DATABASES: CIVILISATION'S GREATEST RESOURCE OR RESOURCE USER?

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Abstract

This paper traces the changing status of knowledge-based databases from being a luxury good of the educated (usually the rich upper class) to the most marketed commodity in what is rapidly approaching the ideals of the perfect market. Commencing at the inception of knowledge-based databases this paper traces development from the time of the Pharaohs to the modern economic establishments, including all levels of government and corporate enterprises.

From this summary of historical development it is concluded that information storage and retrieval is the single largest user of natural and human resources (Land, Labour and Capital), but, also, is the greatest of our human resources (Investment). However, with the passing of pyramids, temples, paper and other historic recording media, innovative and dynamic digital approaches to data storage, retrieval and use are emerging with direct and immediate implications.

1   The Inception

Databases are information recording systems whose purpose is the storage and retrieval of facts that assist management, research or administration. History does not record who invented recorded databases, as the historical invention database did not exist at the time. History does record, however, that databases were existing during the time of the Egyptian Pharaohs who recorded their gifts to the gods in the Pyramids. The Roman Empire also had an extensive database system covering a range of administrative activities including provincial and diocesan taxation collection, contributions to the gods and managing the "Games". However, access to these data was restricted to the educated few, with such monopolistic strategies carrying forward to the 19th century where databases were recorded in Latin rather than the native tongue (e.g. medicine, religion, law and science).

Modern-world databases assume majestic proportions including monumental bureaucratic and research libraries housed in skyscrapers. Being the basis of most human endeavour, databases are possibly the single most resource consuming activity on earth. Alternatively, databases are probably the single most important keystone to civilisation as it has been known over the past 10 millennia. Within the modern context databases can be so restricted in access as to be monopolistic (e.g. government and corporate) while other databases are marketed in almost perfect market conditions (e.g the Internet).

From these simple illustrations we have a mental picture of databases being part of the greatest and most ambitious structures of mankind. In the modern world, database resource use (natural and human) varies greatly - to illustrate:

> *Recording format* ranges from the written to electronic media;
> *Electronic size:* pocket organisers to monoliths;
> *Visual appearance*: libraries of infinite variable size to the undefinable and unseen formats such as the World Wide Web (www).

The economic and ecological costs of creation, format conversion, maintenance and storage of data has never before reached such magnitudes as we are witnessing today. The remainder of this paper summarises and highlights changes in database technology and application to today's workplace. It focuses on what is called "*the information explosion*".

This conference is part of that process - it will add to the more than a third of a million websites dealing

with effluent disposal that assimilate and synthesis data in varying levels of efficiency, meaningfulness, cost effectiveness, and environmental sustainability.

2   Data Retention and Management Systems

Pre-digital recording of data used stone, wood, leather and fabrics - the most recent media being paper, card and similar products. Egyptians used pyramids and temples to remind the gods of gifts made; apparently the early Egyptian gods, while being all powerful, had poor memories and no databases! Similarly, Roman temples used Greek and Egyptian recording methods and were master systems for world wide administration including tax collection, military strategy and accounts referencing.

One major social outcome of these databases was the advent of "paper-money". Traders in precious metals, gems and spices found the dividing of such material objects increasingly difficult as volume of trading increased. According to Shakespeare's *Merchant of Venice* he would even trade in hearts! Fortunately most financial transactions of the time were reduced to paper accounting, particularly by metal smiths who became the first banking institutions. They achieved good profits by reviewing the accounts and seeing which traders operated at what times - and while the account was idle would make some generous loans. Little has changed in the world of usury over the centuries.

More recently, industry experts suggest that Australia is not only competitive in this area of software development but is the world leader. Supporting this statement is the entry of Australian software companies such as TRIM, Software, CompuTechnics, Educom and GMB Research & Development, who are successfully competing in United States markets. Most of these companies have or are applying for select certification by the US Department of Defence under the record management (RM) standard DoD 5015.2. In each instance, firms developed easy-to-use programs which allow organisations to keep track of their physical documents. In recent years, they applied the same sound principles of numbering, classification and subject heading to the growing volume of electronic documents, and the market is growing.

Industry development has concentrated on management - mainly the converting of historical paper documents to digital format. In many instances, this has been a graphical process classified by pre-determined keywords. With the development of high speed scanners, much of this printed material is now being converted to digital format capable of being interrogated by text retrieval systems. These records are assuming a new dimension in many areas of the world's databases, including retailing, medical diagnosis, e-commerce and scientific research. More recently the 'email' has become a major communications format. Many firms are now storing and analysing email data for a variety of purposes, including litigation, staff profiling and knowledge banks. These analytical formats are also being extended to the interrogation of websites' content. As the form and size of databases increases, so does the need to develop interrogation and analytical tools to consolidate and summarise data into supplementary databases. It's a self-perpetuating process.

3   Knowledge Management and Data Generation Systems

Every day the world produces, tailors, reviews, approves, and distributes millions of documents in a myriad of ways including e-mails, word-processing document, spreadsheet, relational database record, an image, or a web page. Documents contain valuable information about a process, a competitor, or a customer. However, this information is a cost burden unless it has three main characteristics:

- Purposeful - implements precise objectives that are integrated with associated activities;
- Practical - efficient and sustainable operations that are subject to quality control and best environmental practices; and
- Performance orientated - achieves immediate objectives and provides basis of future analytical actions.

Basically, Knowledge Management technology is about using documents in as many different ways as possible, thereby assisting the long term future of the enterprise. While Knowledge Databases are simplistic in concept, they are difficult to implement in practice with data quality, integrity and quantity

control as essential ingredients. If input information is invalid and uncontrolled, the reporting and intelligence tools will offer little or no benefit. For Knowledge Management to be effective there must be a complete integration of and fusion between Document Management and Knowledge Management - a fundamental for the success of future enterprises.

Some argue that there is confusion between Document and Knowledge Management systems and there is no clear demarcation; such concepts are irrelevant as the two should be so intertwined that they are one integrated superior system, which, in itself creates 'self-generating databases' that are assuming a number of formats including:

- linked relational databases (e.g. Quattro Pro, Access, Paradox, Excel). Within this structure information from two or more databases create a combination of data to meet certain objectives;
- interrogation of email, networks, office applications and the Internet. These document formats are forcing enterprises to tap into the strategic value contained within the document structure (whether hardcopy or digital);
- text-transformation altering written material to numerical or dichotomous format enabling statistical manipulation, trend projections or modelling;
- conversion of textural information to either relational database formats or a predetermined textural context such as contract preparation, report writing or litigation purposes; and
- Staff Knowledge - experience and work practices transferred to workflow engines.

Reflection on these intertwined developments again illustrates the need to conform with the three principles outlined earlier. In considering databases, attention must be made to the sustainablity of the environment - this includes the cultural or human element. Not uncommonly, firms considered they were held to ransom by employees and employees considered the enterprise was exploiting them - perhaps both were correct. Staff Knowledge databases are assisting in the human relation aspects of enterprise databases.

4   Purpose

The range and functions of database applications have the ability to change organisational operations due to innovation in collecting, distributing and amalgamating information. This involves two main workflow engines:

- input systems associated with the collection, synthesis and storage of data; and
- workflow processing of information.

Data and knowledge management advances will be supplemented by customer management systems that will automatically notify staff of all relevant information. Customer Management systems will be of particular importance to both corporations and government to transfer information (knowledge) to the appropriate staff and connect them to the relevant parties. Consideration of these important attributes often determines the location of the database. Database locations are usually within one or more of the following locations:

- ✓ personal computer - stand-alone systems which may be supplemented by outside sources;
- ✓ small office network where data is shared;
- ✓ intranet systems which tend to be more interactive between users; and
- ✓ internet

With the expansion of internet facilities, it has been estimated that large databases cost about one tenth the price when internet connected compared to 'in-house' mainframe network or intranet systems. These advantages are increased where a number of autonomous organisations (e.g. government departments) are supplying and sharing information. These cost advantages are achieved from:

✓   minimised computer maintenance - this is undertaken by one provider rather than each site where the system is employed;

✓   consistency of data format across sites, although individual sites might not complete all information within the database structure, what is entered is in a format as to permit, albeit limited, comparative analysis;

✓   minimised training time for staff as systems knowledge is not required;

✓   consistency of program version - there is one central program that is updated for every user simultaneously. This means minimisation of computer capital costs, program purchase pricing and associated maintenance.

Mid-term prediction (five years) suggests that proprietary systems like Microsoft's Windows will become relegated to an era that was highly restrictive and unacceptably unproductive. Stand-alone (insular) personal computers technology will represent the closure of 'the age of information scarcity'. It is the closing chapter to the Pharaohs and Roman temples syndrome.

5   Human Capital Considerations

Facilitation of human skills with technical power is an awesome combination. Staff Knowledge databases facilitate creation of best work-place practices, identify who needs what training and when is the optimum time of implementation and increases mobility of the workforce, particularly within the organisation. Training time of newly appointed senior personal can be reduced by 75%. Staff skills and weaknesses are identifiable as are quality evaluations of output.

It has been suggested that Australia inherited its obsession with databases over 200 years ago from the Royal Navy (RN) that had a high standard for maintaining records of its activities and the ability to impose its will on the colonising army forces. While largely ignored within England, the RN ships responsible for transporting military personnel and convicts to all parts of the globe maintained accurate records of these activities. Colonial Governors, usually with RN backgrounds, adopted these procedures in their administrations. However, in a world of increasing litigation (and wealthy lawyers) we are finding that our record keeping is, in most cases, not keeping pace. Consequently, the cost of litigation is on the increase, with an inability to find the most relevant documents a major contributing factor.

A conclusion drawn from this paper is that electronic document management systems involve many different sub-strategies, all of which are off-shoots from the main database strategy. While *prima face* it is suggesting the maxim that 'knowledge is power', more importantly it is stating that 'knowledge is enterprise economic viability and ecological sustainability'. Database management is the technological fusion between repositories, people and systems within the workplace for the purpose of enhancing human capital investment. This function should have three main components:

✓   collection, synthesis and use of information;
✓   creation of new information from existing databases; and
✓   re-cycling of human capital (skills and knowledge).

Database changes are bringing about a number of changes, the environmental impacts of which have not been fully investigated. Where once a library supplied books and journals, we are now confronted with the more efficient digital formats that can be copied, moved and pasted at will. But are we losing by not having the hardcopy?

In a similar vain, e-mail and e-conferencing are replacing older people skills of telephones and conferencing. Both the older methods are more expensive but may make a latent contribution to human capital investment. In striving for economic efficiency, will knowledge databases really take the place of the apprentice/master relationship? Will there not be a need for human mentors rather than electronic KM Engine? Here, the human resources department of an organisation becomes an incredibly powerful ally, provided it develops an enterprise-wide policy for human interaction as a major factor of the technological developments. This in turn is dependent upon HR's ability to effectively and quickly understand the concepts and problems facing modern database-dependant enterprises.

6   Application to On-site Management

It is conclusive ... Databases have been and still are an important and integral part of human society.

Vast natural and human resources have been allocated to the creation and maintenance of databases as well as to the construction of the buildings and technology that accommodate them. There is strong evidence to suggest that databases have been the greatest continuous single user of natural and human resources for the current century.

This trend continues into the modern millennium, not with stone, leather and paper, but electricity, silicon and plastic. The main difference in today's world is the greater proportion of human resources required to maintain the ever increasing need for databases. The evidence before us suggests that databases are civilisation's greatest resource and its greatest resource user. The implications for this conference are profound. In accommodating the changes to legislation and recording and reporting such matters as:

- ✓   extent of on-site septic tanks and aerated systems failure
- ✓   highlighting of inadequate on-site management
- ✓   pro-active approach for system design and operation improvements.

Councils have the following choices:

- ✓   creating another simple relational type database, which stands alone and is isolated from the remaining knowledge-base;
- ✓   expand the present council system with increasing dependance on knowledge-based restrictions, but with greater access to the knowledge-base;
- ✓   formulate a global policy that embraces an internet philosophy providing uniformity of data recording across all councils participating in the scheme (greatest use of the knowledge-base within and outside of the council's own computer structure), minimises the dependance on knowledge-base criteria and minimises the need for technical upgrading.

The latter option is not complex. Using current technology, Internet databases are designed to accommodate the age of information abundance which will be characterised by:

- ✓   Front Office - data collection, formatting, synthesis and processing
- ✓   Back Office systems - computer hardware and software systems; and
- ✓   The middle office - "the roles and functions of knowledge workers who today are positioned between and in the corporate information landscape".

Systems experts suggest that front and back office functions have reached a stage of relative equilibrium and parity across most enterprises, but middle office managers operate in a dynamic and unpredictable world. Human capital is still an important ingredient in middle office operations as success (personal and corporate) is dependant on the coordination of a myriad of information needs, personal connections, and process interactions. Their ability to effectively and quickly navigate through the maze is determined by tacit knowledge that is not easily externalised.

That is, 'middle office' technology is the point where major decisions affecting the enterprises sustainablity are realised, including:

- ✓   competitive and product differentiation is realised (e.g. where products are designed and services determined)
- ✓   customers support is undertaken and maintained;
- ✓   risk analysis undertaken and policy determined;
- ✓   quality control policies developed and implemented;

✓   business plans created and reviewed determining profit/service motives.

This is an area where resource allocation efficiency is most sensitive and critical to the enterprise's longevity.

A search of the web has shown that there are nearly 100,000 sites dealing with sewage, effluent, septic tanks, etc. The operations of councils in complying with NSW's new legislation is to add to that knowledge. How great an advance would it be that all councils used the same internet database with commonality of format and composition that would allow:

▸   internal administration and management confidentiality;
▸   shire, regional and state sensitivity analysis;
▸   inter-regional comparative analysis;
▸   identification of 'hot-spots' with water-catchment areas;
▸   inter-study qualified analysis for remedial works;
.... and so on.

All this and an estimated 90% cost saving.

Delegates, databases are the largest consumer of economic, social and environmental resources, with good planning and foresight these factors can be repaid in full.