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Information technology (IT) management

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This chapter provides an overview of the key issues in the management of health informatics. First the complexity of the health environment will be outlined. Then issues relating to IT management will be presented. This will include project management and IT control and evaluation. The chapter will conclude with a discussion of IT failures, and some of the lessons arising from them.

Management of Information Technology (IT) in Health presents a very special challenge. The IT industry itself is a very dynamic, rapidly evolving field, with a continuous stream of new technologies bringing new possibilities and challenges. However IT is not merely a technological issue, as it is generally found that many of the most difficult problems are about the way the technology relates to the organization. If technology is going to be effective in most cases, then substantial changes in the way the organization operates is necessary (Coombs et al 1992). These changes involve many conflicting factors which can be political, managerial, industrial, cultural, and may require substantial changes in skills, and roles. Implementation is much more than a technical process, and involves skills of politicians, salesmen, project management and organizational change agents (Keen 1991). It is an area that can be highly controversial and very costly, often with considerable dissatisfaction and with significant levels of failure (Sauer 1993). In addition to these problems, health is possibly one of the most complex of environments, which makes the management of information in the health industry extremely demanding.

IT in the health environment

The health information environment itself is very complex. There are a wide range of professional specialities of varying sophistication, each with their own types of information. Much of the information is of a ‘High Level’ involving rich descriptions of complex organisms (people), with factors such as intentionality, cognition, self consciousness and behaviour (Blois and Shortliffe 1990). In addition, much information is qualitative, subjective, intuitive and transient. This information is normally handled directly by professional staff, and not amenable to technological solutions. Thus IT can contribute as only part of the information processes within a health environment. Nevertheless, the data which is computerized can be very important, and needs to be accurate, timely and secure. People’s lives and privacy depend on it. Further, with the continual changing nature and

requirements of information due to advances in medical technology, the need for flexibility must be high. All these factors place considerable demands on the capabilities of the systems.

Within the health industry, two major types of environments can be identified, hospital-based services and community-based services. It is in hospitals that most of the resources in staff and money is expended in the health sector. Two main types of computing in the hospitals pertain to management and clinical activities. Managerial computing originated with financial systems, and gradually expanded to include those systems required to co-ordinate and control the many supporting business functions involved in operating a hospital, including the movement of patients. Clinical systems were originally independent, specialized systems usually directly under the control of the clinicians themselves. Slowly, these systems are being brought together in various ways, with the objective of providing an integrated information system focused on the patient (Minard 1991). However, both groups of systems are often highly fragmented within themselves and most often consist of a mixture of commercial and purpose-built systems, involving different hardware and software platforms.

Expenditure on IT ranges between 7-10% of operating budget in most industries and can be much higher in transaction-intensive organizations such as insurance companies and banks (De Luca 1992). However, in the Health sector, expenditure is much less. In hospital environments in the USA it is estimated to be 2.5-3.5% when telecommunications is excluded (De Luca 1992). Over the last decade investments of IT in the health sector have increased rapidly in Australia. The $800 million 10 year IT strategy in NSW Health will increase the spending in IT from less than 1% of budget to around 2% (Crawford 1992). Queensland will spend $80-100 million in seven years in their project to upgrade IT in 14 of their major hospitals (Fitzpatrick 1992). In spite of the substantial outlays in monetary terms world-wide, the development of IT in the health sector is regarded to be still relatively primitive (Joiner 1992).

The growth of computing in the health sector has typically been concentrated on hospitals. Community-based information systems, despite relative growth over the years, have been neglected, resulting in rather uncoordinated, fragmented systems (Jayasuriya 1993).

Managing IT in organizations has been given more emphasis with the increasing costs of IT and the strategic importance if IT to business (Ward et al 1990, Boynton et al 1992). The most important aspect of managing IT is ensuring that the IS activities are heading in the same direction as the rest of the organization (Glaser 1991). Schmitz (1987) considered that information must be managed as one of the most important resources of the organization. On the lack of importance given to this he says ‘...many organizations give a responsibility to a data processing manager for the information that happens to reside in the computer and trust to luck that all the information in the organization needed to make important organizational decisions will come together in a meaningful way’.

Structures for IT management

Much of the literature on IT structure in organizations has centred around the debate of centralized and decentralized IT management. The general IT literature recognizes that, over time due to the decrease in economic costs and need for strategic alignment of IS to business strategy, there is a move towards decentralization of IT function to line management (Rockart 1988). At the same time it is recognized that the roles and functions of the central IT

group have also undergone major change (LaBelle & Nyce 1987). Devising and negotiating an effective 'IT management structure' is a crucial policy issue. Boyton et al (1992) identified four factors that affect a firm's IT management responsibility and apportioned them to be:

- the extent of the organization's need for networking resources (i.e., exchange of information among multiple business units),
- the specific requirements to share data elements among business units and external firms,
- the extent to which applying common applications across the organization is desirable, and
- the requirement for specialized human resources related to IT.

If the patient is to be the focus of attention and the patient record to be the entity around which all information activities are to centre (Dick & Steen 1991), integration of information is an important strategy. Once health managers come to realize that their information requirements need to closely align with clinicians' information needs or be derived from patient management information, one might be able to vision the data network as the most powerful integrating force in operation in a modern hospital (Barone & Chickadonz 1992).

The current status of IT structures in a typical Australian hospital differs depending on a number of factors. The chief among them has been the organizational structure of the health system which varies by State. Other factors pertain to the size of the hospital and resources available. In NSW, IT services are centralized in an Area/District. Typically the IT department is physically located in the major hospital, though its functions cover all IT for the Area/District. In most instances these Area/District organizations work within the overall state IT strategy. In contrast, in Victoria and South Australia, hospitals were given guidelines for central reporting but each developed their IT independently. However, certain systems are centralised for processing such as payroll.

A recent trend is 'outsourcing' which is the use of external agents to perform one or more of the IT activities (Lacity & Hirschheim 1993). Proponents argue for its increase in IS effectiveness, long-term cost savings and freedom to pursue more strategic IS issues. Opponents on the other hand highlight problems such as loss of IT expertise and the threat of the vendor taking advantage of the client. For instance, experience of the Health Department of the Northern Territory found that outsourcing was inordinately expensive and resulted in the need to rebuild the IS function in the department afterwards (Smith 1993).

Recent trends in Australia suggest that larger IT departments would be in a competitive position to provide services on a 'fee for service' basis to smaller IT units. Smaller health organizations will find it cost-efficient to purchase services for batch processing of financial and administrative data and to obtain 24-hour user support for their clinical systems. Developments in the communication highways throughout Australia would enable health organizations in rural areas to obtain these services. This would eventually lead towards IT departments functioning as 'provider corporations' as is occurring with some large businesses (Nosworthy 1994).

Project management

Project management refers to the co-ordination of a complex of processes associated with a major initiative. Perhaps the biggest challenge that an IT department faces is the selection (or development) and implementation of a major system.

The first requirement is to have a reasonably clear idea of the types of functions that are required to be covered (see Chapter 7). In this process it is critical to have user involvement in the decision. However simple a task might appear from the outside, it is virtually guarantied to be more complex than expected. Users are understandably unwilling to accommodate deficiencies in the system if they weren't adequately involved in the decision making. However, involving users can be a very difficult task as well, particularly if there are a wide range of users involved. The task can be made more difficult if some of the users are too busy to put sufficient effort into understanding the system. In the final analysis, it is important for the users to have a realistic concept of how the system will help them in their work.

Once it is established what the system will do, the next question is whether to build or buy. One would normally expect that buying would have advantages over building, by being able to take advantage of the experience of other users and the capabilities of commercial developers. However, it turns out that many institutions continue to develop their own systems. This is for a combination of reasons:

- Hospitals tend to be organized in many different ways because of their history and the people involved and the legislative and administrative demands on it. They would rather have a system built around their needs, rather than accommodate structures to fit into a bought system. They also don't want to pay for superfluous functions.
- If a hospital builds its own system, then it has greater control over its development, and there is ability to modify it as required.
- Technological developments can make commercial systems obsolete, and make it more attractive to build something that uses the latest technology, and perhaps uses more efficient development techniques.
- Commercial development and marketing costs can outweigh the costs of shared development.

For example, one hospital searching for a commercial radiology system found commercial prices in the region of $400 000 and above, yet these systems did not meet important requirements for integration with other systems. A system was then purpose-built for $30 000.

Vendor selection is a critical step if the decision is taken to acquire a system. Steps in this process are (De Luca 1992):

- Request for Information (RFI). This is an initial screening of vendors using a short questionnaire to gather some basic data from the vendor and its products.
- Request for Proposal (RFP). Which elicits essential information from all selected vendors in a standard format to compare systems with each other.
- Vendor demonstrations and site visits. When buying a system, it is most important that the key staff have an opportunity to see it in operation in a similar institution (not just in

demonstration) and preferably to talk to people who have also purchased it, as well as the people who developed it.

- Assessment of systems. This will consider the overall suitability of the systems including an economic analysis. Sometimes a consultant is brought in at this stage to assess the technology. The systems will be ranked and contract negotiations undertaken with the first ranked vendor.

If the decision is made to develop a system, it is important to ensure that the resources and experience are available. Building a major system requires careful management. In the 1970's a method for managing this development 'the System Development Life Cycle (SDLC)' emerged as the 'Waterfall Model' (Blum & Orthner 1989). At each stage of the life cycle a project milestone is identified and deliverables are signed off. The cycle starts with an analysis of the needs, then the development of a functional specification. This design usually is a combination of data flow diagrams, which describe how information moves from place to place, data structures, which show how the various bits of information link together, and screen layouts, which show how data is presented on the screen, and how the various screens are linked together. These requirements must be checked with the users and signed off before proceeding. Then the design, coding and debugging is undertaken. Finally there is the installation, and maintenance, which includes updating.

In the late 1970's, structured SLDC (or structured systems development) methods emerged, many of which are in use today. One of these, for instance, the Structured Systems Analysis and Design Methodology (SSADAM) has been mandated in the National Health Service in Britain (Hepworth et al 1992). They usually consist of many volumes of detailed instructions, which often need to be adapted to the task. They can, however, make the development process very cumbersome and increase development time.

One of the critical tasks of the SLDC is getting the design right before the system is built, as it is very expensive making changes at a later stage. Therefore much effort is usually put into the design stage, and careful documentation is carried out. One popular means of doing this is the Joint Application and Design (Smith 1992) which involves teams of users working with the developer to establish the requirements.

In the early 1980's the availability of fourth generation languages (4GLs) enabled an alternate development path to be taken. Unlike traditional SLDC, progressive iterative development or 'prototyping' was more feasible. In prototyping, mock-ups of the system are developed so users can get a better feel for how the system will finally work (Sprague & McNurlin 1993).

The above methodologies are based on the assumption that system requirements are basically knowable in advance. However, as shown by Jones (1992), there are many ways in which our ability to see into a future situation are limited. A rather different type of approach is 'evolutionary' development which doesn't assume this pre-knowledge. Evolutionary development recognizes that requirements are going to change, and that users have only limited knowledge initially. The system first built may be only a small part of what is finally envisaged, and once that is in use, then users can refine and expand their requirements for the next version. This can be highly successful for relatively simple systems. Evolutionary development can make it difficult to maintain technical integrity when systems are complex.

With the increasing complexity of system development it is becoming very difficult to ensure everything ties together properly, and a number of tools have been developed to help IT staff. One important tool aimed at automating the development of large applications is Computer Aided Software Engineering (CASE), which automates flow diagrams, data-base design, software engineering, and coding. The benefits of CASE are increased programmer productivity, higher quality software, easier maintenance and coordination of complex jobs. While these can be attractive, sometimes the training costs and other inconveniences can detract substantially from the benefits (Fenton 1993). Another development has been the use of Object-oriented programming systems development methods. With both of these technologies, it is important that there is practical evidence that they achieve what one wants of them in similar circumstances to which they are being used, and that start-up and training costs are properly considered.

Management control and evaluation of information systems

The framework for management control that is widely accepted relates to a model by Anthony et al (1989). They define management control as 'all methods, procedures and devices, including management control systems, that management uses to assure compliance with organizational policies and strategies'. It is difficult to apply traditional management control concepts to control of Information System activities for a number of reasons. Firstly, information systems serve three levels of management. Secondly, it includes many subsystems that vary in relative importance (a good example in Hospital Information Systems is between clinical decision support and accounting information). Finally, information systems are continually needing to work with new IT (and in the case of health, new technologies of medicine and procedures). Therefore, some of those IS activities are of an experimental or research nature.

Some of the concepts from evaluation are useful in the development of a framework for discussing control measures. Formative evaluation encompasses the process of development of the information systems and their maintenance. The evaluation of a system in operation can serve a number of objectives:

- It can demonstrate whether the intended productivity improvements such as, decreases in resources etc., have been achieved.
- Show barriers and difficulties that prevent full exploitation of the system by its users and can lead to action to remove these barriers.
- Provide evidence upon which future developments and plans can be built.
- Reveal unexpected side-effects of the system; positive effects that would give direction for future development and negative effects that need remedial actions (Eason 1988).

Much of the research in IS evaluation has grappled with the measurement of 'impact' of the system. Impact evaluation in the context of information systems is the determination of how the implementation and use of an information systems application affects the organization. A useful classification by Eason (1988) brings in the concept of levels of evaluation (and control). He identifies four levels as:

- Technical systems performance — this encompasses the technical quality of the system which is usually undertaken by Quality Assurance of software development.

- User evaluation of technical services — this level is of use in ascertaining the functionality and usability of the system.
- User performance and satisfaction — this level assesses the impact of the system on the users and their job performance.
- Socio-technical systems performance — at this level an organizational evaluation is conducted to establish whether the system is performing efficiently and effectively. It is at this level the question of cost-benefit is posed.

User satisfaction has been utilized as a construct to measure 'success of IS'. An instrument to measure this construct has been applied in a hospital setting by Zviran (1992). End user satisfaction has also been used by hospital management to take decisions on acquisition of new software (Bailey 1990). However, user perception constitutes only one viewpoint of the multiple dimensions of systems performance.

In the field of Information Systems, though in practice much effort is taken to justify the benefits of the system prior to its development, many organizations do not conduct evaluations of the system once the decision is taken to build it. The conduct of a post implementation review, when the conversion to a new system is complete, provides the organization with useful information on the costs and benefits of the system. Post implementation evaluation (review) includes evaluations performed just before installation, just after installation and considerably after installation once the system has a chance to settle down (Kumar 1990). Evidence from Canada in business shows that in most cases these evaluations are conducted only after a project is completed and usually by the systems development team. Since the evaluation is to test the design and development process, it is questionable whether any basic flaws in the process or product will be discovered by such evaluations (Kumar 1990).

Assessment of IT benefits have generally focused on the measurement of efficiency though Sprague & McNurlin (1993) claim the largest payoffs from IT lie in improving effectiveness. To quantify benefits Keen (1991) suggests using operational indicators of performance that can be used over time called 'anchor measures'. Curley and Henderson (1992) identified that the potential level of IT benefits differ according to level of the organization and that IT investments extend beyond business performance. Based on this concept they developed a value assessment framework to assess IT benefit.

Evaluation of hospital information systems has tended to be limited to those done just before handing over. Though, some IT managers have built in systems of Quality Assurance that allow them to obtain feedback from users as to their satisfaction with the IS support (Robinson 1994). In reality, though major investments in IT have occurred in the health industry in Australia, there have not been many rigourous assessments of its benefits and impact on the work of the organisations.

Early IT systems addressed quite straight forward tasks, and often made very expensive jobs cheaper. However, as the tasks became more complex and the costs increased, then the benefits became more difficult to identify. This was for a number of reasons:

- The benefits were in the capabilities that were provided. These could only be realised if people chose to make use of them. Hence, the value of a system depends very much on political and human issues that are often not properly considered in system design.

- The benefits were widely distributed and confused with many other activities. For instance, many of the benefits of IT investments in the eighties have only come about with the "thinning out" of middle management.
- The systems were 'technology driven'—introduced more because people were impressed with the technology and have a simplistic belief in its benefits. Often they had not made the effort to be specific about the benefits they want achieved.

In order to improve the performance of IT, benefit realisation has been introduced as a strategy. This is directed more at the implementation process, and seeks to measure the impact of the system in terms of corporate benefit. This relies on a clear measurable output for the organisation and a high degree of stability.

However, the complexities and uncertainties of the health industry makes this very difficult to apply. The overall benefits of any system are often complex, variable, and very difficult to measure.

Lessons from IT failures: organizational system issues

Like any technology, IT has its failures, as well as its successes. In areas such as aeronautics or civil engineering, a failure is very thoroughly analysed. There is usually much learnt from such failures. Unfortunately, this is not so in the IT industry, as failures can be partial, and are often lost in a mass of organizational politics. The very definition of failure is uncertain (Sauer 1993). Nevertheless, one can identify some fairly consistent patterns in IS development among the major systems that have been developed around Australia and New Zealand. The implementations are typically embarked upon with substantial promises of benefits, including the enhancement of clinical services, better support for staff, and better management information. Management often approves the programs with very limited understanding of the implications or the risks. Projects are undertaken by a very enthusiastic staff, but they find it very difficult to consult effectively with a large and very busy staff, who may have somewhat unrealistic expectations of the system. Then there are usually delays in the implementation. Throughout this period, dissatisfaction amongst users gradually develops from such causes as inadequate consultation, delayed implementation, inadequate functionality, inconvenience of use and high costs. When management may be reluctant to face the criticism from powerful interest groups, it may be difficult for them to provide unequivocal support for the system. The increasing controversy can have an effect on the IT staff, reducing their morale, and increasing their turnover. In spite of all these difficulties and often with inadequate training and preparation, the system usually does operate, but does not fulfil the original expectations. The frustrated expectations and residual problems leave a general feeling of dissatisfaction.

Following the implementation, rapid changes in technology increase the difference between what people are getting, and what they feel they ought to have, and generate pressure for the early replacement of the system. If any new system is installed, however, it faces the same pressures and may well repeat the same cycle. There is a great gulf between the enthusiasts, who focus on the system's achievements, and the sceptics, who focus on its problems.

While this scenario is not universally the case, it is relatively common, and is largely predictable (Colclough 1992). It is worthwhile considering the lessons that might be learned from these experiences

- Recognize the limitations of initial requirements analysis, and ensure that there is flexibility for the system to grow with expectations and changing demands. Make sure expectations are realistic, and the implementation is divided into steps that are manageable.
- Take into account the complex power sources in the organization. Ensure that the management and principle power groups understand the implications of the system and are prepared to commit themselves to coping with the political implications of it. They must recognize the complex of interests involved, and have staff of sufficient seniority to address the issues.
- Understand the nature of the corporate objectives. Corporate planning in health is relatively immature, and plans do not always relate effectively to the work that the organization does.
- Monitor top management support, and determine any reason that support is flagging. An IT project may be seen as merely one more claim for scarce resources, rather than as a strategic asset. An IT department can easily miss out on the claim for funds, making it even more difficult to deliver promises.
- Ensure there are good relationships between IT staff and users. This is a problem that has been most prevalent with central IT staff in IT in general (Smith 1992), and is common in health. Any major system forces changes on the organization that are usually difficult to understand, and tension is almost inevitable. It is important that IT staff understand the problems, and are focused on helping users cope with the system.
- Beware of the phenomenon of 'escalating commitment to a failing cause'. When decision makers do not accept failure, they will continue to commit resources without abandoning the system.

Conclusion

Management of IT in health care organizations is not merely a technological issue. If it is to be of substantial use, changes in the way health care organizations operate are necessary. This has not been the usual case, partly because of the many inherent factors in a complex organization such as a hospital that is driven by professionals. IT management therefore requires the skills in implementing projects, managing organizational change and evaluation. Techniques and tools have emerged in recent years to help in management of IT. However, experience in Australia and overseas shows that IT has had significant failures which are very costly. Lessons from IT failures are useful in refining these methods that could address demanding organizations such as those found in the health sector.

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