Chapter 4
Management Perspective: Scopes and Tasks of Managing Health Information Systems

4.1 Introduction

In Chap. 3, we discussed the technological perspective of health information systems. We will now examine how health information systems have to be managed so they will fulfill the requirements of the stakeholders as presented in Sect. 1.3.

As already introduced in Sect. 2.12, management of information systems ensures systematic information processing that supports information and knowledge logistics and therefore contributes to the health care setting's goals. High-quality health information systems and their components can only by achieved if the health information systems are systematically planned, monitored, and directed.

Management of information systems can be differentiated into strategic, tactical, and operational management of information systems. In this chapter, we will first discuss these three scopes of management of information systems and how they are interlinked in more detail. We will then focus in more detail on strategic management of information systems and discuss tasks and methods of strategic planning, strategic monitoring, and strategic directing of health information systems. We will also discuss organizational structures for systematic management of information systems.

Finally, it is important to remember that for the management of information systems we can only say in a few cases what is indeed right and what is wrong. Rather, in practice, decisions must be made again and again as to which solutions and approaches are best suited in the respective setting (Fig. 4.1). In doing so, a balance must be reached between at times conflicting goals. This balancing act is what the last section is about.

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Fig. 4.1 Health information systems constitute an essential part of providing good health care. Managing health information systems requires both professional skills and communication

After reading this chapter, you should be able to

- define management of information systems and explain the differences between strategic, tactical, and operational management of information systems,
- describe the tasks of strategic planning, monitoring, and directing of health information systems,
- describe the tasks of tactical and operational management of health information systems,
- discuss appropriate organizational structures for the management of information systems in health care settings, and
- explain examples of balancing priorities in strategic management of health information systems.

Please note that the terms highlighted in italics are terms from the glossary or represent functions or application system types.

4.2 Dimensions of Managing Health Information Systems

In this section, we present in more detail the tasks of managing health information systems in health care facilities. We will discuss strategic, tactical, and operational management, their goals, and their tasks.

As already discussed in Sect. 2.12, *management of information systems* encompasses the management of all components at the three layers of an information system—the management of functions, processes, and entity types, of application components and services, and of physical data processing systems. We consider these components the objects of *management of information systems*.

Although the layers help to structure *management of information systems* by objects, it is helpful to also divide *management of information systems* with regard to its scope into strategic, tactical, and operational management.

Strategic management of information systems deals with the information system 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 management of information systems deals with particular functions, application components, or physical data processing systems that are introduced, removed, or changed. Usually, these activities are done in the form of projects. Tactical information management projects are initiated by *strategic management of information systems*. Thus, *strategic management of information systems* is a vital necessity for *tactical management of information systems*. The result of tactical information management projects is an updated information system.

Operational management of information systems is responsible for operating the components of the information system. It ensures the smooth operation of the system in accordance with the strategic management of information systems plan. Additionally, operational information management plans, directs, and monitors permanent services for the users of the information system.

Regardless of which objects are currently being processed and on which scope *management of information systems* is currently focused, *management of information systems* is always involved in the tasks of planning, directing, and monitoring.

This results in three dimensions for classifying *management of information systems* as shown in Fig. 4.2. When combining the three scopes, the three main tasks, and the three major objects of *management of information systems*, we can also define a $3 \times 3 \times 3$ matrix of information management activities.

This separation of activities of *management of information systems* is essential because each of the information management scopes has different perspectives and therefore uses different methods and tools. For example, planning within *strategic management of information systems* focuses on strategic information management plans. Planning within tactical management needs, for example, methods for project management or user requirements analysis, while directing within tactical management needs methods for 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.

Strategic, tactical, and operational management depend on each other. Figure 4.3 presents their relationships in a three-layer graph-based metamodel ($3LGM^2$) domain layer.

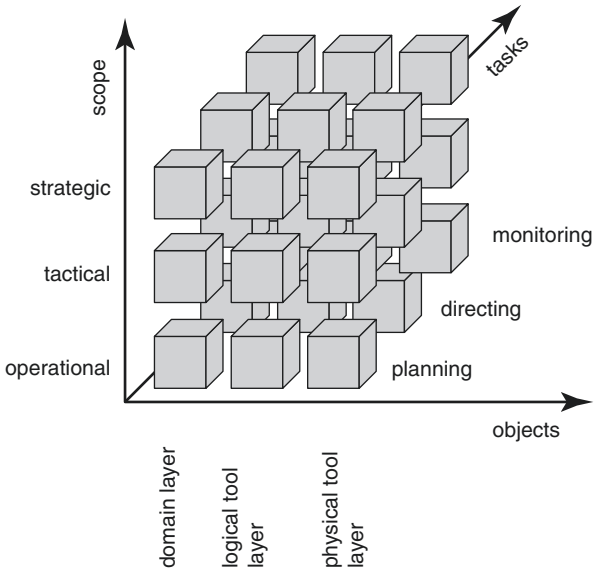

Fig. 4.2 Three-dimensional classification of activities of *management of information systems*

Within *strategic management of information systems*, a strategic information management plan and project portfolios have to be created as a result of planning activities. Strategic planning depends on the business strategy of the enterprise, defined by the strategic enterprise management, on information from HIS quality indicators, and on legal regulations. Since the strategic information management plan contains a project portfolio to be performed in the coming years, strategic directing means initiating these projects. Strategic directing updates a project charter which is then processed by *tactical management of information systems*. Strategic monitoring collects various information regarding the state of the information system components and users' and patients' requirements and compares these with the strategic information management plan and the project portfolio. The resulting HIS quality indicators are fed back to strategic planning.

Within each project of *tactical management of information systems*, the course of the project must be planned (project plan) and the project will be directed and monitored according to this plan. The result of a project are updated information system components. When a project ends, the result is documented in a handover protocol which is passed to *operational management of information systems* for further operation of the information system component.

Executive operational tasks (such as operating a computer server) are not part of information management. Nevertheless, these operational tasks must be planned, directed, and monitored. This is carried out by *operational management of information systems*.

As already indicated in Fig. 4.3, *management of information systems* in health care facilities is performed in an environment full of influencing factors. Decisions

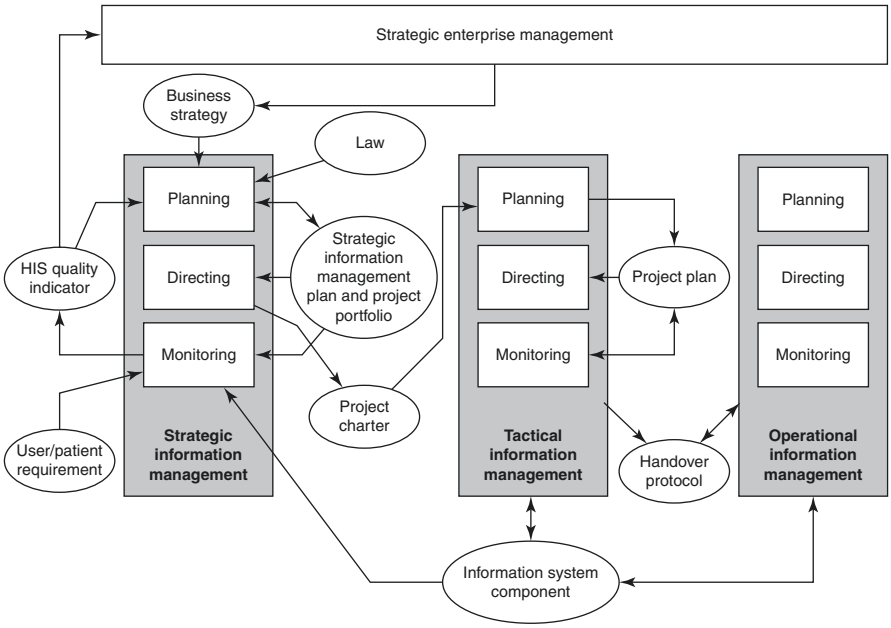

Fig. 4.3 3LGM[3] representation of the relationships between functions of "strategic, tactical, and operational management of information systems and related entity types"

made by the strategic enterprise management of the health care facility directly influence *management of information systems*. For example, the decision of the strategic enterprise management of a health care facility to cooperate in a health care network will have an impact on the future state of the information system. New legal regulations also have an effect on the *management of information systems*. For example, a law enforcing the introduction of a new billing system based on patient grouping will require adaptations in application components. Patients and users, as important stakeholders of an information system, also influence *management of information systems* with their values, attitudes, and requirements. Patients may demand a patient portal to access some of their data from home, for example. Or *management of information systems* itself may affect the management of the health care facility. If, for example, *management of information systems* proposes the introduction of a multi-professional *electronic health record system (EHRS)*, this must in turn lead to strategic activities such as process reorganization within the health care facility.

Figure 4.4 summarizes these relationships between management and operation of a health information system and the influencing factors.

We now look at the activities of strategic, tactical, and operational management of information systems in health care facilities.

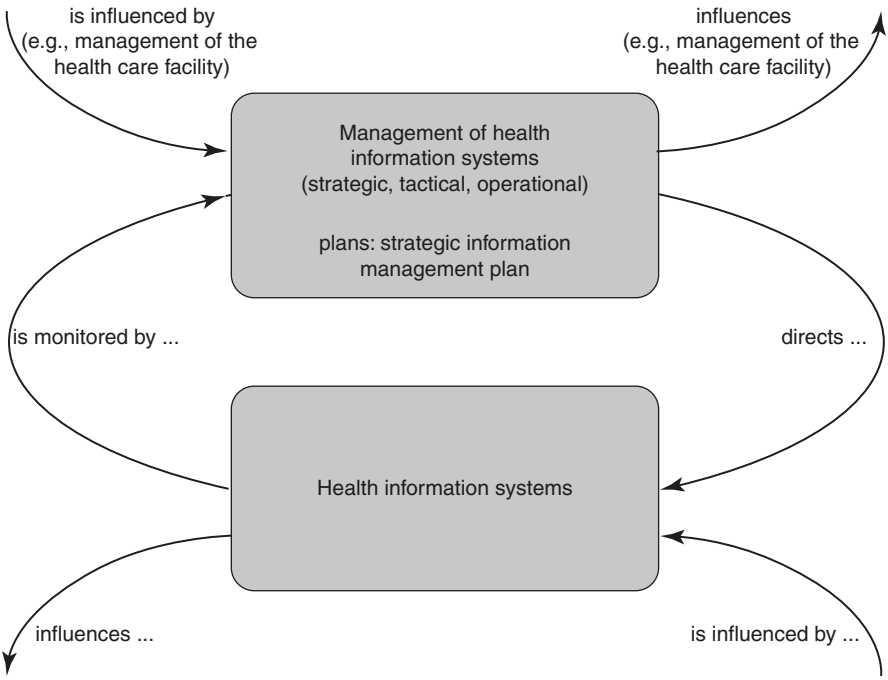

Fig. 4.4 Strategic, tactical, and operational management of information systems in health care facilities and their relationships

4.3 Strategic Management of Information Systems

Strategic management of information systems deals with the information system of a health care facility as a whole. It depends on and must be aligned to the facility's vision, mission, and strategic goals.

Strategic management of information systems and its strategic information management plan are the prerequisites for tactical and operational management of information systems in a health care facility.

We will now discuss in more detail strategic planning, monitoring, and directing of *management of information systems* in health care facilities.

4.3.1 Strategic Planning

Strategic planning is the first step of a systematic strategic information management process and leads to a strategic information management plan as basis.

Planning, as part of *strategic management of information systems*, must translate vision, mission, and strategic goals into a specific strategic information management plan. Thus, the most important tasks of strategic planning are *strategic alignment* of business goals and strategic information management goals, and the development of both a long-term *strategic project portfolio* as part of a strategic information management plan and *annual project portfolios*.

4.3.1.1 Strategic Alignment of Business Goals and Information Management Goals

The basis for *strategic management of information systems* in a health care facility is the mission of the facility. The mission describes what the basic functions of the facility are and what it stands for. For university medical centers in Germany, for example, it is stipulated by law that they must offer the basic functions of *patient care*, medical research, and teaching of future physicians.

Strategic goals are concrete specifications of how this mission is to be fulfilled within a certain, usually longer, period of time. Such goals are set by the management of the facility. The strategic, long-term goals of a health care facility are also called *business goals*. The term "business goal" should not be understood in a purely profit-oriented or economic way, which means focusing on financial gain only. Instead, as health care facilities should serve the needs of individual patients and of society, we should understand business goals as all goals of a health care facility that reflect its mission in *patient care*, *research*, *and education*.

Health care facilities aim to provide efficient, high-quality health care. They may thus define, for example, one or more of the following business goals as their strategic, long-term goals:

- offering holistic, interprofessional, patient-oriented care,
- offering integrated care in close cooperation with external health care providers,
- offering high-quality care for a special patient group (e.g., by specialized medical competence centers),
- attracting patients from other regions,
- supporting clinical research and medical education (e.g., as university-affiliated hospital),
- being very cost-effective, or
- being an innovative and modern health care facility (e.g., by using up-to-date technology for clinical diagnostics).

Different goals and sub-goals result in different information management strategies and different architectures of information systems. Also, advances in information and communication technology (ICT) may influence business goals. The role of *management of information systems* thus varies between two extremes. At one

extreme, *management of information systems* may be seen as a purely supporting function; that is, the business goals determine the information management planning activities. This is called "organizational pull" and the person in charge of *strategic management of information systems* needs to know the business goals of the health care facility. At the other extreme, *management of information systems* is seen as the strategic resource from which the health care facility gains competitive advantage. The application of technological advances mainly determines the further development of the health care facility and its position on the health care market. This is called "technology push." For this, the top management needs to know the potential of information systems with regard to supporting or shaping the business goals. *Strategic management of information systems* must thus be able to offer this information to top management in adequate and understandable form.

Strategic alignment describes the process that balances and harmonizes the business goals of the health care facility and the information management strategies to obtain the best results. Strategic alignment ensures that the strategic information management plan directly supports the business goals and that IT projects and IT budget can be directly tied to these business goals.

4.3.1.2 Strategic Information Management Plan

The *strategic information management plan* represents the long-term planning of the information system of a health care facility. This plan describes the business goals, the information management goals, the current state of the information system, the future state of the information system, and the steps to transform the current into the planned information system. *Strategic management of information systems* must create and regularly update this plan. The strategic information management plan is the basis for all tactical and operational information management activities and is the precondition for systematically directing and monitoring the information system of a health care facility.

Strategic management of information systems is an ongoing process, and there is no use in trying to solve all problems of information processing at the same time. Solely a stepwise approach, based on different levels of priorities, is feasible. The strategic information management plan is therefore the basis for a *strategic project portfolio* that describes projects or groups of projects, their priority, and a rough timeline for their initiation for 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 more quickly than the strategic information management plan, or strategic monitoring results may require a faster adjustment or an update of prioritization of projects. This is reflected in the annual project portfolio (Sect. 4.3.1.3) that is annually derived from the strategic project portfolio. It lists the projects to be executed in the next year.

The strategic information management plan should be written by the persons responsible for *strategic management of information systems* (e.g., the chief information officer (CIO)) and approved by the top management. Without proper strategic planning, it would be a matter of chance if the information system of a health care facility fulfilled strategic information goals. But considerable efforts have to be made for creating strategic plans.

Figure 4.5 presents an overall view on strategic information management planning and use.

In larger health care facilities, several stakeholders are typically involved in the creation, updating, approval, and use of strategic plans, such as top management, clinical and administrative departments, service departments and information management departments, staff members, funding institutions, consultants, or hardware and software vendors.

These stakeholders may have different expectations of a strategic plan and are involved in different lifecycle phases for the following 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 (e.g., both the information management department and hardware and software vendors) refer to the plan when needed, and
- 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.

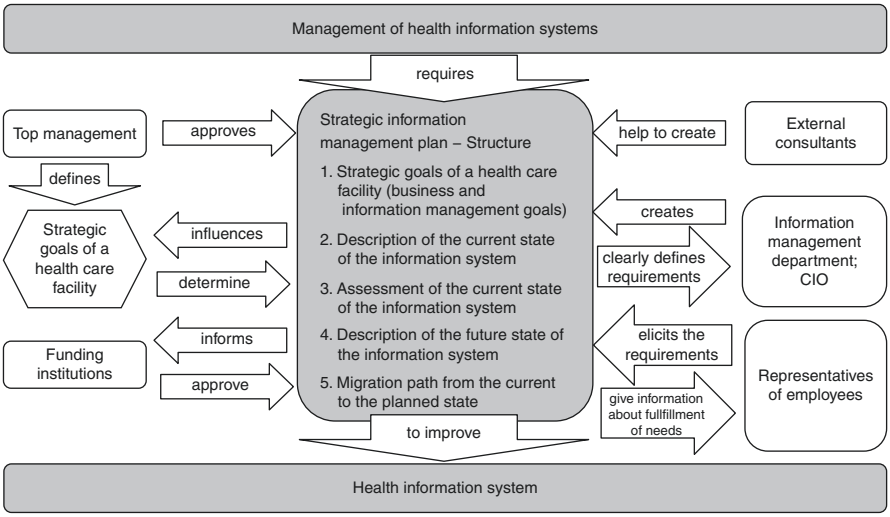

Fig. 4.5 Strategic information management planning of health care facilities. A "strategic information management plan" gives directives for the construction and development of an information system. It describes the recent and the intended information system's architecture

Usually, the CIO, supported by the information management department, creates and maintains a proposal for the strategic information management plan. The CIO is interested in having clearly defined requirements for *management of information systems*. Top management is interested in the seamless and cost-effective operation of the health care facility. Top management approves the plans (probably together with the funding institutions). Employee representatives should be involved in eliciting the requirements, as they will be using the resulting information systems. The current strategic plan will be used by the information management departments and the vendors of components when modifying the information system. External consultants may help to create the plan though they may also be engaged in negotiations for the approval of the plan.

The most essential purpose of a strategic information management plan is to improve the information system so that it can best contribute to the business goals of the health care facility. 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 business goals are achieved as far as possible and reasonable.

A strategic information management plan thus should encompass the business goals, the resulting information management goals, the current state of the information system, and an assessment of how well the current information system fits the goals. Based on this assessment, the future state of the information system is described, together with a migration path represented by a strategic project portfolio that allows this future state to be reached.

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

The general structure of strategic information management plans is described in the following paragraphs and is summarized in Fig. 4.6. It should be noted that this is only a basic structure which may be adapted to the specific requirements of a health care facility.

1. **Strategic goals of the health care facility** (business goals) and of *management of information systems:* Based on a presentation of the business goals, the strategic information management goals are described based on strategic alignment.
2. **Current state of the information system**: Before any planning starts, the information system's current state is 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 is the basis for identifying those functions of the health care facility that are well supported by the information system and those functions that are not (yet) well-supported. Thus, application components and physical data processing systems are to be described, including how they support the functions. The metamodel 3LGM² (Sect. 2.14) and related software is very helpful for this task.

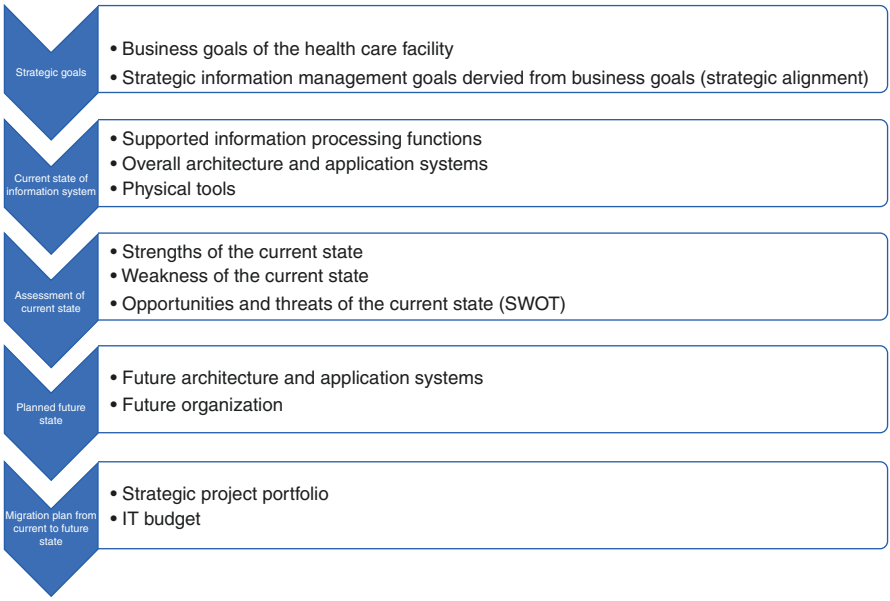

Fig. 4.6 Structure of a strategic information management plan

3. **Assessment of the current state of the information system:** The current state is then assessed with respect to the achievement of information management goals. Note that the lack of computer support for a certain function may not in all cases be assessed as a sign of poor support for that function. For example, a lack of computers in patient rooms and, consequently, the use of paper-based documentation for clinical findings may be part of the goal of being a humane hospital without using computers and hand-held digital devices in this area. Chapter 5 will discuss further criteria to assess the quality of an information system.
4. **Planned future state of the information system:** Based on the assessment of the current state, a new state is described that achieves the goals better than the current state. Again, $3LGM^2$ is useful here. The description of the planned state can be complemented by the description of the planned organizational structure of *management of information systems*. In many cases, this is an opportunity to introduce a CIO or to clarify his or her role.
5. **Migration path from the current to the future state:** This section describes a step-by-step path from the current to the future state. In the strategic information management plan, every such step is a project or a group of related projects (such a group is also called "program" in project management). The resulting migration path of projects describes priorities of projects as well as dependencies between projects. The resulting projects and their priorities can also be called a strategic project portfolio. This portfolio thus represents the migration path.

A short management summary and appendices describing the organizational structure, personnel resources, the building structure, etc. are likely to complement a strategic plan. Section 4.8.1 presents as example the structure of the strategic information management plan of Ploetzberg Hospital.

4.3.1.3 Annual Project Portfolio

The *annual project portfolio* is derived from the strategic project portfolio as described in the strategic information management plan. While the strategic project portfolio represents the planned projects for a longer period of time (e.g., 3–5 years), the annual project portfolio describes the projects to be executed in the next year.

The annual project portfolio thus contains a list of projects to be initiated in the next year together with their priorities, timeline, and rough resources. This annual project portfolio implements the long-term strategic project planning into an annual planning. It may reflect changes in prioritization of projects due to internal or external changes in the health care facility (e.g., a new data protection law or the availability of a new mobile technology). The annual project portfolio must be approved by top management, which also provides the needed resources for all projects.

An important instrument for building, managing, and updating annual project portfolios is portfolio management. Originating in the field of finance, the term portfolio management is today used in different management contexts.

A portfolio is a collection of objects grouped together to facilitate effective management of activities to meet strategic business objectives. Managing a portfolio comprises the selection and management of objects based on their value for the health care facility, but also based on their costs and risks and on their dependencies (i.e., one project can only start when another project has ended). Portfolio management establishes categories of objects (i.e., projects or application components) and defines priorities for each category (i.e., which projects should start first). Each category carries a different degree of risk and may thus need different project management methods.

In the context of *management of information systems*, portfolio management can focus on projects of information management or on components such as application components or physical data processing systems.

Project portfolio management categorizes IT projects, among other things, according to their contribution to the business goals, their risks, and their expected costs. Based on prioritizing projects, project portfolio management allows for the planning and controlling of IT projects. A project portfolio is typically built when an organization defines or refreshes its strategic goals and its strategic information management plan. Both the final strategic project portfolio and the derived annual portfolio need to be authorized by the top management. To build a project portfolio, the following steps can be followed [1]:

1. Create an up-to-date list of ongoing or planned projects (e.g., take the strategic projects defined in the strategic information management plan or project from the annual project list).
2. Define the evaluation criteria that will define the priority of each project (e.g., contribution of the project to major business goals, costs of the project, and risks of the project) and decide on the weight of each criterion.
3. Evaluate each project against the evaluation criteria by collecting information from various sources (e.g., assess contribution to business goals based on assessment by the CEO, assess project costs from the project plan or IT budget, and assess risks of the project based on assessment by the project manager).
4. Calculate an overall priority score for each project by using collected information and weight (e.g., multiply each evaluation score by the weight of each evaluation criteria and add the scores to get the overall priority score for a project).
5. Select the projects with highest priority for execution in the next time period (e.g., selecting the most important projects to be initiated in the next year and thus to be included in the annual project list). Balance the number of selected projects with the available financial resources.
6. Keep the project portfolio up to date on a regular basis (e.g., annually) by adding new projects or removing completed projects and by recalculating the priorities for the next annual project list.

Unlike project portfolio management, application component portfolio management considers different types of components. For example, the portfolio proposed by the Gartner Group distinguishes three categories of application components: Utility applications are application components that are essential for the operation of the health care facility but have no influence on the business success and, therefore, are independent of the business goals (e.g., the *patient administration system*). Enhancement applications are application components that improve the performance and thus contribute to the success of a health care facility (e.g., computer-based *nursing management and documentation system (NMDS)*). Frontier applications are application components that influence the position of the health care facility in the health care market (e.g., telemedical applications). Information management planning should aim at a well-balanced application portfolio—on the one hand, to efficiently support essential functions of the health care facility and, on the other hand, to not miss out on future technological innovations.

4.3.2 Strategic Monitoring

After having planned the information system strategically, one may expect that the information system will operate well in most of its functions, in most of its information processing tools, and in most parts of its operating organization. In many cases,

however, problems may occur. Confidentiality of data may not be assured in some circumstances; transmission of clinical reports may not be timely; adequate data integration capabilities may not be provided and thus consistency of redundant data may not be assured between application components; or, since there is no data warehouse, the health care facility may not be able to collect and analyze aggregated data to support *patient care* and operations. There may be additional problems to be taken into account at a strategic level. For example, users may be increasingly dissatisfied with a specific 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 an unforeseen amount of high effort for support and training, or the number of medical errors may rise due to software errors or unusable software.

Besides low software quality, badly organized projects in tactical *management of information systems* or errors in *strategic management of information systems* may also lead to the problems described above. Such problems may become apparent very slowly, for example, when a formerly "good" component is not updated to match the overall technical progress, leading to inacceptable performance and functionality, or when more and more new application components need to be integrated into a spaghetti-styled architecture (compare Sect. 3.6.4). 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 makes a wrong decision, and the patient is harmed.

Monitoring, as part of *strategic management of information systems*, means continuously auditing quality and cost of the information system and assessing whether the strategic information management plan has been implemented as intended. Auditing determines whether the information system is able to fulfill its tasks efficiently, i.e., whether it contributes significantly to the facility's vision and mission, meets the stakeholders' requirements (Sect. 1.3), and fulfills the relevant laws. To allow auditing, monitoring needs to receive information from *tactical management of information systems* (e.g., on the successful completion of projects) and from operational management (e.g., on number of service desk calls) as well as information from users (e.g., from user satisfaction surveys) and from strategic management of the health care facility (e.g., on changes in the vision and mission). Additional information on the quality of the information system can be gained through evaluation projects. Monitoring results are used as input to direct tasks of *management of information systems*, 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.

Typically, strategic monitoring comprises activities such as permanent monitoring activities, *benchmarking*, and ad hoc monitoring. These are explained in more detail in the following sections.

4.3.2.1 Permanent Monitoring Activities by Key Performance Indicators (KPI)

An information system of a health care facility is typically too complex to allow all its components to be monitored at the same time. However, it is useful to define a subset of quality criteria that is to 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* (*KPIs*). In general, KPIs are a set of quantitative and well-defined performance measurements that demonstrate how effectively an organization is achieving key objectives. KPIs not only allow areas of improvement to be identified but also help to compare own achievements to similar organizations (benchmarking).

KPIs for information systems demonstrate how effectively key objectives of the information system, as typically defined in the strategic information management plan, are reached. These KPIs could comprise, for example:

- functional coverage of the application components (e.g., percentage of functions that are supported by computer-based application components, or percentage of documents created in computer-based form),
- standardization of the information system's architecture (e.g., percentage of interfaces using standards such as Health Level 7 (HL7)),
- homogeneity of the architecture (e.g., number of different application components),
- availability of the application components (e.g., downtimes per year),
- performance of the application components (e.g., response time),
- user satisfaction (e.g., quantifiable by regular user surveys),
- costs for *management of information systems* (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 *strategic management of information systems* (e.g., percentage of successfully initiated IT projects as planned in the strategic project portfolio or the annual project portfolio), and
- quality of *tactical management of information systems* (e.g., percentage of successfully completed IT projects).

In Chap. 5, we will further discuss indicators for the quality of an information system and how they can be structured.

These KPIs should be recorded in quantitative and, as far as possible, in automated form to allow monitoring on a regular basis. Example 4.8.2 presents some KPIs of the information system of Ploetzberg Hospital.

Besides monitoring those indicators, data from other sources can also be related to the quality of the information system and thus be of interest for *management of information systems* as well, such as data from patient satisfaction surveys, medical error reports, or commentary on the health care facility in the local press. 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 information system.

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 to identify areas of improvement, but they can also be used to compare the quality of the information system with other organizations or with established standards in the form of benchmarking. Some benchmarking approaches are presented in the following section.

4.3.2.2 Benchmarking of Health Information Systems

Benchmarking in general describes a process in which organizations evaluate various aspects of their performance and compare it to given standards or to the best organizations ("best practice"). Benchmarking uses quantitative criteria (KPIs) for comparing situations.

In strategic management, benchmarking is seen as an important approach to assess the performance of a health care facility. Benchmarking is often seen as part of a continuous quality improvement process in which health care facilities measure and then steadily improve their performance.

In strategic management of the information system of a health care facility, benchmarking can be used to assess the quality and costs of the information system in comparison with the information system of comparable facilities. Often, regional groups of health care facilities join together on an ad hoc basis to define and compare benchmarking criteria.

The Digital Maturity Self-Assessment [2], for example, measures how well secondary care providers in England use digital technology to achieve a health and care system that is paper-free at the point of care. The assessment measures digital maturity against the following three key themes: readiness, meaning the extent to which health care facilities are able to plan and deploy digital services (e.g., strategic alignment and financing of IT); capabilities, meaning the extent to which health care facilities are using digital technology to support the delivery of care (e.g., IT use to support functions such as order management or decision support); and infrastructure, meaning the extent to which health care facilities have the underlying infrastructure in place to support these capabilities. These three key themes are self-assessed using a set of questions. Results can be easily compared between health care facilities to highlight opportunities for improvement or support investment decisions.

4.3.2.3 Ad hoc Monitoring Activities by Evaluation Projects

Ad hoc monitoring activities may be initiated after larger changes of a component (e.g., introduction of a new application component) have been performed or when sudden larger problems have been observed. Ad hoc activities help to analyze a certain situation in detail in order to better understand the reasons of an observed problem or the consequences of a larger change. These ad hoc activities are conducted in the form of evaluation studies that are planned and conducted as evaluation projects by *tactical management of information systems* [3].

For example, during and after the introduction of a *computerized physician order entry system (CPOE)*, its quality and its effects on clinical care could be analyzed using a selection of the following evaluation questions:

- How accurate and complete is the ordering data entered into the *CPOE system*?
- Is the offered functionality sufficient to support all steps of the ordering process?
- Is there any redundant functionality with other components?
- Is the *CPOE system* being used as intended and as trained?
- Does the efficiency and quality of the ordering process change?
- Are physicians satisfied with the new component?
- 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 clinical care?
- What are areas of improvement of the *CPOE system*, for example, regarding functionality, integration, or training?

Typically, quantitative and qualitative methods can be combined to answer such evaluation questions. Monitoring, as part of *strategic management of information systems*, collects and reports the evaluation results to directly give feedback to strategic planning of the information system.

We will discuss planning and conducting evaluation projects in more detail in Sect. 5.4.

4.3.3 Strategic Directing

Strategic directing of information systems is a consequence of planning and monitoring the functions and the architecture of the information systems and the organization of *management of information systems*.

Directing, as part of *strategic management of information systems*, means transforming the strategic information management plan into action, i.e., systematically updating the information system to make it conform to the strategic plan. The system's manipulation is usually done by the initiation of projects. The projects deal with the construction or further development of components of the information system.

The projects to be initiated are taken from the strategic project portfolio as established in the strategic information management plan. The decision to initiate certain projects is part of strategic information planning. Strategic directing is then responsible for their prioritization, coordination, and initiation. Planning, directing, and monitoring these projects are the tasks of *tactical management of information systems*. Operational management will then be responsible for the proper operation of the components. An example of strategic directing is the initiation of a project for the introduction of the *CPOE system*.

In detail, the following main tasks of strategic directing can be identified:

- initiation of projects from the strategic project portfolio,
- assignment of a project manager,
- provision of the needed resources for the project.

4.4 Tactical Management of Information Systems

Tactical management of information systems deals with specific components at the information system's three layers. It aims to introduce, remove, change, or maintain those components. Activities of *tactical management of information systems* are usually performed within projects. *Projects* are unique undertakings that are characterized by objectives, by restrictions with regard to available time and resources, and by a specific project organization. Projects have to be initiated as part of an information strategy, which is formulated in the strategic project portfolio of the strategic information management plan. The result of all tactical information management projects is an updated information system [4].

Examples of projects of *tactical management of information systems* are:

- analysis of the structure and processes of order entry,
- selection and introduction of a new *CPOE system*,
- replacement of an application system for *discharge summary writing* in outpatient units,
- assessment of user satisfaction with a new application system for an intensive care unit (ICU).

Planning, as part of *tactical management of information systems*, means planning projects and all the resources needed for them. Even though tactical information management projects are based on the strategic information management plan, they each need an individual project plan. This project plan describes the project's scope and motivation, the problems to be solved, the goals to be achieved, the tasks to be performed, the activities to be undertaken to reach the goals, and the resources needed to complete the project.

Directing, as part of tactical management, means the execution of such tactical information management projects based on their project plan. Therefore, directing includes typical tasks of project management such as execution of the planned

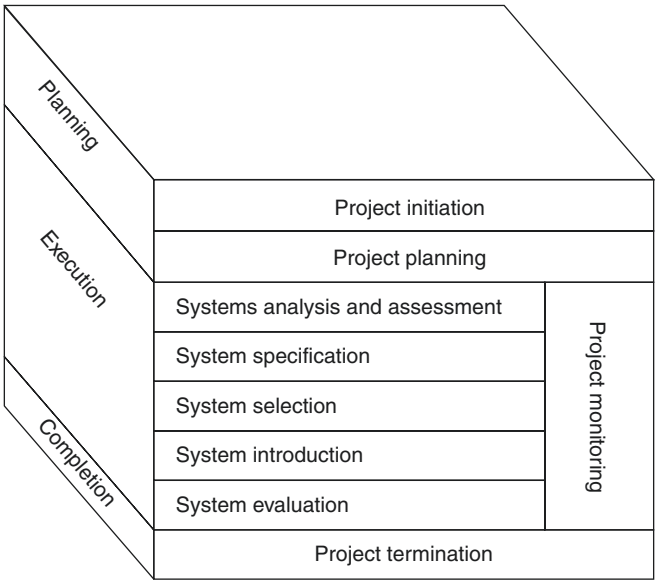

Fig. 4.7 Typical phases of tactical information management projects

working packages, resource allocation and coordination, and reporting of the project's results.

Monitoring, as part of tactical management, means continually checking whether the initiated project is running as planned and whether it will produce the expected results. Monitoring results may 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.

Typically, tactical information management projects comprise a planning phase (including project initiation and planning), an execution phase (which is about monitoring the project and one or more of the following activities: system analysis and assessment, system specification, system selection, system introduction, and system evaluation), and a completion phase (Fig. 4.7).

4.5 Operational Management of Information Systems

Operational management of information systems is responsible for operating the components of the information system. It ensures their smooth operation in accordance with the strategic information management plan of the health care setting.

Planning, as part of *operational management of information systems*, means planning organizational structures, procedures, and resources (e.g., finances, staff,

rooms, or buildings) that are necessary to ensure the faultless operation of all components of the information system. For example, *operational management of information systems* may require the installation of a user 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 planned and be made available for a longer period. Therefore, they should be allocated based on the 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).

To guarantee the continuous operation of the most important *components of an information system*, it is helpful to draw up a long-term plan for *operational management of information systems*. Such a concept should clarify which components have to be supported, who is responsible for the operational support, and what the intensity of operational support should be. Table 4.1 presents components, responsibilities, tasks, and the intensity that should be defined as part of the operational management concept for the computer-based part of an information system.

As an example, a concept for operational management in a health care facility could clarify:

Table 4.1 Dimensions to be considered for *operational management of information systems* of the computer-based part of an information system

Dimension	Facets
Components	Decentralized application systems (e.g., in departments)
	Central application systems (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)

- 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 is provided for certain application systems by the vendors of the respective application software products.
- Clients (e.g., personal computers (PCs)) are supported by the local technical staff in each department. They offer first- and second-level support during the day. They are available by mobile phone.

Directing, as part of *operational management of information systems*, is the sum of all management activities that are necessary to implement the plan and to ensure proper responses to operating problems of components of the information system. This comprises, for example, providing backup facilities, operating a service desk, maintaining servers, and keeping task forces available to repair network components, servers, PCs, or printers. Directing in this context deals with engaging the resources planned in such a way that faultless operation of the information system is ensured.

Monitoring, as part of *operational management of information systems*, deals with monitoring the proper working and effectiveness of components of the information system. For example, a network monitoring system may continuously be used to monitor the availability and correct working of network components of the health care facility.

Typically, three levels of operational support can be distinguished. First-level support is the first address for all user groups with any kind of incidents disrupting the desired operating flow. It may consist, for example, of a central 24-hour hotline (service desk) responsible for first trouble shooting and the management of user accounts, or it may consist of decentralized information managing staff. When solutions cannot be found for the reported incidents during first-level support, second-level support must take over. This is performed by specially trained informatics staff, often located 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 be performed, for example, by specialists from the software vendor.

Operation and maintenance of components of the information system are part of its *operational management*. However, if problems occur (e.g., frequent user complaints about a *medical documentation and management system (MDMS)*), appropriate projects may be executed by *tactical management of information systems* (e.g., introducing a better version of the documentation system).

Built on top of *strategic and tactical management of information systems*, *operational management* thus offers users comprehensive services. These services go beyond simply delivering hardware and software. Rather, they are designed to help

users use these components in a way that is helpful for their professional work. Such services are also known as *IT services*. Thus, the information management department of a health care facility is an IT service provider that delivers IT services to its customers, the users of the facility's information system. The management activities that serve to provide quality IT services are grouped under the term *Information Technology Service Management* (ITSM). ITSM therefore has the task to design, provide, deliver, and improve such customer-centered services. The Information Technology Infrastructure Library (ITIL) [5] is the de facto standard framework for ITSM. ITIL was developed for the British government in order to define best practices for all governmental data centers.

For *operational management of information systems*, ITIL recommends setting up the following processes in particular:

The incident management process deals with the handling of incidents that disrupt users in the completion of their work (e.g., a non-functioning application system or printer). The aforementioned service desk is used to receive complaints about such incidents. If a solution for the customer cannot be found there immediately, the incident is declared a problem and passed on to the problem management process. If the problem management process reveals that changes need to be made to the components directly affected by the incident or to other components of the information system, the change management process will handle this. Since both small and large changes can always have side effects, ITIL also recommends a change management board as part of the process to coordinate and monitor the required changes. Incident, problem, and change management all require configuration management. With this term, ITIL means the processes that ensure that *management of information systems* always has a correct overview of all components of the information system and their connections, i.e., the information system's configuration. Corresponding configuration management systems can be based on 3LGM^2 and the three levels defined there (Sect. 2.14).

Especially in a health care facility, where human lives may depend on the proper operation of the information system, it is recommended to have a systematic ITSM and to follow ITIL.

4.6 Organizational Structures for the Management of Health Information Systems

Organizational structures for *management of information systems* differ greatly among health care facilities. In general, for each facility the adequate organization for strategic, tactical, and operational management of information systems and its proper integration into the decision structures of the facility must be established by *IT governance* as mentioned before. The resulting structures will depend on the facility's size, internal organization, needs, and goals.

Organizational structures can be described at the level of the health care facility as a whole (e.g., a chief information officer, a central information management department) and at the departmental level (e.g., specific information management staff for a certain department, a certain outpatient unit). We will now look at the role of the CIO and the information management department in more detail.

In this section, we first discuss IT governance and the decision-making processes before discussing important roles in this context: the CIO, the *Information Management Board*, and the Information Management Department.

4.6.1 IT Governance and Organizational Structures for Information Management

IT governance is the part of the overall management of a health care facility that deals with the organizational structures for decision-making in *management of information systems* [6]. The decision-making structures must be defined in such a way that the *management of information systems* is well integrated with the facility's management and is aligned to its strategic goals.

The organizational structures for decision-making must enable the *management of information systems* to create value for stakeholders (compare Sect. 1.3 for a list of stakeholders and their requirements) and minimize risks related to the information systems. Simply said, IT governance focuses on which organizational structures are needed to achieve value from the information system, and *management of information systems* describes how to use the structures for creating this value by properly planning, directing, and monitoring the information system.

In order to find the right organizational structures for decision-making for a health care facility, one should first be clear about the fields in information management where decisions need to be made. In strategic information management, these are, in particular, decisions on the planned state of the facility's information system as part of the creation of the strategic information management plan. This includes decisions on the application systems to be used (Sect. 3.4), the architectural style to be used (Sect. 3.6), the design of the IT infrastructure (Sect. 2.11), and the basic IT principles that should be followed. IT principles refer, for example, to the use of certain standards (Sect. 3.7.2). In addition, there are the decisions on the migration path and the associated strategic project portfolio (Sect. 4.3.1.2). Of particular importance are the financial decisions about the amount of investment in the information system and the allocation of the (limited) budget among the projects in the portfolio. In tactical information management, decisions must be made within the projects about the project plan and repeatedly about the appropriate execution of the individual project steps. In operational information management, decisions must be made repeatedly, especially about the prioritization of daily tasks.

Decisions in these decision-making fields can be made in different constellations depending on the circumstances of the health care facility and the management culture customary there. The types of such constellations described in the literature include business and IT monarchies as well as feudal and federal structures. In the monarchical constellations, the decision on the information system is made by the top management of the facility or by the information management leadership. Advisory bodies are often used to prepare the decisions. In feudal constellations, decisions are delegated to the management of sub-departments, such as the medical departments. In federal constellations, decisions on the information system tend to be made collegially by bodies such as an information management board (Sect. 4.6.3). Federal constellations are particularly common in large institutions or even corporate groups, as they are most likely to take into account both local characteristics and the interests of various stakeholders. Anarchic situations can also be observed, in particular in large institutions, though they may be desirable, for example in academia as a way of promoting creativity.

A framework for implementing IT governance principles in companies is COBIT (Control Objectives for Information and Related Technology) which is published by the Information Systems Audit and Control Association (ISACA). COBIT defines goals both for the governance and the *management of information systems*. Furthermore, it describes processes and best practices that must be implemented in a company in order to achieve value creation through the information system and information. COBIT is being continuously developed and is currently available in version COBIT 2019 [7].

Depending on the decision-making field (see above), the decision-making constellations in the same facility may well vary. Regardless of the decision-making constellations chosen, two structures are indispensable: the CIO and the information management department he or she is in charge of.

4.6.2 Chief Information Officer (CIO)

It is generally useful to centralize responsibilities for the *management of information systems* in one role. In larger health care facilities such as hospitals, this role is usually called *chief information officer* (*CIO*) . Other common designations include vice president (or director) of information systems, of information services, of *management of information systems*, of ICT, or of information resources.

The CIO bears overall responsibility for the strategic, tactical, and operational management of the information system and the budgetary responsibility and has authority over all employees concerned with management of the information system. The specific position of the CIO demands dedicated medical informatics competencies, executive and managerial competencies, and economic competencies.

Depending on the size of the health care facility, the role and the tasks of a CIO may be performed by one dedicated person (e.g., a full-time medical informatics specialist) or may be covered by another high-ranking role within the top management (e.g., by the chief executive officer (CEO)).

Sometimes, the role of CIO is supported or replaced by more specific roles such as the chief medical information officer (CMIO) and the chief nursing information officer (CNIO), each responsible for the related clinical aspects of information management.

If the institution has an information management board (Sect. 4.6.3), it is usually chaired by the CIO. Conversely, the leader of such a board is often considered the CIO if the position of CIO has not been explicitly established.

Ideally, the CIO should report directly to the top management of the health care facility and, therefore, should be ranked rather high in the organizational hierarchy. For example, the CIO may be chair of the information management department and in this role directly report to the CEO.

The CIO's role should be a strategic one that comprises the following tasks of strategic management of the information system:

- make or prepare all relevant strategic decisions on the information system, especially with respect to infrastructure, architecture, and information management organization,
- align the vision, mission, and strategy of the health care facility with the strategic information management plan,
- establish, promote, and implement the strategic information management plan,
- oversee tactical management of the information system and the project portfolio in order to prioritize and initiate its projects,
- initiate evaluation studies and adequate monitoring activities of the information system,
- oversee operational management of the information system and identify and solve serious information system problems, and
- report to the CEO or the board of directors.

The CIO's close relation to or, in some cases, even the membership within the top management team should provide the possibility to influence the vision and mission of the health care facility using IT as a strategic resource. Therefore, both business and medical knowledge and the ability to effectively communicate with other managers, for example, the chief financial officer (CFO) or the nursing director, is important for a CIO.

In some cases, the CIO may focus more on tactical and even operational management of the information system than on its strategic management. This may depend on the size and internal organization of the health care facility, such as top management membership, internal communication networks among top executives and the CIO, top management's strategic knowledge about the strategic role of the information system, and the personality of the CIO.

4.6.3 Information Management Board (IT Steering Committee)

As explained in Sect. 4.6.1, in federal decision-making structures, strategic decisions on the information system tend to be made collegially by bodies such as an *information management board*. Members of this board are typically high-level representatives from the top management and from the main departments of a health care facility (see Sect. 4.8.3 for an example). Such a board is often referred to as the IT Steering Committee.

If the institution has an information management board, it is usually chaired by the CIO. Conversely, the leader of such a board is often considered the CIO if the position of CIO has not been explicitly established.

An information management board is particularly common in large institutions or even corporate groups, as they are most likely to take into account both local characteristics and the interests of various stakeholders.

4.6.4 Information Management Department

In larger health care facilities, there is usually one central information management department (often called the department for medical informatics, data center, or ICT department). This department handles the facility's strategic management of the information system and at least of the tactical and operational information management of those parts of the information system with facility-wide relevance (e.g., the *enterprise resource planning system (ERPS)*, the *medical documentation and management system (MDMS)*, and the computer network).

In larger health care facilities, the information management department may consist of units that are responsible for certain tasks (e.g., different units for incident management, project management, clinical systems, administrative systems, IT networks, or medical devices). If the information management department also handles the strategic management of the information system, the head of this department can be considered the CIO.

With regard to the responsibilities for tactical and operational management of the information system, it is sometimes not useful and often not feasible to totally centralize these services. Especially in larger health care facilities, the services are performed in cooperation between central units and the decentralized staff. This staff may be comprised of dedicated medical informaticians or especially skilled users. These local information managers have responsibilities for tactical and operational management of the information system with regard to their own department but in accordance with the central information management department. For example, they may (with support from the central unit) introduce a facility-wide application component in their department and operate it. On the other hand, they will also have

to handle 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.

In Sect. 4.8.3, we present as an example the organizational structure of information management of Ploetzberg Hospital.

4.7 Balance as a Challenge for the Management of Health Information Systems

After reading the previous sections, it may seem that *management of information systems* must merely define strategic goals for *management of information systems*, aligned with the business goals of the health care facility, and work towards them. However, reality is not that simple. *Management of information systems* is a lot about balancing priorities between various and often conflicting goals. We will now discuss five aspects of this task of "balancing" priorities.

4.7.1 Balance of Homogeneity and Heterogeneity

The collection of information processing tools (both on the logical and at the physical tool layer) should be as homogeneous (i.e., comparable in appearance and usability, for example, using tools from the same vendor) as possible and as heterogeneous as necessary. In general, a homogeneous set of information processing tools makes training and support of users easier and thus leads to reduced costs for the health information system. However, in reality, we usually find a very heterogeneous set of tools at both the logical and the physical tool layer. Why?

In any health care facility, we need application systems at the logical tool layer for the support of the functions. Maximum homogeneity, at least for the computer-based part of a health information system, can easily be reached by a (DB^1, AC^1, V^1) architecture, when just one application system exists that is implemented through a single application software product from a single manufacturer. Usually, however, diverse application software products from different manufacturers have to be purchased, which can lead to very heterogeneous (DB^n, AC^n, V^n) architectures. These products might please the various stakeholders of the health care facility (which will all have optimal support for their tasks), but they will make integration, operation, and user support much more difficult. These difficulties are often overlooked by the stakeholders concerned. In this situation, it is the task of the *management of information systems* to ensure and support an appropriate compromise between the need for economical homogeneous information processing and the needs of the various stakeholders.

At the physical tool layer, heterogeneity is often the consequence of the evolution of the health information system, comprising different generations of computer systems. This could be prevented only if all components are completely exchanged regularly, which is generally not sensible. In addition, heterogeneity is not always bad. For example, different mobile tools (laptops, tablets, and smartphones) may be needed to best support different user needs in different situations. But again, when this heterogeneity of information processing tools is not systematically managed, it can lead to the uncontrolled proliferation of tools and to unnecessary costs.

The better all stakeholders are involved in *strategic management of information systems* through an appropriate organization, the more this situation can be avoided.

4.7.2 Balance of Computer-Based and Paper-Based Tools

It is the task of managing health information systems to manage information processing in such a way that the strategic goals of the health care facility can best be reached. For a health care facility whose goal it is to provide very personal and humane treatment, it might therefore make sense to abstain from the use of technology and especially computers for all immediate physician–patient contact. This would include, for example, writing with paper and pen (or with the so-called digital pens) during a direct physician–patient encounter, rather than using a computer for data entry, as this may help support this strategic goal.

For a health care facility whose goal involves technological leadership and integrated processes, it might be more appropriate to proceed in the opposite direction, i.e., to strive for a good support of all working processes through computer-based tools.

That is, the optimum of computer support is not defined by the maximum; rather, it evolves through the strategic goals of the health care facility and its stakeholders as well as through the functions to be supported.

4.7.3 Balance of Data Security and Working Processes

The data stored in a health information system are worth protecting. Patients must be confident that their data will not be made available to an unauthorized third party. To ensure this, the appropriate laws of the particular country are to be adhered to. However, health information systems are not just purely technical, but rather are socio-technical systems. This means that people are also part of the information system and are therefore also responsible for data security and protection.

A health information system should implement strict access control methods to ensure that unauthorized access is impossible. However, this can lead to hindrances in the daily work of the health care professionals. For example, it may occur that a medication cannot be prescribed in an emergency when the attending physician belongs to another hospital department and therefore does not have the right to read the lab result or to order a medication. This can, in an extreme case, even lead to a life-threatening situation. Thus, an access control system that is strict and adapted to predefined tasks and roles in a department can hinder the cooperation between health care professionals and other departments. This would be unfortunate, as it is the job of the *management of information systems* to build the health information system in such a way that cooperation is supported. Consequently, following a thorough risk analysis, it should be weighed whether access control measures in certain situations should be less strict for medical staff, thereby strengthening their own level of responsibility.

Similar risks should be considered in determining how long data should be kept. Health care laws, research needs, and lawsuit requirements should be addressed. So, for example, following the expiration of the storage period, if documents are destroyed, it could be difficult to prove that the hospital carried out a correct medical process in the event of a lawsuit. The resulting consequences would be requests for damage compensation and possibly punishment. However, long-term storage of data may be costly and space-consuming (e.g., archive room, disk storage capacity). Risk management must be carried out with strong support from the health care facility's management.

4.7.4 Balance of Functional Leanness and Functional Redundancy

Functional leanness describes a situation where one function is supported by one and only one application component. The opposite is functional redundancy where a specific function is supported by more than one application components. For example, imagine a health care facility where two different *NMDS* are in use, one in the surgical units, and the other in the other units. In this case, central functions such as nursing care planning are supported by two application systems. This situation will result in additional costs both for investment, maintenance, training, and support. But as discussed with controlled data redundancy, functional redundancy is not always bad and may best support the specific needs of the users in the different areas.

Functional redundancy may also be found between different types of application systems. For example, *patient admission* may be supported by application systems other than the *patient administration system* to allow easy *patient admission* during

nighttime, for example, in a radiology department, by using the *radiology information system (RIS)*. This situation may be suitable, as it will provide a more convenient and well-known tool in the diagnostic area and a faster and more sophisticated tool in the patient administration unit. However, clear organizational rules and interfaces between both application systems are needed to achieve data integration and to avoid double documentation or transcription.

Thus, it is the management's task to check carefully where and why there is functional redundancy because unmanaged functional redundancy may lead to disruptions of work processes, confusion of users, and unnecessary costs. If needed, application systems or functions within application systems need to be removed to increase functional leanness.

4.7.5 Balance of Documentation Quality and Documentation Efforts

Documentation of clinical data is needed for many purposes, such as for information exchange within the health care team, for clinical decision-making, for clinical research, for reimbursement issues, for hospital controlling, and for legal statistics. Consequently, many groups inside and outside the hospital profit from a complete, accurate, and timely clinical documentation.

On the other hand, high-quality documentation takes time. Physicians and nurses may feel that the time needed for documentation reduces the time they have for *patient care*. The feeling is especially strong in facilities where documentation is not well supported by existing tools and documentation processes. Insufficient organization of documentation may lead to documentation that is more time-consuming than necessary, to double documentation of the same data, and to transcriptions and media breaks. This all reduces the motivation for documentation and may lead to the feeling that documentation is not helpful but a burden. This in turn may reduce the quality of the documented data. This fact is especially relevant if data items need to be documented by staff that will not use this data for their own purposes. Due to the integrated nature of the processes within a hospital, this is rather common.

Management of information systems must therefore carefully balance the amount of documentation that is really needed for the various purposes and the effort that health care professionals have to invest. Well-designed documentation forms, high level of standardization, integrated documentation tools, and a systematic planning of documentation help to reduce effort and to increase the awareness that documentation is an important and indeed useful part of clinical practice.

4.8 Examples

4.8.1 Strategic Information Management Plan of Ploetzberg Hospital

Table 4.2 presents the structure of the strategic information management plan of Ploetzberg Hospital.

Table 4.2 Structure of the strategic information management plan (2022–2026) of Ploetzberg Hospital

Management Summary
1. Intention of this strategic information management plan
2. Ploetzberg Hospital and Medical School 2.1 Hospital mission statement 2.2 Strategic hospital 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 management of the information system 3.2 Organization of management of the information system 3.3 Guidelines and standards for the management of the information system 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 the information management
6. Planned activities until 2028 6.1 Project portfolio 6.2 Time planning 6.3 Cost planning
7. Conclusion

4.8.2 Health Information System Key Performance Indicators (KPIs) of Ploetzberg Hospital

The CIO of Ploetzberg Hospital annually reports to the hospital's management about the amount, quality, and costs of information processing of the Ploetzberg Hospital information system. For this report, the CIO uses health information system KPIs that have been agreed on by a regional group of hospital CIOs (Table 4.3). Each year, the hospitals exchange and discuss their reports as part of a best practice benchmark with other hospitals—this comparison is not shown in the table.

Table 4.3 Extract from the Ploetzberg Hospital health information system's benchmarking report 2024. *KPI* key performance indicator

KPIs for the hospital	
Number of staff	5500
Number of beds	1100
Number of inpatient cases	40,000
Mean duration of stay	8.1 days
Hospital budget	€800 million
KPIs for health information system's costs	
Overall IT costs	€20 million
IT costs per inpatient case	€500
IT costs in relation to hospital budget	2.5%
KPIs for health information system's management	
Number of HIS staff	46
Number of HIS users	4800
Number of workstations	1350
Number of mobile IT tools	2500
HIS user per mobile IT tool	1.9
Number of IT problem tickets	15,500
Percentage of solved IT problem tickets	96%
Availability of the overall HIS systems	98.5%
Number of finalized strategic IT projects	13
Percentage of successful IT projects	76%
KPIs for health information system's functionality	
Percentage of all documents available electronically	45%
Percentage of all diagnosis coded electronically	77%
Functionality index of *patient administration system*	52%
Functionality index of *MDMS*	87%
KPIs for health information system's architecture	
Number of computer-based application components	84
Percentage of standard interfaces between applications	87%
Functional redundancy rate	0.44

4.8.3 Organization of the Management of the Ploetzberg Hospital Information System

Figure 4.8 presents the organization of management of the information system of Ploetzberg Hospital. The CIO here is Mrs. Garzia. She is head of the information management department and also chair of the information management board. In both positions, she is responsible for strategic, tactical, and operational management of the information system at the hospital. The operational management of the information system is partly supported by local information managers (e.g., technical specialists or medical informaticians) in dedicated department such as the radiology or the cardiology.

Mrs. Garzia directly reports to Mrs. Johns, the CEO of Ploetzberg Hospital. Recently, both discussed the strategic information management plan that is just being updated. The discussions focused on the question whether the strategic

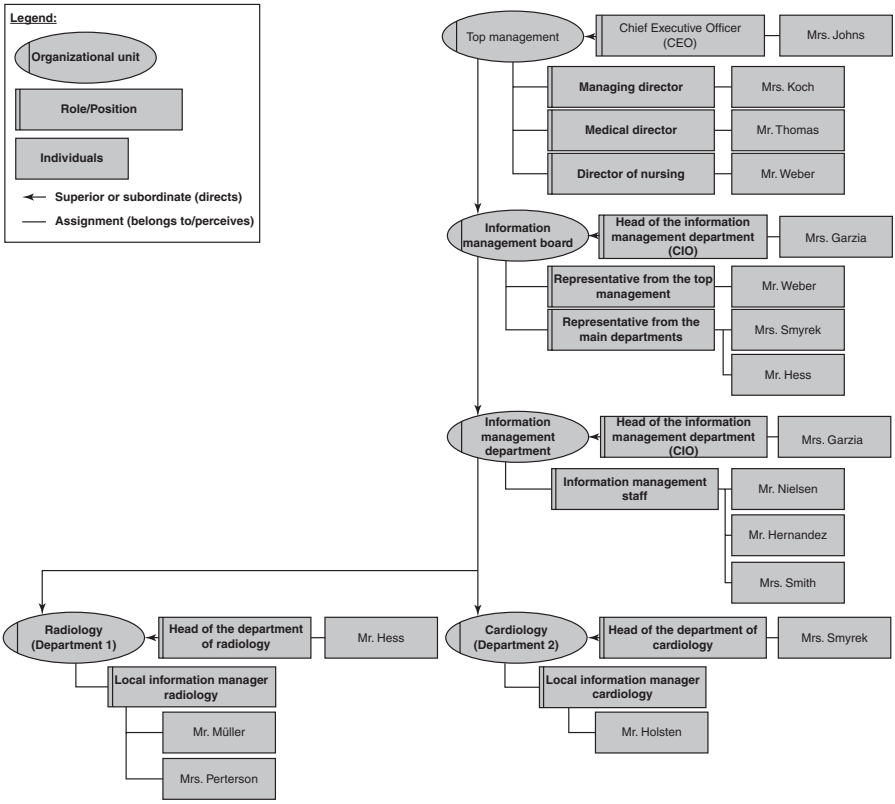

Fig. 4.8 Extract from the organizational structure of the management of the information system at Ploetzberg Hospital

information management plan is fully aligned with the general business goals of Ploetzberg Hospital. As CEO, Mrs. Johns will present and approve the strategic information management plan in the next meeting of the top management.

The draft of the strategic information management plan was developed by Mrs. Garzia. It already has been discussed and confirmed by the information management board. This board includes a representative from top management (e.g., the director or nursing) as well as the deputy head physicians of the radiology department, Mr. Hess, and of the cardiology department, Mrs. Smyrek. The board supported Mrs. Garzia in aligning the strategic information management plan with the needs and requirements of the clinical departments.

4.9 Exercises

4.9.1 Activities of Managing Information Systems

In Sect. 4.2, we introduced a three-dimensional classification of activities of management of information systems (Fig. 4.2). How would you describe the scope and tasks of the following activities of managing information systems?

- Developing a strategic information management plan (e.g., this is related to strategic planning),
- Initiating projects from the strategic project portfolio,
- Collection and analysis of data from user surveys on their general satisfaction with the health information system,
- Planning a project to select and introduce a new *CPOE system,*
- Executing work packages within an evaluation project of a *CPOE system,*
- Assessment of user satisfaction with a new intensive care system,
- Planning of a user service desk for a group of clinical application components,
- Operation of a service desk for a group of clinical application components,
- Daily monitoring of network availability and network failures.

4.9.2 Strategic Alignment of Hospital Goals and Information Management Goals

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 workplace.

Which main goals for *management of information systems* could you define based on this information? Which functions should be prioritized to be supported by new application systems? What could a strategic project portfolio and a migration plan for the next 5 years look like?

4.9.3 Structure of a Strategic Information Management Plan

In Sect. 4.8.1, we presented the structure of the strategic information management plan of Ploetzberg Hospital. Compare its structure to the general structure presented in Sect. 4.3.1.2, consisting of strategic goals, description of current state, assessment of current state, future state, and migration path. Where can you find this general structure in Ploetzberg Hospital's plan?

4.9.4 An Information-Processing Monitoring Report

Look at the health information system's KPIs of Ploetzberg Hospital in Example 4.8.2. Try to figure out some of these numbers for a real hospital and compare both hospitals' KPIs in the form of a benchmarking report. It may help to look at the strategic information management plan of this hospital or at its website.

4.9.5 Relevant Key Performance Indicators (KPIs)

Imagine you are the CIO and have to select the three most relevant indicators for the quality of your information system at your hospital: Which would you select? You can look at the examples in Sect. 4.8.2 to get ideas. Explain your choice.

4.9.6 Organizing User Feedback

You are asked to organize regular (e.g., every half year) quantitative user feedback on the general user satisfaction with major clinical application components of your hospital as part of health information system's monitoring. Which user groups would you consider? How could you gather user feedback regularly in an automatic way? Explain your choice.

4.9.7 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 [8]:

"We are architects. […] We have designed numerous buildings, used by many people. […] We know what users want. We know their complaints: buildings that

get in the way of the things they want to do. […] We also know the users' joy of relaxing, working, learning, buying, manufacturing, and worshipping in buildings which were designed with love and care as well as function in mind. […] We are committed to the belief that buildings can help people to do their jobs or may impede them and that good buildings bring joy as well as efficiency."

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