Strategic Information Management in Hospitals

9

9.1 Introduction

Until now we have discussed how health information systems look like and how their quality can be described and measured. We will now examine how high quality health information systems can be achieved and how high quality can be maintained, especially in hospitals.

High quality HIS can only by achieved and HIS failures can only be prevented if the HIS are systematically planned, monitored and directed. We summarize this triad by the term 'information management'.

In this chapter, we will first differentiate information management with regard to different scopes. Hence we introduce definitions for *strategic, tactical* and *operational information management*. But this chapter, like the entire book, will focus on *strategic information management*. Systematic information management as a whole requires clear organizational structures. Implementing these is one of the first tasks of *strategic information management*. After discussing appropriate organizational structures for information management in hospitals we will explain what planning, monitoring and directing means especially in a strategic context.

After reading this section, you should be able to answer the following questions:

- What does information management mean and how can *strategic, tactical* and *operational information management* be differentiated?
- What organizational structures are appropriate for information management in hospitals?
- What are the tasks and methods for strategic HIS planning?
- What are the tasks and methods for strategic HIS monitoring?
- What are the tasks and methods for strategic HIS directing?
- How can experts for information management in hospitals be gained?

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9.2 Strategic, Tactical and Operational Information Management

In this section, we present in more detail the tasks of information management in hospitals. After reading this section, you should be able to answer the following questions:

- What does information management in general and in hospitals encompass?
- What are the three main scopes of information management?
- What are the tasks of *strategic, tactical*, and *operational information management* in hospitals?
- What is meant by IT service management and how is it related to information management?

9.2.1 Information Management

The concept 'management' can stand for an institution or for an enterprise function (see Sect. 6.3.3.8 and footnote 3 in Chap. 6). As an institution, management comprises all organizational units of an enterprise that make decisions about planning, monitoring, and directing all activities of subordinate units. As an enterprise function, management comprises all leadership activities that determine the enterprise's goals, structures, and activities.

We can distinguish between (general) management dealing with the enterprise as a whole and management dealing with distinguishable units of the enterprise. The management of the business unit information processing is called information management. In general, information management should contribute to fulfill strategic enterprise goals. Information management in an enterprise manages its information system and thus deals with the following objects:

- enterprise functions and entity types,
- application components, and
- physical data processing systems.

Information management

- plans the information system of an enterprise and its architecture,
- directs its establishment and its operation, and
- monitors its development and operation with respect to the planned objectives.

Different management scopes have different perceptions and interests. Hence, it is helpful to divide information management with regard to its scope into *strategic, tactical*, and *operational management*, which all comprise as main tasks planning, directing, and monitoring.

- *Strategic information management* deals with the enterprise's information processing as a whole and establishes strategies and principles for the evolution of the information system. An important result of strategic management activities is a strategic information management plan.

- *Tactical information management* deals with particular enterprise functions or application components that are introduced, removed, or changed. Usually these activities are done in the form of *projects*. Such *tactical information management projects* are initiated by *strategic information management*. Thus, *strategic information management* is a vital necessity for *tactical information management*. The result of *tactical information management projects* is the enterprise information system.
- *Operational information management* is responsible for operating the components of the information system. It cares for its smooth operation in accordance with the strategic information management plan. Additionally, *operational information management* plans, directs and monitors permanent services for the users of the information system.

This separation is essential because each of these information management scopes has different perspectives, and therefore uses different methods and tools. For example, *strategic information management* focuses on strategic information management plans (compare Sect. 9.4.3). Tactical management needs, for example, methods for project management, user requirements analysis, and software development or customizing. Operational management requires methods and tools for topics that range from intra-enterprise marketing of services to service desk and network management.

Figure 9.1 presents the relationships among *strategic, tactical*, and *operational information management*. Within *strategic information management* a strategic information management plan has to be created as result of planning activities. This depends clearly on strategic goals of the enterprise, which are given by the strategic enterprise management. Since the strategic information management plan contains a list of projects to be performed in the coming years (compare Sect. 9.4.3), strategic directing means to initiate these projects as tasks of *tactical information management*. Strategic monitoring collects different information regarding the state of the information system, its operation, users' opinions and directives of the strategic enterprise management. Within each project of *tactical information management* the course of the project has to be planned (project plan) and the project will be directed according to this plan. The results are components (application components and/or physical data processing systems) of the information system. Again, monitoring is needed in collecting information of the information system's state and deriving consequences for the respective projects but also for strategic decisions. When a project ends, the results have to be operated and thus we enter the scope of *operational information management*.

Management comprises only those tasks that are nonexecutive. Therefore, operational tasks (such as operating a computer server) are not part of management's tasks. However, those operational tasks have to be planned, directed, and monitored. This is carried out by *operational information management*.

Figure 9.2 presents a three-dimensional classification of information management activities. It shows the three objects of information management (functions, application components, and physical data processing systems), the three tasks (planning, directing, monitoring), and the three scopes (strategic, tactical, operational).

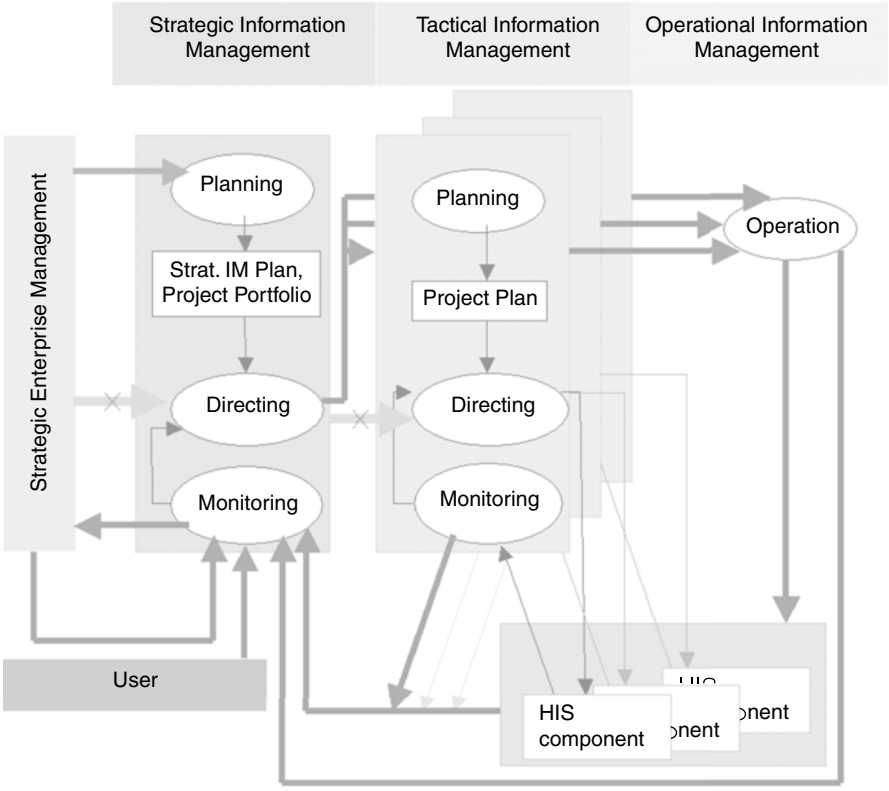

Fig. 9.1 Relationship between planning, directing, and monitoring during *strategic, tactical*, and *operational information management.* For explanation see paragraph before

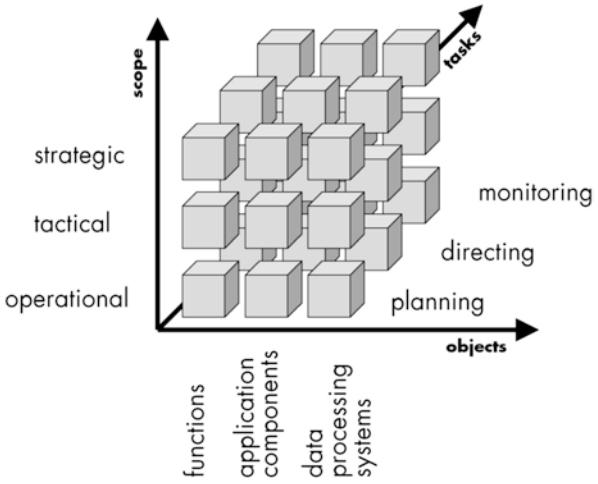

Fig. 9.2 Three-dimensional classification of information management activities

9.2.2 Information Management in Hospitals

We can now apply the defined management concepts to the enterprise "hospital". Information management in hospitals is the management of hospital information systems; hence we can use "HIS management" as a synonym. The tasks of information management in hospitals are:

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

Information management in hospitals is performed in an environment full of influencing factors. For example, decisions made by the hospital's management directly influence information management (e.g., a decision to cooperate in a health care network). New legal regulations have an effect on information management (e.g., a law enforcing the introduction of a new billing system based on patient grouping). Patients and users of the hospital information system with their values, attitudes, comments, demands, and fears also influence information management. On the other side, information management itself may affect, for example, the management of the enterprise (e.g., information management may propose to introduce a hospital-wide, multiprofessional *electronic patient record system*; this must in turn lead to strategic activities such as process reorganization).

Figure 9.3 presents this relationship between HIS management and HIS operation, and the influencing factors.

We now look at the activities of *strategic, tactical*, and *operational information management* in hospitals.

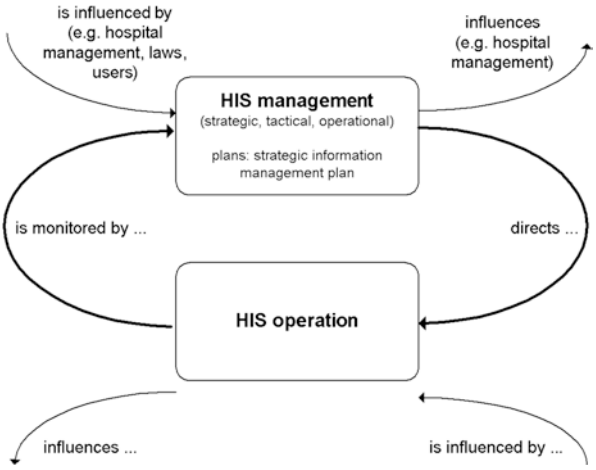

Fig. 9.3 *Strategic, tactical*, and *operational information management* in hospitals, HIS operation, and their relationships

9.2.3 Strategic Information Management

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 an appropriate information strategy. The planning activities of *strategic information management* result in a specific strategic information management plan. This 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 is presented in Sect. 9.4.3. The strategic information management plan is the basis for strategic project portfolios. They contain concrete projects, which implement the objectives of the strategy, and shall be revised regularly. For example, the strategic information management plan might contain the introduction of a *clinical information system* on all wards within the next 2 years to provide health care professionals with the right information, in the right place, at the right time. The strategic project portfolios could then contain individual projects, for example, on *decision making, planning and organization of patient treatment*, *order entry*, and *medical admission*.

Directing as part of *strategic information management* means to transform the strategic information management plan into action, that is, to systematically manipulate the hospital information system to make it conform to the strategic plan. The system's manipulation is usually done by the initiation of projects of the strategic project portfolio. The projects deal with the construction or further development and maintenance of components of the hospital information system. Planning, directing, and monitoring these projects are the tasks of *tactical information management*. Operational management will then be responsible for the proper operation of the components. An example of strategic directing would be to initiate a project for the introduction of a *provider/physician order entry system*.

Monitoring as part of *strategic information management* means continuously auditing HIS quality as defined by means of its strategic information management plan's directives and goals. Auditing should determine whether the hospital information system is able to fulfill its tasks efficiently, that is, whether it can contribute significantly to the hospital's goals (Sect. 8.4.1), meet the stakeholders' expectations (Sect. 8.4.2) and fulfill the laws (Sect. 8.4.3).

The management's task is to install "sensors" to audit the information system's quality (compare Sect. 8). Management has to receive information from the current projects, from operational management, from users, and from the various stakeholders. Additional information can be gained through evaluation projects (see Sect. 8.6).

Monitoring results are used as input for the directing tasks of information management, which could for example initiate further projects. Monitoring results will also give feedback to update the strategic information management plan, which could for example lead to further activities of strategic management.

Strategic information management and its strategic information management plan are the vital requirements for *tactical* and *operational information management* in a hospital.

9.2.4 Tactical Information Management

Tactical information management deals with particular enterprise functions or application components. It aims to introduce, remove, change, or maintain components of the hospital information system. Such a component could be a *provider/physician order entry system*. Related activities are usually performed within projects. These projects have to be initiated as part of an information strategy, which is formulated in the project portfolio of a strategic information management plan as drawn up by the *strategic information management*. The result of all tactical information management projects is the HIS itself.

The organization of the operation and maintenance of information processing tools is part of *operational information management*. However, if problems occur during the operation of HIS components (e.g., frequent user complaints about a *medical documentation system*), appropriate projects may be executed by *tactical information management* (e.g., introducing a better version of the *medical documentation system*). Typically, those tactical information management projects comprise a planning phase, a running phase (which could contain, for example, system analysis, evaluation, selection, specification, or introduction), and a finishing phase (see Fig. 9.4).

Planning in *tactical information management* means planning projects and all the resources needed for them. Even though tactical information management projects are based on the strategic plan, they need a specific tactical project plan. This plan has to describe the project's subject and motivation, the problems to be solved, the goals to be achieved, the tasks to be performed, and the activities to be undertaken to reach the goals.

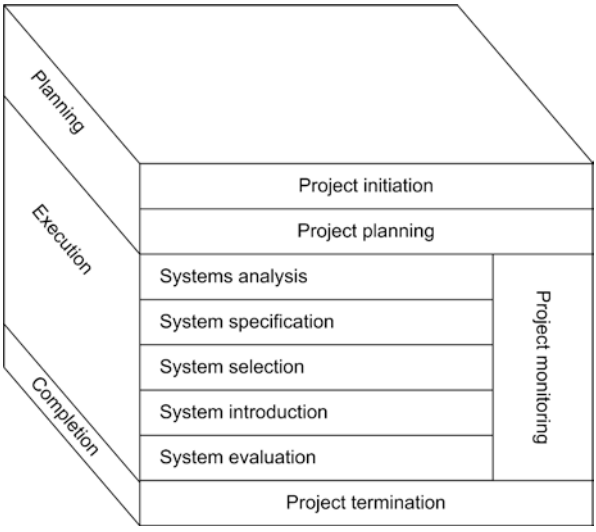

Fig. 9.4 Typical phases of *tactical information management projects*

Directing in tactical management means the execution of such tactical information management projects in hospitals, based on a project plan. Therefore, it includes typical tasks of project management such as resource allocation and coordination, motivation and training of the staff, etc.

Monitoring means continually checking whether the initiated projects are running as planned and whether they will produce the expected results. Monitoring results influence project planning, as a project's plan may be updated or changed according to the results of the project's monitoring in a given situation.

9.2.5 Operational Information Management

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

Planning in *operational information management* means planning organizational structures, procedures, and all resources such as finances, staff, rooms, or buildings that are necessary to ensure the faultless operation of all components of the hospital information system. For example, *operational information management* may require the installation of a service desk and a service support system that enables the quick transmission of users' error notes to the responsible services. Such systems but also respective staff resources need to be available for a longer period of time. Therefore, they should be allocated as part of a strategic information management plan. Moreover, planning in this context concerns the allocation of personnel resources on a day-to-day basis (e.g., planning of shifts for staff responsible for user support or network management).

Directing means the sum of all management activities that are necessary to ensure proper responses to operating problems of components of the hospital information system, that is, to provide backup facilities, to operate a service desk, to maintain servers, and to keep task forces available for repairing network components, servers, personal computers, printers, etc. Directing in this context deals with engaging the resources planned by the strategic information management plan in such a way that faultless operation of the hospital information system is ensured. *Operational information management* does not mean to exchange a server, but to organize the necessary services and resources.

Monitoring deals with caring for the verification of the proper working and effectiveness of components of the hospital information system. For example, a network monitoring system may regularly be used to monitor the availability and correct working of network components (compare Fig. 9.5).

To guarantee the continuous operation of the most important components of a HIS, it is helpful to draw up a concept for *operational information management*. Such a concept should clarify the following:

Fig. 9.5 Monitoring of the server of a hospital information system

- Which components have to be supported?
- What tasks comprise operational support?
- Who is responsible for the operational support?
- What should be the intensity of operational support?

Typically, three levels of operational support can be distinguished. First-level support is the first address for all user groups with any kind of problem. It may consist, for example, of a central 24-h-hotline (service desk) that is responsible for the management of user accounts and first trouble shooting, or of decentralized information processing staff. When the first-level support cannot solve the problems, it hands them over to the second-level support, specially trained informatics staff in the central information management department who are usually responsible for the operation of the specific application components. The third-level support, finally, addresses the most severe problems that cannot be solved by the second-level support. It can consist, for example, of specialists from the software vendor (Fig. 9.6).

Table 9.1 presents objects, responsibilities, tasks, and the intensity that should be defined as part of the operational management concept for the computer-based part of a HIS. As an example, a concept for operational management in a hospital could clarify

Table 9.1 Dimensions to be considered for *operational information management* of the computer-based part of hospital information systems

Dimension	Facets
Objects	Decentralized application components (e.g., in departments)
	Central application components (e.g., *patient administration system*)
	Workstations
	Decentralized servers
	Central servers
	Networks
	Backbone
Responsibility	Local (in departments)
	Central (in departments for information processing)
	Vendors
Task	First-level support (incident taking, incident analysis, problem solving if necessary, user training)
	Second-level support (training courses, regular operation, data protection)
	Third-level support (software development, problem solving, contact with vendors)
Intensity	Availability (e.g., 24 h/day, 7 days/week)
	Presence (e.g., locally, by pager, by hotline)
	Timeliness (e.g., answering time < 2 h)

- that central servers and networks are supported by the central information management department, which offers first- and second-level support 24 h a day. A service desk guarantees response time in less than 1 h. Third-level support (see Table 9.1) is provided for certain application components by the vendors of the respective application software products.
- that clients (e.g., personal computers) are supported by the local technical staff in each department. They offer first- and second-level support during the day. They are available by pager.

9.2.6 Relationship Between IT Service Management and Information Management

IT service management (ITSM) is information management centered on the customer's perspective of IT's contribution to the business, in contrast to technology-centered approaches. It comprises all measures and methods that are necessary to support the business processes.

Fig. 9.6 An immediate support center for third-level support of a vendor

Independent of how an institution defines the term "service," there must be an added value for the customer. If, for example, the nurse does not have to call the laboratory for a quick test result but has it immediately available on her portable, it gives her an added value because she can concentrate on her core functions. So, IT Service Management has the task to design, provide, deliver and improve such customer-centered services. The IT Infrastructure Library (ITIL) is the de-facto standard framework for IT Service management. ITIL was developed for the British Government in order to define best practices for all governmental computing centers. In its version 3, the phases of ITIL are described in five core publications:

- service strategy,
- service design,
- service transition,
- service operation,
- continual service improvement.

These publications comprise 26 processes which range from strategic alignment of the IT to continual improvement of processes. Among others, ITIL V3 defines a Service Lifecycle consisting of a circle of service design, service transition and service operation. Service operation usually influences new service designs – and the circle moves on.

Many hospitals use ITIL for selected information management tasks, but have not already implemented the whole lifecycle. Typical ITIL processes that can often be found implemented in hospitals are in the phase of service operation the incident management process and the problem management process, the service desk, and in the phase of service transition the change management and the service asset and configuration management.

ITIL conformant information management processes may be part of *strategic, tactical*, and *operational information management* as best practice.

9.2.7 Example

9.2.7.1 Typical Projects of Tactical Information Management

Typical *tactical information management projects* in the Plötzberg Medical Center comprise:

- analysis of the structure and processes of *order entry* in order to select a new computer-based application component to support this function;
- further development of a *medical documentation system* in order to support new legal demands on diagnoses-related patient grouping and billing;
- introduction of an *operation management system* for *execution of diagnostic, therapeutic and nursing procedures* and *medical discharge and medical report writing* in an operation theater;
- replacement of an application component for *medical discharge and medical report writing* in outpatient units;
- design, implementation, and introduction of an application component to support *medical and nursing care planning;*
- assessment of the user acceptance of a new application component for an intensive care unit.

9.2.8 Exercises

9.2.8.1 Influences on HIS Operation

Look at Fig. 9.3 and find examples of factors influencing HIS operation.

9.2.8.2 Typical Projects of Tactical Information Management

Look at Fig. 9.4 which shows typical phases of information management projects. Match the typical tactical information management projects from example 9.2.7.1 to those typical project phases.

9.2.8.3 Diagnostics and Therapy of HIS

Planning, monitoring, and directing of hospital information systems to a certain extent can be compared to health and the diagnostics and therapy of diseases. Discuss similarities and differences.

9.2.9 Summary

Information management in hospitals is a complex task. To reduce complexity, we distinguish between *strategic, tactical*, and *operational information management*. Each of these information management scopes has different perspectives and uses other methods and tools.

The tasks of information management are:
- planning of a hospital information system and its architecture;
- directing its establishment and its operation;
- monitoring its development and operation with respect to the planned objectives.

IT Service Management comprises tasks of all scopes of information management but emphasizes that information management should be regarded as a service offered by the information management department to a customer in or outside the hospital.

9.3 Organizational Structures of Information Management

Organizational structures for information management in hospitals differ greatly among hospitals. In general, each hospital should have an adequate organization for *strategic, tactical*, and *operational information management*, depending on its size, its internal organization, and its needs.

Organizational structures can be defined at the overall hospital level (e.g., a chief information officer (CIO), a central information management department), and at the departmental level (e.g., specific information management staff for a certain department, a certain outpatient unit).

9.3.1 Chief Information Officer

It is generally useful to centralize responsibilities for information management in one role. This role is usually called chief information officer (CIO); but the role is also often called vice president (or director) of information systems (or information services, information management, information and communication technology, information resources) or chief of information services.

The CIO bears the overall responsibility for the *strategic, tactical*, and *operational* management of the information system and the budgetary responsibility, and has the authority for all employees concerned with information management. The specific position of the CIO demands dedicated professional skills. Of course health/medical informatics competencies are required. But additionally more general executive and managerial competencies, and business and economic competencies are necessary as well.

Depending on the size of the hospital, the role and the tasks of a CIO may be performed by one dedicated person (e.g., a full-time health/medical informatics specialist) or by a high-ranking member of the hospital's board (e.g., the chief executive officer, CEO). The CIO may be supported by an information management board. Such a board can often be found in larger hospitals (Fig. 9.7). Members should include one representative from the hospital's board of directors, representatives from the main departments and user groups, and the director of the information management department (see Sect. 9.3.2) if this director is not the CIO simultaneously. If no dedicated CIO position exists, the president of this board can be regarded as the CIO of the hospital.

The CIO should report directly to the CEO or the hospital's board of directors and, therefore, should be ranked rather high in the hospital's organizational hierarchy, optimally as a member of the top management team of the hospital. The CIO's role should be a strategic one that comprises the following tasks of *strategic information management*:

- make or prepare all relevant strategic decisions on the HIS, especially with respect to infrastructure, architecture, and information management organization;
- align the hospital's business plan with the strategic information management plan;
- establish and promote the strategic information management plan;
- initiate and control projects for *tactical information management*;
- initiate HIS evaluation studies and adequate HIS monitoring activities;
- identify and solve serious information management problems;
- report to the CEO or the hospital's board of directors.

Fig. 9.7 An information management board meeting at a university hospital. Participants in this meeting are (from the left): the director of procurement, the chair of the staff council, the assistant of the information management department's director, the director of the information management department, a senior physician as chair of the board, a medical informatics professor as vice-chair of the board, a director of a medical research department as representative of the medical faculty and medical school, the director of nursing. The director of finance and vice-director of administration took the photo

The CIO's membership in the top management team should provide the possibility to influence the hospital's strategies using information technology as a strategic resource. Therefore, business knowledge and the ability to effectively communicate with other business managers, for example the chief financial officer (CFO) or the chief operating officer (COO), is important for a CIO. Nevertheless, reality often differs greatly from this image. Whether the role of the CIO is a strategic one or a more tactical or even operational one depends on internal hospital factors such as the CIO's top management membership, the internal communication networks among top executives and the CIO, the top management's strategic knowledge about ICT, the hospital's strategic vision of ICT, and on the personal skills of the CIO.

9.3.2 Information Management Department

There is usually one central information management department (often called the department for medical informatics, hospital computing center, or ICT department). This unit takes care at least of the *tactical* and *operational information management* of those parts of the HIS with hospital-wide relevance (e.g., the *enterprise resource planning system*, the *clinical information system*, and the *computer network*). In larger hospitals, there may be subdivisions with respect to tasks (e.g., different units for desktop management, user support, clinical systems, or networking).

If the information management department also cares of *strategic information management*, the head of this department is typically the CIO.

With regard to the responsibilities for *tactical* and *operational information management*, it is sometimes not useful and often not feasible to totally centralize these services. Especially in larger hospitals, they are performed in cooperation between central units and the decentralized staff. This staff may be dedicated medical informaticians or especially skilled users. These local information managers have responsibilities for *tactical* and *operational information management* with regard to their department, but in accordance with the central information management department. For example, they may (with support from the central unit) introduce a hospital-wide application component in their department, and operate it. On the other hand, they will also take care of additional information needs of their departments, for example by introducing a dedicated departmental system. However, this should be done only in accordance with the strategic information management plan.

9.3.3 Example

9.3.3.1 Organizational Structures for Information Management

Figure 9.8 presents the overall organization of information management at the Plötzberg Medical Center and Medical School (PMC).

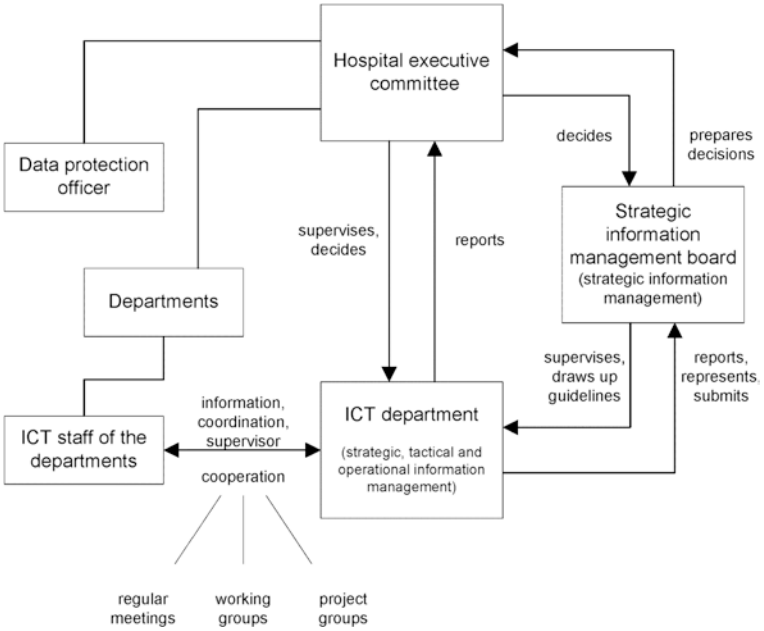

Fig. 9.8 Organization of information management at the Plötzberg Medical Center and Medical School (PMC)

9.3.4 Exercises

9.3.4.1 Information Systems Managers as Architects

Information systems managers can be partly compared to architects. Read the following statement, and discuss similarities and differences between information system architects and building architects:

> We‘re architects.... We have designed numerous buildings, used by many people.... We know about users. We know well their complaints: buildings that get in the way of the things they want to do.... We also know well users’ joy of relaxing, working, learning, buying, manufacturing, and worshipping in buildings which were designed with love and tender care as well as function in mind.... We’re committed to the belief that buildings help people to do their jobs or impede them and that good buildings bring joy as well as efficiency.[1]

[1]Caudill WW et al. Architecture and You. New York: Whitney Library of Design; 1978. p. 6.

9.3.4.2
Organizational Structures for Information Management in a Hospital

Look at a real hospital you know and at its information system.

- Which organizational units are involved in information management?
- Which boards and persons are involved in information management?
- Who is responsible for *strategic information management*?
- Who is responsible for *tactical information management*?
- Who is responsible for *operational information management*?
- Who is the CIO, and what is his or her responsibility?

9.3.4.3
Centralization of Organizational Structures

Discuss the pros and cons for centralization and decentralization of *strategic, tactical*, and *operational information management*. Find concrete examples for your arguments.

9.3.4.4
Organizational Structures for Information Management at PMC

Look at the description of the organizational structures for information management at the Plötzberg Medical Center and Medical School (PMC) in Fig. 9.8. Discuss the advantages and disadvantages of this organizational structure and discuss alternatives.

9.3.5
Summary

Each hospital should have an adequate organization for *strategic, tactical* and *operational information management*.

In general, a chief information officer (CIO) is responsible for information management. The CIO's most important tasks should be the strategic alignment of business plans and the strategic information management plan. She or he is responsible for all scopes of information management in the hospital.

There is typically one central department for information management. Usually the CIO directs this department. In addition, there may also be decentralized information management staff, located at the individual departments of the hospital. But this staff has to be coordinated by the CIO as well.

9.4 Strategic Planning

We will now focus on *strategic information management*. Strategic planning is the first step of a systematic *strategic information management* process and leads to a strategic information management plan as basis. It comprises planning of the HIS architecture and of the organization of information management.

After reading this section, you should be able to answer the following questions:
- What are the typical tasks for strategic HIS planning?
- What are the typical methods for strategic HIS planning?
- What is the goal and typical structure of a strategic information management plan?

9.4.1 Tasks

The most important tasks of strategic HIS planning are strategic alignment of business plans and strategic information management plans, long-term HIS planning, and short-term HIS planning.

9.4.1.1 Aligning Business Plans and Information Management Plans

The basis for *strategic information management* in a hospital are the strategic goals as defined in the hospital's business plan. Advances in ICT may influence these strategic business goals. Therefore, it is one main task of *strategic information management* to align business plans and strategic information management plans. Hospitals aim to provide efficient, high-quality health care. However, this mission may be further refined by goals as in Sect. 8.4.1, for example.

Different hospitals may choose different subsets of these goals, which would result in different information management strategies and different architectures of HIS. If hospital chosen goals are conflicting, *strategic information management* must try to solve these conflicts and establish a clear order of priorities, in accordance with the enterprise's business plan.

It is obvious that the CIO as person in charge for *strategic information management* needs knowledge about the enterprise strategy and the enterprise business plan. But also, the hospital's management needs knowledge about the potential of information processing with regard to formulation, realization, and evaluation of the hospital's strategy. *Strategic*

information management must be able to offer this information to hospital management in adequate and understandable form. Methods for strategic alignment are presented in the methods section, below.

9.4.1.2 Long-Term HIS Planning

Strategic planning of HIS distinguishes between long-term and short-term HIS planning.

The strategic information management plan contains the results of long-term planning of HIS. It describes the hospital's goals, the information management goals, the current HIS state, the future HIS state, and the steps to transform the current HIS into the planned HIS. *Strategic information management* must create and regularly update this plan. The strategic plan must take into account quality criteria for HIS structures, processes, and outcome. It must be guaranteed that the strategic information management plan is the basis for all other information management activities. HIS planning is an ongoing process, and there is no use in trying to solve all problems at the same time. Solely a stepwise approach, based on different levels of priorities, is possible and useful. The strategic information management plan, therefore, must contain a general priority list of most important projects to be done in the coming years.

The long-term strategic information management plan is usually valid for a longer period of time (e.g., 3–5 years). However, requirements (e.g., due to legal changes or new user requests) and resources (staff, money) may change quicker than the strategic information management plan; or strategic monitoring (see Sect. 9.5) results may require an adjustment.

The detailed structure of strategic information management plans is described later on.

9.4.1.3 Short-Term HIS Planning

Major task of short-term HIS planning is to establish an (annual) project list with recent projects, priorities, and upcoming planned projects. This project list, also called the project portfolio, has to be approved by the hospital management, which decides which projects to execute and how to organize necessary resources. The project portfolio has to match the (more general) priority lists described in the strategic information management plan. However, its annual update reflects detailed prioritization and changes in the environment.

Because of the temporal limited validity of the strategic information management plan, HIS planning is a permanent task of *strategic information management* in hospitals.

9.4.2 Methods

9.4.2.1 Strategic Alignment

The role of information management varies between two extremes. At one extreme, information management may be seen as a purely supporting function; that is, the hospital strategy determines the information management planning activities. This is called "organizational pull." At the other extreme, information management is seen as the strategic resource, from which the hospital gains competitive advantage. The application of technological advances mainly determines the further development of the hospital and its position on the health care market. This is called "technology push." Strategic alignment describes the process that balances and coordinates the hospital goals and the information management strategies to get the best result for the hospital.

Several models exist for strategic alignment. The component alignment model (CAM) of Martin et al. considers seven components – the external environment, emerging information technologies, organizational infrastructure, mission, ICT infrastructure, business strategy and ICT strategy – that should be continually assessed with respect to their mutual alignment. Tan's critical success factor (CSF) approach is a top-down approach that first identifies factors critical to the hospital's success or failure. Strategic information management planning is then derived with regard to these factors.

Successful strategic alignment requires that hospital top management as well as information managers have a basic knowledge of each other's competence and share the same conception of the role of information management.

9.4.2.2 Portfolio Management

An important instrument for information management strategic planning is portfolio management. Originally coming from the field of finance to acquire a well-balanced securities portfolio, today the term portfolio management is used to refer to multiple strategic management problems.

Portfolio management concerning information management categorizes certain components of an information system, like application components or physical data processing systems, but also projects, using certain criteria to assess the value of these components for the enterprise and to balance risks and returns. The assumption is that there are different management issues and priorities for each class.

Project portfolio management categorizes projects, looking, for example, at project objectives, costs, time lines, resources, risks, and other critical factors. McFarlan proposes eight distinct project categories along the dimensions of project size, experience with the technology, and project structure. Each category carries a different degree of risk, and thus he recommends different project management tools to use. Today, project portfolio management is primarily used to plan and control IT investments.

The portfolio proposed by the Gartner Group distinguishes three categories according to the contribution of an application component to the hospital's performance. Utility applications are application components that are essential for the hospital's operation, but have no influence on the success of a hospital, and, therefore, are independent of the hospital's strategic goals. A good example is the *patient administration system*. Enhancement applications are application components that improve the hospital's performance, and, therefore, contribute to the hospital's success (e.g., computer-based *nursing management and documentation system*). Frontier applications are application components that influence the hospital's position in the health care market, for example, the enforced use of telemedicine. Information management planning should aim at a well-balanced application portfolio – on the one hand, to efficiently support essential hospital functions, and on the other hand, not to miss future technological innovations.

9.4.3 The Strategic Information Management Plan

An important aim of strategic HIS planning is to establish the strategic information management plan. The previous sections made clear that without a strategic information management plan, neither tactical nor operational management would work appropriately. A strategic information management plan is an important precondition for systematic directing and monitoring the hospital information system.

The strategic information management plan should be written by the CIO and approved by the hospital management. Without proper strategic planning, it would be a matter of chance if a hospital information system fulfilled strategic information goals. But considerable efforts have to be made for creating strategic plans.

In this section, the goals and structure of strategic information management plans are presented in more detail. Figure 9.9 presents an overall view on strategic information management planning.

9.4.3.1 Purpose of Strategic Information Management Plans

Different stakeholders[2] are involved in the creation, updating, approval, and use of strategic plans. Such stakeholders may include:

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

[2]The term stakeholder is used to refer to anyone who has direct or indirect influence on or interest in a component of an information system.

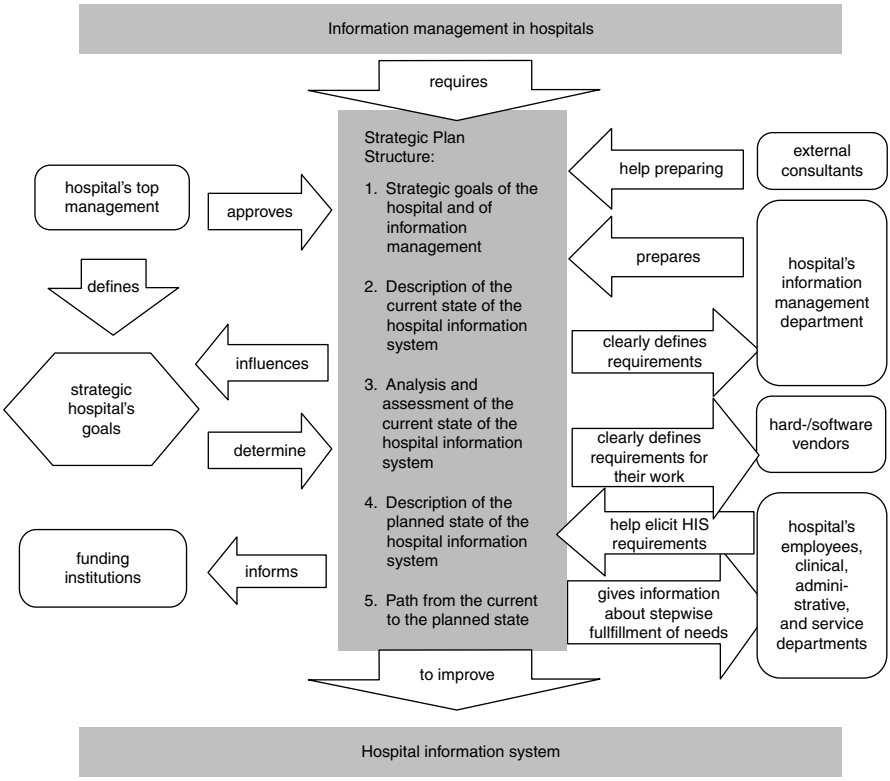

Fig. 9.9 Strategic information management planning of hospitals. A strategic information management plan gives directives for the construction and development of a hospital information system. It describes the recent and the intended hospital information system's architecture. (Details are explained in the following sections)

These stakeholders may have different expectations of a strategic plan and are involved in different life-cycle phases for 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 when needed;
- updating when a new version is required (because of new requirements, new available technologies, failure to achieve individual tasks, or just leaving the time frame of the plan). After the first version, the creation and update phases merge into a cyclic, evolutionary development of the plan.

The CIO and the information management department usually create and maintain proposals for the strategic information management plan. They are interested in clearly defined requirements for their work, which is greatly concerned with *tactical information management* issues. Top management is interested in the seamless and cost-effective operation of

the hospital. Top management approves the plans (probably together with the funding institutions). Representatives of the employees should be involved in eliciting the requirements, since they will use the resulting information systems. The current strategic plans will be used by the information management departments and the vendors of HIS components when constructing or maintaining components of hospital information systems. External consultants may help to create plans, but also be engaged in negotiations for the approval of the plans.

The most essential purpose is to improve a hospital information system so that it can better contribute to the hospital's goals. This purpose should determine the structure of strategic plans; that is, 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.

9.4.3.2 Structure of Strategic Information Management Plans

A strategic information management plan should encompass the hospital's business strategy or strategic goals, the resulting information management goals, the current state of the hospital information system, and an analysis of how well the current information system fits the goals. The planned architecture should be derived as a conclusion of this analysis.

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

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

- strategic goals of the hospital and of information management,
- description of the current state of the hospital information system,
- analysis and assessment of the current state of the hospital information system,
- description of the planned state of the hospital information system, and
- 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, etc. are likely to complement a strategic plan.

Strategic Goals of the Hospital and of Information Management

Based on a description of the hospital's strategic goals (e.g., presented in a mission statement), the *strategic information management* goals should be derived using the method of

strategic alignment (see Sect. 9.4.2.1). Despite the imperative to individually derive information management goals from the hospital's strategic goals predefined catalogs of goals may be helpful. One of these catalogs is provided by the information management standards of the Joint Commission in the USA (see Sect. 8.7.2).

Of course there will be goal conflicts eventually. They need to be taken into account and resolved.

Description of the Current State of the Hospital Information System

Before any planning commences, 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, i.e., a model of the current state is the basis for identifying those functions of the hospital that are well supported, for example, by information and communication technology, and those functions that are not (yet) well supported. Thus, application components as well as existing information and communication technology have to be described, including how they contribute to the support of the hospital's functions.

Hence the metamodel 3LGM² (see Sect. 5.3) and related software is very helpful for this task.

Analysis and Assessment of the Current State of the Hospital Information System

The model of the current state has to be analyzed with respect to the achievement of information management strategies. Note that missing computer support for a certain function may not be assessed in all cases as being poor support for that function. For example, missing computers in patient rooms and consequently paper-based documentation of clinical findings may be conforming more to a goal of being a humane hospital than the use of computers and hand-held digital devices in this area.

Description of the Planned State of the Hospital Information System

Based on the analysis of the current state, a new state should be modeled that achieves the goals better than the current state does, provided that the current state does not already achieve the hospital's goals. Note that besides technical aspects, organizational aspects also have to be discussed. The model of the planned state can thus be completed by the description of the planned organizational structure of information management. In many cases, this is an opportunity to introduce a CIO or to clarify his or her role.

Migration Path from the Current to the Planned State

This section should describe a step-by-step path from the current to the planned state. In the strategic information management plan every such step is a project. Every project

description should include assigned resources, that is, personnel, estimated investment costs as well as future operating costs, etc., and concrete deadlines for partial results. The resulting path of projects could also assign priorities to individual projects as well as dependencies between projects.

This migration path is the basis for annual project portfolio preparation.

9.4.4 Example

9.4.4.1 Structure of a Strategic Information Management Plan

Table 9.2 presents the structure of the strategic information management plan for 2010–2015 of the Plötzberg Medical Center and Medical School (PMC).

9.4.5 Exercises

9.4.5.1 Life Cycle of a Strategic Information Management Plan

Why is a strategic information management plan usually valid for 3–5 years? Could there be situations where a shorter or longer period may be useful? Explain your answer.

9.4.5.2 Deviation from a Strategic Information Management Plan

A strategic information management plan should serve as a guideline for information management. Could there be situations where information management is allowed to deviate from the strategic information management plan after it has been approved? Explain your answer.

9.4.5.3 Strategic Information Management and Strategic Hospital Management

We have discussed the strategic alignment of business plans and information management plans. Could you imagine situations where this alignment is difficult? Find examples where the hospital's goals and the information management goals may conflict. Discuss reasons and possible solutions.

Table 9.2 Structure of the strategic information management plan (2010–2015) of the Plötzberg Medical Center and Medical School (PMC)

1. Intention of this strategic information management plan
2. Plötzberg Medical Center and Medical School (PMC)
2.1 Mission statement
2.2 Strategic goals
2.3 Environment analysis
2.4 Organizational structure
2.5 Hospital indicators
2.6 Hospital layout
3. Current state of the information system
3.1 Goals of information management
3.2 Organization of information management
3.3 Guidelines and standards for information processing
3.4 Functionality
3.5 Application components
3.6 Physical data processing systems
4. Assessment of the current state of the information system
4.1 Goals attained
4.2 Weak points and strengths of the information systems
4.3 Required activities
5. Future state of the information system
5.1 Visions and perspectives
5.2 Planned functionality
5.3 Planned application components
5.4 Planned physical data processing systems
5.5 Planned organization of information management
6. Planned activities until 2015
6.1 Overview
6.2 Task planning
6.3 Time planning
6.4 Cost planning
7. Conclusion

9.4.5.4 Establishing a Strategic Information Management Plan

Imagine you are the CIO of a hospital in which almost no computer-based tools are used. One of the hospital's goals is to support health care professionals in their daily tasks by offering up-to-date patient information at their work-place.

Which main goals for information management would you define based on this information? Which hospital functions should be supported by new computer-based information processing tools?

9.4.6 Summary

Strategic information management deals with the hospital's information processing as a whole. It comprises planning of the HIS architecture and of the organization of information management.

Tasks of strategic HIS planning include strategic alignment of business plans and information management plans, long-term HIS planning, and short-term HIS planning. Strategic alignment describes a process to balance and coordinate hospital goals and information management strategies to get the best result for the hospital. The long-term planning of HIS is defined in the strategic information management plan. Short-term strategic HIS planning establishes an (annual) project portfolio.

A strategic information management plan is an important precondition for systematic monitoring and directing of the hospital information system. A strategic information management plan should encompass the hospital's business strategy or strategic goals, the resulting information management strategies, the current state of the hospital information system, and an analysis of how well the current information system fits the strategies. The planned architecture should be derived as a conclusion of this analysis. Finally, the path from the current to the planned state should be described.

The strategic information management plan should be written by the CIO and adopted by the hospital management.

9.5 Strategic Monitoring

After having planned the HIS strategically, one may expect the HIS will operate well in most of its functions, with most of its information processing tools, and in many parts of its operating organization. However, in many cases problems may occur. If we consider the quality criteria as discussed in Chapter 8 problems like the following may arise: Confidentiality of data may not be assured in some circumstances; transmission of reports may not be timely; adequate data integration capabilities may not be provided and thus consistency of redundant data may not be assured in a number of application components;

since there is no data warehouse, the hospital may not be able to collect and analyze aggregated data to support *patient care* and operations; the needs for knowledge-based information in *patient care* may hardly be met, since easy access to current medical journals is not provided. But there may be additional problems to be taken into account at a strategic level such as, for example, users may be increasingly dissatisfied with an application component, technical or motivational problems may lead to a decrease in documentation quality; increased documentation time may limit the time available for direct patient care; there may be unplanned high efforts for support and training; or the number of medical errors may rise due to software errors or unusable software.

Besides low software quality, also badly organized projects in *tactical information management* or errors in *strategic information management* may lead to the described problems.

Problems may get visible very slowly, for example, when a formerly "good" HIS component is not updated to match the overall technical progress, leading to more and more inacceptable performance and functionality; or, when more and more new application components have to be integrated into a spaghetti-styled architecture. But problems may also arise very suddenly, for example when a server suddenly crashes, and no replacement is available; or, when due to a software error, a wrong finding is presented to a patient, a physician takes a wrong decision, and the patient is harmed.

After reading this section, you should be able to answer the following questions:

- What are the typical tasks of strategic HIS monitoring?
- What are the typical methods of strategic HIS monitoring?

9.5.1 Tasks

As explained in Sect. 9.2.3, strategic monitoring means to continuously audit HIS quality, to make sure it corresponds to the quality defined in its strategic information plan. The management's task is to install "sensors" to audit the information system's quality. In general, strategic management has to make sure that it regularly receives and analyzes HIS quality information (permanent monitoring). In addition, information can be gained through dedicated evaluation projects (ad-hoc monitoring).

Typically, both permanent monitoring activities as well as ad-hoc monitoring activities are combined for strategic HIS monitoring. Both represent sub-types of an evaluation study. Thus, both activities should be planned and executed as described in details in Sect. 8.6, comprising the activities of study exploration, first study design, operationalization of methods and detailed study plan, execution of the study, and report and publication of the study.

9.5.1.1 Permanent Monitoring Activities

A hospital information system is too complex to allow monitoring all its components with regard to all quality criteria as defined in Chapter 8. However, it is useful to define subsets of criteria that should then be monitored on a regular (daily, weekly, monthly, yearly) basis.

Quantitative measurements for regular monitoring of the achievement of strategic goals are also called key performance indicators. These indicators could comprise, for example:

- functional coverage of the application components (e.g., level of saturation of the overall HIS architecture, see Sect. 8.2.2, or percentage of documents primarily created in computer-based form);
- user satisfaction (e.g., by regular user surveys);
- standardization of the HIS architecture (e.g., percentage of interfaces using standards such as HL7);
- homogeneity of the HIS architecture (e.g., number of different application components);
- availability of the application components (e.g., down times per year);
- performance of the application components (e.g., response time);
- costs for information management (e.g., overall costs, costs in relation to number of users or number of workstations);
- quality of IT training (e.g., IT training hours per user);
- quality of IT support (e.g., number of hotline calls that are successfully solved within 2 h);
- quality of *tactical information management* (e.g., percentage of successfully completed IT projects).

To allow monitoring on a regular base, these key performance indicators should be collected in quantitative and as far as possible in automated form. Reports should be presented to the information management board.

Besides monitoring those indicators, further permanent monitoring tasks may comprise patient satisfaction surveys, medical error reports, or the local press containing comments on the hospital's HIS. In addition, national legislation (e.g., new data protection law) and standardization initiatives (e.g., new version of HL7) should be monitored as both may affect the HIS.

Sudden changes in monitored numbers can indicate problems (e.g., malfunctioning of a component), which could then initiate more detailed analysis and corrections that are then to be initiated by strategic directing.

Permanent monitoring activities can be used locally, but they can also be used to compare HIS quality with other organizations or with established standards in the form of a so-called benchmarking. Details on HIS benchmarking are explained later in Sect. 9.5.3.1.

9.5.1.2 Ad Hoc Monitoring Activities

Ad-hoc monitoring activities may be initiated when larger changes of a component are planned, or when sudden larger problems of HIS components have been observed. Ad-hoc activities help to analyze a certain situation in detail, in order to better understand reasons and consequences of an observed or expected problem. The execution of those ad-hoc activities entails systems evaluation studies which are planned and conducted by *tactical information management*.

Evaluation studies can focus on structure quality, process quality and quality of outcome of a HIS component (see Sects. 8.2–8.4). For example, during the introduction of a *nursing documentation and management system*, the effects on nursing care could be analyzed by a sub-set of the following evaluation questions:

- How accurate and complete is nursing documentation after introduction of a computer-based nursing documentation system?
- How are nurses satisfied with the new component?
- Is the offered functionality sufficient to support all steps of the nursing care process?
- Is there any redundant functionality with other components?
- Did the introduction of the component affect the time that is available for direct patient care?
- Does the quality of nursing care change?
- Did the level of data integration with regard to nursing data improve after the introduction of the component?
- How is the consistency of nursing data, comparing the new component and the remaining paper-based patient chart?
- What did the purchase and introduction of the component cost?
- What do support and training of the component cost?
- Are there any unexpected negative effects on nursing care?

Typically, quantitative and qualitative methods (see Sect. 8.6 for details) can be combined to answer study questions. Strategic HIS monitoring collects and reports the results, to directly give feedback to strategic HIS planning.

9.5.1.3 Certification of HIS

Certification in general means to confirm that an object or organization has certain characteristics. HIS certification in general describes a process where an accredited body confirms that the HIS fulfills certain pre-defined quality characteristics. While approaches to assess the overall HIS quality are rare, there exist established certification systems for individual software products (e.g., software for a *medical documentation system*) such as CCHIT and EuroRec (for details on different approaches, see Sect. 9.5.3). Depending on the certification approach, security, functionality or interoperability of the application component are assessed.

Many vendors try to obtain these certificates, as they hope to get an competitive advantage. In fact, when buying software for a new application component, more and more hospitals check for the availability of these certificates. In general, certification increases transparency of different products and fosters buyers' knowledge about products, as certification organizations often compile information about the different products and technologies. Increased transparency and knowledge in turn have a positive impact on the buyers' willingness to invest in new technology. Even when a HIS certification does not guarantee that a HIS is good with regard to all and every criteria, certification may contribute to an increased quality of HIS in general.

9.5.2 Methods

Details on planning and execution of evaluation studies as well as on general evaluation methods have already been presented in Sect. 8.6. They form the basis for ad-hoc studies. We will now concentrate on HIS benchmarking, as an approach for permanent monitoring activities, as well as on HIS certification approaches.

9.5.2.1 HIS Benchmarking

Benchmarking in general describes a process in which organizations evaluate various aspects of their performance and compare it to a given standard or to the best organizations ("best-practice"). Typically, benchmarking comprises quantitative evaluation criteria such as costs, quality of structures, quality of processes, or quality of outcome. In strategic hospital management, benchmarking is seen as an important approach to assess a hospital's performance. Benchmarking is often seen part of a continuous quality improvement process, in which organizations measure and then steadily improve their performance.

If a hospital wants to establish permanent monitoring activities on its HIS in the form of a best-practice-benchmark, it needs to select standardized and clearly defined evaluation criteria. Often, regional groups of hospitals join together on an ad-hoc basis to define and compare their HIS benchmarking criteria. Besides, there are also international standards for HIS benchmarking. For example, the criteria defined by COBIT (compare the example 9.5.3.2) or criteria derived from ITIL (Sect. 9.2.6) are used to benchmark especially the quality of information management.

9.5.2.2 HIS Certification

Several approaches for the certification of hospitals and their HIS exist. For example, ISO 9001 standard[3] assesses the hospital's compliance with certain quality management standards. An ISO 9001 certificate states that an organization follows certain formalized business processes, that it monitors the outcome of its processes, and that it facilitates their continuous improvement; ISO 9001 focuses on the quality of processes. Another example is the Joint Commission's certification program; details of which have already been presented in Sect. 8.7.2. So-called excellence programs, such as the EFQM Excellence Model[4] in Europe or the Malcolm Baldrige National Quality Award in the U.S. (for details, see Sect. 8.7.1) also strive for quality improvement. They use a scoring system that makes it possible to compare the performance of organizations to one another, and to continually observe improvement in

[3]International Organization for Standardization. ISO 9001 standards on quality management, http://www.iso.org

[4]European Federation for Quality Management (EFQM) http://ww1.efqm.org

quality of structures, quality of processes, or quality of outcome. Most of these certification or excellence programs also comprise aspects on the quality of a HIS. For example, the Baldrige program (see Sect. 8.7.1) and the Joint Commission standards (see Sect. 8.7.2) offer specific health care information management criteria, to different extents.

There also exist certification approaches specific for hospital information systems. In the USA, the Certification Commission for Healthcare Information Technology (CCHIT)[5] is developing quality criteria and a certification process for Electronic Health Records. In Europe, the EuroRec Institute[6] is developing a repository of certification criteria to support quality certification for Electronic Health Records. Finally, the IHE initiative[7] tries to achieve interoperability between different clinical information systems based on existing standards such as HL7 and DICOM. IHE offers a standardized interoperability testing of clinical application components of different vendors in so-called Connectathons that take place in different parts of the world each year.

9.5.3 Examples

9.5.3.1 A HIS Benchmarking Report

The CIO of the Plötzberg Medical Center and Medical School (PMC) bi-annually reports to the hospital's management about the amount, quality, and costs of information processing of Plötzberg's hospital information system. For this report, the CIO uses HIS benchmarking criteria that have been agreed to by a regional group of hospitals' CIOs (see Table 9.3). Each year, the hospitals exchange and discuss their reports as part of a best-practice-benchmark.

9.5.3.2 COBIT

CobiT[8] is developed by the IT Governance Institute. It provides a common language for executives to communicate goals, objectives and expected results of IT systems and IT projects. COBIT is built on a process model that defines 34 IT-related processes within four domains: plan and organize; acquire and implement; deliver and support; monitor and

[5]Certification Commission for Healthcare Information Technology, http://www.cchit.org
[6]EuroRec, http://www.eurorec.org
[7]IHE International, http://www.ihe.net
[8]http://www.isaca.org/cobit

Table 9.3 Extract from the PMC HIS benchmarking report 2010 (KPI = key performance indicator)

KPIs for the organization	
Number of staff	5,500
Number of beds	1,100
Number of inpatient cases	40,000
Mean duration of stay	8.1 days
KPIs for HIS costs	
Overall IT costs	€5 million
IT investment costs	€0.8 million
IT costs per inpatient case	€125
IT costs in relation to hospital budget	1.7%
KPIs for HIS management	
Number of HIS staff	45.5
Number of HIS users	4,800
Number of workstations	1,350
Hospital staff per workstation	4.1
Number of IT problem tickets	15,500
Percentage of solved tickets	97.5%
Availability of the overall HIS systems	97.5%
Number of IT projects finalized	13
Percentage of successful IT projects	76%
KPIs for HIS functionality	
Percentage of all documents available electronically	45%
Percentage of all diagnosis coded electronically	77%
Functionality index[9] of patient administration system	52%
Functionality index of medical documentation system	87%
Functionality index of …	…
KPIs for HIS architecture	
Number of computer-based application components	84
Percentage of standard interfaces between applications	87%
Functional redundancy rate[10]	0.44

[9]A functionality index describes how many of the related hospital functions are already supported by a computer-based application system.
[10]For details, see Sect. 8.7.4.

evaluate. For each of these 34 processes, among others, information is provided on how the specific process goals can be measured, what the key activities and major deliverables are, and who is responsible for them. The following list presents an overview of the four domains and selected, simplified key metrics (key performance indicators) for each of them.

Plan and Organize

This domain covers strategy and tactics, and concerns the identification of the way IT can best contribute to the achievement of the business objectives. Selected key metrics:

- percentage of strategic IT objectives that are aligned to the strategic hospital plan;
- percentage of redundant or duplicated data elements within the IT architecture;
- number of business processes that are not yet supported by IT;
- percentage of stakeholders that are satisfied with IT quality;
- percentage of IT projects that are on time and within budget.

Acquire and Implement

IT solutions need to be identified, developed or acquired, implemented and integrated into the business process as well as maintained. Selected key metrics:

- percentage of users that are satisfied with the functionality of the new IT system;
- number of IT problems that lead to non-operation periods;
- percentages of IT systems that do not conform to the defined technical standards;
- percentage of IT systems where adequate user training is provided.

Deliver and Support

This domain is concerned with the actual delivery of required IT services, including management of security and continuity, service support for users, and management of data and operational facilities. Selected key metrics:

- percentage of stakeholders that are satisfied with IT support;
- number of user complaints with regard to an IT service;
- percentage of satisfactory response times of an IT system;
- number of lost hours due to unplanned IT downtimes.

Monitor and Evaluate

All IT processes need to be regularly assessed over time for their quality and compliance with control requirements. Selected key metrics:

- frequency of reporting from IT management to enterprise management;
- satisfaction of management with IT performance reporting;
- number of independent IT reviews.

9.5.3.3 CCHIT Functional Quality Criteria

CCHIT is a not-for-profit organization and offers certification for inpatient EHRs, ambulatory EHRs and other application components.[11] The certification primarily covers functionality, security, and interoperability, and is hierarchically structured in criteria and sub-criteria. Table 9.4 shows some examples of functional criteria.[12] Vendors are provided with a certification handbook and test-scripts for self-evaluation. The actual certification is then carried out by CCHIT auditors. The CCHIT certificate is typically valid for 3 years.

Table 9.4 Examples of CCHIT functional criteria for medication ordering

	Criteria
10.01	The system shall provide the ability to define a set of items to be ordered as a group
10.04	The system shall provide the ability to allow the clinician to order medication doses in mg/kg/min, µg/kg, and µg/kg/min
10.06	The system shall provide end-users with the ability to browse or search for a drug by therapeutic class when ordering a medication
10.14	The system shall provide the ability to modify medication orders including dosing information without having to discontinue the order
10.26	The system shall provide the ability to compute drug doses, based on appropriate dosage ranges, using the patient's body surface area and ideal body weight
12.01	The system shall provide the ability to check for potential interactions between medications to be prescribed/ordered and current medications and alert the user at the time of medication prescribing/ordering if potential interactions exist

[11]Certification Commission for Health Information Technology, http://www.cchit.org
[12]Taken from Inpatient EHR Criteria at http://www.cchit.org/sites/all/files/certifications/2011Inpatient_4.zip

9.5.4 Exercises

9.5.4.1 An Information Processing Monitoring Report

Look at the HIS benchmarking report in example 9.5.3.1. Figure out some numbers for a hospital you know. It may help to look at the strategic information management plan of this hospital.

9.5.4.2 COBIT

Please look at the examples of COBIT key metrics presented in Sect. 9.5.3.2. Analyze how they correspond to the quality criteria for structures, for processes, and for outcomes as described in Chapter 8. To which quality criteria can they be matched?

9.5.4.3 Most Relevant Key Performance Indicators

In case you had to select the five most relevant indicators for HIS quality for your hospital: Which would you select? You can look at examples in Sect. 8.7 and in Sect. 9.5.3 to get ideas. How would you proceed to get regular information on your five most relevant indicators?

9.5.4.4 Organizing User Feedback

You are asked to organize regular user feedback facilities for the *medical documentation system* of your hospital. How would you proceed? How would you gather user feedback? Which user groups would you take into account? Which types of data (quantitative and/or qualitative) would you collect? Which technical means would you use? Discuss different possibilities.

9.5.5 Summary

The task of strategic HIS monitoring is to continually audit the quality of the hospital information system at strategic level. Monitoring can be done on a permanent base, but also as dedicated ad-hoc monitoring activities.

Permanent monitoring activities comprise the definition of a subset of quantitative key performance indicators that are to be automatically monitored on a regular (daily, weekly, monthly, yearly) basis. Permanent monitoring is supported by national and international certification, accreditation or excellence activities. Ad hoc monitoring activities are organized as regular evaluation studies.

9.6 Strategic Directing

Strategic directing of HIS is a consequence of planning and monitoring hospital functions, HIS architectures, and information management organizations.
After reading this section, you should be able to answer the following questions:

- What are the typical tasks of strategic HIS directing?
- What are the typical methods of strategic HIS directing?

9.6.1 Tasks

Strategic directing of information systems mainly transforms the strategic information management plan into projects. These projects are taken from the strategic project portfolio or the migration path as established in the strategic information management plan. The decision to initiate projects is part of strategic information planning; the execution of this decision is part of strategic information directing.

Planning, running, and (successfully) finishing projects are tasks of *tactical information management*. However, strategic directing must initiate them and prepare an adequate framework for them. In detail, the following main tasks can be identified:

- initiation of projects;
- general resource allocation;
- general time allocation;
- general controlling of the project progress;
- adoption of the project's results.

9.6.2 Methods

For a project of important strategic relevance (e.g., introduction of a hospital-wide *clinical information system*), a project management board will typically be established.
Such a project management board supports the project manager by providing an interface between the project manager, future user groups, vendors involved in the project, and strategic information management authorities like CIO and information management board. Its tasks are:

- controlling the project with respect to allocated resources, allocated time and the planned results,
- settling disputes and solving conflicts which may arise between project management, vendors, involved hospital departments and strategic management authorities.

Typically, the project management board comprises representatives from strategic information management authorities, from hospital management and from the hospital departments and vendors involved. The project manager reports to this board and should be part of it.

9.6.3 Example

9.6.3.1 Project Management Boards at PMC

Currently, two project management boards are established at Plötzberg Medical Center and Medical School (PMC):

1. Project management board for the *clinical information system*. Head of the board is the CIO. Members are representatives from the hospital board of managers (vice president for nursing, vice president for administration), representatives from the main user groups (senior physician from the surgery department, senior physician from the internal medicine department), a representative of the software vendor, as well as the project manager.
2. Project management board for the introduction of a new computer-based intensive care *patient data management system*. Head is the manager of the quality assurance department. Members are the manager of the information management department, representatives from main user groups (senior physician and head nurse from the surgery department), and the project manager.

9.6.4 Exercise

9.6.4.1 A Project Management Board at PMC

At the Plötzberg Medical Center and Medical School (PMC), a project is going to be initiated to introduce a hospital-wide *nursing documentation system*. This application component comprises functionality of comprehensive nursing data management as well as supporting communication with other health care professionals.

Due to the high significance of nursing documentation, a project management board will be installed. Who should the members of this board be? Explain your answer.

9.6.5 Summary

Strategic directing of information systems mainly consists of transforming the strategic information management plan into projects. It is at least as important as strategic planning and strategic monitoring, but often, from a methodological point of view, an immediate consequence of them.

For projects of important strategic relevance (e.g., introduction of a hospital-wide *electronic patient record system*), a project management board typically is established. This project management board serves as an interface between *strategic* and *tactical information management*.

9.7 Last But Not Least: Education!

For *strategic information management* in hospitals, well-educated specialists in health informatics/medical informatics are needed. They should have appropriate knowledge and skills to systematically manage such information systems, in order to appropriately and responsibly apply information and communication technology to the complex information processing environment of hospitals – and beyond (see, e.g., the next chapter).

Curricular national frameworks for educating such specialists are very important. In this book and with respect to this importance, we want to refer to the recently updated recommendations of the International Medical Informatics Association (IMIA) on education.[13] These recommendations are designed to help in establishing courses, course tracks or complete programs in biomedical and health informatics and to further develop existing educational activities in the various nations. They also provide examples of how education has been established within nations.

The IMIA recommendations by the way clearly and explicitly mention the relevance of educating knowledge and skills in health information systems and its architectures and strategies (see also the citations at the beginning of this book).

As education is not in the scope of this book, we only want to refer to the need to educate. The exclamation mark at the end of this section heading should help to highlight the outstanding importance of education for professional and high-quality information management.

9.8 Summarizing Examples

9.8.1 Deficiencies in Information Management

The following letter was written by the head of the Department of Internal Medicine of the Plötzberg Medical Center and Medical School (PMC) to the chief executive officer. He complains about failures in information management.

> Dear colleague,
>
> I am sitting here again, having organized the duties for Good Friday and the whole Easter weekend in a way that *patient care* as far as the physicians are concerned is guaranteed. I can also be sure that nursing is well organized for these days, so I want to use the holidays to catch up with my work in the clinic. On the other hand, I have to realize that the network

[13] Mantas J et al.; IMIA Recommendations on Education Task Force. Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics. Methods Inf Med. 2010;49:105–120. Accessible, e.g., at www.IMIA.org

of our clinic is down yet again and that consequently, starting from the door-keeper's office to every ward and every lab, there isn't any kind of data processing or EDP support. The door-keeper sends visitors coming to see their relatives to the wards by trusting their luck. At the wards, essential information is missing and scientific work is delayed by the cutting off of all internal and external scientific networks.

With this letter I want to express my protest once again and complain about the fact that the way information processing is managed in our hospital is completely unacceptable. I do not know what still has to happen so that we can finally get an emergency service for nights and for holidays. This is why I want to ask you to immediately make sure in the board of the PMC and in the Committee for Information Processing that such a technical standby service is installed for the maintenance of the network and for breakdowns in the same way that we provide on-call services for all important clinical processes.

In summary, I want to express my deep disappointment about the whole situation. Nowadays, information processing has gained such an important standing in daily patient care that we can really put patients at risk if we do not immediately – and with this I mean at once – find a remedy for this problem.

Yours sincerely,
in a very annoyed mood
Prof. Dr. K.
Director of the Dept. of Internal Medicine

9.8.2 Computer Network Failures[14]

The computer system of Plötzberg Medical Center and Medical School (PMC) crashed repeatedly over 3½ days last week, periodically blocking access to patient records, prescriptions, laboratory reports, and other information, and forcing the hospital to revert to the paper-based systems of what one executive called "the hospital of the 1970s."

Hospital executives said yesterday that patient safety was never jeopardized. But scores of employees worked overtime printing records, double-checking doses, physically running messages from the labs to the wards and back – even rushing to buy copier paper on the credit card of the chief operating officer (COO), Dr. E. The crisis, which lasted from Wednesday afternoon until Sunday, took the hospital by surprise. Its electronic network was named the nation's best in health care last year by the magazine Information Week, and its chief information officer (CIO), Dr. H., is an authority on medical computing.

As hospitals are urged to convert their record keeping to computers as part of the battle against errors, hospital and public health officials are calling the incident a wake-up call for hospitals across the country, whose computer systems may not be able to keep up with their growing work load. At PMC, the systems handle 40 terabytes of information daily – or 40 times the information in the Library of Congress.

[14]This example is based on a report in Boston Globe, November 19, 2002, page B1.

"Imagine if you built a house and you put in an extension cord to it, and then you hook up a lawnmower, and then you hook up a barbecue. Eventually the breaker is going to blow," the CIO, Dr. H., said. "I as CIO feel a moral obligation to share the lessons we have learned over the last few days with every other CIO in the country. Have you got systems in place to deal with a problem like this? And if you have infrastructures that are at risk, have you done due diligence to really look at your hospital and make changes?"

Although computer systems have allowed hospitals to work with more speed and flexibility, executives said, last week's events showed how frightening it can be when they fail. "Any time you're taking care of very sick patients, when everything isn't as you're used to it, you get a little nervous," said the COO, Dr. E.

The crisis began when a researcher installed software to analyze data, and a large amount of information started flowing over the network. Doctors noticed intermittent problems with e-mail and data entry. But at 4 p.m. on Wednesday, most of the systems – from e-mail to accessing patient records to entering laboratory data – slowed or stopped and stayed down for 2 h.

The hospital called in a special forces team of specialists from the manufacturer that provides and maintains its computer networks. But the crashes kept happening every 4–6 h, so rather than go back and forth between paper and computer systems, the hospital decided to switch to all-paper.

The emergency room shut down for most of Friday, and the hospital decided to refuse all transfers except in life-threatening emergencies. Some lab tests that normally take 45 min to complete took closer to 2 h, so doctors reverted to lower-tech methods of diagnosis. "There was a sense of old-fashioned medicine," said Dr. S., an intensive-care physician.

In response to the incident, the manufacturer plans to warn hospitals to update their systems, the CIO said. He also plans to talk about the subject with the systems managers of the state's hospitals on Thursday, at a previously planned meeting of the regional Health Data Consortium.

All hospitals were required to put in disaster plans. PMC had such a plan in place, but because systems evolve so quickly, it was already outdated. The hospital has not calculated how much the computer setbacks will cost. The COO said there may be some delay in receiving payments from insurers because billing relies on the computer network.

9.8.3 Information Management Responsibilities[15]

The senior executives (chief executive officers, chief operating officers, or chief information officers) at ten health care organizations conducted audits to evaluate the effectiveness of information management in their own organizations. The organizations ranged from rural hospitals to university affiliated teaching hospitals, with bed size ranging from 60 to 1,232.

[15]This example is based on Austin KD, Hornberger JE, Shmerling JE, Managing information resources: a study of ten healthcare organizations, J Healthc Manag 45(4);2000:229–238; discussion 238–239.

The audits evaluated how well the following seven information technology management responsibilities were carried out: (1) strategic information systems planning; (2) employment of a user focus in system development; (3) recruiting of competent IT personnel; (4) information systems integration; (5) protection of information security and confidentiality; (6) employment of effective project management in system development; and (7) postimplementation evaluation of information systems.

The audit results suggest that most of these responsibilities are being met to a considerable extent by a majority of the organizations studied. However, substantial variation across organizations was noted. Executives participating in the study were able to define areas in which the management of information resources in their organizations was in need of attention. The audit process encourages senior management to provide the leadership required to ensure that information technology is used to maximum advantage.

9.8.4 Safely Implementing Health Information and Converging Technologies

From the Sentinel Event Alert from the Joint Commission, Issue 42, December 11, 2008[16]:

> "As health information technology (HIT) and "converging technologies" – the interrelationship between *medical devices* and HIT – are increasingly adopted by healthcare institutions, users must be mindful of the safety risks and preventable adverse events that these implementations can create or perpetuate....
>
> There is a dearth of data on the incidence of adverse events directly caused by HIT overall. The United States Pharmacopeia MEDMARX database includes 176,409 medication error records for 2006.... Of those medication error records, 43,372, or approximately 25 percent, involved some aspect of computer technology as at least one cause of the error....
>
> Inadequate technology planning can result in poor product selection, a solution that does not adapt well to the local clinical environment, or insufficient testing or training. Inadequacies include failing to include front-line clinicians in the planning process, to consider best practices, to consider the costs and resources needed for ongoing maintenance, or to consult product safety reviews or alerts or the previous experience of others. Implementing new clinical information systems can expose latent problems or flawed processes with existing manual systems; these problems should be identified and resolved before implementing the new system. Technology-related adverse events also happen when healthcare providers and leaders do not carefully consider the impact technology can have on care processes, workflow and safety.
>
> If not carefully planned and integrated into workflow processes, new technology systems can create new work, complicate workflow, or slow the speed at which clinicians carry out clinical documentation and ordering processes. Learning to use new technologies takes time and attention, sometimes placing strain on demanding schedules. The resulting change to clinical practices and workflows can trigger uncertainty, resentment or other emotions that can affect the worker's ability to carry out complex physical and cognitive tasks. Additionally, safety is compromised when healthcare information systems are not integrated or updated consistently. Systems not properly integrated are prone to data

[16] http://www.jointcommission.org/SentinelEvents/SentinelEventAlert/sea_42.htm

fragmentation because new data must be entered into more than one system. Multiple networks can result in poor interoperability and increased costs. If data are not updated in the various systems, records become outdated, incomplete or inconsistent."

9.8.5
Increased Mortality After Implementation of a Computerized Physician Order Entry System[17]

The Department of Critical Care Medicine of the University of Pittsburgh School of Medicine, Pennsylvania, USA, implemented a commercially sold computerized *physician order entry system* (*CPOE*) in an effort to reduce medical errors and mortality. The researchers had the hypothesis that *CPOE* implementation results in reduced mortality among children who are transported for specialized care. During an 18-month period, demographic, clinical, and mortality data were collected of all children who were admitted via interfacility transport to the hospital. During this period, a commercially sold *CPOE* program was implemented hospital-wide. The data were retrospectively analyzed comparing pre-CPOE and post-CPOE period. The researchers found that, using univariate analysis, mortality rate significantly increased from 2.80% (39 of 1394) before *CPOE* implementation to 6.57% (36 of 548) after CPOE implementation. The authors argue that they found an unexpected increase in mortality coincident with *CPOE* implementation. Reasons they discuss comprise increased time needed for documenting orders which interferes with the time-criticial treatment of very ill patients, interruptions of communication processes between physicians and nurses by the *CPOE*, and delayed administration of time-sensitive medication.

9.9
Summarizing Exercises

9.9.1
Management of Other Information Systems

Are there any differences between management of hospital information systems and management of information systems in other industries? Explain your answer.

9.9.2
Beginning and End of Information Management

When does hospital information management start, and when does it end? Directing and monitoring are ongoing tasks of information management. Is this true for planning as well?

[17] cf.: Han YY, Carcillo JA, Venkataraman ST, Clark RS, Watson RS, Nguyen TC, Bayir H, Orr RA. Unexpected increased mortality after implementation of a commercially sold computerized physician order entry system. Pediatrics. 2005 Dec;16(6):1506–1512.

9.9.3 Cultivating Hospital Information Systems

Look at the following description of the duties of a forest's owner (taken from respective German law) and discuss the similarities and differences of cultivating a forest and of information management in a hospital:

The duties of a forest's owner are:
- to cultivate the forest according to its purpose,
- lastingly...
- carefully...
- systematically... and
- competently...,
- using recognized forest-managerial methods...

9.9.4 Hospital Information System Failure

Look at example 9.8.2. What are the reasons given for this hospital information system failure? What has been the impact of this failure on clinical workflow and *patient care*? Analyze the problems and suggest appropriate activities to prevent the described problems in the future.

9.9.5 Increased Mortality

Please look at example 9.8.3 and try to explain how the *CPOE* could have contributed to an increase in mortality rates. Please look also at example 9.8.4 to solve this question.

9.9.6 Relevance of Examples

Note that the examples given in Sect. 9.8 are partly taken from the first edition of this textbook and are therefore rather old. What do you think about the relevance of these examples for information management nowadays? (How) do you think, technology and organization of information management have changed?

9.9.7 Problems of Operational Information Management

Look at the following problems, derived from the report of the assessment of the *operational information management* at Plötzberg Medical Center and Medical School (PMC). How would you proceed to solve these problems?

- The ICT Department (see example 9.3.3.1) is distributed over several areas that are some miles away from the hospital's building. This causes long delays, loss of information, and delayed response times in case of local problems.
- The costs of information management and information processing are unclear. For example, the total costs of the introduction of an electronic mailing system for all staff of the hospital are not exactly known.
- In the case of emergencies (e.g., fire) in the computing center, there may be extensive data losses and a longer unavailability of important application components.

9.10 Summary

High quality HIS can only by achieved and HIS failures can only be prevented if HIS are systematically planned, monitored and directed.

The tasks of information management in hospitals are planning, directing, and monitoring of HIS. It can be distinguished into *strategic, tactical*, and *operational information management*. *Strategic information management* deals with the hospital's information processing as a whole. *Tactical information management* deals with particular enterprise functions or application components. *Operational information management* is responsible for operating the components of the hospital information system.

Each hospital should have an adequate organization for *strategic, tactical*, and *operational information management*. In general, a chief information officer (CIO) should be responsible for information management and a central information management department. If there is decentralized information management staff, located at the individual departments of the hospital, this staff has to be controlled by the CIO.

Consequently high quality HIS need not only adequate financial investments but also considerable financial and human resources for their *strategic, tactical*, and *operational information management*.

Strategic HIS planning deals with planning of HIS architecture and the organization of information management. Tasks of strategic HIS planning are the strategic alignment of business plans and information management plans, the long-term HIS planning, and the short-term HIS planning. The main methods are the strategic alignment of hospital goals and information management goals, adequate portfolio management, and the establishment of a strategic information management plan.

Strategic HIS monitoring aims to continually audit the quality of the hospital information system. It comprises permanent monitoring activities as well as ad hoc monitoring activities such as dedicated evaluation studies.

Strategic HIS directing mainly consists of transforming the strategic information management plan into projects.

Summarizing, some quality criteria for an efficient information management can be defined, such as:

- systematic *strategic information management* with a strategic information management plan as the basis;

- systematic *tactical information management*, with clear management of the projects;
- systematic *operational information management*, with an appropriate support strategy to guarantee the continuous and faultless operation of the information processing tools;
- clear decision structures, roles, and responsibilities for *strategic, tactical*, and *operational information management*;
- sufficient and ongoing training of the users;
- motivation and competence of IT staff, which is essential for the efficient functioning of the information systems and for a high acceptance by the users.