processing personnel and end users will sit round a table with all the co-operation of two nine-year-old boys fighting overe a cricket bat! In the Eighties and Nineties, such unbusinesslike behaviour cannot be tolereated. The stakes of economical survival and profitability are now too high to allow individuals or groups to play ego games inside an organisation.. data processing managers are in a perfect position to break the cycle of disagreement and mistrust which seems to developed whenever their staff and the end users get together. Several very simple steps have been suggested by Singer [9] to help insure that such a team approach can be achieved :-

- Nontechnical users must be educate in basic data processing concepts, such as disk versus tape operations, database as opposed to conventional files, and in-house development versus purchased packages. The nature of the educational process will depend on the situation and circumstances of the organisation and the specific project.

- Verify that all data processing staff involved an a design project with users have a basic understanding of the application in question. Just as many data processing managers are surprised by the lack of basic computer knowledge of users, user management are equally surprised at the lack of communication caused by data processing staff who have absolutely no idea what users are talking about.

- Once bothe data processing and users have been cross-trsained to some degree, data processing managers can then take the lead by planning the entire task around a formalised project management approach. The degree of formalisation will depend on the length. the complexity, and the importance of the task or project in question.

Besides user involvement in the development of thier own systems, there is another significant trend in recent years, namely the Information Centre. The function of an Information Centre is to encourage, train, and support end users to develop applications themselves. With help, end users can generate a wide variety of applications including data query, data input and editing, report generation, decision-support systems, and many classes of application programs. The traditional data processing systems life cycle is thus bypassed, which gives users results much fater, but at a cost ot their own time. In theory, developers are then free to concentrate on systems without having to shift priorities to accomodate an end-user's ad hoc requests.

Information Centres utilise a wide variety of languages and tools. usally these facilities include general purpose tools such as query languages, report generators, grphic generators, decision support systems, and application generators. Additional specialisied tools may also be used for financial planning, statistical analysis, project management, text processing, desk-top publishing, and coputer-aided design. It is important to note in regard to this area that although the software tools get most of the spotlight, they still need to operate upon data. The data has to be stored and managed somehow, usually by a database management system. The choice of database management system will actually set limits upon what end users can and cannot do with those friendly software tools. Two distinct schools of thought on this subject have eveloved, namely the "truth database approach" and the "dual database approach".The dual database approach manadates that redundancy between opersational systems and decsision support systems is a valid approach. Examples of database management systems that support this are IBM's DB2 and IMS, FOCUS,and ICL's IDMS with INGRES. The truth database approach dictates that there will be one and only one copy of the database for all users. Examples of database management systems that support this approach are Applied Data Research's DATACOM/DB, Cincom's TIS/XA and Cullinet's IDMS/R.

The Information Centre has not only had to tackle this software probl;em of which approach to adopt, but also has fallen into the mistake of "empire building" in a number of instances. The Information Centre should provide assistance to the end users to develop their own solutions and not to do the work itself. The one main exception to this rule would be in the case of board level management. Here the best way that I have heard of was describe by David Owen of ICL Asia Pacific Pty Limited at MNCC'85 [10]. Each Senior Executive had a computer expert as an assistant. This person provided the technical knowledge and wisdom to be able to extract the required information using the best possible software tool in the quichest possible manner. In the paper he described how these consultants were used to help the executives put together the organisation's yearly plan, whereas it used to take some 3 monthes to do this , it was now possible to do this in 3 weeks.Here we have a fine example of effective use of data processing people with good knowledge of a business area, providing effective and efficient service to the end users.

Perhaps the greatest danger of Information Centre operation, or of the spread of small computers and user-friendly software, is that multiple, uncoordinated data structures will be used. The answer to this is well-controlled data administration.

8. CONCLUSIONS

If we are to effectively use Fourth Generation tools, we must be prepared to evolve our organisational structures. The role of data processing is changing rapidly and the needs of our end users are changing even more and even faster. With the realisation amonst senior user management, that to survive in business in the Eighties and the Nineties, they will need to be able to tap the Information Resource more effectively and to control it, we in data processing have to be able to respond quickly and effectively. This is not possible with :-

- the use of Third Generation Languages
- the use of Third Generation methodologies, such as SSADM and Infromation Engineering in their current form
- the rigidity of the current data processing organisation, as shown in figure 4
- the demaraction line and in-fighting between end users and data processing

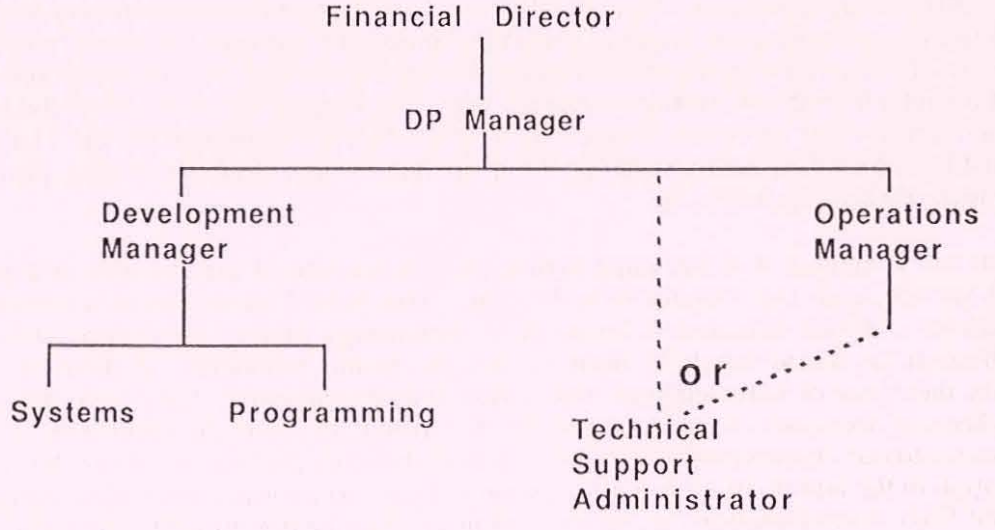

Figure 4 : Traditional Data Processing Department Strucutre

How can we tackle this? What is it we must do?

Fourth Generation Languages in themselves are not the answer. A new langauage will only help in the coding and teating phases of an application's life cycle. We need to be able to assist the analysis and design phases much more to produce the goods for our end users. The adoption of prototyping techniques, has certainly, where done in a controlled way, proved to be of assistance in the design phase. The CCTA have already started to adapt SSADM to use prototyping and to work more effectively with certain Fourth Generation Tools [11]. LBMS and CACI have also started to adapt their methodologies to use prototyping.

The currently avaiable methodologies are very paper oriented. David Gradwell [4] has spoken of them not only building paper mountains but of building paper mountain ranges!

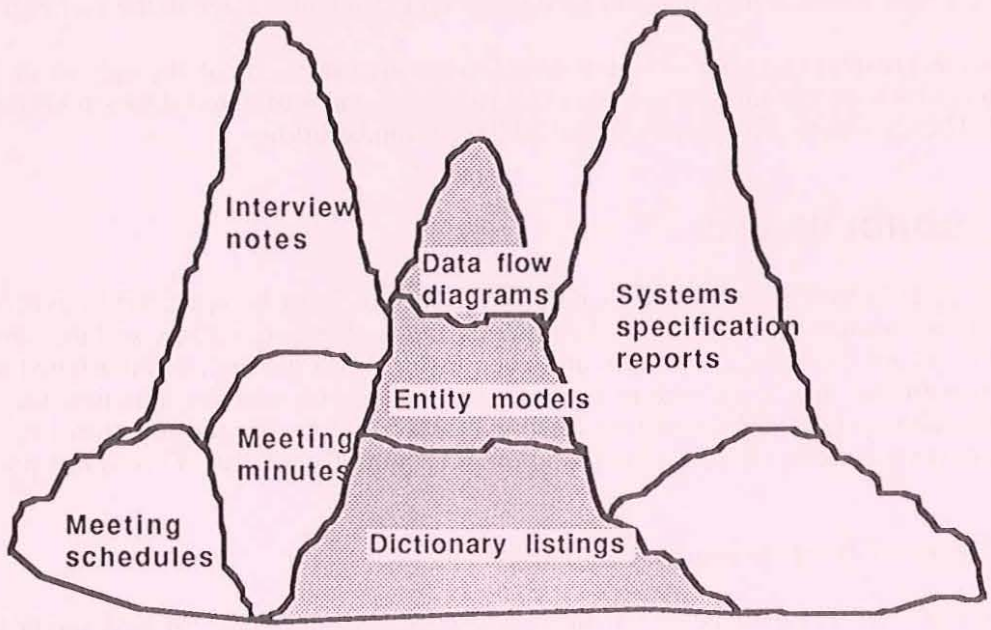

Figure 5 : Paper Mountain Ranges

It is here that CASE tools will assist with the automation of documentation and graphics. They will also provide the means of tackling the "analyst overload". We must be prepared to adopt a methodology that suits our organisation, as well as being able to work with our current software and hardware. To take advantage of Fourth Generation technology the methodology we choose must support not only prototyping but also structured analaysis and design. The methodology must be flexible, so that new techniques can replace old ones without a complete redo of the methodology. This is only possible if the methodology is based on a framework approach, as advocated by the British Computer Society Database Specialist Group's Information Systems Analysis and Design (ISAD) working party in their Journal of Development [12].

The structure of data processing must evolve to take account of the changes in demand upon its service, and the changes in technology. Too often I have seen as a consultant organisations , whose structure is based upon technology of the late Sixties, with the power base in the wrong hands.In addition data processing managers are themselves to blame for their lack of knowledge of new software and techniques. They have not spent time on keeping abreast of our changing world. We must understand the importance of data as a resource to our organisations, and give power within data processing , if not within the organisation to the adminiatration of this resource. I have in a forthcoming book looked at ways that Data Administration can be evolved in an organisation to get to the right level [13]. But it is not just data administration that is important. Development of systems has changed dramatically, thanks in the main to Fourth Generation technology and to adoption

of methodologies. The use of teams of coders, designers, analysts and end users has proved effective when all the right planning has been done up front.

What sort of organisation should we being aiming for then? In figure 6, I show what I believe should be our goal.

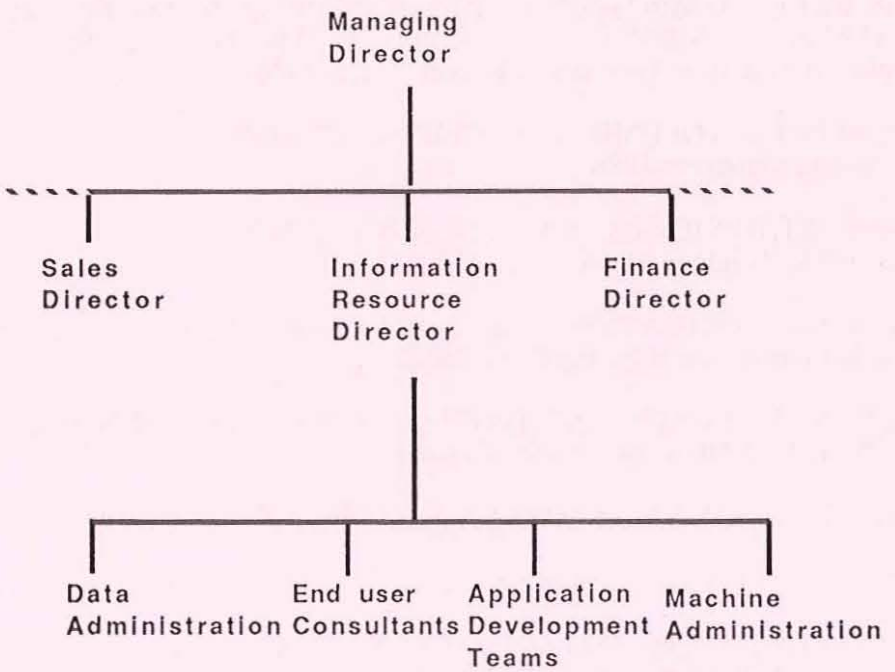

Figure 6 : Data Processing - The Future structure ?

The probable outcome of the latest Fifth Generation work will be to strengthen communications between users and developers. This communication will not be confined as at present to the specification document, but will use computer graphics facilities, as seen in current CASE tools and prototyping techniques. If the prototype is to be easily converted to the final system then Fourth generation tools technology I an sure will be used as a basis for the software needed.

The use of Fourth Generation systems and CASE tools will remove the current bottleneck of systems development, but only if data processing itself recognises that it must reorganise itself. In addition we must realise that software tools on their own will not help . Neither will methodologies on their own solve the problem. It is the combination of the ttols and the techniques with the right organisation.

The potential for new methods and machines and software within an intelligent workbench, falls under the heading of "knowledge transfer". This includes not only the initial capture of knowledge during analysis, but also all mapping activities, such as physical databas edesign. In each case , the rules governing the activity will be defined and used in a rule-based expert system , to support and automate a given function in the application life cycle. These principles of knowledge engineering and artificial intelligence, combined with the use of models of the business and prototyping will allow the users of computer systems to become more colpletely involved in their creation. Computer systems will become an extension of the business, with the creation of new systems and maintenence of existing systems being triggered solely by changes in the business environment.

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Organisational Implications caused by the Fourth Generation environment

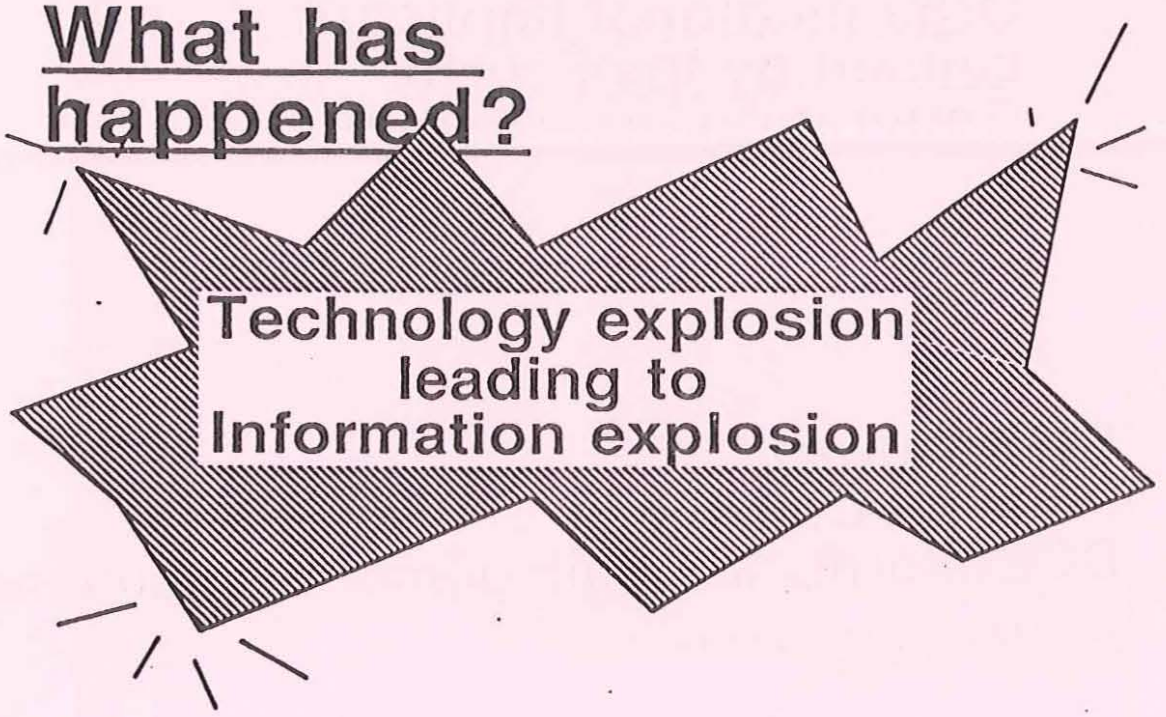
S R Holloway
Principle Consultant
DCE Information Management Consultancy

43/45 St John Street, London, EC1M 4AN
Telephone: 01 4901242

Organisational Implications

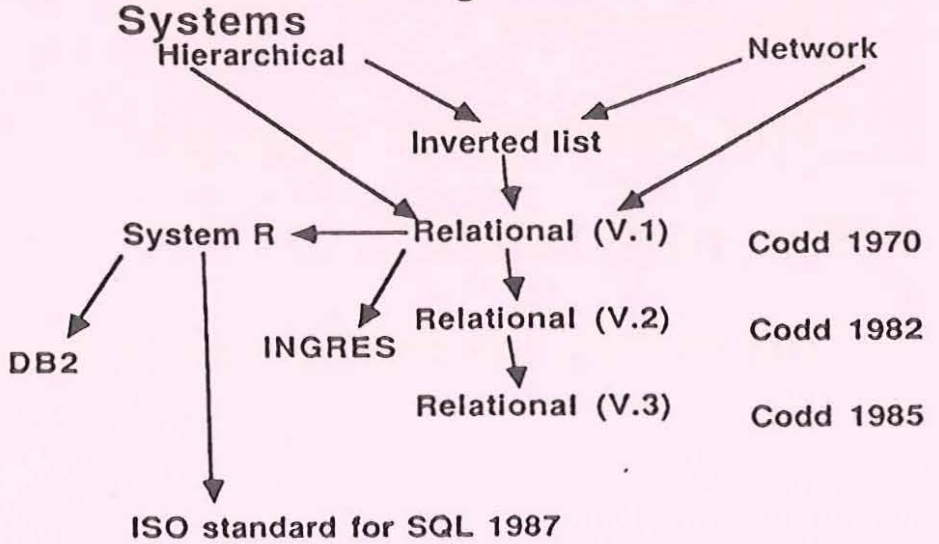
- The present
- "The causes for change"
- The new roles
- The effect on the organisation

What has happened?



Technology explosion

- Database Management Systems

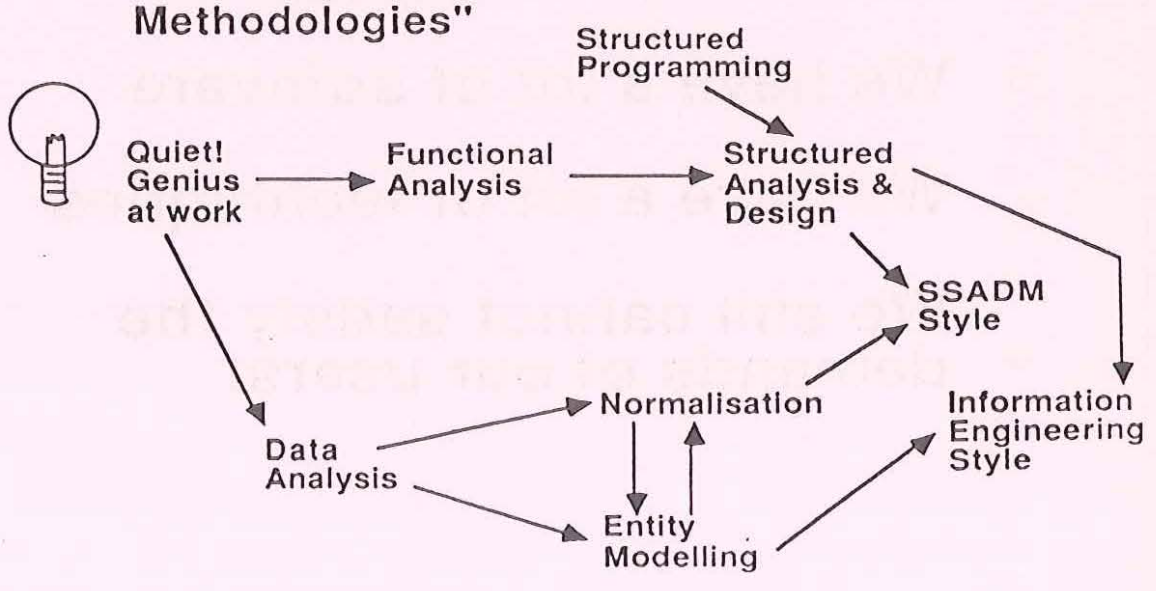


Technology explosion

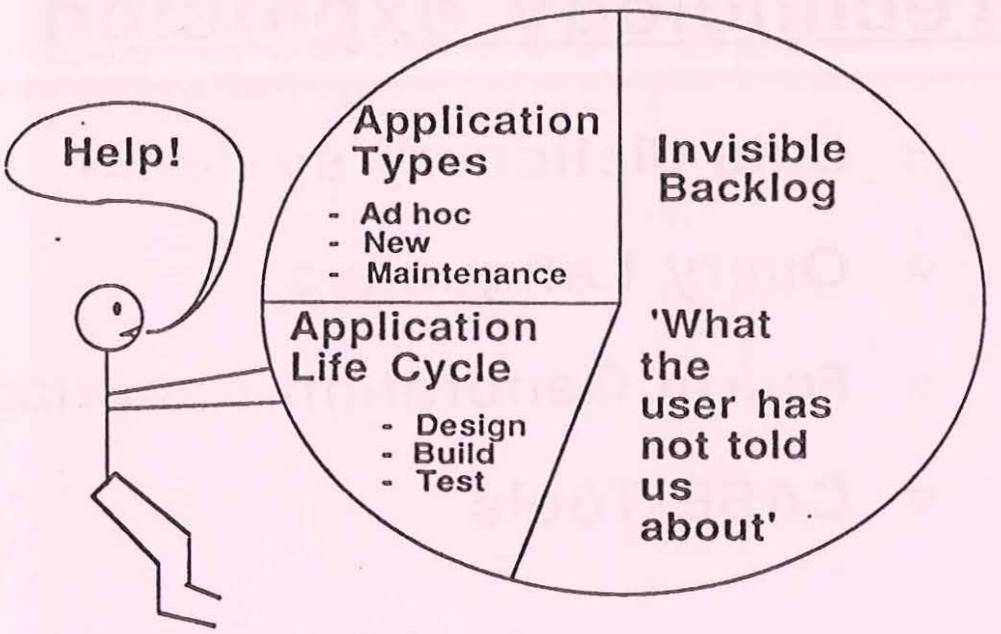
- Data dictionary systems
- Query Languages
- Fourth Generation Languages
- CASE Tools

Application life cycle

"The Evolution of Methodologies"



The application backlog



10/7

The present day

- We have a lot of software
- We have a lot of techniques
- We still cannot satisfy the demands of our users!

10/8

Information Explosion

Information - An organisation's Lifeblood

- 'Information is a prime asset of an organisation, second only to Human resource'

  Franz Edelman VP RCA

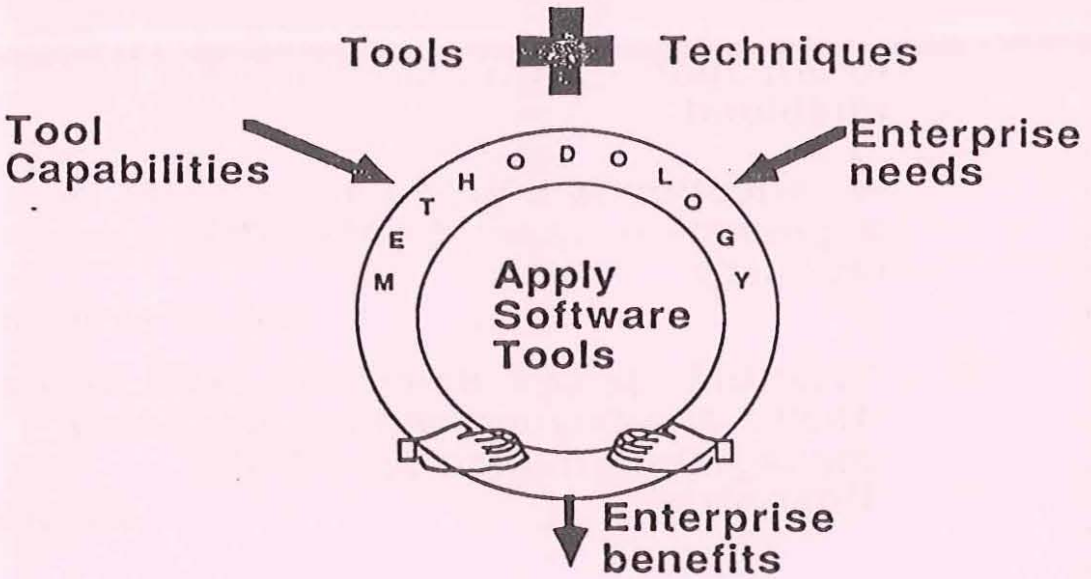
- 'The Enterprises which will excel in the 1980's and beyond will be those that manage Information as a Major Resource'

  John Diebold

What is Information ?

'Data in Context'

Holloway's solution to the Application Backlog (1986)



The Causes of the Changes

Cause 1: Relational debate is over

Cause 2: Distribution is coming

Cause 3: Expert systems will destroy the last vestiges of the black art

Cause 4: CASE tools are here

The Causes of the Changes

Cause 5: End users can understand data analysis

Cause 6: End users can program in 4GLs and Query Languages

Cause 7: Code generation is coming

Cause 8: Information is the second most important resource in an organisation

Cause 9: End users want control of their own information destiny and needs

Who is effected?

- End Users
- Data Processing
  - Development
  - Data Management
  - System Programmers

Holloway's solution to the Application Backlog (1987)

Tool

Techniques

Right Organisational Structure

The new roles

"The Deathknell of DP as we have known it"

- Data resource control
- Implementors
- Information consultants
- Tuners
- Security Control

The New Roles

- Data Resource Control

Who? - The IT Professional involved in providing the corporate service which controls and/or coordinates the definitions and usage of reliable and relevant data

Requirements -

Business Area Knowledge
Communication Skills
Methodology Knowledge
Data Administration Knowledge

The New Roles

Data Resource Control

- Data resource policy making
- Corporate information requirements analysis
- Corporate awareness of existence and value of data
- Data analysis centre of expertise
- Data definition control
- Data dictionary control
- Data access control
- Policies for security, privacy and integrity of data

The new roles

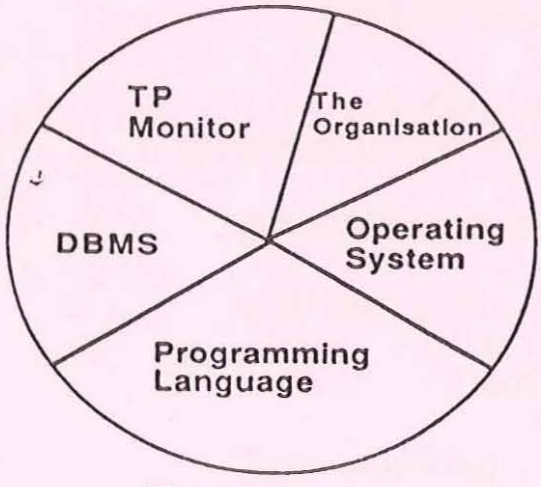
Implementor

Who? - The IT professional involved in helping users to get operational and to get management systems implemented

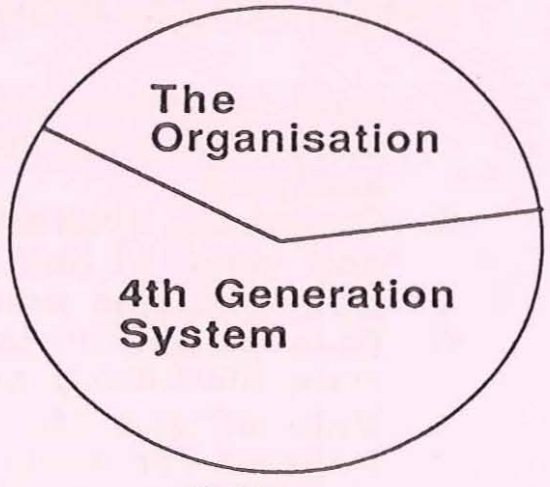
Requirements -

- Business area knowledge
- CASE tool/4th Generation system knowledge
- Methodology knowledge
- Communication Skills

Fourth Generation Software Impact on Programmers

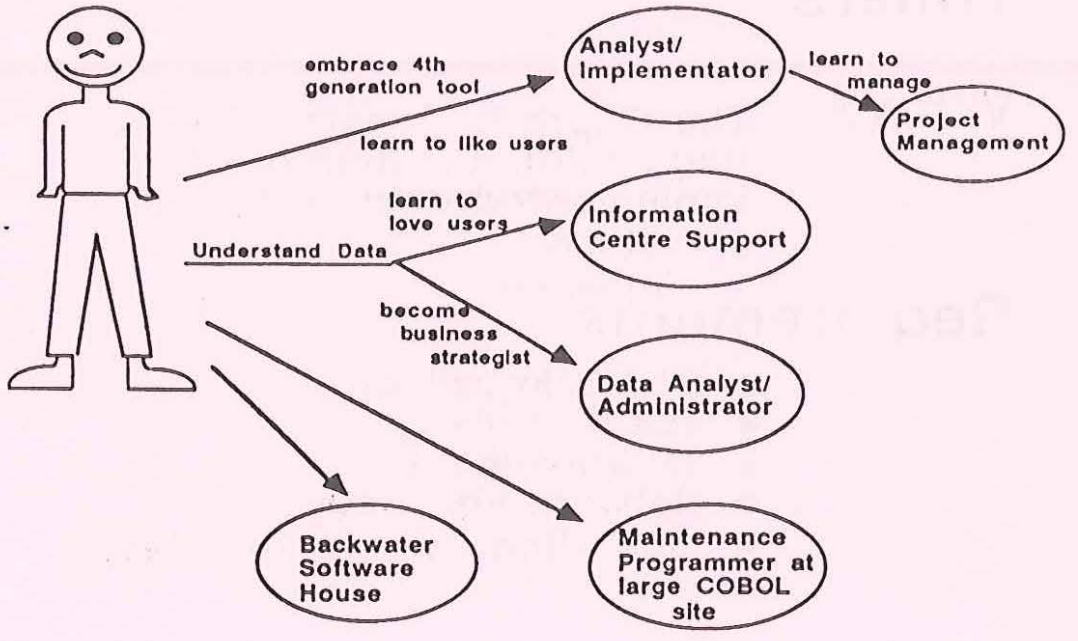


Before



After

Career paths for Programmers



The new roles

Information Consultants:

Who? - The IT professionals involved in helping the user management get decision support systems implemented and in helping formulate information strategies for given business areas

Requirements -

- Business area knowledge
- Query language knowledge
- Methodology knowledge
- CASE tool knowledge
- Communication Skills
- Decision Support Tool knowledge

The new roles

Tuners

Who? - The IT professionals who are responsible for tuning the implemented data and process structures

Requirements -

- DBMS knowledge
- 4GL knowledge
- TP knowledge
- Network knowledge
- Operating system knowledge

The New Roles

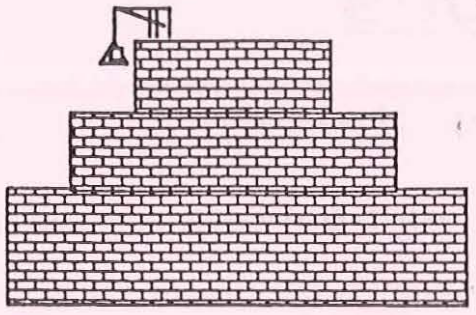
Security Control

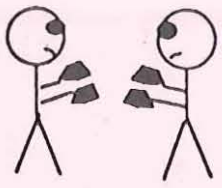
Who? The IT professionals who are responsible for the implementation and maintenance of the organisation's security policy in respect of data and access to data, using software packages

Requirements -

- DBMS knowledge
- 4GL knowledge
- TP knowledge
- Security package knowledge

End Users versus DP

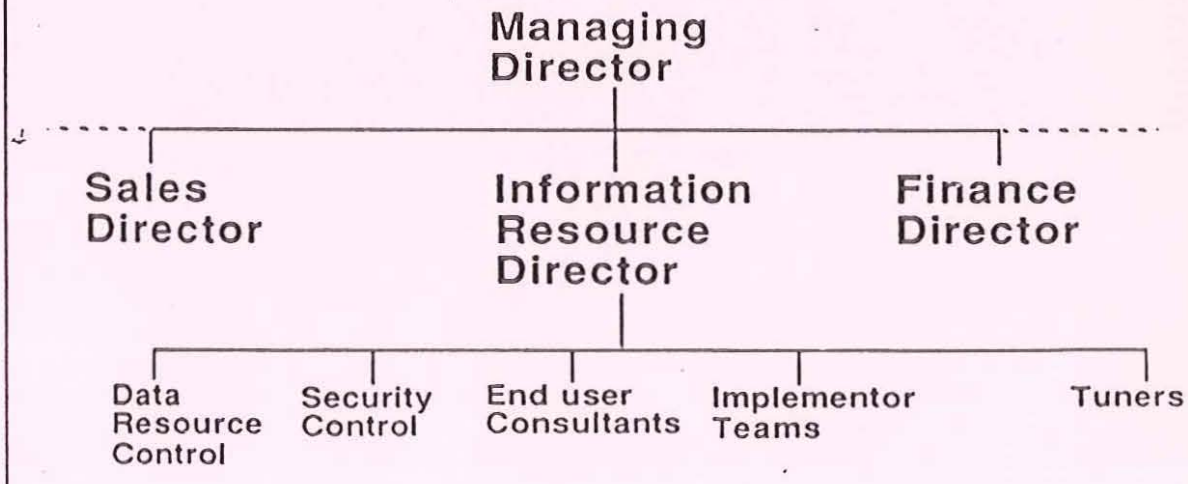




'If this is what they can do as a beginning, then nothing that they resolve to do will be impossible for them. Come, let us go down and there make such a bable of their language that they will not understand one another's speech'

Genesis 11:6,7

Organisation Structure for the Nineties?



Conclusions

To succeed in the 90s:

- Manage data as a corporate resource
- Have right mix of software tools
- Have a flexible methodology
- Automate application life cycle
- Evolve organisation structure