

# Requirements Index for Information Processing in Hospitals

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## ABSTRACT

Reference models describing typical information processing requirements in hospitals do not exist to date. This causes high expenses in the management of hospital information systems as well as in tender processes for obtaining software application programs. Therefore, it would be helpful to have a description of the most important requirements for information processing in hospitals.

We established such an index of requirements for information processing in university hospitals with the aim to support the systematic management of hospital information systems. It contains functional and function-independent requirements, ordered according to the typical primary care process and additional supporting information processing functions of a hospital.

In this paper, we will present some background as well as the structure and content of the first German version of the requirements index for information processing in hospitals.

**Keywords:** Requirements index, hospital information system, strategic information management, information processing requirements

## INTRODUCTION

The term hospital information system (HIS) comprises all information processing actions and the involved human or technical actors in their information processing roles ([1]).

Management of information systems is information management in hospitals. It comprises the strategic, tactical and operational management of information, application systems, and physical subsystems (such as computer systems). The tasks of HIS management are planning, directing, and monitoring HIS ([1], [2]).

Reference models that describe typical structures of information processing or typical business processes in hospitals are only beginning to emerge. The lack of uniform reference models for information processing causes high expenses in the

strategic management of hospital information systems. For example, for framework planning of information processing, quality criteria are needed. These could be derived from such a reference model. The quality criteria would also be very helpful in evaluating hospital information systems. In tender processes for obtaining software application programs, information processing reference models could offer a guideline for their comparison and selection.

Therefore, to support HIS management, it would be helpful to have a description of the most important information processing requirements for hospitals.

In the context of a research project funded by the German Research Association (DFG), we therefore established a requirements index for information processing in university hospitals.

## OBJECTIVES

The aim of the 2-year-project was to establish an index of requirements for information processing in hospitals. This index should offer a guideline for good information processing practices in hospitals by presenting the main information processing requirements. The requirements index should support the systematic management of HIS.

## METHOD

### Theoretical background

At first, it was important to find an overall structure for the requirements index which is general enough to be adapted to different architectures and circumstances, but at the same time, is easy to understand and practical. After thoroughly researching the literature available on requirements engineering, we decided on the following structure and proceedings:

**Understandable description:** The requirements index will be used by many different people and should therefore be formulated in an

understandable, informal way. Therefore, concise sentences were established that describe requirements (e.g., "New findings should be available to the responsible physician within a pre-defined length of time"). The sentences should be formulated in a way that they can be evaluated (true, false or a quantitative measure) in a given environment (cp. [3]).

**Types of requirements:** Two different types of requirements can be distinguished: function-independent requirements and functional requirements. Function-independent requirements are those which are valid for each information processing function (e.g., data security). Functional requirements can directly be matched to a specific information processing function (e.g., timely transmission of findings) (cp. [4], [5]).

**Top-down-proceeding:** All requirements should be derivable from the main aims of an information system. Therefore, the requirements index should first state the main aims of a HIS, and then derive the requirements in a step-wise manner. For functional requirements, this means that they are directly derived from the information processing functions and activities of a HIS.

Function-independent requirements should be derived from the general tasks of HIS (cp. [6], [7]).

**Structured description:** Functional requirements are described systematically, using the concept of modeling requirements with the help of Unified Modeling Language (UML) use cases as a reference point (cp. [4], [8], [9]). This offers a structure to model the requirements of each function in a systematic and easy to understand way. The description of the function "order-entry with appointment management" is presented in Figure 1 as an example. An information processing function is decomposed into its parts, which we call activities. For each activity we formulate functional requirements.

<b>Function 1.4</b>	<b>Order-entry with appointment management</b>
Critical point	Functional units often want to make appointments themselves. Thus, a solution, in which the ordering person adds an appointment to the appointment book of the functional unit, might not work.
<b>Activity 1.4-1</b>	<b>Fill out order form and explain order:</b> <ol style="list-style-type: none"> <li>1. The requested order can be selected from a structured list of available services.</li> <li>2. Already existing data can automatically be inserted into the order form.</li> <li>3. Formulation of the clinical question and further details is supported.</li> <li>4. It is possible to enter free text.</li> <li>5. The responsible or authorized person can sign the order.</li> </ol> <p>....</p>

<b>Activity 1.4-2</b>	<b>Arrange appointment</b> <ol style="list-style-type: none"> <li>1. Reservation, acknowledgment, cancellation,... of appointments is possible.</li> <li>2. Urgency and a preferred date can be submitted.</li> <li>3. Planning aids for continued appointments exist.</li> <li>4. All people involved (e.g., on ward, transportation services, functional units, patient) have access to the relevant dates.</li> <li>5. All people involved are informed about relevant changes of appointments.</li> </ol> <p>....</p>
<b>Activity 1.4-3</b>	<b>Transmission of orders</b> <ol style="list-style-type: none"> <li>1. Orders are transmitted from the client unit to the service unit within a definite time.</li> <li>2. The order is documented in the patient record.</li> </ol> <p>....</p>
....	....

Figure 1: Extract of a description of an information processing function and its requirements.

For details on requirements engineering for hospital information systems, see also [10].

### Creation of the requirements index

The requirements index is built upon the general consensus of two dozen university hospital experts in Germany, using a cyclic review process.

We started with an initial one-day workshop with all experts to get consensus on the overall structure and the further proceedings. After this workshop, communication between the experts was conducted by e-mail.

The first version of the requirements index was based on available literature on requirements and on existing requirements catalogs for HIS. This first version was then refined stepwise by the experts in a four-round process which finally led to the first official version of the catalog published in February 2001.

## RESULTS

The first German version of the requirements index is now ready and available through the World Wide Web.

### Structure of the Requirement Index

The structure on which the functional requirements of the requirement index is built is presented in Figure 2 at the end of this paper. To stress the importance of the primary care process, it is useful to distinguish between primary care functions (such as admission, therapy, diagnostics, discharge) and supporting functions (such as archiving or scheduling). Those supporting

functions are extremely important to guarantee high-quality and efficient patient care. We have structured the primary care functions in a logical manner (on the left side of Figure 2). The supporting functions are presented on the right side and are divided into three categories: handling of patient records; work organization and resource planning; hospital management.

#### Table of contents of the requirements index

Figure 3 presents the table of content of the requirements index.

1. Introduction
2. Functional requirements (Detailed Structure: see Figure 2)
2.1 Central Process: Treatment of Patient
2.2 Handling of patients records
2.3 Work organisation and resource planning
2.4 Hospital management
3. Function-independent requirements
3.1 Management of information systems Framework concept Project management
3.2 Operation of information systems Organisation of central databases Operation of information components Network management User support Data security Reporting
3.3 Integration Process integration Tool integration
3.4 System architecture Data schemata Adaptation and Support Performance
3.5 Data protection Data protection Data security
3.6 User interface
4. References
5. Index

Figure 3: Table of contents of the requirement index.

#### Availability of the requirements index

The requirements index is available in paper-based and electronic form. Its electronic version can be used to adapt and refine the requirements index according to the specific needs of different users. Both versions are available at the German Research Association (DFG) Internet site:

<http://www.dfg.de/foerder/hbfg/kapitel8.html#8.9>

as well as at the German Association for Medical Informatics, Biometry and Epidemiology (gmnds) site: [www.gmnds.de](http://www.gmnds.de)

#### Usability of the requirements index

In order to adapt the requirements index to specific tasks of information management, the following steps should be taken:

- Selection of the information processing functions relevant in a given environment.
- Refinement of the requirements presented in the requirements index, and appointing of clear criteria.
- Quantification of requirements: in order to reproduce assessments, possible values for the criterion of each requirement must be defined in advance.

The electronic form of the requirements index can be used for this purpose.

#### Evaluation of the requirements index

The first version of the requirements index was finished and published in February 2001. It is now open for discussion and evaluation. In order to access its usefulness, the index should be used in different information management tasks in hospitals and evaluated in a clinical trial. This would allow evaluation, for example, of whether the requirements index can really speed up the process of developing requirements specifications or of HIS framework planning.

#### DISCUSSION

In the paper, we presented the idea and the construction of a requirements index for information processing in hospitals. This index can be used as a reference model to support the systematic management of hospital information systems.

The requirements index is available and should now be used in different projects of information management such as framework planning or the selection of application systems. A detailed evaluation of its application should take place. Following such an evaluation, we will also be able to answer the following questions:

- Is the requirement index complete for the mentioned tasks?
- Is the granularity of the requirements index suitable for the mentioned tasks?

In order to ensure a patient centered view within the context of information processing, we have highlighted the process of patient treatment and have stepped back from a view that focuses on different departments of a hospital (e.g., radiology information system, laboratory information

systems). Surely this will be a point of criticism as the catalog users will not be able to find specific requirements for the mentioned specific areas immediately. However, many of the mentioned functions and their requirements are important in various areas (e.g., order entry is a function used in radiology, laboratory, and other areas). This motivated us to abstract away from the different areas and to find general requirements. Detailed requirements which will surely differ between areas (e.g., order entry with or without sample) must be derived according to the specific aims of the users. The suitability of this approach must be evaluated in detail now.

The requirements index is not an assembly of available requirements indices, as they are mostly too specific for a given area. The index can be rather seen as a structure to be used and refined according to own tasks and surroundings.

The index is based on the idea that information processing requirements are primarily independent of the tools used. For example, a timely transmission of new findings does not depend on the transmission media (electronic network, or conventional mail), but rather on the results: can the physician or the nurse access the new finding within a pre-defined time period? Therefore, the requirements of the catalog are formulated independent of the tools used or of the architecture found in a given hospital. The requirements index can thus be used in any surrounding. However, the general requirements certainly must be adapted to the specific surroundings. This approach must also be evaluated.

#### CONCLUSION

The requirements index can be seen as a reference model for information processing in hospitals, independent of the HIS architecture and of the HIS tools used. Its German version is available freely over the Internet. Its usefulness will now be evaluated in detail.

We hope that the requirements index can support the systematic management of information processing, the communication between hospitals and vendors and between hospitals and accreditation institutions, support high-quality information processing, and finally, high-quality patient care.

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Figure 2: Information processing functions of a hospital.

