Management Information Systems in Process-oriented Healthcare Organisations

by

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Submitted to the School of Engineering at Linköping University in partial fulfilment of the requirements for the degree of Licentiate of Philosophy

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Linköping 2003
The aim of this thesis work was to develop a management information system model for process-oriented healthcare organisations. The study explores two questions: “What kinds of requirements do healthcare managers place on information systems?” and “How can the work and information systems of healthcare managers and care providers be incorporated into process-oriented healthcare organisations?”

The background to the study was the process orientation of Swedish healthcare organisations. The study was conducted at the paediatric clinic of a county hospital in southern Sweden. Organisational process was defined as “a sequence of work procedures that jointly constitute complete healthcare services”, while a functional unit was the organisational venue responsible for a certain set of work activities.

A qualitative research method, based on a developmental circle, was used. The data was collected from archives, interviews, observations, diaries and focus groups. The material was subsequently analysed in order to categorise, model and develop small-scale theories about information systems.

The study suggested that computer-based management information systems in process-oriented healthcare organisations should: (1) support medical work; (2) integrate clinical and administrative tools; (3) facilitate the ability of the organisation to measure inputs and outcomes.

The research effort concluded that various healthcare managers need the same type of primary data, though presented in different ways. Professional developers and researchers have paid little attention to the manner in which integrated administrative, financial and clinical systems should be configured in order to ensure optimal support for process-oriented healthcare organisations. Thus, it is important to identify the multiple roles that information plays in such an organisation.
1. Introduction

Swedish healthcare organisations are required by law to maintain a holistic view of their processes (Prop. 1999/2000:149). Thus, such organisations need to have an overview of the entire scope of health service delivery. As a result, system thinking is vital (Senge, 1990). An organisation must be able to collect data from its operational processes and furnish health service management with data concerning the way in which they have utilised their resources (Kaplan & Norton, 1996). As a response to this imperative, many healthcare providers have begun to introduce process-oriented structures recently. There are a number of theories about how to design such structures. One theory is based on Business Process Reengineering (BPR), the purpose of which is to identify and redesign organisational processes (Davenport, 1993). Another approach is to analyse a healthcare organisation as a Complex Adaptive System (CAS), an interdisciplinary method that focuses on the self-organisation of systems and patterns, as well as the way in which outcomes emerge. The purpose of a CAS analysis is to resolve issues associated with adaptable systems (Zimmerman, Lindberg & Plsek, 2001). Regardless of whether a BPR or CAS approach is employed, process-oriented organisational structures face difficulties stemming from the fact that healthcare organisations operate on multiple levels, including county councils, hospital management, clinical management, and care providers, each with its own information requirements (Andersson, Vimarlund & Timpka, 2002). Each level struggles to survive under difficult economic constraints, limited growth and the constant threat of regulation (Luce & Elixhauser, 1990). Healthcare organisations need an integrated structure in order to quickly disseminate information among managers and care providers (Van de Velde, 2000). The first challenge is to structure information systems such that they support the workflow in a healthcare environment (Strauss et al., 1985).

Thus, it is not surprising that healthcare managers are increasingly seeking help from health information systems (HIS). Their objective is to minimise the overall costs of healthcare delivery, to improve the quality of their services (Greenes & Lorenzi 1998; Clayton & van Mullingen, 1996) and to correlate costs with resources consumed (Stead & Lorenzi, 1999). One option for gathering data in an
HIS is to use censors and other devices that continuously furnish the healthcare organisation with data about its finances, quality, competence and level of satisfaction. However, before an HIS can be designed, both managers and developers need to be familiar with work routines, information requirements, and other key parameters at the clinical level, given that medical information is linked to the environment in which it is generated (Berg & Goorman, 1999). Thus, the organisation must outline its information requirements and work procedures. The HIS that ultimately emerges will be embedded in the organisation’s processes and must satisfy the care provider’s information needs (Berg, 1999).

To sum up, in order to design an HIS in process-oriented healthcare organisations, attention must be paid to issues such as patient focus, cost effectiveness, service quality, adaptability to the constraints of the organisation, and integrated use of information at both the hospital and clinic level (Övretveit, 1992; Flarey, 1995). Moreover, a holistic overview based on system thinking is vital, including the gathering of data from multiple sources in order to correlate costs with the utilisation of resources. The challenge is to define models that can support the design of an HIS.

1.1.1. Organisational and work process models in medical informatics

The main purpose of reengineering was to focus on the processes rather than the functions of an organisation (Hammer, 1990). Further organisational enhancement could be achieved with quality methods such as Total Quality Management (TQM), which included process-oriented models. Another approach is to modify the business culture such that it becomes a learning organisation (Senge, 1990). In the financial area, Balanced Scorecard has been used to translate mission and strategy statements into operational objectives and measurement variables (Kaplan & Norton, 1996). When it comes to medical informatics, attempts have been made to design various kinds of organisational models, such as socio-technical modelling (Berg et al., 1998). The rationale for introducing these models is to gain a greater understanding of the ways in which an HIS will affect the allocation and content of work tasks. Changes in work activities require modification of information management (Berg, 2001). The validity of a technology rests not only on the fulfilment of functional specifications, but also on the interaction of the technical system with its
organisational environment (Brender, 1998). The resulting conclusion that has been drawn today is that social, organisational, cultural and contextual issues should be taken into consideration at an early stage of the development process (Kaplan, 2001).

Moreover, approaches such as cultural-historical activity theory have been used to perform contextual analyses of clinical cognition and activity. Cultural-historical activity theory argues that studying the present healthcare setting is insufficient – a researcher must also become acquainted with the history of the setting, given that clinical cognition is embedded in broader institutional structures and longstanding evolution (Engeström, 1995). One method was to highlight patient data on the presumption that the objective of any healthcare organisation is to improve the health of individuals (Engeström, 1999). Other researchers argue for a framework that allows for a constant interplay of different models, theories and perspectives (Maij et al., 2002). The advantages of integrated frameworks are that methods and models can be optimised during the development process, while methods with specific weaknesses can be reinforced by others (Timpka, 1995). Finally, there are approaches for exploring the ways in which healthcare providers tend to reason in clinical contexts – such as situated action, an emerging perspective for studying human cognition and behaviour in order to design intelligent systems (Patel, Kaufman & Arocha, 1995). Such models address the clinical tasks that are to be performed within specific guidelines and define criteria for selecting appropriate options when there is a set of potentials (Wang et al., 2002).

1.2. Aims of the study

The aim of this thesis is to develop a management information system model for process-oriented healthcare organisations, based on two questions: “What kinds of requirements do healthcare managers place on information systems?” and “How can the work and information systems of healthcare managers and care providers be incorporated into process-oriented healthcare organisations?”

The work is based on a circular process, during which models are developed by collecting and categorising data, as well as by designing small-scale theories about information systems. Organisational process is defined as “a sequence of work procedures that jointly constitute complete healthcare services”. A work
activity is defined as a set of work procedures that are closely related by virtue of their purpose and means of performance. A functional unit is the organisational venue responsible for a certain set of work activities. Healthcare Information Systems (HIS), Management Information Systems (MIS) and Information and Communication Technology (ICT) all define computer-based information systems.

2. Research methods

A qualitative research strategy, based on an idiographic case study, was employed. Qualitative research, which has evolved within several disciplines, consists of a set of interpretive practices. It does not accord priority to any single methodology for data collection and analysis, nor does it have a theory or paradigm that is distinctly its own (Denzin & Lincoln, 1998). Qualitative research is best suited for understanding the processes inherent to a situation, along with the beliefs and perceptions of the people involved. Nevertheless, qualitative researchers can make their findings more widely applicable (Firestone, 1993). Furthermore, a case study is both a process of inquiry and the product of that inquiry (Stake, 2000). The researcher needs a wide array of information about the case in order to provide an in-depth assessment (Creswell, 1998). A primary distinction is between single-case and multiple-case designs of such studies (Yin, 1994). A case study whose primary mode of research is hermeneutic is idiographic in a natural setting - its main type of data is qualitative and its fundamental level of analysis is holistic (Fishman 1999). Interpretive studies are well served by a considerable degree of openness to field data, along with willingness to re-examine initial assumptions and theories. The result is an iterative process of data collection and analysis during which initial theories are expanded upon, revised or abandoned altogether (Walsham, 1995).

2.1. The setting of the case study

The setting of the study was a paediatric clinic at a county hospital in Sweden. In 1996, the county council adopted a wide-ranging quality program based on TQM and a Plan-Do-Check-Act (PDCA) cycle. In 2000, the county council started using Balanced Scorecard to measure the healthcare organisation’s outcomes. At the time of the study, the county’s development and change program for
organisational quality was based on a CAS strategy. Furthermore, a process-oriented healthcare information system was being designed.

With some 30 clinics and 3,200 employees, the hospital had identified its main organisational objectives as the delivery of emergency and specialist healthcare, as well as county-wide rehabilitation and habilitation services. The purpose of habilitation is to enable someone with a congenital impairment, whereas rehabilitation focuses on recovering lost ability. Above and beyond the responsibilities of healthcare managers in accordance with the functional structure, all clinics at the hospital (including paediatrics) had developed work processes for specific groups of patients. These Patient Need Group Processes (PNGPs) centred on the healthcare needs of individual patients. The main objective of the PNGPs was to cultivate and maintain a high level of knowledge about medical care at the paediatric clinic. The scope of the processes varied considerably. However, a PNGP unit always comprised at least a doctor, nurse and secretary. If necessary, several clinics, hospitals and county councils could collaborate on the same process. In order to improve nursing care, development teams, staffed by practitioners interested in development work, were set up. Specific development areas included palliative care and the use of technical equipment. The teams produced documents concerning their specific areas that could prove of value for their co-workers. New work routines were developed for nursing care and for activities that are indirectly related to the patient care process, such as meal delivery, ordering medication and play therapy. The teams had contact people at each ward who were prepared to step in whenever nursing care problems arose. The team members normally attended meetings during their free time – or overlapping time when two shifts were on duty simultaneously.

The paediatric clinic also cooperated with maternity wards and a total of 13 Child Health Centres (CHCs) throughout the county. The clinic was part of a network of specialist clinics in southern Sweden that focused on the exchange of knowledge and experience. At the time of the study, the paediatric clinic employed 12 senior physicians, 21 physicians, 91 nurses, 77 paediatric nurses (specialist nurse’s aides) and 13 secretaries. The management team consisted of six senior physicians, seven nurses and one secretary from the clinic. During the period of the study, the paediatric clinic supplied approximately 16,000 bed-days to inpatients, performed 5,000 scheduled surgical interventions and handled
6,000 emergency room visits by children. The paediatric clinic comprised one surgical unit and three wards, each with a physician responsible for medical matters and a nurse as manager. The ward for neonatal patients had eight beds for intensive care and ten for prenatal care. The ward for contagious patients had 16 isolation rooms for newborn babies and contagious children. The institutional care ward for children older than a year had 18 beds. The clinic used 15 PNGPs.

2.2. The data collection

The collection of data was conducted throughout documents, archives, interviews, observations, diaries, focus groups and feedback loops.

2.2.1. Archival data

Archival data was used to place the research into context before, during and after the studies at the clinical site (Drury, 2002). An obvious danger posed by fixed data is that it can easily become outdated unbeknownst to the researcher. In these studies, archival data was related to: 1) annual reports by the clinic; 2) the county council’s quality pronouncements; 3) the government’s bill for the healthcare organisation; 4) the physical and mental health survey of hospital employees; 5) reports concerning the county council’s development plans for an HIS.

2.2.2. Interviewing

A common interviewing technique is to meet face to face (Fontana & Frey, 1998). The interview may be structured, semi-structured or unstructured. The scope of an interview can range from five minutes to the lifetime of the subject (Fontana & Frey, 2000). This study involved semi-structured interviews with four doctors and four nurses. A series of open-ended questions addressed daily work routines and communication patterns.

2.2.3. Diary method

The holistic perspective of this approach identifies connections among the individual, societal and organisational levels. One of the techniques that have evolved is the diary method, which proceeds from subjective assessments of time utilisation. The various steps require a practitioner to enter time, activity,
location, the names of co-workers with whom they interact and other comments
during a specified period (Ellegård, Nordell & Westermark, 1999). In this study,
a ward nurse kept a diary during one workweek. She entered the nature of her
work tasks, the times that she performed them and the names of the co-workers
with whom she interacted.

2.2.4. Observation

Observation involves gathering impressions of the surrounding world. Qualitative observational research is fundamentally naturalistic (Adler & Adler,
1998). There is “descriptive observation”, in which the researcher assumes that
he or she knows nothing about what is going on and takes nothing for granted.
He or she employs “focused observation”, ignoring that which is defined as
irrelevant. Finally there is “selective observation”, the most systematic approach,
during which the researcher concentrates on the attributes of various activities
(Angrosino & Mays de Pérez, 2000). This type of observation requires a
notebook, a storage location for the data that is collected during the process (Ely,
1993). The researcher observes and interacts with care providers at the paediatric
wards before and after their rounds. Alongside the observations, the clinical
staffs were interviewed again about what they were doing, why they were doing
it, what they hoped to gain from an HIS and what benefits they expected. Field
notes were entered into a log during the observation study.

2.2.5. Focus groups

A focus group’s planning process should begin as soon as it is set up. The
process includes the following steps: establish research objectives, appoint a
moderator, develop moderator guidelines and draw up procedures. The
moderator plays an important role during the group session. He or she conducts
the interviews. It is important that the moderator not be the same person that
put together the moderator guidelines and questions. In this study, a focus
group session was held with seven nurses and three paediatric nurses, all of
whom were women selected by a ward nurse. The participants had various
duties at the paediatric clinic, where they had been employed for anywhere from
9½ to 32 years. Five nurses were ward managers and two also managed
development teams. They all had experience at each ward, as well as the
paediatric surgery. The researcher had furnished the group moderator with
guidelines and questions (Greenbaum, 1993). The questions were based on the clinic’s profile of itself: administrative activities, care provision and development work. Questions also dealt with work activities and the exchange of information with other units. Some questions focused in on a patient’s relations with the care providers, as well as the time and place for the performance of care activities. The entire focus group session was videotaped and transcribed.

2.2.6. Feedback loops

Feedback loops throughout the research project permitted the generation of reports for evaluating data collection. A total of four reports were sent to the practitioners as a result of the case study. In addition, four seminars were held with the practitioners, the purpose of which was to discuss the research findings. The practitioners discussed and critiqued the results.

2.3. Analyses

There was no theory at the beginning as to how the material should be analysed. The first step was to break down healthcare management into the hospital, clinical and care process levels. Statements from the various management levels were interpreted on the basis of information requirement, i.e. main objectives, system functions, expected benefits and risks to be avoided. The second step was the analysis of three main work activities, each with three work procedures, at the clinic level. The third step involved the design of a management information system model. All empirical data was categorised. Various themes were identified and classified. After the categories had been cross-compared and clustered, abstract new categories were defined (Strauss & Corbin, 1990). The final analysis started with a category-by-category comparison, which enabled the identification of core categories that were sent to the paediatric clinic as a preliminary report for comment and critique (Glaser, 1978). Finally, the categories were modified in response to the comments. The focus was to come up with a context-based, process-oriented description and explanation of the phenomena (Orlikowski, 1993).

The categories were incorporated into two small-scale theories. The first theory interpreted the information requirements of three management levels. The second theory interpreted the work processes employed by institutional care.
2.4. **Modelling**

In order to conduct the final analysis, the two small-scale theories were applied to the modelling of a management information system. Various possible approaches included data modelling (Connolly, Begg & Strachan, 1996), function modelling and object-oriented modelling (Booch, Rumbaugh & Jacobson, 1999). To handle such approaches, various modelling languages have been developed, including the object-oriented Unified Modelling Language (UML) (Fowler & Kendall 1999). The symbols and notations of the various languages can be difficult for the uninitiated to grasp (Sommerville & Sawyer, 2000). Furthermore, the notation and logic for modelling a system must work in tandem with the people involved in the development process. Thus, it is useful to visualise the information flow by means of a modelling approach, using notation and logic that have been established by consensus. As a result, the management information system models were designed in dialog with the practitioners in the case study. The notation was taken from Eriksson & Penker’s (2000) business processes but modified on the basis of the discussions.

3. **Results**

The results are presented in accordance with the three sub-analyses. The first sub-analysis focused on the requirements of healthcare managers for an HIS. The second sub-analysis focused on interpreting organisational and work processes in relation to the HIS. The third sub-analysis focused on designing a management information system model for process-oriented healthcare.

3.1. **The requirements of healthcare managers for an HIS**

Hospital management expressed its intention to use an HIS to empower patients while maintaining control of resource utilisation. Thus, the planned HIS was expected to encourage a greater overall awareness of cost effectiveness with respect to the services provided by various units of the hospital. The biggest risk noted was that of a mismatch between the system and the existing organisational culture, in which it was easy to identify and reward employees who handled

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1 Requirements and demands are used as synonym in this chapter and in article 1.
emergencies. As a result, some of the staff appeared to resist a new way of transmitting information throughout the various levels of the organisation.

The goals of the functional units (i.e. clinic management) focused on patients and the introduction of leadership based on co-determination. While management accepted patient empowerment and cost effectiveness as their main objectives, they thought it was important that employees be allowed to make their own organisational decisions. Management wanted to see a new approach to measuring the activities of their organisational unit. In order to achieve these goals, they sought a way to define the data that is essential to making a reliable estimate.

In managing the healthcare process, the objectives of an HIS centred on developing and maintaining specific clinical competence by enhancing support for decision-making and co-operation on the part of care providers. While all the process managers agreed that sharing information and knowledge was important to improving the decision-making process, they were unaware of resource competition issues. However, the withholding of information was not always intentional. Due to limited resources and full schedules, process managers were often unable to share their knowledge with other employees.

3.2. Interpretation of organisational and work processes in relation to HIS

Work activities included: (1) co-ordination of information exchange management; (2) care, including documentation of the care provided and the practice that had evolved at the clinic; (3) supply, including patient assistance and psychosocial support. The work procedures of the various activities were often related to and dependent on each other.

Co-ordination activities were oriented toward management of the wards and the clinic. The activities focused on co-ordinating various types of information in order to support the care effort. External co-ordination is related to the exchange of information between the paediatric clinic and other care units. This co-ordination continued after the patients had been discharged from the clinic. Thus, the coordination of external resources and inter-organisational collaboration was important to the management of the clinic. Patient co-ordination started before a patient was admitted to institutional care. There were two
reasons for such approaches. First, the amount of time that patients stayed at the wards proved expensive for the healthcare organisation. Thus, such approaches saved money. Second, these approaches enhanced the relationship between care providers and caretakers, assuming that patients and their families were kept well informed. Internal co-ordination was related to management and planning activities at the clinic and the wards. Such activities were linked to external and patient co-ordination, given that providers needed to cooperate with other units and patients in order to manage ward care.

Care activities were underpinned by what had been agreed upon during the co-ordination of work activities and the information that was to be used by various co-ordination procedures. Care provision involved medical and nursing care performed by physicians, nurses and paediatric nurses. Care activities were broken down among the various professions. But care was regarded as teamwork from the point of view of the patients. Thus, the work tasks of the various professions cumulatively became what are referred to as the outcome of care provision. Practice development took in both medical and nursing care issues. The knowledge and information cultivated was incorporated into the ordinary work routines of the paediatric clinic. Care documentation activities were linked to care work and development efforts. Documentation provides protection for both care providers and patients. Care documentation served as a means of communication among care providers.

Supply activities were indirectly related to care activities. Among employees who performed supply activities were nurses, paediatric nurses, kitchen staff, cleaning staff, play therapists and teachers. Material provision furnished care activities with pharmaceuticals, equipment and materials. Based on the resources that material provision furnished to care activities on a daily basis, estimates were prepared concerning the resources the activities would require over time. Bandages, diapers, syringes, etc. were also a part of material provision. Material provision also included equipment and supplies for play and school activities, such as games, videotapes and textbooks, as well as kitchen and cleaning supplies. Psychosocial support activities called for an information system that could offer emotional support, such as administrative tasks associated with permitting patients to have their own personal phones. Thus, psychosocial support depended on the ability of patient co-ordination efforts to proceed smoothly, assuming that both patients and their families could be kept well
informed. The main purpose of Patient assistance, which included both material provision and psychosocial activities, was to assist care activities. Such activities were related to supporting the physical and mental well-being of patients while undergoing medical and nursing care.

3.3. A management information system model for process-oriented healthcare

The county council formally required that hospital management monitor and report on service production with regard to quality and cost. As a result, hospital management needed data about resource utilisation and healthcare quality from the hospital organisation, along with information systems that could support methods such as Total Quality Management (TQM) and Balanced Scorecard. To monitor costs and quality, hospital management needed data from the functional units after determining what needed to be collected.

The focus of process management was developing and maintaining a high level of quality in the medical and nursing care processes. The process unit was responsible for documentation and quality control operations. Process management needed directives from the functional management unit about both data collection templates and quality for medical and nursing care. Process management generated information about medical and nursing quality data for functional unit management. Best practice guidelines and decision support protocols for clinical practitioners were involved in the clinical process. The HIS application required by process management was a service quality control system that could extract data from and support decision making for medical and nursing care.

Functional unit management comprised managers at both the clinic and ward levels. Clinic management organised the monitoring of the clinic’s resources, while ward managers co-coordinated the exchange of information at the wards. Functional unit management requested information about resource allocation specifications and templates for expenditure reports, as well as for patient satisfaction and staff work satisfaction data, from hospital management. Functional unit management needed data concerning the perceptions of patients and staff with regard to the services provided by the unit. Management was also looking for a way to relate its expenditures to resources utilised. In other words, its primary needs were in the areas of data collection, storage and access tools.
Thus, functional unit management required data from clinical activities, but not at an individual or contextual level. The systems it was seeking were to supply data for use at a composite level, including the volume of financial and human resources that specified care activities necessitated.

To monitor service delivery, management units in process-oriented healthcare organisations need data in three distinct areas: (1) medical and nursing care, (2) patient flows and (3) the utilisation of human and material resources. Although the management units may have access to a common data warehouse, requirements for data analysis and presentation vary considerably. Similarly, data collected from the healthcare organisation during daily work routines can be shared, but the primary data must be converted into a format that is usable by healthcare managers. The data that is collected should ideally be located where it can be made available to ordinary healthcare activities. For instance, networked devices can be used to monitor pharmaceutical use. Intelligent devices can also be connected to equipment in order to track their use, and material storage and use (diapers, sheets, etc.) can be traced by bar-code systems. Furthermore, patients and healthcare staff can be registered with smart cards as they come and go. However, computerised patient records (CPRs) are the most logical central resource for data collection in the clinical setting. The data that is documented in the records can be used to monitor the clinical activities that have been performed. CPRs can also furnish data about work activities at the healthcare organisation. Such data is of little value as long as it is limited to individual patients. What is useful is to analyse cumulative data, such as the number of radiology examinations that have been conducted on leukaemia patients. The purpose of the data warehouse is to store what has been collected from various sources. The application and its interface are the parts of the HIS with which healthcare managers interact and with which users most readily identify. Thus, the application must help healthcare managers use information and must supply the right information to the right healthcare managers. Moreover, the application must support the specific analysis methods, tools and data formats required by current organisational analysis procedures, such as Balanced Scorecard and quality assurance methods.
4. Discussion

The aim of this thesis was to develop a management information system model for process-oriented healthcare organisations. The research effort employed qualitative methods such as archival data analyses, interviews, observations, diary analyses and focus group analyses. Constant feedback loops among the participants in an idiographic case study helped establish a balanced interpretation. Meanwhile, categorising and modelling formed the pattern of interpretation for the management information system model.

The main findings of the study are that an HIS in a process-oriented organisation must support the medical work, integrate clinical and administrative tools, and furnish information that allows for the measurement of organisational inputs and outcomes. As a result, it is important to identify the multiple roles that information plays in a process-oriented healthcare organisation. Most of the organisational development methods that healthcare currently takes advantage of, such as reengineering and quality management, include process definitions. However, the interaction between various groups of processes has seldom been analysed. Several recent organisational methods, such as Balanced Scorecard (Kaplan & Norton, 1996), address the problem of relating costs to resources.

The areas in which information systems are expected to enhance care delivery range from access to medical knowledge bases, patient and clinician communication, and the minimisation of medical errors. Nevertheless, little attention has been paid to how integrated administrative, financial and clinical systems should be configured in order to support process-oriented healthcare organisations in an optimal manner. Internal co-ordination is informed by and dependent on documentation of care activities, particularly by monitoring the way in which human resources are harnessed to take care of patients. Furthermore, such co-ordination relies on information about the utilisation of material resources, i.e. durable equipment and disposables. Thus, internal co-ordination must obtain information from care activities in order to synchronise the work of the clinic, as well as to track costs associated with care and supply activities. The various processes monitor costs and allocate resources, relating them to the kinds of care activities that have been provided.
The third sub-analysis discovered that the various management levels in process-oriented healthcare organisations need the same type of primary data, though in differing formats. An HIS for healthcare management in a process-oriented healthcare setting can adhere to its structure and practice activities. Moreover, CPRs and other tools can be used to directly collect management data where and when the activities take place. But the data is useful only if healthcare management has the opportunity to examine it with its own analysis tools. For instance, while computerised ordering systems are regarded as important, the fit between organisational and information system models is not identified as a success factor.

Clearly, there is a need for systems that optimise clinical workflow, as well as those that support the maintenance of equipment and supplies. However, systems provide optimal organisational value only if they support an integrated organisational model and business plan.

5. Conclusions

This thesis points out that healthcare managers at different levels in an organisation all need the same primary data. The differences among the various management levels all concern the ways in which they compile the data that they need for their work.

One problem when developing management information systems for healthcare organisations has been a lack of interest in integrating administrative, financial and clinical systems. In process-oriented healthcare organisations, integration is essential to obtaining the full benefits of such a structure. System thinking must also pervade the development of healthcare management information systems. As a result, the multiple roles played by information in process-oriented healthcare organisations must be identified.

6. Future work

Identifying the multiple roles played by information in a process-oriented healthcare setting requires additional research about the process of designing an HIS. In the complex environment that healthcare organisations represent, various practitioners are required to pinpoint data sources and information
requirements, as well as to advocate for the process of change in the organisational and information structure. Healthcare managers have differing preferences when it comes to information requirements, organisational processes and work activities. Thus, the development process relies on tools that can incorporate those divergent needs into system thinking. As a result, primary data is refined into information differently at the various levels of a process-oriented healthcare organisation.

More research is required concerning information system models and their notation. Though various groups (system analysts, designers, programmers and healthcare managers) can employ models and modelling activities during a development process, their objectives differ. Healthcare managers need to visualise their work environment and organisational processes, system analysts are interested in developing information systems in collaboration with designers, and programmers are looking for coding specifications. They may share a vision in terms of designing a healthcare information system, but their perspectives vary. Thus, the modelling effort should be based on at least two dimensions: (1) furnishing models with notations and objectives oriented towards specific groups; (2) ensuring that the models visualise the same system but address varying interpretations.

Arguments based on the cognitive and practice perspective have identified prototyping as a fruitful approach to the development process (Houde & Hill, 1997). Prototyping is often used when the design calls for a high degree of involvement on the part of practitioners and end-users (Bødker & Grønbæk, 1991). Modelling, on the other hand, is linked to an organisational perspective and is frequently employed by system analysis methods. Thus, there is an opportunity to combine these two perspectives during the development process. Modelling is useful as part of a design theory with a high degree of practitioner involvement alongside of system analysts, designers and programmers. The process can subsequently be analysed based on the representations in the models that emerge from the requirements of the various groups. Additional research should examine what the groups need when it comes to the substance of the models, how the models are to be visualised and the ways in which they can interact with the differing requirements of the groups in order to ensure a fruitful development process.
7. References


