Database Resources

Subject: Information Technology for Managers

Level: Formation 2

Author: Seamus Rispin, current examiner
This report examines the different type of databases that are available in the marketplace today and in doing so looks at future database trends. From a management perspective, this is a case study where a company examines some key elements that are required in choosing an appropriate database management system. For the purpose of this report the company name has being removed.

TABLE OF CONTENTS

PART 1 - CURRENT AND FUTURE DATABASE TRENDS .........................3
  1.1 DISTRIBUTED DATABASES ...............................................................4
  1.2 OBJECT ORIENTED AND HYBRID MODELS ....................................................4
  1.3 MULTI-DIMENSIONAL DATA ANALYSIS .........................................................6
  1.4 DATA WAREHOUSE .................................................................................6
  1.5 LINKING DATABASES TO THE WEB ..........................................................7

PART 2 - A CASE STUDY ..............................................................................8
  2.1 PROBLEMS IDENTIFIED WITH THE MANUAL PROCESS .........................8
  2.2 NEW BUSINESS PROCESSES .................................................................8
  2.3 BENEFITS ACHIEVED BY THE NEW SYSTEM ...........................................9
  2.4 FACTORS IN DETERMINING THE TYPE OF DATABASE SELECTED ..........10
  2.5 FUNCTIONALITY OF THE NEW SYSTEM ..................................................11
  2.6 LONG TERM APPLICATION ...................................................................12
  2.7 DELIVERY OF THE SYSTEM ....................................................................12
  2.8 TRAINING REQUIREMENTS .....................................................................12
  2.9 LESSONS TO BE LEARNED ......................................................................13

CONCLUSION ............................................................................................14
Part 1 - Current and Future Database Trends

In the late 1960s and early 1970s, there were two mainstream approaches to constructing Database Management System’s (DBMS’s). The first approach was based on the hierarchical data model, typified by IMS (Information Management Systems) from IBM, in response to the enormous information storage requirements generated by the Apollo space program. The second approach was based on the network data model, which attempted to create a database standard and resolve some of the difficulties of the hierarchical model, such as its inability to represent complex relationships DBMSs. However, these two models had some fundamental disadvantages:

- Complex programs had to be written to answer even simple queries
- There was minimal data independence
- There was no widely accepted theoretical foundation.

Many experimental relational DBMS were implemented thereafter, with the first commercial products appearing in the 1970’s and early 1980’s. Relational DBMSs are referred to as second-generation DBMSs. Relational DBMS technology used extensively in the 80’s and 90’s was limited in meeting the more complex entity and data needs of companies, as their operations and applications became increasingly complex. In response to the increasing complexity of database applications, two “new” data models have emerged; the Object-Relational Database Management Systems (ORDBMS) and Object-Oriented Database Management Systems (OODBMS), which subscribes to the relational and object data models respectively. The OODBMS and ORDBMS have been combined to represent the third generation of Database Management Systems.

There is considerable debate between OODBMS and RDBMS proponents as to the adequacies of these applications. The OODBMs proponents claim that RDBMs are satisfactory for standard business applications but lack the capability to support complex applications. The relational supporters claim that relational technology is a necessary part of any real DBMS and that complex applications can be handled by extensions to the relational model.
Recent database trends include the growth of distributed databases and the emergence of object-oriented and hyper-media databases.

1.1 Distributed databases

The growth of distributed processing and networking has been accompanied by a movement towards distributed database. A distributed database is one, which is stored in more than one physical location. Parts of the database are stored physically in one location, and other parts are stored and maintained in other locations. There are two main ways of distributing a database. The central database can be partitioned so that each remote processor has the necessary data to serve its local area. Changes in local files can be justified with the central database on a batch basis, often at night.

Another strategy is to replicate the central database at all remote locations. This strategy also requires updating of the central database off hours.

Both distributed processing and distributed databases have benefits and drawbacks. Distributed systems reduce the vulnerability of a single, massive central site. They permit increases in systems’ power by purchasing smaller less expensive computers.

Finally, they increase service and responsiveness to local users. Distributed systems, however, are dependent on high quality telecommunication lines, which themselves are vulnerable. Moreover, local databases can sometimes depart from central data standards and definitions, and they pose security problems by widely distributing access to sensitive data. The economies of distribution can be lost when remote sites buy more computing power than they need. Despite these drawbacks, distributed processing is growing rapidly.

1.2 Object Oriented and Hybrid Models

These models have emerged in an attempt to store, search and manipulate data about objects, which have complex inner data structures. Object-oriented database management systems (OODBMS) are systems which are designed from scratch, whereas hybrid DBMS are some combination of RDBMS and OODBMS.
Traditional DBMS including RDBMS store just data, without the procedures required to manipulate the data. This provided the long sought-after in-dependence between application programs and their operational data. In contrast, OODBMS store objects. An object contains data about an entity, and also the methods that process those data. An object may be anything to which a concept applies, e.g. a number, a document, a vector, a sound or an image.

Whereas in conventional DBMS, any kind of procedure can access the data (a consequence of data independence), in OODBMS the data can only be accessed through the methods stored with them as part of a class. Objects can be composed of other objects, which in turn can be composed of other objects, and so on. This enables the capture of highly complex data structures.

A major difference between the two approaches is that RDBMS databases are passive, meaning that they contain only data. OODBMS databases, on the other hand, are active, because an attempt to read or update the data would trigger certain actions automatically.

Unlike the relational data model, the object-oriented data model is not based on a formal mathematical model, but is a collection of concepts such as data and behaviour encapsulation, inheritance, reuse and message passing, which have proved to be of great use in developing applications. These and other concepts allow the OODBMS to capture more of the semantics of the real world.

However, although OODBMS have significant strengths, they are not free of limitations, the foremost of which is the lack of a strong underlying theory. Further, for OODBMS there still exists the lack of a standardized easy-to-use query language.

Object oriented and hypermedia databases can store graphics and other types of data in addition to conventional text data to support multimedia applications. Hypermedia databases allow data to be stored in nodes linked together in any pattern established by the user. Web sites use a hypermedia database approach to store information as interconnected pages containing text, sound, video and graphics.
In the future databases will be required to store and retrieve not only structured numbers and characters but also drawings, images, photographs, voice, and full motion video e.g., object oriented multi-media database.

1.3 Multi-dimensional Data Analysis

Multi-dimensional databases are a compact and easy-to-understand way of visualizing and manipulating data elements that have been inter-relationships. Multi-dimensional structures are best visualized as cubes of data, and cubes within cubes of data. Each side of a cube is a dimension.

The cube can be expanded to include other dimensions, for example a company selling four different products, in four different regions, might want to know actual sales by product for each region and might also want to compare them with projected sales. This analysis requires a multi-dimensional view of data. Each aspect of information/product, pricing, cost, region, or time period – represents a different dimension so a product manager could use a multi-dimensional data analysis tool to learn how much of a product was sold in a certain region, in a certain month, how that compares with the previous month and the same month of last year, and how it compares with the sales forecast.

1.4 Data Warehouse

A data warehouse is a database, with tools, that stores current and historical data of potential interest to managers throughout the company. The data originates in many core operational systems and external sources and are copied into the data warehouse databases as often as needed.
The data is standardized and consolidated so that it can be used across the enterprise for management analysis and decision-making. The data is available for anyone to access as needed but cannot be altered. A data warehouse system includes a range of ad hoc and standardized query tools, analytical tools, and graphical reporting facilities. These systems can perform high-level analysis of patterns or trends, but they can also drill into more details when needed. Database warehouses not only offer improved information, but also they make it easy for decision makers to obtain it. They even include the ability to model and remodel the data. These systems also enable decision makers to access data as often as they need without affecting the performance of the underlying operational systems.

1.5 Linking Databases to the Web

It has been estimated that 70 percent of the world’s business information resides on mainstream databases, many of which are older legacy systems. Many of these legacy systems use hierarchical DBMS or even traditional flat files where information is difficult for users to access. A new series of software products has been developed to help users gain access to this mountain of legacy data through the Web.

There are a number of advantages to using the Web to access an organisation’s internal database. Web browser software is extremely easy to use, requiring much less training than even user-friendly database query tools. The web interface requires no changes to the legacy database. Companies leverage their investments in older systems because it cost much less to add a Web interface in front of a legacy system than to redesign and rebuild the system to improve user access.
Part 2 - A Case Study

This case study examines a health care company that recently purchased a Database System. It also considers some of the issues that needed to be considered during the purchase procedure.

2.1 Problems identified with the manual process

- Paper files had to be pulled each time the client came in and sometimes they could not be found.
- There was limited space available for filing resulting in some files being located in different locations.
- There was no standard method adopted in relation to filing which resulted in multiple paper files for a client in a location.
- There was no standard approach adopted in way a file was created.
- Different groups of therapists used slightly different processes.
- Different groups of therapists used different forms across the region.
- Statistics requested on an ad-hoc basis had to be gathered by referring back to paper files. This was time consuming and laborious.
- Users had to manually write reports for other departments

2.2 New Business Processes

The new system operates as follows:

- To search for a client search via the Client Index Database or enter client details.
- Key information from a referral is entered onto the database, namely “date”, “who from” and “reason for referral”.
- The senior user will view all unassigned referrals and assign them to individual users electronically.
- The system automatically creates an appointment and an appointment letter will be printed on the individual user’s printer.
- The user will receive an email automatically, informing them of the new referral and the suggested appointment date.
- The user can change the appointment date and create an alternate letter.
• The user will give the letters to their clerical support to be sent out or send them themselves.

• When the client presents for assessment and/or treatment, the user will:-
  1. See the client and fill out the appropriate forms.
  2. The forms will be printed with the client information, using the computer system, thus saving the therapist time filling the form.
  3. Later the user updates the database with key information from the assessment and/or treatment, namely “date, actions, presenting conditions and free text”.
  4. The user will make a new appointment using the computer and the client will be handed a letter leaving the clinic with the date, time and location for the next appointment. (The majority of fields are drop down boxes).

• Each week a user or manager can view open referrals that have had no activity for a specified period.
• A new referral cannot be created until the existing referral and treatments have been closed off, for any client.
• All statistics can be achieved using an ad-hoc report generator, using combinations of drop down boxes.
• All reports for other health care professionals can be generated automatically by the secretary and they just need to be signed by the user.

2.3 Benefits achieved by the New System

• The new IT system shares information electronically.
  This improves the service to our clients and allows us manage client interactions more effectively. Information can be shared with other departments as appropriate.
• The new IT system is aligned to the business processes and the business processes are thought out.
• The business processes are standardised across the region (4 counties)
• The IT solution supports and prescribes standardised filing and numbering across the region.
• The IT solution is a working tool with statistics as a by-product.
• The system allows the users manage and monitor appointments at client level electronically.
• The therapists can get Ad-hoc reports off the system to get information.
• The system can produce referral reports for other departments as required.
• Statistics from the system influences the service planning process.
• Credibility; the health care professionals have experienced that an information system can make their work easier, thus improving services to clients.
• The users on the project group learned a lot about developing a computer system and reengineering business processes.

2.4 Factors in Determining the Type of Database Selected

The following factors were considered in deciding the most appropriate system:

• The requirement for an integrated computer system that could link to existing computer systems
• Security of data was a huge factor with the need to safeguard client information from being accessed by unauthorised personnel.
• Features such as manageability, availability, scalability and reliability were important factors.
• A demand for higher availability features and more functionality, which could adapt to the complex and changing environment.
• The requirement of a system that was compatible with existing systems and networks.
• A recognised and trusted supplier who understood the environment and our systems
• There was an emphasis on the need for tried and tested technology as opposed to cutting edge technology, which carried a higher risk of failure.
2.5 Functionality of the New System

The new system is client focussed, integrated and shares information across all systems across the subsidiary outlets. This client centred database ensures consistency and standardisation of client data across a wide range of services.

*How it works:*

The object-oriented database is constructed on a modular based system with the client as the central object (See Appendix 1). Object oriented database management systems (OODBMS) integrate client details from a variety of sources. The software allows for sharing of information with other professionals, and interface with over 200,000 existing clients in the region.

This system is also useful for storing data types such as recursive data. Within the health department the system allows for recording of referrals and client interactions, and also the development of reports and statistical information.

This system is characterised by the support of the following features:

- Data persistence – the ability for data to outlive the execution of a program and possibly the lifetime of the program itself.
- Data Sharing or Concurrency - the ability for multiple applications (or instances of the same one) to access common data possibility at the same time.
- Reliability – the assurance that the data in the database is protected from hardware and software failure.
- Scalability – the ability to operate on large amounts of data in simple ways
- Security and Integrity – the protection of the data against unauthorised access, and the assurance that the data conforms to specified correctness and consistency rules.
- Distribution – the ability to physically distribute a logically interrelated collection of shared data over a computer network, preferably making the distribution transparent to the user.
2.6 Long Term Application
In the future this system can be used to manage various multimedia components. Medical data on clients/patients may be stored in this multimedia database.

Health care professionals will be able to access patient files including vital images to generate reports and derive the information they need to deliver quality health care quickly. It was for this reason this system was chosen over the Relational DBMS, which cannot store more complex types of information. This database will be capable of handling the projected amounts of data over an extended period of time.

2.7 Delivery of the system
The delivery of the new system was achieved by the following:-

- Feedback from workshops came up with various enhancements to be made to the system.
- Any changes made and delivered were made in conjunction with training of project groups.
- Each week a new release of the software was delivered with the changes and the project group continued to use the system for a select number of client transactions.
- At the end of a month, the project groups were satisfied that the software delivered met their expectations.

2.8 Training Requirements
Information was gathered from the senior users and IT support staff, to identify training requirements.

This training included:-

- Introduction to computers
- Introduction to Microsoft Word
- Email
Further training incorporating the following aspects was also included:

- A description of this new environment
- How information is shared across sections.
- Making changes to information that is shared with other departments
- Workflow theory and practise
- The new IT system
  - How to find a client
  - How to add a client
  - How to add / update and delete a referral, assessment, treatment
  - Appointments
  - Reporting
  - Statistics

2.9 Lessons Learned

There is a need for a data quality function to monitor data entry and data quality on an ongoing basis. This is to prevent duplication of data on the system. Standardisation of data input is vital to the success of the system e.g. Surname details such as O’Sullivan, O’Brien must be entered with space after O and no apostrophe e.g., O Sullivan.

There is also a need for an unlinked department to monitor processes and procedures and ensure that they are followed. This department should identify training and future enhancements as systems and processes evolve.
Conclusion
One of the major difficulties associated with IT systems in the health care service sector over the years has been the ad hoc approach in which systems were developed and implemented. By allowing different departments and disciplines in the organisation to maintain their own files independently, the traditional file environment created problems such as data redundancy and inconsistency, program-data dependency, inflexibility, poor security and lack of data-sharing and availability. This resulted in inconsistent and inaccurate statistical reports as well as inflexible systems that are unable to respond to the complexities of the environment in which we now operate.

The adoption of an object-based database has allowed for an integrated client centred system. This enables relevant disciplines across the services to access and share relevant data of clients on an integrated and secure basis.

This is in keeping with the objectives of the National Health Strategy which states that our health services should be client centred. It also states that client health information should be shared across all health service departments as a means to creating a holistic service to customers.
APPENDIX 1 - Object Oriented Database System (Modular Based System)

Client Focussed – Integrated Shared Information Across Services

Client

- Medical Cards
- Occupational therapy system
- Immunisation system
- Hitech drugs scheme
- Long term illness
- X-Ray Dept
- Physiotherapy
- Drug payments scheme