



ELSEVIER

International Journal of Medical Informatics 64 (2001) 99–109

International Journal of
**Medical
Informatics**

www.elsevier.com/locate/ijmedinf

Strategic information management plans: the basis for systematic information management in hospitals

A.F. Winter ^{a,*}, E. Ammenwerth ^m, O.J. Bott ^c, B. Brigl ^a, A. Buchauer ^b,
S. Gräber ^d, A. Grant ^e, A. Häber ^a, W. Hasselbring ^f, R. Haux ^m,
A. Heinrich ^g, H. Janssen ^h, I. Kock ⁱ, O.-S. Penger ^j, H.-U. Prokosch ^k,
A. Terstappen ^c, A. Winter ^l

^a Institute for Medical Informatics, University of Leipzig, Statistics, and Epidemiology, Liebigstraße 27, D-04103 Leipzig, Germany

^b Institute for Medical Biometry and Informatics, University of Heidelberg, Heidelberg, Germany

^c Institute for Medical Informatics, Technical University of Braunschweig, Braunschweig, Germany

^d Institute for Medical Biometry, Epidemiology and Medical Informatics, Saarland University Hospital, Homburg, Germany

^e Department of Clinical Biochemistry, University of Sherbrook, Quebec, Canada

^f Department of Software Engineering, Faculty of Computer Science, C.v.O. University of Oldenburg, Oldenburg Germany

^g Network Department GmbH, Berlin, Germany

^h Central Hospital Reinkenheide, Bremerhaven, Germany

ⁱ Kock, Arnold & Partner Business Consulting, Hamburg, Germany

^j SMS Dataplan, Hamburg, Germany

^k Institute for Medical Informatics and Biomathematics, University of Münster, Münster, Germany

^l Institute for Software Technology, University of Koblenz–Landau, Landau, Germany

^m University for Health Informatics and Technology, Tyrol, Innsbruck, Austria

Abstract

Information management in hospitals is a complex task. In order to reduce complexity, we distinguish strategic, tactical, and operational information management. This is essential, because each of these information management levels views hospital information systems from different perspectives, and therefore uses other methods and tools. Since all these management activities deal only in part with computers, but mainly with human beings and their social behavior, we define a hospital information system as a sociotechnical subsystem of a hospital. Without proper strategic planning it would be a matter of chance, if a hospital information system would fulfil the information strategies goals. In order to support strategic planning and to reduce efforts for creating strategic plans, we propose a practicable structure. © 2001 Published by Elsevier Science Ireland Ltd.

Keywords: Hospital information system; Hospital information system management; Information management; Organizational issues; Strategic plan

* Corresponding author.

E-mail address: winter@imise.uni-leipzig.de (A.F. Winter).

1386-5056/01/\$ - see front matter © 2001 Published by Elsevier Science Ireland Ltd.

PII: S1386-5056(01)00219-2

1. Introduction

High quality healthcare depends on extensive and carefully planned information processing. The expenses associated with information processing have been subjected to cost analysis and already in 1993 it was estimated that within the European Union about 3.5 billion Euro were spent on the computer supported parts of hospital information systems, with a projected 15 billion Euro in 2000 ([1], p. 2). A more recent investigation states, that ‘the current European market size for hospital information systems is 2.4 billion \$US compared to 2.7 billion \$US in US’ [2]. To this amount, the costs of conventional/manual information processing must be added. This indicates the paramount importance of information processing (regardless if computer-based or conventional/manual) and information management for hospitals. At the same time it indicates that information management is developing from a secondary to a primary subject of institutional management [3,4].

Success of information systems implementations does not only depend on the quality of hard- and software used. Berg cites in [5] that some 75–98% of computer supported management information systems ‘should be considered as failures’ and argues similarly as [6] that organizational issues are and have been the key factors for success, precisely unsuccessfulness. As a consequence, Aarts et al. propose in [7] a model for describing the stages involved in information and systems changes. Knaup et al. report on a method for planning and executing projects for introducing information systems’ components properly and systematically [8]. Hence these papers concentrate on tactical tasks of information management.

The costs and ‘success’-rates mentioned make obvious, that organizational issues in

health informatics and especially the quality of information management are important factors for hospitals to gain a competitive edge. In the USA for example, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO)¹ includes 10 information management standards in its accreditation process to assess the quality of an organization as a whole. For a review of the information management standards the healthcare organizations have to present a strategic information management plan [9]. So JCAHO stresses the strategic aspects of information management. Similarly, professional consultants on healthcare emphasize the important role of a systematic information management and the necessity of strategic plans [10]. This corresponds to the personal experiences of the authors who are working as information managers in large hospitals, as consultants, and in software industries.

These considerations in mind the aim of this paper is

- to clarify the difference between strategic, tactical, and operational information management in hospitals,
- to explain the significance of strategic information management plans for *all* information management activities and
- to give support for the construction of strategic plans by proposing a practicable structure.

We will define the terms *information management in hospitals* and *hospital information system* and differentiate *strategic*, *tactical*, and *operational information management*. We will show, that tactical and operational management depend on strategic information management and especially on strategic information management plans. The proposed structure of strategic plans should serve as a basic guideline for drawing up such plans.

¹ <http://www.jcaho.org>

2. Information management in hospitals

2.1. Definition of information management in hospitals

Interpreting the term management in a functional manner, management contains all leadership activities that determine the enterprise's goals, structures, and behavior. According to [11] (p. 21), we define:

Information management in hospitals is the sum of all management activities in a hospital that transpose the potential contribution of information processing to fulfill the strategic hospital goals into hospital's success.

Therefore, it manages the maintenance and operation of an appropriate information system for the hospital. When a new hospital is planned and constructed the hospital information system's initial construction has also to be managed.

2.2. Definition of hospital information systems

Hospital information systems can be characterized by their functions, their types of processed information and their types of services offered. In order to support patient care and the associated administration, the tasks of hospital information systems are to provide:

- information, primarily about patients, in a way that it is correct, pertinent and up to date, accessible to the right persons at the right location in a usable format. It must be correctly collected, stored, processed, and documented;
- knowledge, primarily about diseases—but also for example about drug actions and adverse effects—to support diagnosis and therapy;

- information about the quality of patient care and about hospital performance and costs.

This highlights, that hospital information systems have to provide high quality communication between the various hospital sectors in terms of both information and knowledge related functions [12].

In addition to patient care, university hospitals undertake research and teaching to gain medical knowledge and deepen understanding. New knowledge is gained from specific experiences in patient care through careful data collection.

A hospital is itself a system, precisely a sociotechnical system, in which human beings and machines carry out specific actions following established rules. In this context, it is not surprising, that introducing components of a hospital information system needs a sociotechnical approach [5]. Therefore, we should consider a hospital information system as a sociotechnical subsystem of a hospital [13] and we define similar to [14]:

A hospital information system is that socio-technical subsystem of a hospital, which comprises all information processing actions as well as the associated human or technical actors in their respective information processing role.

That part of the hospital information system in which computer systems are used as tools for information processing is referred to as the computer-supported part of the hospital information system; the remaining part is referred to as the non-computer-supported part.

2.3. Classification of information management tasks in hospitals

Because each hospital has a hospital information system from its very beginning we

must not question whether a hospital should be equipped with a hospital information system or not. The question of information management rather focuses on the issue, whether the performance should be enhanced, for example by using computer-supported information processing tools. Accordingly, information management engages in the following objects ([15], p. 1):

- information,
- application systems,
- computer-supported and non-computer-supported information and communication techniques.

The general tasks of management are planning, directing, and monitoring [11]. For information management in hospitals this means

- *planning* the hospital information system, respectively its architecture,
- *directing* its establishment and its operation, and
- *monitoring* its development and operation with respect to the planned objectives.

With respect to its scope information management can be differentiated into strategic, tactical, and operational management [11]. The corresponding activities will be specified in the next sections.

In summary, activities of information management can be classified by a three dimensional classification as depicted in Fig. 1.

2.4. Strategic information management in hospitals

Strategic information management deals with the hospital's information processing as a whole. It depends strictly on the hospital's business strategy and strategic goals and has to translate these into a well fitting information strategy.

The result of strategic information management *planning* activities is a strategic in-

formation management plan [16]. The plan includes the direction and strategy of information management and gives directives for the construction and development of the hospital information system by describing its intended architecture. A proposal for the structure and content of strategic information management plans will be presented in Section 3.

The strategic plan is the basis for strategic project portfolios. They contain concrete projects, which implement the objectives of the strategy, and shall be revised regularly.

Directing a hospital information system as part of strategic information management means to transform the strategic plan into action, i.e. to systematically manipulate the hospital information system in order to make it conform to the strategic plan. The system's manipulation is done by the initiation of the projects of the strategic project portfolio. The projects deal with the construction or further development and the maintenance of components of the hospital information system.

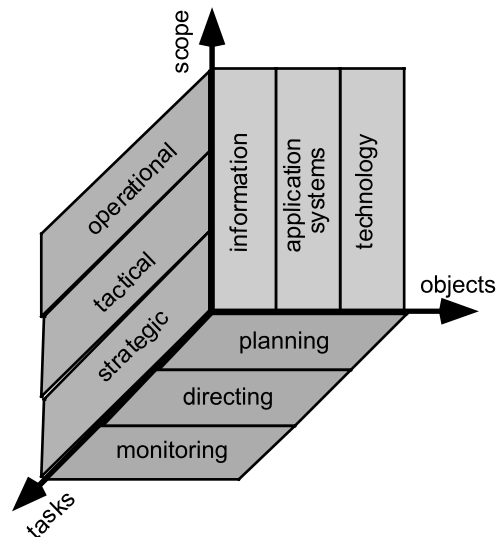


Fig. 1. Three-dimensional classification of information management activities.

Planning, directing and monitoring these projects are the tasks of tactical information management. Operational management will be responsible for the proper operation of the components.

Monitoring a hospital information system as part of the strategic information management means continuously auditing its quality as defined by means of its strategic plan's directives and goals. It should be audited, whether the hospital information system is able to fulfill its tasks. In order to be able to audit the information system's quality the management task is to install 'sensors'. They have to receive information from the projects running, from operational management, from users and from the various stakeholders. Additional information can be gained by evaluation projects (e.g. [17]).

Strategic information management and in result the strategic plan are the vital requirement for tactical and operational information management in a hospital.

2.5. Tactical information management in hospitals

Tactical management deals with certain enterprise functions [18], i.e. with hospital functions as for example the planning and documentation of operations. It aims to construct or to maintain components of the hospital information system. According to the example above, this could be an application system for planning and documentation of operations. Related activities are usually executed as projects; they have to be initiated as part of an information strategy, which is formulated in the project portfolio of a strategic plan as drawn up by the information management.

Planning in tactical information management means planning of projects and all resources needed. Even though projects of

tactical information management are based on the strategic plan they need a specific i.e. tactical project plan. This plan has to describe the project's subject and motivation, the problems to be solved, the aims to be achieved, the tasks to be performed, and the activities to be undertaken to reach the aims [8]. Based on that *directing* in tactical management means the execution of such projects of tactical information management in hospitals. Therefore, it includes typical tasks of project management like resource allocation and coordination, motivation and training of the personnel etc. *Monitoring* means continuously checking, whether the initiated projects are running as planned and whether they will still produce the expected results.

2.6. Operational information management in hospitals

Operational information management is responsible for maintaining the installed hospital information system and its components. It has to care for its operation in accordance with the strategic plan.

Planning in operational information management means planning of all resources like organizational structures, finance, personnel, rooms, buildings that are necessary to ensure the faultless operation of all components of the hospital information system. These resources need to be available for a longer period of time. Therefore, they should be allocated as part of a strategic plan. Moreover, planning in this context concerns the allocation of personnel resources on a day-to-day basis (e.g. planning of shifts).

Directing means the sum of all management activities, which are necessary to ensure proper reactions to operating faults of components of the hospital information system i.e. to provide back-up facilities, to operate a helpdesk, to maintain servers, to keep ready

task forces for repairing of network components, servers, personal computers, printers etc. Directing in this context deals with engaging the resources planned by the strategic plan in such a way that faultless operation of the hospital information system is ensured.

Monitoring deals with verifying the proper working and effectiveness of all components of the hospital information system. For example, a messaging infrastructure must be installed, which enables a quick transmission of users' error notes to the responsible services.

3. Strategic information management plans in hospitals

A strategic information management plan documents, how the goals of a particular hospital shall be supported by information technology. Therefore, it describes how information management will be organized, what the different working groups have to do and how the various stakeholders are concerned (Fig. 2). The strategic plan defines direction and schedule for all tactical and operational information management activities in the hospital.

As a result of our experiences in drawing up strategic information management plans for a municipal hospital in Bremerhaven and for university hospitals in Utrecht (Netherlands) [19], Heidelberg,² Homburg,³ and Leipzig⁴ we want to make some recommendations concerning structure and content of such plans [20].

3.1. Stakeholders and their concerns

There are various stakeholders⁵ involved in the creation, updating, approval, and use of strategic plans:

- top management,
- funding institutions,
- employees, e.g. physicians, nurses, administrative staff,
- clinical, administrative, and service departments,
- information management department (IM department),
- consultants,
- hardware and software vendors.

It has also been suggested to involve patients or patient organizations as stakeholders [19]. These stakeholders may have different expectations from a strategic plan and are involved in different life-cycle phases of strategic plans:

Creation, i.e. writing a first plan,

Approval, i.e. making some kind of contract among the stakeholders,

Deployment, i.e. asserting that the plan is put into practice,

Use, i.e. the involved stakeholders refer to the plan whenever needed,

Updating when a new version is required (because of new requirements, new available technologies, failure to achieve individual tasks, or adjusting the time frame of the plan). After the first version, the creation and update phases merge into a cyclic, evolutionary development of the plan.

Top management is interested in seamless and cost-effective operation of the hospital. They approve the plans, probably together with the funding institutions, which are pri-

² <http://www.med.uni-heidelberg.de/mi/department/service/rahmenko.zip>

³ <http://www.med-rz.uni-sb.de/zik/rahmenkonzept2000.pdf>

⁴ <http://www.imise.uni-leipzig.de/~gabi/KAS/Ueber-sichten/rahmenkonzept.html>

⁵ The term stakeholder is used to refer to everyone who may have some direct or indirect influence on the system requirements [21] (p. 80).

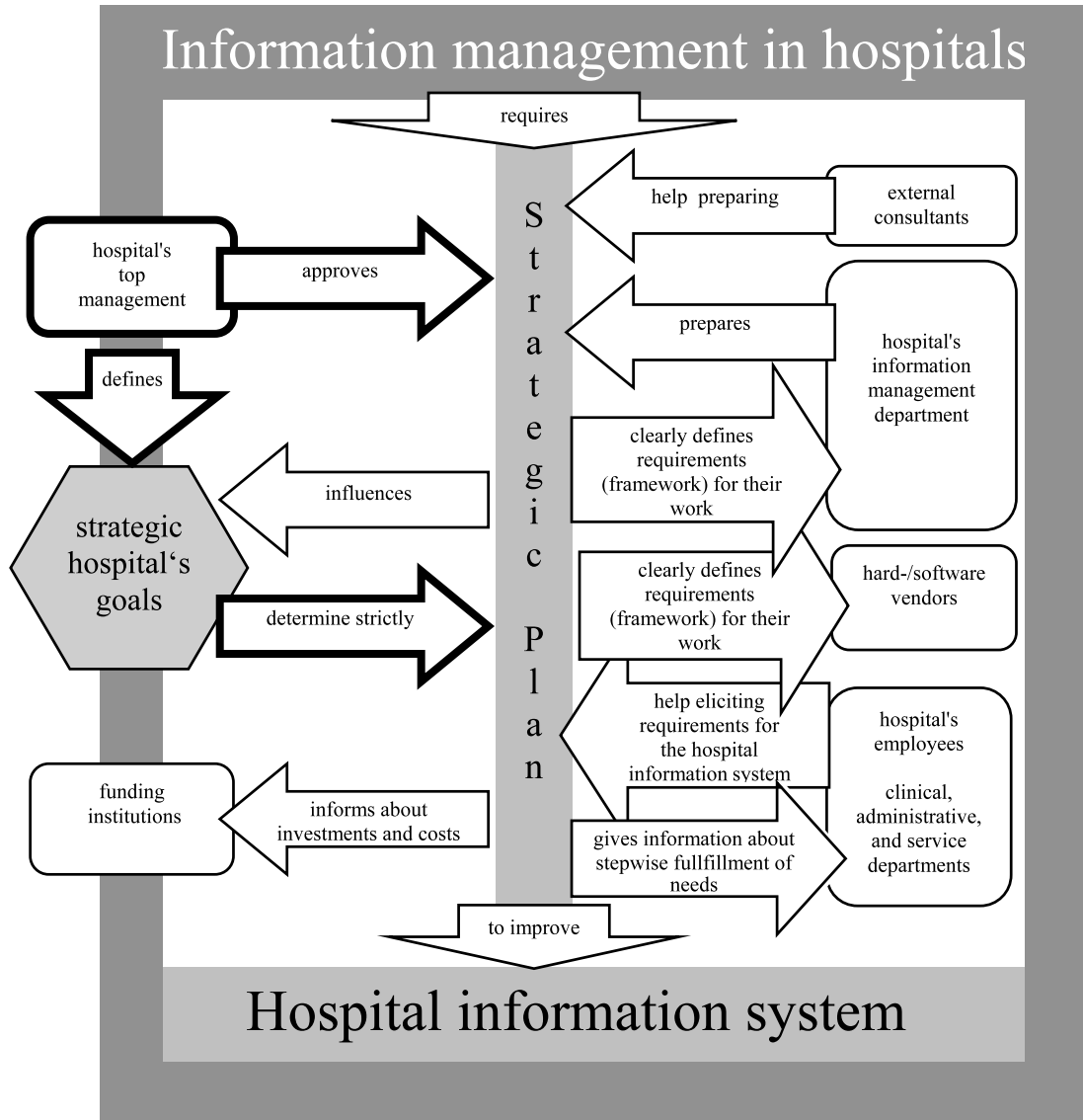


Fig. 2. Strategic plans for information management in hospitals.

marily interested in the financial consequences. Employees as well as the different hospital departments should be involved in eliciting the requirements, since they will use the resulting information systems. IM departments will usually create and maintain proposals for the plans. They are interested in clearly defined requirements for their work,

reflecting tactical management issues. Additionally the IM department usually has to deploy the plan, which cannot be done without effective backing from the top management. Due to technological and market changes and the development of the hospital over time, the validity of a strategic plan is temporal limited. Therefore, after a period of

3–5 years the IM department will initiate the update of the plan. External consultants may help creating or updating plans, but can also be effective in negotiations for the approval. The actual strategic plans will be used by the IM departments as well as by software or hardware vendors when constructing or maintaining components of hospital information systems.

3.2. Structure and content of strategic information management plans

The most essential purpose of a strategic plan is to improve a hospital's information system in a way it better contributes to the hospital's goals. This purpose determines its structure, i.e. it should show a path from the current situation to an improved situation, in which the hospital's goals are achieved as far as possible and reasonable.

A strategic plan should encompass the hospital business strategy or strategic goals, the resulting information management strategies, the current state of the hospital information system, and an assessment on how far the current information system fits to the strategies. The planned architecture should be derived as a conclusion of this assessment.

The strategic plan also has to deal with the resources needed to realize the planned architecture, and has to include a strategy for the operation of the resulting hospital information system and a description of appropriate long term organizational structures. Examples for resources are money, personnel, soft- and hardware, energy, rooms for servers and (paper-based) archives, and for training. The resources should fit to the architecture and vice versa.

The general structure of strategic plans for information management in hospitals can be summarized as follows:

- Strategic goals of the hospital and of the information management
- Description of the current state of the hospital information system
- Assessment of the current state of the hospital information system
- Description of the planned state of the hospital information system
- Path from the current to the planned state

This is only a basic structure that may be adapted to the specific requirements of individual hospitals. Particularly, a short management summary and appendices describing the organizational structure, personnel resources, the building structure, the network architecture, etc. are likely to complement a strategic plan.

3.2.1. Strategic goals of the hospital and of the information management

Hospitals aim at providing health care. However, these goals may be further refined. For instance, specific goals could be to increase the number of outpatients, to decrease the average duration of inpatient stays, to perform best quality patient treatment, to improve collaboration with healthcare institutions in the nearer region, to be more competitive by an image of being a modern hospital with all the latest technical means, to offer wholesome patient care by less technical but more personal engagement, to increase profit, and so on. Obviously, such very different and partly conflicting goals can result in different and conflicting information management strategies and different architectures of hospital information systems.

3.2.2. Description of the current state of the hospital information system

Before any planning is commenced, the hospital information system's current state should be described. This may require some discipline, because some stakeholders may be

more interested in the planned (new) state than in the current (obsolete) state.

The description of the current state will be the basis for identifying those functions [18] of the hospital that are supported well—e.g. by information technology—and those functions that are not (yet) well supported. Thus, application systems as well as existing information and communication technology have to be described including their contribution to the overall performance of the hospital's functions. The functions having to be considered here can be derived from the goals of the hospital.

Problems in information processing do not always have technical reasons only, but may also be caused by shortcomings in organizing information management [6]. Thus, the description of the current state should be completed by the description of the current organizational structure of information management.

3.2.3. Assessment of the current state of the hospital information system

When the current state is described, it should be assessed with respect to the achievement of the hospital's strategic goals and the related information management strategies. Note that missing computer support for a certain function may not be assessed in all cases as being a bad support for that function. For example, missing computers in patient rooms and in consequence a paper-based documentation of clinical findings may be more conforming to the goal of being a patient-oriented hospital than the use of computers and handheld digital devices in this area.

3.2.4. Description of the planned state of the hospital information system

Based on the assessment of the current state, a new state should be described that

achieves the goals better, provided that the current state does not already achieve the hospital's goals. Note that beside of technical aspects also organizational aspects have to be discussed. In many cases this is an opportunity for introducing a chief information officer (CIO) or to clarify its role respectively.

3.2.5. Path from the current to the planned state

This section should describe a project portfolio as a step-by-step path from the current to the planned state. It should include assigned resources, i.e. personnel, estimated investment costs as well as future operation cost, etc. and concrete deadlines for partial results of the portfolio's projects. This path could also assign priorities to individual projects as well as dependencies between projects.

4. Conclusion

Information management in hospitals is a complex task. In order to reduce complexity, we distinguish strategic, tactical, and operational information management. This is essential, because each of these information management levels views hospital information systems from different perspectives, and therefore uses other methods and tools. While strategic information management focuses on strategic plans, tactical management needs methods for project management, user requirements analysis, software development or customizing, etc. Operational management requires methods and tools for topics, which range from intra-enterprise marketing of services to helpdesk management and network management.

All these management activities deal only in part with machines and computers, but

mainly with human beings and their social behavior. As a consequence we proposed to define a hospital information system as a sociotechnical subsystem of a hospital.

We showed, that without a strategic information management plan, neither tactical nor operational management would work appropriately. A strategic information management plan is the ‘plot’ for planning, directing, and monitoring the hospital information system. It should be written and approved by the hospital management. Without proper strategic planning it would be a matter of chance, if a hospital information system would fulfil the information strategies goals.

But obviously, considerable efforts have to be made for creating strategic plans. Therefore, we propose a practicable structure, which might help information managers organizing their work.

Though we stated, that hospitals, which have a properly organized information management and especially an adequate strategic information management plan, gain better hospital information systems, we could not empirically prove this assertion so far. There are some arguments, which support this hypothesis:

- As cited in [22] (p. xxi), a study amongst practitioners, educators, and consultants determined ‘improving information systems strategic planing’ as one of the three most important issues of information management (out of 25).
- U.S. funding institutions seem to rely more on those hospitals, which are certified by the JCAHO and therefore have an adequate strategic information management plan.
- It is argued in [5,6] that bad information management leads to bad information systems.

The latter studies may be possible since it will not be so difficult to define what a really

‘bad’ information system is. But what are criteria for ‘good’ hospital information systems? So future work has to define such criteria, which enable us to compare ‘chaotically’ developed hospital information systems with systematically developed hospital information systems based on strategic plans.

References

- [1] J.H. van Bommel, An international perspective on information management and technology in health care, in: *Proceedings of Conference on Clinical Information*, London, 1993.
- [2] I. Iakovidis, *Towards a Health Telematics Infrastructure in the EU*, Information Technology Strategies from US and the European Union: Transferring Research to Practice for Health Care Improvement, IOS press, Amsterdam, 2000, pp. 23–33.
- [3] C.J. Austin, J.M. Trimm, P.M. Sobczak, Information systems and strategic management, *Health. Care. Manage. Rev.* 20 (3) (1995) 26–33.
- [4] A.L. Lederer, V. Sethi, Guidelines for strategic information planning, *J. Bus. Strategy* 12 (6) (1991) 38–43.
- [5] M. Berg, Patient care information systems and health care work: A sociotechnical approach, *Int. J. Med. Inf.* 55 (1999) 87–101.
- [6] N.M. Lorenzi, R.T. Riley, *Organizational Aspects of Health Informatics: Managing Technological Change*, Springer, New York, 1995.
- [7] J. Aarts, V. Peel, G. Wright, Organizational issues in health informatics: a model approach, *Int. J. Med. Inf.* 52 (1998) 235–242.
- [8] P. Knaup, R. Haux, A. Häber, A. Lagemann, F. Leiner, Teaching the fundamentals of information systems management in health care-Lecture and practical training for students of Medical Informatics (Heidelberg/Heilbronn), *Int. J. Med. Inf.* 50 (1998) 195–206.
- [9] M. Thomas, G. Vaughan, Preparing for the joint commission survey: the information systems perspective, *HIMSS. Proceedings* 3 (1998) 369–382.
- [10] Gartner Group, *Three Documents for Healthcare IT Planning*, Gartner Group’s Healthcare Executive and Management Strategies Research Note, KA-03-5074, 1998.

- [11] L.J. Heinrich, Informationsmanagement: Planung, Überwachung und Steuerung der Informations-Infrastruktur (Information Management: planning, monitoring, and directing of information infrastructure), Oldenbourg, München, 1999. (in German).
- [12] H.U. Prokosch, Hospital information systems: a pragmatic definition, in: H.U. Prokosch, J. Dudeck (Eds.), *Hospital Information Systems: Design and Development Characteristics; Impact and Future Architecture*, Amsterdam, Elsevier, 1995, pp. XI–XIII.
- [13] E. Lang, O.J. Bott, D.P. Pretschner, Specification of an Information System for Ophthalmology using Modelling and Simulation Techniques, in: R.A. Greens, H. Peterson, D. Protti (Eds.) *MED-INFO'95—Proceedings of the 8th World Congress on Medical Informatics*, 1995, 1092.
- [14] A. Winter, R. Haux, A Three-Level Graph-Based Model for the Management of Hospital Information Systems, *Methods Inf. Med.* 34 (4) (1995) 378–396.
- [15] H. Krcmar, *Informationsmanagement (Information management)*, Springer, Berlin, 1997 (in German).
- [16] J. Ward, P. Griffiths, *Strategic Planning for Information Systems*, John Wiley & Sons, Chichester, 1996.
- [17] E.M.S.J. van Gennip, F. Grémy, Challenges and Opportunities for technology Assessment in Medical Informatics. Report of MEDINFO'92 workshop, *Med. Inform.* 18 (3) (1993) 179–184.
- [18] J. Martin, *Information Engineering, Book II: Planning & Analysis*, Prentice Hall, Englewood Cliffs, 1990.
- [19] W. Hasselbring, R. Peterson, M. Smits, R. Spanjers, Strategic information management for a Dutch University Hospital, in: A. Hasman, B. Blobel, J. Dudeck, R. Engelbrecht, G. Gell, H.-U. Prokosch (Eds.), *Medical Infobahn for Europe*, IOS Press, Amsterdam, 2000, pp. 885–889.
- [20] A. Winter, B. Brigl, A. Buchauer, C. Dujat, S. Gräber, W. Hasselbring, R. Haux, A. Heinrich, H. Janssen, I. Kock, A. Winter, Purpose and structure of strategic plans for information management in hospitals, in: A. Hasman, B. Blobel, J. Dudeck, R. Engelbrecht, G. Gell, H.-U. Prokosch (Eds.), *Medical Infobahn for Europe*, IOS Press, Amsterdam, 2000, pp. 880–884.
- [21] I. Sommerville, *Software Engineering*, Addison-Wesley, Reading, MA, 1996.
- [22] S.H. Spewak, S.C. Hill, *Enterprise Architecture Planning*, John Wiley & Sons, New York, 1992.