

Developments in Hospital Management and Information Systems

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Abstract

Hospital management and business processes in hospitals have changed considerably over the past twenty years, as did the use of hospital information systems. In this paper a 'stages of growth' framework is developed and used to describe the relations between types of hospital management and the use of hospital information systems over time. In this paper the framework is applied in a case study of a large general hospital in the Netherlands. It was found that the use of IS in this hospital did not develop according to the needs and developments in the hospital organisation over the past decade.

Key words: health care, hospital management, hospital information systems, stages of growth

1. Introduction.

Health care in the Netherlands, as in many other countries, is confronted with a growing demand for medical treatments and services, due to factors such as a 'greying' population, and higher individual standards for the quality of life [Fellegi, 1988; Dekker, 1988; Mooney and Salmons, 1994]. Health care has been an issue of growing importance for national governments [Miller, 1994]. Many national and regional health care plans have been developed in the past decades, in order to control the costs, the quality, and the availability of health care for all citizens. These plans have created a complex environment for local health care institutions. This paper is focused on the way hospital management has coped with the various environmental

changes over the last 20 years, and how this related to changes in hospital information systems (IS).

An interesting question is how organisational, managerial and IT developments take place in hospitals, and how these developments influence each other, in terms of impact, alignment, and reinforcement. For instance, hospital management can focus on centralised financial control, on decentralisation of budgets, on co-ordination of the primary medical processes, or on external networking with other hospitals or medical services. The latter often occurs in combination with a focus on control of the total costs of medical services and health care for specific groups of patient, often indicated as clients.

Recently several hospitals in the Netherlands have reorganised by combining different cure and care processes into patient oriented clusters. In this paper an overview is given of recent developments in hospital management and a framework is presented to relate three types of hospital management to the use of IT in a hospital. In doing so, a 'stages of growth model' [Nolan, 1992] is created, resembling the model presented by Galliers and Sutherland [1991], but tailored to the developments in hospital organisation and use of IT in hospitals. The framework is applied in a case study of a hospital in the Netherlands. Ultimately the framework is aimed (i) to provide guidelines for transforming information systems while transforming hospital management, and (ii) to compare hospitals management and the use of hospital information systems in practice.

First, the developments in hospital management in the past decade are described in section 2., and the developments in hospital information systems in section 3.

Table 1. Management actions to improve quality and cost effectiveness of care services in European hospitals by 1998 (Andersen Consulting, 1993)

actions	agree %
implement IT to support administrative tasks	88
conduct efficiency drives in service departments	86
implement IT to support patient care activities	80
introduce revised procedures for determining nursing staff requirements	75
redesign patient care procedures	75
redesign administrative procedures	75
use documented care plans and treatment protocols	74
establish multi-disciplinary care teams	71

The conceptual framework to describe relations between hospital management and hospital information systems is presented in section 4, and applied to describe a hospital case situation in section 5.

2. Developments in hospital management

2.1. National health care.

Traditionally, health care in the Netherlands is supplied by privately run institutions. Health care in the Netherlands consists of primary care (provided by general practitioners, dentists etc.) and hospital and specialist care provided by hospitals and medical specialists. The government influence and interference in public health care was formalised by an amendment to the constitution in 1983 “the government shall take measures to promote public health”. It is the task of the government to ensure that the health care system is accessible to all.

In 1983 the system of budget financing for hospitals was introduced, based on cost without regard to effectiveness. Since that point institutions have, periodically and in advance, been assigned a budget to finance the services and facilities they provide. In the years after 1983, cuts have been made, squeezing the budgets.

Under a budget system the expansion of medical activities imposes a heavy burden on the manpower and material resources of an institution, so that priorities have to be set. On account of the fact that hospitals may in many ways be regarded as a business that makes facilities available to specialists as independent practitioners, hospital management is generally not well equipped to set priorities. This resulted in an enormous workload for nursing staff, further increased by the reduction in the average term of nursing and substantial increases each year in the total volume of treatment provided to patients. [Dekker, 1988]

The responses to the challenges facing national health care systems have wide ranging implications. Hospital managers respond to falling revenues by re-organising and redesigning the structure and processes in their hospitals, to improve the cost and quality of the care they provide. It is expected for the coming years that the number of inpatient beds will continue to decrease and resources will continue to shift from hospitals to primary care. Hospitals will strive to offer more outpatient and ambulatory services, and the operational management will be more and more decentralised. Hospitals consider co-operating with other care organisations. A survey, held under 2752 European hospital managers, identified a range of actions which were most likely to take place by 1998 (table 1) [Andersen Consulting, 1993].

These changes may challenge many of the traditional roles in a hospital, including those of doctors, nurses, and other disciplines. This will consequently require management to work closely with health care professionals resulting in an effective institution.

Modern hospitals nowadays supply professional services, in stead of products. Until the 1980's a patient actually purchased production capacity of the hospital organisation, often through an insurance scheme. Hospitals had a high quality technological infrastructure in order to sell medical capacities. This organisational type is now under pressure, including decreasing financial budgets, due to the changes in society, politics, and population. Hospitals move in the direction of a social market organisation [Wulff, 1996]. In the near future, traditional hospitals in the Netherlands will be replaced by day care, home care, and short stay facilities. Home care services are provided to patients requiring basic care. Hospitals will continue to focus on specialised services for specific groups, requiring high technology facilities. Until now hospitals do not use quality measurements nor performance results.

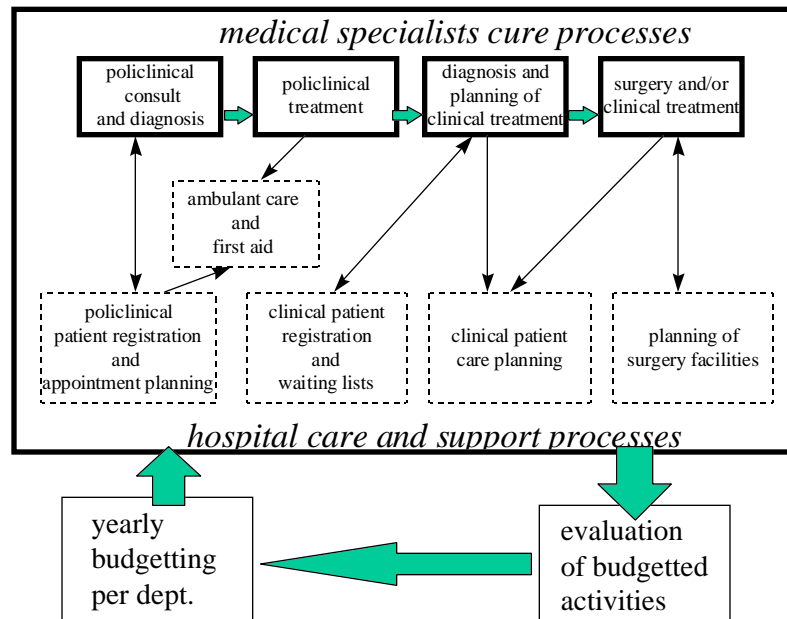


Figure 1. Relations between the two primary processes in hospitals.

2.2. Core processes in a general hospital

Most employees in a hospital work in the primary care processes. Due to the health care laws in the Netherlands up to 1997 most medical specialists are not employees of a hospital, but work as private practitioners, making use of hospital facilities. Figure 1 gives an overview of relations between the two primary processes in hospitals: the specialist cure process, and the care and support process. The figure demonstrates that patients and information about patients are exchanged between the two primary processes. Both in the field of quality assurance in the cure process and the care and support process and in the field of management information this gives rise to specific problems of coordination. These are enhanced by the fact that the medical specialists act as private entrepreneurs in the hospital environment [Postma, 1989].

2.3. Hospital management

Within the rules of national legislation and regulations, hospitals in the Netherlands are responsible for internal hospital management. Long and medium term hospital planning is adjusted to regional and local developments, and hospital budgets are allocated to resources. Hospitals negotiate with local government and insurance companies for the planning of clinical and outdoor services. Hospital

management plays an important -intermediate- role in the national health care management network [Van der Zwan, 1993; CMCZ, 1994].

On a national level, the government aims to control the costs of health care by taking relatively detailed budgetary measures, by drastic cuts in specific budgets, limiting numbers of specific treatments, and introducing out of pocket payments by patients. In stead of these detailed measures, hospitals prefer more global and long term governmental measures, in order to be more able to adjust hospital planning to the national and environmental rules.

Hospitals can be regarded as professional bureaucracies [Mintzberg, 1989]. Hospitals can also be regarded as organisations based on high technology and information intensive processes. According to Lawrence and Dyer [1982] such organisations are not hierarchically structured bureaucracies, but are often based on democratic control mechanisms with institutionalised stakeholder influence in decision processes. It is interesting to investigate if hospitals nowadays have a bureaucratic or a democratic control structure. To support this investigation we have defined three types of hospital management: capacity management, functional management, and network management, as given in table 2.

In the 'capacity management' category a patient actually purchases production capacity of the hospital organisation,

Table 2. Identification of three types of hospital management

	Capacity management	functional management	network management (process management)
services to customers	broad specialists	sub specialists	networked specialists
success factors	availability and reliability	correct diagnosis and treatment	quality of life and well being
knowledge owners	medical specialists	medical sub-specialists	networks of medical professionals
knowledge sources	clinical training and experience	scientific approach, academic training and journals	knowledge networks, electronic networks
management orientation	control and financial reporting	(internal) functional management	(external) process management and marketing
co-ordination mechanisms	top down, centralised	decentralised clusters	standardisation and communication

often through an insurance scheme. Hospitals maintain a high quality technical infrastructure in order to sell medical capacities, and support medical specialists. This organisational type is now under pressure, because of decreasing financial budgets and changes in society, politics, and patient expectations.

Hospitals can respond to these pressures by transforming into 'functional specialisation'. In this way the organisation tries to reduce costs and to improve the quality of specialised medical services.

A more recent response of hospitals is to move into 'network management'. In this organizational type a hospital is seen as only one piece of a more elaborate network of medical care [Wulff,1996]. A networked hospital tries to improve its 'input-output' or 'market' relations with primary care physicians and for instance 'elderly care and home care institutes'. Also internally the hospital is run more like a networked organization in which coordination between internal and external processes is the main focus of management. In this type of organization business process redesign [Hammer and Champy] and supply chain management [Venkatraman, 1997] can be used to improve the efficiency and effectiveness of hospital services. The effectiveness of the services is measured in terms of the well being of the patients. Well known principles of quality

management [Juran, Demming] are used in this type of organization. So called 'Diagnosis Treatment Combinations' [Baas, 1996] (resembling Diagnosis Related Groups) describe medical hospital products that can be 'purchased' by patients. Cost of care can be calculated in terms of 'production units' [NZI 1994]

Hospital structures tend to change nowadays from 'capacity' to 'network management', or in terms of Mintzberg from 'management by hierarchy and formal control' to 'management by network and collective control' [Mintzberg and Glauberman, 1995].

3. Developments in hospital information systems.

3.1 Actual situation

A survey under 2752 European hospital managers indicates that technology can substantially influence hospital activities and services, as shown in table 3 [Anderson, 1993]. It is also expected that health care budgets and funding will depend significantly on sophisticated patient and diagnosis classifications. The use of IT in diagnostic and treatment processes will add to the development of networks of clinical, hospital and health care processes.

Table 3. Preferred IT implementation in European hospitals by 1998 (Andersen, 1993).

IT implementation	preference %
computerised reimbursement procedures	86
executive information systems	79
communication between hospital departments	74
computerised medical records	68
library information directly available to doctors	65
electronically stored radiology images	64
computerised medical and nursing plans	63

The communication processes are critical for improving the links between health care demands and providers.

Until recently, in the Netherlands, the focus of IT in health care was on personnel, logistics, and finance. It is expected that in the coming years the focus will be on the care process, including electronic medical files, and quality measurements. It is also expected that the older information systems will become more integrated with the new, primary process oriented applications of IT. Of major concern at this moment is the financing of the development and the governance of the new hospital information systems [Wulff, 1996].

3.2. Technological developments over 30 years

In this paragraph a framework is presented to classify the use of IT in hospitals. The framework is based on the 'stages of growth model' [Nolan, 1992]. The framework uses three main eras or stages described by Nolan, without going into detailed sub-stages in each era. Another difference with the Nolan model is that the criteria and properties of each era are specific for the hospital situation and the national health care network. As a result we arrive at the stages of development of IT as described in table 4.

The original hospital information systems were designed and constructed by internal IT departments often supported by external software houses. Primary responsibility for design, deployment control and maintenance of IT were with the IT department. Hospital applications, both in the

administrative, the medical technical- and the cure and care processes were isolated individual systems supporting isolated parts of the business processes. Computer technology mainly existed of mainframes and of intelligence built into individual medical systems.

In the second era, mainly due to the enormous costs of investment in IT, hospital management felt more and more responsible for investments in IT and important IT decisions were centralised. The IT function was separated from the business function, either in the form of separate profit centres or even in the form of independent external IT suppliers. Internal integration of systems started in all sectors. IT technology started to be distributed in internally linked administrative and primary applications. The third era, emerging nowadays in the Netherlands, shows interconnections of hospital information systems through external networks, with systems of other medical organisations like insurance companies, general practitioners, pharmacists, etc. Because business unit (or cluster) oriented systems can be superimposed on the general IT infrastructure of the hospital, some investment decisions are taken by the hospital management, and others by cluster management. Often decisions on IT are made in close co-operation with external IT providers. Also in this era integration of IT in medical systems and in cure and care systems reaches the full extend of its possibilities. In this third era, provision to IT to hospitals is client oriented, process oriented, integrating applications along the lines of

Table 4 developments of IS in hospitals (based on Nolan, 1992)

	DP era	IT era	network era
role of administrative IT	transaction processing	information processing	information delivery
value of IT	data	information	knowledge
responsibility	head of IT department	hospital management	heads of product-oriented clusters top and BU management
infrastructure	monolithic mainframe	distributed	3 layer architecture
users	not involved	observer	participant
systems design	in-house design and development	many suppliers with many independent products	limited number of suppliers with limited number of integrated hospital information systems
organisation	IT department	privatised IT function	co-sourcing
role of IT in primary cure and care processes	none	isolated applications	integrated applications supporting all cure and care
role of IT in medical equipment	IT embedded in stand-alone medical equipment		interconnected equipment and interconnected IT,

business processes and integrating administrative, medical and cure and care systems. Further more the technology enables flat internal organisation structures and integration of the hospitals activities in local, regional and national healthcare systems.

4. Conceptual framework

In this paper we use the framework only to describe hospital management and information systems. Thus our criterion for success is the degree to which we are able to classify actual hospital situations in term of the descriptions the axes of the framework prescribe. By doing this we analyze combinations of management and IS that are found in the real world. In later parts of the research we can try to describe costs and benefits of the different situations and possible paths of growth and change. The approach taken is similar to the one presented in Galliers and Sutherland [1991]. The main difference being that our framework and analysis are dedicated to the use of IT in hospital organizations. The advantage of this approach is that developments in IT and developments in organization are brought together in one general framework. This is in line with recent publications on IS strategy that argue that changes in IT and changes in organization should go hand in hand (Feeny; Earl).

A hospital can be positioned in the grid in figure 1 by

analysing (i) the hospital management style, by identifying the properties listed in table 2, and (ii) the information systems approach, by using the properties in table 4. Position A indicates a hospital showing the capacity management style, combined with the computer management style. B, C, and D show other possible combinations.

Drawing the positions of a hospital at various moments in figure 1 can indicate situations of impact and alignment of IT [Henderson and Venkatraman, 1993; Smits and Van der Poel, 1996]. A hospital that moves from position [A] to [B] and then to [C] shows alignment of IS to hospital management. Impact of IS has occurred with a move from [A] to [D] to [C]. Alignment starts from the existing business organisation, and its needs, generating the supporting IT services. Impact starts from IT opportunities and generates changes to the overall business plan and the hospital processes.

In this way the grid can be used to follow the developments in a hospital over time. Obviously, the grid can also be used to compare several hospitals at a given moment. In the next section we use the framework to analyse the situation a specific hospital in the Netherlands in 1987, 1990, 1993 and 1997.

5. The case: maasland hospital.

A case study was done in 1997 by analyzing a selection

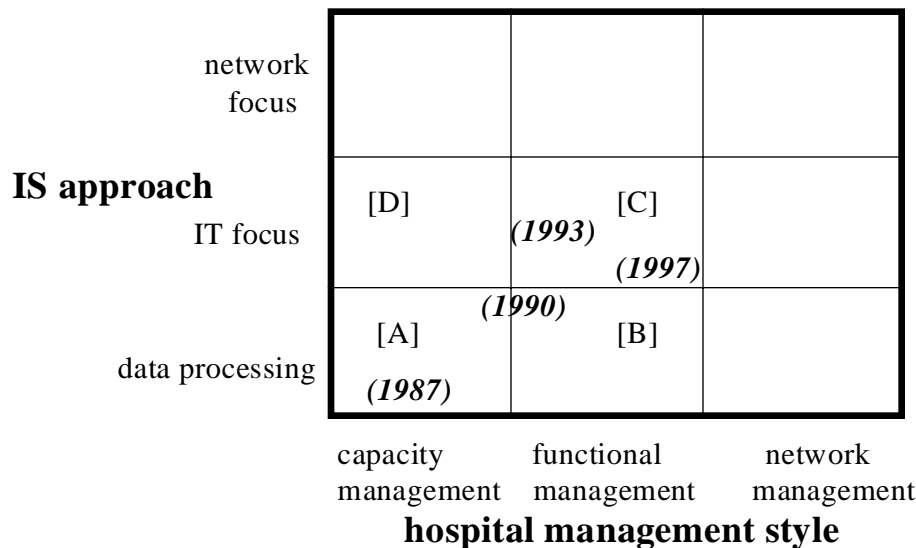


Figure 2. Grid showing the relations between hospital management and information systems (the numbers between brackets refer to section 5).

of the hospital documents and reports over the past 20 years, and by interviewing several managers and medical specialists involved. The changes in hospital management and IS are given in sections 5.1 and 5.2. Then the Maasland hospital is positioned in the framework in 5.3. The final section 5.4 presents the findings of a second round of interviews focusing on the actual problems in hospital management, primary processes, and information systems.

5.1. Changes in hospital management.

The Maasland hospital was founded around 1900 in Limburg in the south of the Netherlands. Until 1993 the hospital management style was the classical model of capacity management, primarily based on financial control. Hospital activities such as nursing care, catering, cleaning, administration, and laboratories, were all managed separately, in different operational units with many hierarchical levels. Communication in the hospital was complex, including complex regulations, and extensive use of standards and paper work.

By the end of the 1980s the hospital refocused on its core activities. Next to the existing classical departments, new departments were formed, such as the unit for Clinical Treatment, and the unit for Outpatient Treatment. In 1993, the new general manager of the hospital reorganised the hospital into new 'product oriented' departments or clusters. Each cluster has units for cure, care, and management having shared responsibility for a set of health care services and budgets.

5.2. Changes in information systems

Automated information systems were used in the hospital since the 1970s in the financial department. In the hospital laboratory a stand alone system was installed for administrative purposes in the beginning of the 1980s. In 1987 the first 'integrated hospital information system' was installed, based on a turn key contract with a supplier. The supplier went bankrupt in 1989. In 1990 the hospital decided to develop its own hospital wide information system, including the support of various medical and paramedical activities in the hospital. In 1993 a large number of medical support activities were supported by the new system. Over 200 application modules were used in a network of 750 workstations. IS was heading for the development of 'integrated hospital wide information systems'. The hospital has never had a (large) record of outsourcing IT activities.

Organisationally, the IS department had been part of the financial department in the 1970s. In the 1980s the IS department became a department, reporting directly to the hospital board. During the hospital reorganisation process

in 1993, the senior manager of the IS department mentioned repeatedly the growing problems with the integrated hospital information system. In his view the system would not be able to deliver the information services needed by the new hospital management structure. Hospital general management decided not to focus on information services, and made the IS department, including further development of the integrated hospital information system, a sub-unit of the facilities department.

5.3. Positioning Maasland hospital in the framework

The developments in the Maasland hospital can be visualised in figure 1 as follows.

1987: the hospital is organised according to a bureaucratic structure, aiming at control of capacities and facilities to support medical specialists. IT is dispersed and focused on administration. The IT department is part of the financial department. The hospital information system was built by an external supplier. Operations, control and maintenance are done internally.

1990: the hospital focused on core activities and functional management by creating different departments for clinical and outdoor treatments. IS gets attention of general hospital management, aiming to develop an integrated hospital system, with still a focus on financial and administrative functions. IT management reports directly to general management. Again an external supplier was invited to build the system. IT operations are still executed, controlled and maintained internally. IT processing power is still centralised

1993: medical cure and care functions have representatives in the hospital board. Friction occurs between capacity management (1987) and the functionally organised cure and care (1990). IT supports various medical activities, and almost each administrative process. Incidentally, IT is used as a change agent: the use of EDI to communicate with general practitioners, and the development of electronic medical files to support the primary processes. The hospital is reorganised. IT management now reports to the head of the 'facilities' management and thus at greater distance from general management. IT systems are still operated, controlled and maintained internally. Information systems are obtained from many different suppliers. IT processing power is distributed now.

1997: the hospital is now a 'cluster organisation', with only three hierarchical layers. Budgets and responsibilities are decentralised and delegated to management teams. Each team consists of cure, care, and administrative functions. Sometimes attention is given to co-

operation with local partners and health care providers. IT is slightly changed since 1993: management requests have lead to new 'island' applications, stand alone, and uncontrolled. This shows that some IT decisions are taken on the level of cluster management while a general supporting IT structure is lacking. This hampers the integration of the separate systems. IT systems are still operated, controlled and maintained internally. Even more external suppliers are involved in the delivery of information systems. IT processing power is highly decentralised.

The hospital management and IT situations in the years 1987, 1990, 1993, 1997 are drawn in figure 1.

5.4. Actual problems in the maasland hospital

Having positioned the Maasland Hospital in the framework, new interviews were held to assess managers opinions regarding the quality of information services. Based on growing complaints from various departments and clusters, the hospital board decided to investigate the information services in the hospital. The aim was to make an inventory of complaints and needs. Twenty five interviews were held with 13 medical specialists and 12 senior managers. It was found that:

the respondents don't see any coherence in information services provided. The reorganisation in 1993 was not followed by a change of administrative processes, nor information systems. The management structure is based on decentralised control, while the administrative processes and IS are still based on centralisation. The board appears to be focused on administrative processes in stead of care and cure.

there is a lack of information to support the primary processes. Medical specialists have a need for electronic medical files to reduce the paper work involved in the hospital administrative processes, to reduce duplication of patients medical files as well as the care and administrative files, and to fasten the treatment processes. The respondents suggest data management and files to be patient oriented in stead of specialist or departmental orientation.

management information is not adequately combined with the administrative processes. Paper based information processing is too slow, and goes through too many steps. IT support for operational planning in clusters and departments is lacking.

no explicit contracts exist between central hospital management and the decentralised medical clusters and departments. There is no explicit agreement between management levels on the performance measures of clusters and department. Budgets form the basis for cure and care, and are adjusted yearly in an incremental way.

The general conclusion is that information systems have changed insufficiently to follow the organisational developments in the Maasland hospital, as well as the developments in the national health care system.

6. Conclusions

In this paper relations were described between changes in hospital management and the use of hospital information systems between 1980 and 1995.

The case of the Maasland Hospital shows that reorganisation processes occurred without management awareness for information systems. Hospital management, organisational structure, and primary processes have been changed in several steps in the last two decades. Hospital information systems could not provide the information services that were needed, neither in the actual situation, nor in previous situations.

A framework was used to evaluate management and IS developments in hospitals. In the Maasland Hospital case study the framework provides an overview of impact and alignment over time; and gives an overview of the actual situation and discrepancies between hospital management and IS. Further research and application of the framework in other hospitals must be done to provide guidelines for planning and prioritisation processes for IS in hospitals.

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