

Generic model for business activities and information objects

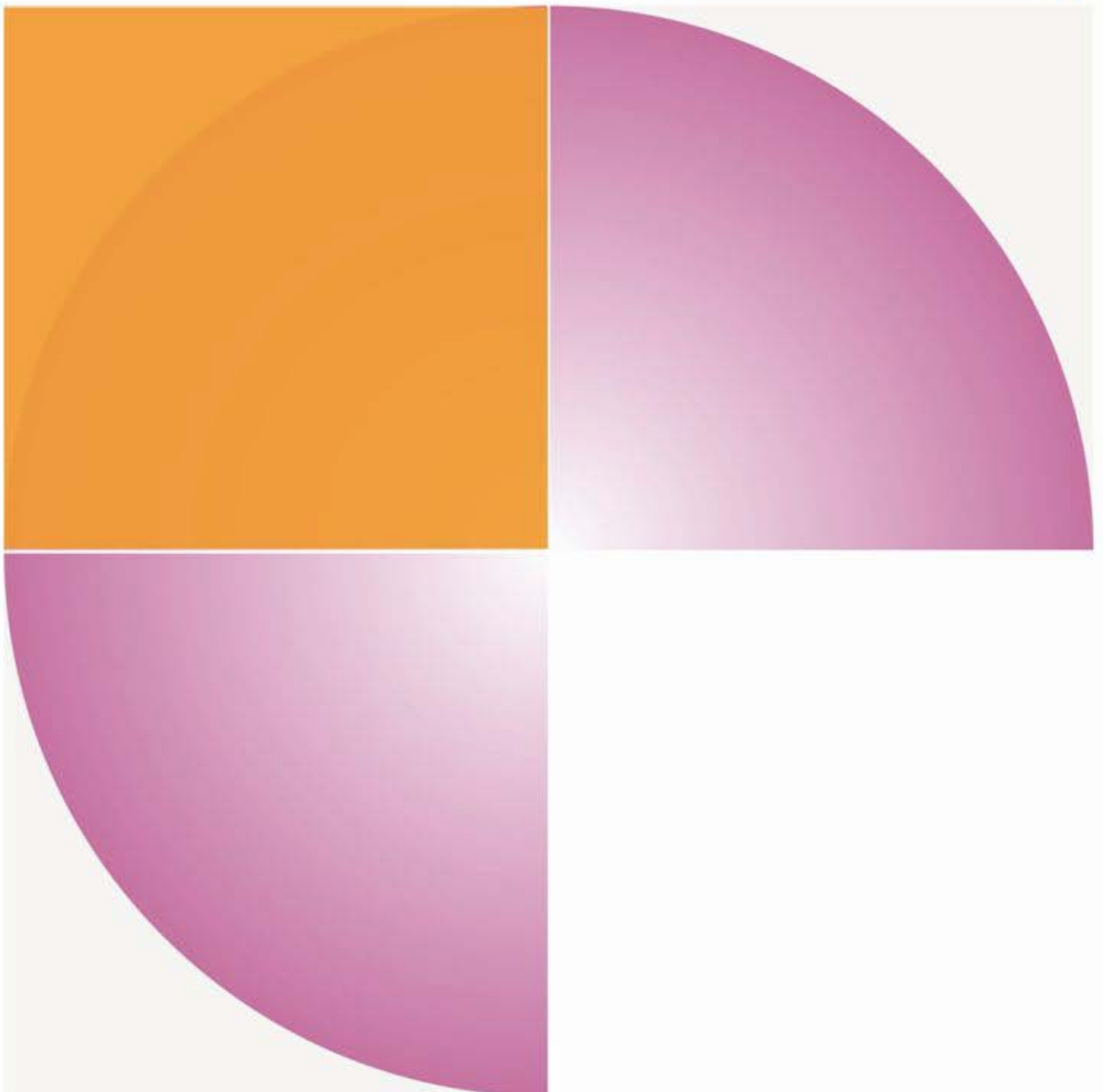
Domain Reference Model for Hospitals version 2 DRH v2

INFORMATION TECHNOLOGY FOR HOSPITALS

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Betere zorg
door betere informatie

Nictiz 



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Domain Reference Model for Hospitals version 2 DRH v2

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Introduction

In 2009, a collaboration under the name 'i-Ziekenhuis' was started with, for and by Dutch hospitals. iZiekenhuis is an initiative of NVZ (Netherlands Association of Hospitals) and Nictiz (National IT Institute for Healthcare in the Netherlands) and offers hospitals a joint platform and a knowledge center for information exchange and sharing best practices in relation to information management in Dutch hospitals. One of the goals is to achieve a reference architecture that supports the organization of information technology in Dutch hospitals. This Domain Reference Model for Hospitals (DRH) is considered to be an initial step on the way towards achieving a full reference architecture.

Many hospitals have successfully and enthusiastically used the model since the publication of version 1 of the DRH in April 2011. Users indicated that further development of the DRH was needed.

In addition to healthcare, version 2 of the DRH also includes research, education, governance and accountability and business support in the model.

The DRH has been modeled in Archimate and a first mapping has been defined with the HL7 EHR Functional Model. Recognizability, simplicity and usability have remained important priorities. The most frequently used element of the DRH, the domain template in PowerPoint, is still there.

Developing, creating and maintaining an accepted architecture is an ambitious goal. The development of the Domain Reference Model for Hospitals is an initial step towards a common vision of a reference architecture for hospitals. The parties who have contributed to the development, including the authors, can therefore be pleased with this outcome. Acceptance of the reference model is the key success factor. The Domain Reference Model for Hospitals is developed based on practical experience from various hospitals.

We invite you to consider and to contribute towards the optimization of the model. The aim is to achieve a live model that is also used as an initial generic model by and for Dutch hospitals and is therefore subject to change, expansion and improvement.

Maarten Fischer, NVZ Association of Hospitals
Fred Smeele, Nictiz, Program Manager iZiekenhuis

Summary

I-Ziekenhuis, an initiative of NVZ and Nictiz, has existed since 2009 in order to achieve a framework (reference architecture) that supports the provision of information in hospitals. One of the most important priorities within this collaboration is to establish a generic model for information domains with business activities and information objects in hospitals. This generic model is the Domain Reference Model for Hospitals and is described in this document and its appendices. The theoretical framework and the methodology are explained in the first two chapters of this document, and an explanation and description of the model itself are provided.

The Domain Reference Model for Hospitals, Domain Model or DRH in short, provides a basis for individual hospitals that can then be expanded and adapted according to their own situations. The Domain Model can also be used in a variety of ways. Chapter 3 'Applications' elaborates on the possibilities for using the Domain Reference Model.

In creating the model, acceptance by the sector (hospitals) is seen as the most important success factor. For this reason, a great deal of time has been spent with a core group of hospitals in setting up the model and testing its usability in practice. Hospitals have applied this model and have discussed the results with information architects during 'work conferences'.

The model uses the concepts and methodology such as those used, for example, within the open and independent descriptive language of enterprise architecture 'ArchiMate'.

The model consists of a spreadsheet and a presentation. This document, including appendices, provides examples of practical applications, a spreadsheet and a presentation. The spreadsheet consists of the underlying set of business activities and information objects. The presentation consists of the Domain Reference Model for Hospitals v 2.

The model is ideal for use in hospitals because it has been developed from the bottom-up (i.e. with the hospitals). In order to optimize the use of the model, it is subject to change, expansion and improvement.

Therefore, in addition to delivering the actual Domain Model (with spreadsheet), a process of change, expansion and maintenance is also simultaneously delivered. The basics of this are described in Chapter 4.

Following the publication of version 1 of the Domain Model in April 2011, its use in practice has been encouraged and supported. This has been organized via an active approach to the primary target group including, amongst others, information architects from hospitals and commercial parties (suppliers) that support hospitals in the implementation of information technology.

Questions, comments or suggestions can be submitted via info@nictiz.nl, stating reference 'iZiekenhuis'. The contact person is Fred Smeele, Program Manager.

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Introduction

The iZiekenhuis program commenced in 2009, on the initiative of the NVZ (Netherlands Association of Hospitals). The iZiekenhuis program has a dual goal:

- the setting up, acceptance and maintenance of a framework to support the information technology organization within hospitals in the Netherlands ('reference architecture');
- providing a platform for collaboration and exchange of knowledge to hospitals in the area of information technology.

The platform for information exchange and collaboration is given shape by offering a digital environment for sharing knowledge, information and best practices. In addition, 'work conferences' are organized regularly for and with information architects. Currently (April 2011), there are more than 40 Dutch hospitals that are actively involved, including some of the teaching hospitals.

One of the first topics raised within this platform was the need for a generic model for hospital business activities and information objects. In this context, generic means: generally valid for all hospitals and usable in an individual hospital. This has resulted in the Domain Reference Model for Hospitals.

Many participating hospitals contributed to the creation of this Domain Model. The core group from the participating hospitals consists of nine different hospitals. The individuals and hospitals, who have contributed to the development of the model, are listed on the front page of this document.

Purpose and target group

The purpose of the Domain Model is to provide support to information managers, ICT architects, process designers, policy advisers and IT managers in Dutch hospitals on issues at the cutting edge of the business (care) and information technology. The primary target groups of users of the Domain Model are information architects from hospitals and (commercial) parties (suppliers) who support the organization of information technology in hospitals.

The Domain Reference Model for Hospitals can serve as a basis and starting point for further development towards a Reference Architecture for Dutch hospitals, and is identified as one of the goals within the 'iZiekenhuis' program.

This document presents content and background in relation to the Domain Reference Model for Hospitals. This text forms a single entity together with the spreadsheet and the presentation (graphical representation of the model). The spreadsheet contains multiple worksheets, in which, amongst other things, the business activities and information objects are listed by name and description. It can be used as a starting point by individual hospitals. In addition to this document and the associated spreadsheet and presentation, further presentations are also available. These are derived from the Domain Model and serve as inspiration and clarification of the use and application possibilities of the model. Chapter 2 contains a full list of the products and components of the Domain Model and of the additional set.

H-1 Methodology

This chapter describes the theoretical framework and the methodology used to arrive at the Domain Reference Model for Hospitals.

The concept of the Domain Reference Model for Hospitals is explained first:

- *Reference*: this provides a common base that can be applied directly but can also be adapted and expanded to specific hospital situations.
- *Domain Model*: this indicates that the model consists of information domains. The concept of information domains is explained in paragraph 1.3.
- *Hospitals*: this covers the organization of information technology in hospitals.

A model is not a goal in itself. A model serves to answer questions for a specific purpose. It abstracts from reality by omitting details. The focus on essential characteristics of this reality is increased considerably due to this abstraction. Good understanding of a model is necessary for optimum application.

The concept of *information domains*¹ is often used within the world of IT architecture and information planning. Information domains are the main building blocks of the Domain Reference Model for Hospitals. In the Domain Reference Model for Hospitals, the methodology used to achieve information domains is aligned with concepts used within ArchiMate².

Knowledge of the underlying methodologies is not strictly necessary in utilizing the Domain Model but it does help with understanding the model. The necessary theoretical basis is explained in this chapter.

Information technology design begins with an understanding of the essence of an organization. What are the organization's mission, vision and

¹ See for example www.businessinformatieplanning.nl

² See for example www.archimate.org

strategy? What products and services are provided? What business activities, business processes and business functions provide these products and services? What information is needed to perform the business activities?

Paragraph 1.1 describes the concept of business activity. Paragraph 1.2 deals with the concept of information objects. Finally, paragraph 1.3 explains how to create an information domain. Also explained in this paragraph is the added value of information domains for the organization of information technology.

1.1. Activities, processes and functions.

A **business activity** is a task that can be assigned to a single person or to a single role. An example of a business activity is the running of pre-operative screening.

A **business process** is a sequence of business activities, with a clear starting point and a clear end point, which leads to a clear outcome. An example of a business process is the surgical process. In the surgical process, various business activities are (consecutively) carried out, such as scheduling the surgery, preparation for surgery, pre-operative screening, the surgery itself and the draft surgery report.

A **business function** is a set of interrelated business activities concerning the necessary knowledge, skills or resources. Business functions often have a more permanent nature than business processes. An example of a business function is nursing and care. A business function provides an organization with functionality that contributes to one or more business processes.

Figure 1 shows the relationship between the concepts of business activity, business process and business function.

Business Function = a set of business activities that have the required knowledge, skills or resources in common (e.g. "capacity planning")

Business Activity = a task with the right granularity to be assigned to a specific person or role (e.g. "take anamnesis")

Business Process = a sequence (over time) of activities with a clear starting point which leads to a clearly identified end (e.g. "surgical process")

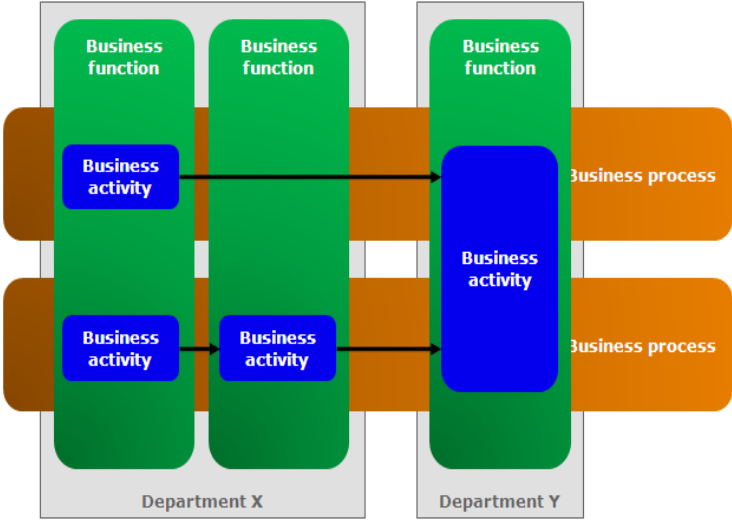


Figure 1 - Activities, Processes and Functions

1.2. Information objects

An information object is a unit of information that is relevant from a business perspective. An information object has significance for the objective and the functioning of an organization. An example of an information object is a surgery report.

Information objects are independent from their physical appearance or implementation in an organization. They can be translated into a physical model and into physical manifestations of information (for example, tables in a database, information in a data warehouse environment, information in documents). This means that a distinction must be made between the **content** of a concept (as a concept, something with relevance in reality) and the **physical manifestation** in which the content is stored or represented (paper, some kind of digital manifestation, a label, patient I.D. card). The **physical manifestation** is not relevant to and not defined in the process of identifying information objects.

1.3. Information domains

An **information domain** is a set of business activities with maximum cohesion in the information produced and used by the activities.

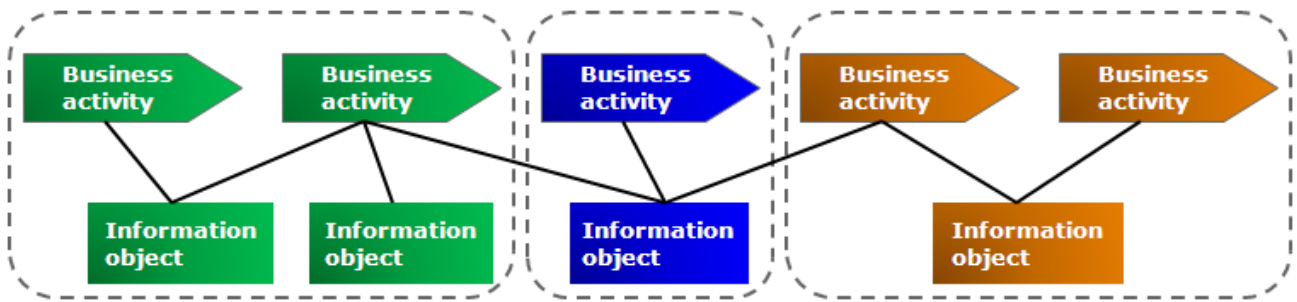


Figure 2 – Business activities and information objects

An information domain is defined by the business activities and by the information objects within it. Clustering business activities and information objects into information domains is based on consistency of information use. As a result, the defined information domains exchange as few information objects as possible with other information domains.

Information domains are logical building blocks for the organization of information technology within an organization and can, for example, be applied as a basis for the architecture of applications. This

allows the organization of information technology to be tailored to the needs of the organization. Chapter 3 deals with other uses of information domains.

For information-intensive organizations, it is often the case that business functions and information domains coincide with each other. For comprehensibility and identifiability, it is preferable to maintain this one-to-one relationship between business functions and information domains.

H-2 Domain Reference Model for Hospitals

The Domain Reference Model for Hospitals consists of the following components:

- This descriptive document (Domain Reference for Hospitals version 1)
- A graphical presentation of the Domain Model (Presentation of the Domain Reference Model for Hospitals version 1)
- A spreadsheet (Spreadsheet for the Domain Reference Model for Hospitals version 1) with the following worksheets:
 - matrix with business activities and information objects that are clustered into information domains;
 - list of concepts: a list of information objects and business activities with descriptions.

In addition to the Domain Model, there are derivative products that fall outside the maintenance process:

- the DRH modeled in Archimate in Enterprise Architect (eap format);
- an XML/XMI export for import to other architecture tools;
- an HTML export (clickable) version of the model;
- A relationship table between business activities from the DRH with the functional EPD requirements from the HL7 EHR-S Functional model.

This chapter includes an explanation of the Domain Reference Model for Hospitals.

2.1. The Domain Reference Model for Hospitals

The Domain Model was established in a number of workshops with different hospitals. In the workshops, the business activities and information objects are determined as recognized within the hospitals. For version 1, the scope was deliberately limited to the direct care process (the care that is delivered directly to or for the patient) within the hospitals. This was undertaken so that the initial step was not too big. Consequently, practical

experience of use, application, comments and recommendations could be taken into account for the development of this Domain Model.

The business activities and information objects are listed in a matrix after they are identified. A judgment is then made on the intersections between the rows and columns of the matrix in respect to whether the specific business activity is using (U) or creating/using/maintaining/deleting (C) the specific information object.

After entering the C's and U's in the matrix, the business activities and information objects are clustered so that (information) domains arise in the matrix.

Figure 3 – Matrix with clustered objects and activities used in the process of creating the Domain Model.

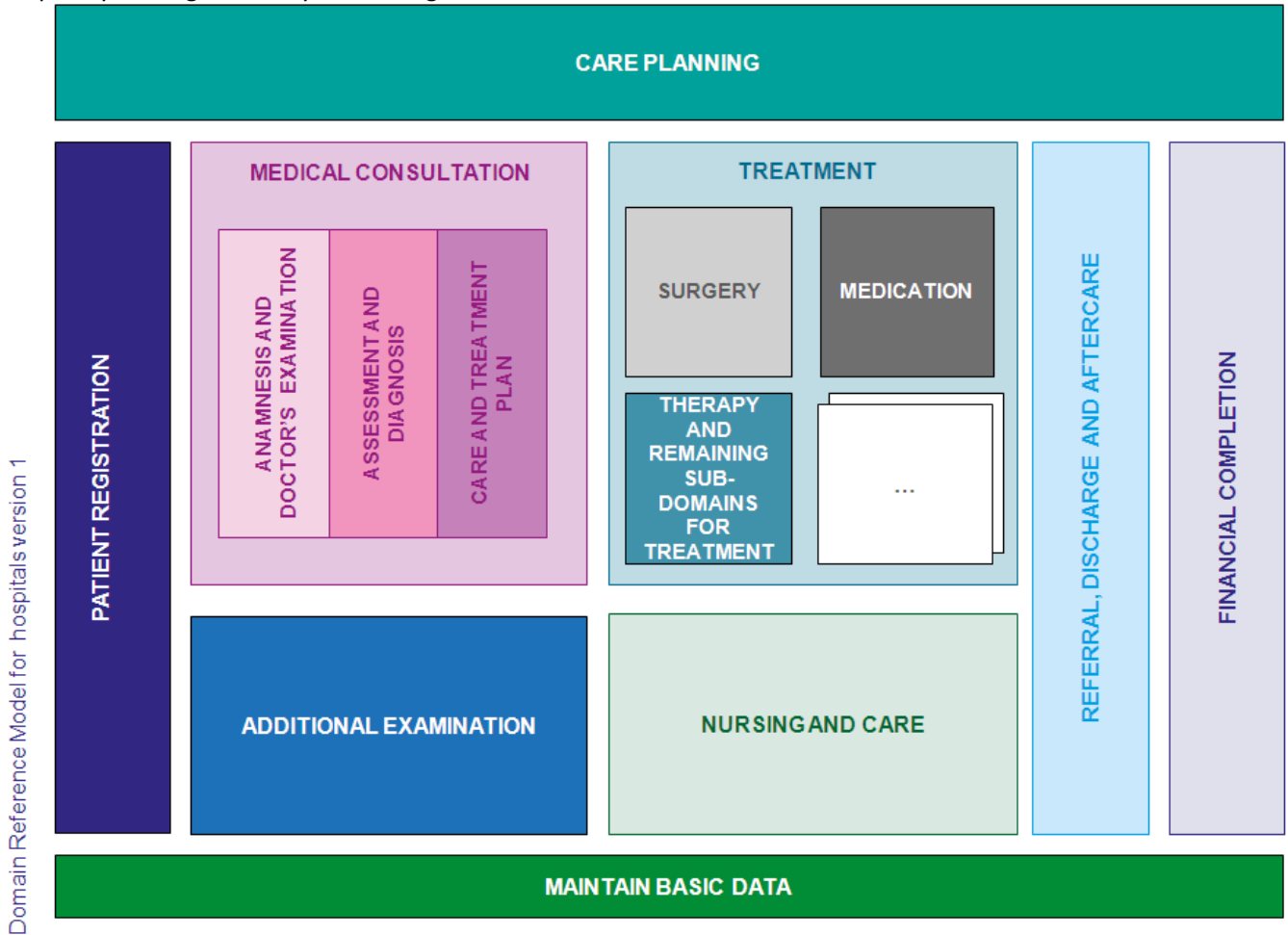
In this matrix, the information objects are listed in the rows and the business activities in the columns.

The colored squares are the information domains; a set of business activities with maximum coherence in the information objects they use and create.

What becomes explicit in the matrix is that there are many relationships between business activities and information objects outside of their information domains. This is a reflection of the complexity and high intensity of exchange of

information in the direct care process within hospitals.

The information domains that follow from the matrix are then displayed in a logical way in the Domain Reference Model for Hospitals (also see Appendix 1).



Scope: direct care process

i-ziekenhuis

Figure 4 – The Domain Reference Model Hospitals version 1

2.2. The Domain Reference Model for Hospitals version 2

Version 2 of the DRH is not limited to primary care; the other domains have been identified. The domains of research, education, governance and accountability have been identified. A separate domain has been identified for participation, referral and knowledge management.

The version 1 domains remained intact and recognizable in version 2 as much as possible. Parallel to the development of DRH to version 2, the metamodel of the DRH (see Appendix 3) is described, thereby making possible the modeling and the mapping to other models. The DRH is modeled in 'Archimate' for uniformity, standardization, maintainability and portability.

Important starting points for version 2 are:

- the model is recognizable within the hospitals;
- the care and the patient are priorities;
- more attention to (new) developments.

The DRH is a Reference Model. Use it, apply it and customize it to suit the specific situation and purpose.

The DRH is:

- a reference list of domains, business activities and information objects in a hospital
- a basis, a starting point and a reference;
- a tool for communication on issues on the boundary between the care process and information management in the hospital.

The DRH is not:

- a fully developed and standardized reference architecture for hospitals;
- a diktat for the hospitals
- an organizational structure
- a detailed process model for hospitals;
- an EHR specification;
- something technical, only for ICT.

The DRH version 2 communication template is included on the next page and in the appendix. This

model is also available separately in a presentation (PowerPoint).

The spreadsheet shows which business activities and information objects are part of a domain. The tab 'DRH matrix v2' shows the domains with their business activities, and the information objects are on the CU intersections. The domains are aggregated in up to two levels. The 'DRH business activities' tab contains the business activities per domain and a description of the business activities. The 'DRH information objects V2' tab contains the information objects along with a brief description.

Within the DRH, we distinguish between direct care, research and education. The (healthcare) support process provides support to these three core functions. This includes healthcare logistics, financial completion and maintaining the care relationships. Cooperation is explicitly designed into the model by grouping the domains of participation, referral, information exchange and knowledge management. Governance and accountability result from the domains of strategic management, marketing and innovation. Business support domains are included to support the hospital as a business.

The domains:

Each domain contains business activities and information objects. For each domain, the principal business activities and information objects are included.

Business activities often have a registration component (which is made explicit by the CU in the relationship matrix). For example, 'register the anamnesis' is a sub-activity within the business activity 'take anamnesis'. Registration activities are thus a part of (and sometimes nearly identical to) business activities.

The information objects have been described without defining their manifestations. So no letters, documents, files or messages. This is because the manifestation of the information depends on the purpose and specific implementations.

Figure 1 – Main representation DRH version 2

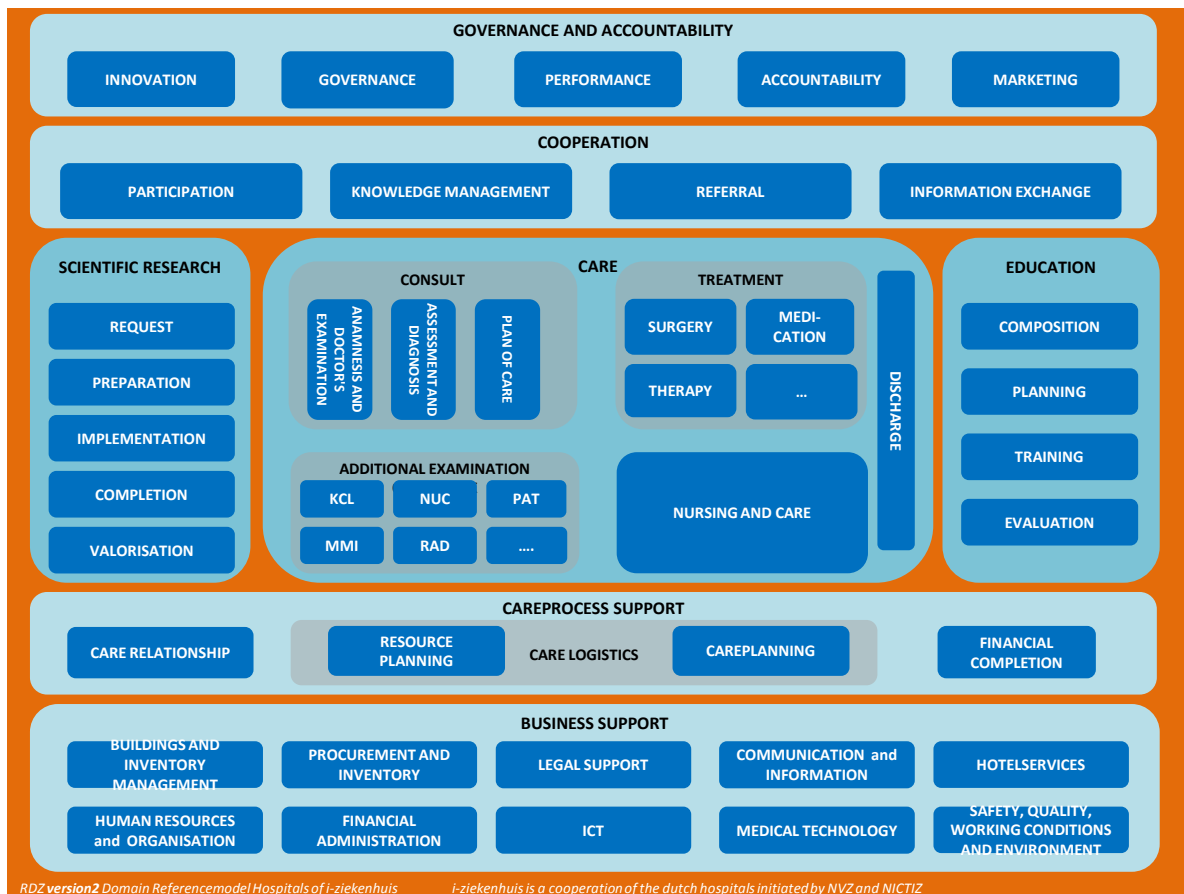


Figure 2 – DRH version 2 with domains

Valorization
 Organization Reference model iZiekenhuis is a cooperation of the Dutch hospitals initiated by NVZ and NICTIZ Care process Care planning Hotel services

In the following domain descriptions, we limit ourselves to a general description of each domain. Refer to the matrix to see which business activities and information objects are in each domain. The spreadsheet also contains a description of the business activities and information objects.

GOVERNANCE AND ACCOUNTABILITY

This includes the domains of governance, performance, accountability, marketing and innovation. It includes not only the strategic governance and accountability from senior management, but also the governance and accountability at the tactical and operational levels.

Governance

This domain contains the business activities (and related information objects) for determining the mission, vision, strategy and policy, including the installation and management thereof.

Performance

Includes business activities and information objects for creating, measuring and managing of performance indicators.

Accountability

The business activities for the accounting of the hospital to its environment are located in this domain.

Marketing

Marketing is about the optimum balance between supply and demand, hospital and patient in order to grant the greatest possible value to existing services as well as to respond to new service development.

Innovation

Innovation in the sense of (further) development of existing and new services. For example:

- Developing products and services;

- Determining innovation agenda;
- Developing Enterprise Architecture;
- Program management.

COOPERATION

Cooperation contains the domains of participation, referral and knowledge exchange. Cooperation has become a separate domain. Cooperation takes place over several domains, for example between care domains, education and research, but also over the domains of referral and information exchange with other care organizations and care providers. Cooperation also has its own specific activities and information objects, e.g. self-management (information). Cooperation fits well with new developments such as Zorg2.0, eHealth, interoperability and need for cooperation, exchange and connection.

Participation

Participation includes activities and information necessary for the participation of the patient in his/her own care process. Examples include receiving information from the patient, self-management and the provision of care information specific to the patient.

Referral

The activities for referrals to other healthcare providers such as receiving and processing a referral and sending a request for referral.

Information exchange

This domain contains the activities for the exchange of information between healthcare providers.

Knowledge management

This domain includes the activities necessary for managing the information exchange between knowledge provider and knowledge customer. Knowledge management is, for example, making available of searches, indexing and updating of content such as:

- protocols;
- manuals;
- instructions;
- documents on quality;
- process descriptions
- research publications;
- education materials.

CARE

Medical consultation: includes all activities and information objects necessary for determining and adjusting the diagnosis and the treatment plan, including anamnesis, self-examinations and monitoring treatment.

Additional examination: includes all forms of additional examinations, such as laboratory tests, X-ray, ultrasound examination, pathological examination, microbiological examination, examination of bodily functions and others.

Treatment: includes all types of treatment, with sub-domains for surgery, medication, therapy and other forms of treatment.

Nursing and Care

This is the domain in which the nursing anamnesis is taken, the nursing plan is determined and the patient receives nursing care, including the registration and maintenance of all types of information that is necessary for nursing and care.

CARE PROCESS SUPPORT

Care process support covers the domains that support the care process. These include care logistics, care relations, care planning, resource planning and financial completion.

Care planning

Subject planning of individual patients (who is treated when and by whom).

Resource planning

Within resource planning is the allocation of capacity over time to patient groups, specialists (planning volume), resources and locations. It includes capacity scheduling per patient group on available capacity.

Care relations

This includes the activities for maintaining and identifying care relationships, including patients, care providers and healthcare insurers.

Financial completion: the registration part of the process, in which the relationship is determined between the care provided, the patient and the services provided. Further financial completion takes place outside the healthcare domain.

BUSINESS SUPPORT

Buildings and inventory management

Domain for activities and information about managing, operating and advising of building and inventory.

Procurement and inventory

Activities and information objects for procurement and logistics, strategic, tactical and inventory management.

Human resources and Organization

The activities and information necessary for good management of staff and personnel. Supports the input, throughput and outflow of personnel.

Legal support

Legal advice, support and policy. Advising on the application of legal policy on, for example, medical-ethical issues and legal support in the handling of complaints and appeals.

Financial administration

The activities and information for the financial administration of the hospital. Managing accounts receivable, accounts payable, general ledger, invoices and performing financial transactions. Also includes financial settlement with insurers as well as managing payroll and managing the assets (Treasury).

Security, quality, labor conditions and environment:

Activities and information objects to monitor and optimize the safety, quality, labor conditions and environmental issues within the hospital.

Hotel services

The provision of hospitality services to patients, visitors and staff.

Communication and information

Activities and information for communicating with and providing information to patients, visitors and healthcare professionals.

ICT

All activities to develop, manage and support the ICT supply and ICT services.

Medical technology

All activities and associated information for maintaining, managing and supporting medical equipment.

2.3. Explanation of the DRH spreadsheet.

The spreadsheet includes three worksheets:

- DRH Business activities V2
- DRH information objects V2
- DRH matrix V2

Several sources are used for the description of business activities and information objects (the first two worksheets):

1. documentation available from participating hospitals, including design documents, data models and manuals for (sub) systems.
2. definitions and terms used within the communications infrastructure for care (AORTA);
3. information model and terminology used within relevant IHE profiles;
4. generally accessible sources, like:
 - Wikipedia
 - www.encyclo.nl
 - www.thesauruszorgenwelzijn.nl
5. Relevant legislation.

The purpose of the description is to explain what is included in the definition of the business activity or information object. It is not intended as the only correct description.

At the matrix, the explicit explanation is: The business activities, information objects and the CU-marks do not contain the complete truth, but only one interpretation thereof in order to determine the domains.

2.4. DRH as reference for process design

The domains are the logical building blocks of information provision to support the business. The domains consist of (related) business information objects. Processes make use of activities and objects within the domains.

This is visualized by the red line in figure 7 A care process uses the information and functions (services) from domains.

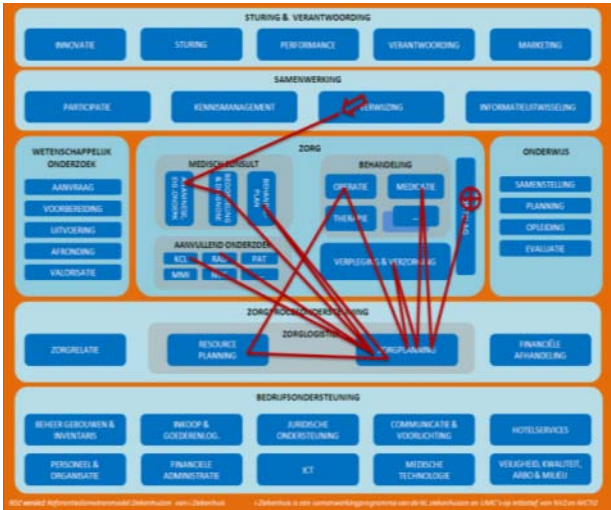


Figure 7 – A process uses business activities and information objects from domains

With a view to the future, through further development of this reference model, a library of flexible standard services could be made available from which hospitals can compose their specific care process.

The DRH is a domain model and not a process model. However, the business activities,

information objects and domains can be used as starting points and references for the process design. Bear in mind that, depending on the desired granularity, further detailing of business activities and information objects may be required.

2.5. Further development DRH

The further development of the DRH after version 2 will be determined mainly by the experiences and feedback on applications via the maintenance process.

With sufficient interest, support, commitment and willingness from the hospitals, the DRH will develop into a mature reference architecture for hospitals. In addition to a reference layer for the domains, the following may also be considered:

- development of business services in a service portfolio layer;
- elaboration of application services in an application function layer;
- reference library of principles for the DRH-domains;
- mapping of CCR data-elements to domains;
- defining standard services based on the DRH.

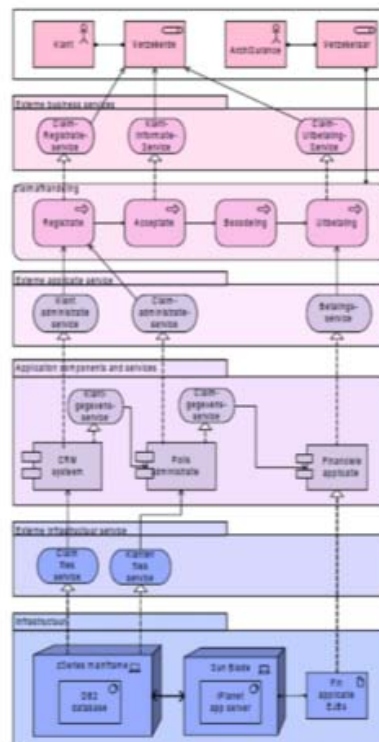
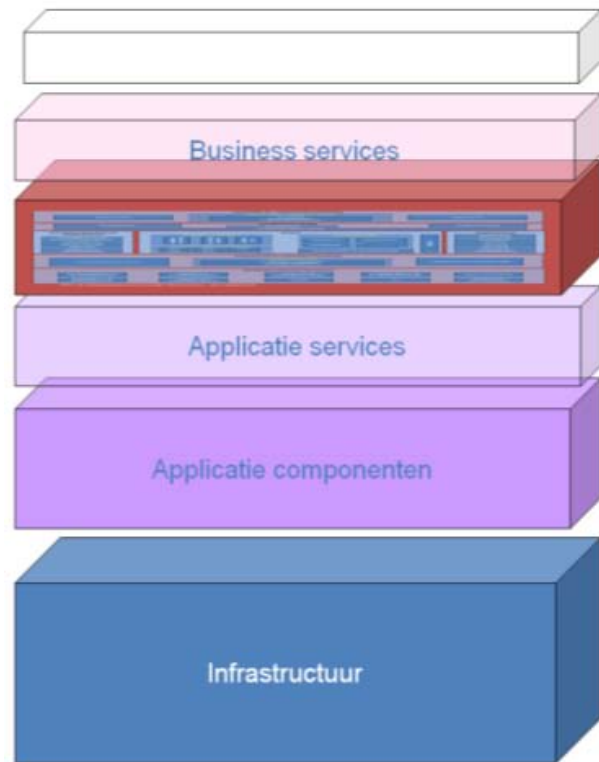


Figure 8 – DRH in relation to ArchiMate

The DRH describes the business activities and the information objects. These correspond to the activities in ArchiMate.

The business layer is supported by the application layer (application services that are delivered by software applications).

This figure indicates that further development of the DRH can lead to a reference architecture for hospitals.

H-3 Model applications

The Domain Reference Model for Hospitals can be used in various ways. This chapter provides suggestions and examples of potential applications.

Starting point for the architecture in a hospital

The Domain Model can serve as a starting point for hospitals that wish to use architecture as a tool and method for organizing information technology. In particular, it may be a starting point for hospitals that have not yet used or have had very limited use of architecture to support the organization of their information technology. Architecture always starts - or should always start – by viewing the hospital as a company and understanding the care processes.

Tasks, responsibilities and authorizations

It can serve as a basis for assigning tasks, responsibilities and authorizations (TRA's) for the management of information. In the field of information, domains are relatively independent from each other. This makes the assignment of TRA's within an information domain clearer, for example the management of information definitions or the management of applications within a domain.

Basis for sourcing decisions

Key characteristics of the Domain Reference Model for Hospitals are that information domains have as few links with each other as possible and that these domains are clearly defined. Thanks to these characteristics, the model can provide a good basis for making sourcing decisions. For example, the business activities that fall into domain X are crucial for the distinctive character of a hospital and for this reason the decision can be made to keep domain X completely under one's own control and to support the business activities in this domain using bespoke software.

Insight into IT performance

When a hospital wishes to gain insight into its application landscape, into the extent to which applications meet user expectations, and into the costs that the applications generate, it can really

help to build up this kind of insight on the level of information domains.

Common vocabulary

By communicating in the concepts of the Domain Model, stakeholders inside and outside of the hospital are able to understand each other faster and better. This will avoid misunderstandings, and communication will become more effective and efficient. The concepts (business activities and information objects) used in the Domain Model for Hospitals are defined in the spreadsheet. The domains themselves are defined in terms of the business activities they support and in terms of the information objects that are assigned to the domains.

Framework for the application landscape.

The characteristics of the Domain Model are extremely suitable for use in making choices with respect to the organization of the application landscape. The ideal landscape for applications follows the information domain of the Domain Model. Where existing or new applications differ from these domain boundaries, and these domain boundaries can be exceeded, an informed and reasoned decision can be made to deviate from the ideal situation of the information domains in the model. An example of how an application landscape can be plotted against the Domain Model is included in Appendices 4 and 5.

Definition of IT roadmaps and project calendars

The Domain Model can be used when a hospital starts a large-scale IT project. It supports the process of choosing the order of implementation of applications or when determining which applications need to be replaced, implemented or modified simultaneously. By plotting projects or a roadmap against the Domain Model, greater understanding is acquired of those parts of the hospital that will be affected and when.

Hospital IT alignment

The Domain Model offers a perspective from which a manager can look to the application landscape from a business perspective. This gives the manager an overview of which parts of the hospital process are supported by which applications. Conversely, the Domain Model also gives the IT Department insight into the essence of the hospital (business processes). Ensuring that the information domain actually fits the business of the hospital and that the strategic goals of the hospital are well plotted against the Domain Model, provides an important contribution to the efficiency and effectiveness of IT within the hospital.

AIC categorization for NEN7510

NEN 7510 (standard for information security) within care requires that information is categorized and that requirements are placed on the organization of information technology regarding Availability (A), Integrity (I) and Confidentiality (C). These requirements are defined from a care and from a business perspective. Information domains are suitable to serve as a framework for security requirements because the use (activities) and the information itself come together in the domains. Once the AIC requirements of the information domains are determined, they can also be applied to the applications and data collection within these domains

H-4 Maintenance of the Domain Model

Introduction

On publishing version 1 of the Domain Reference Model for Hospitals, including appendices, the associated spreadsheet and the presentation, the need to establish a maintenance process arose. The use of the Domain Model is currently free of charge, with a citation as a condition for use.

This chapter describes the headline aspects of the maintenance process. Further details can be found at www.nictiz.nl/ziekenhuis.

The following roles are to be distinguished in this procedure:

User: a person or an organization that uses the Domain Model and submits a change or an expansion to the model.

Administrator: the functional administrator for the reference model. If it is a change request with impact, the administrator can then make the necessary resources available, in addition to registering the change or expansion requests. Also, in consultation with the Review Team, the administrator compiles a new version of the model from approved change requests and expansion. Following approval at the Approval Meeting, he/she makes the new version available to users.

Review Team: a team consisting of representatives from hospitals and other users that has the following tasks:

- assessing a change or expansion request;
- assessing the impact of a change or expansion request;
- reviewing and, following implementation of a change or expansion request, assessing and approving the end result.

The current members of the review team can be found at www.nictiz.nl/ziekenhuis.

Resources: resources necessary for a change or expansion to the Domain Model. These resources are provided by the administrator.

Approval Meeting: the meeting which formally approves a set of implemented change or expansion requests into a new version of the Domain Reference Model for Hospitals. The Administrator creates the new version and presents this to the meeting for approval. Following approval, the new version is made available to users.

Submitting a change request

Each user and/or the Administrator of the Domain Reference Model for Hospitals can submit a change or expansion request. A request can relate to the existing concepts in the information domains, the underlying information objects or business activities, including definitions. The maintenance process includes the figures in the Domain Model. Additional information is requested from the applicant when, in the opinion of the Administrator, the request is insufficiently defined or explained.

The applicant and/or the Administrator must register information for each request necessary for managing the procedure. The details of the information to be registered can be found in a detailed description of the maintenance procedure at www.nictiz.nl/ziekenhuis

Reviewing and approving a request

Each change request is approved, rejected or deferred by the Review Team.

The review and assessment of a request includes the availability of the necessary resources (man-hours, budget). The Administrator makes the resources available that are necessary to implement changes or expansion that will have an impact. After the implementation of these changes or expansions that have an impact, the Review Team shall re-assess the result.

Publishing a new version.

The Administrator compiles a new version of the model from approved change requests.

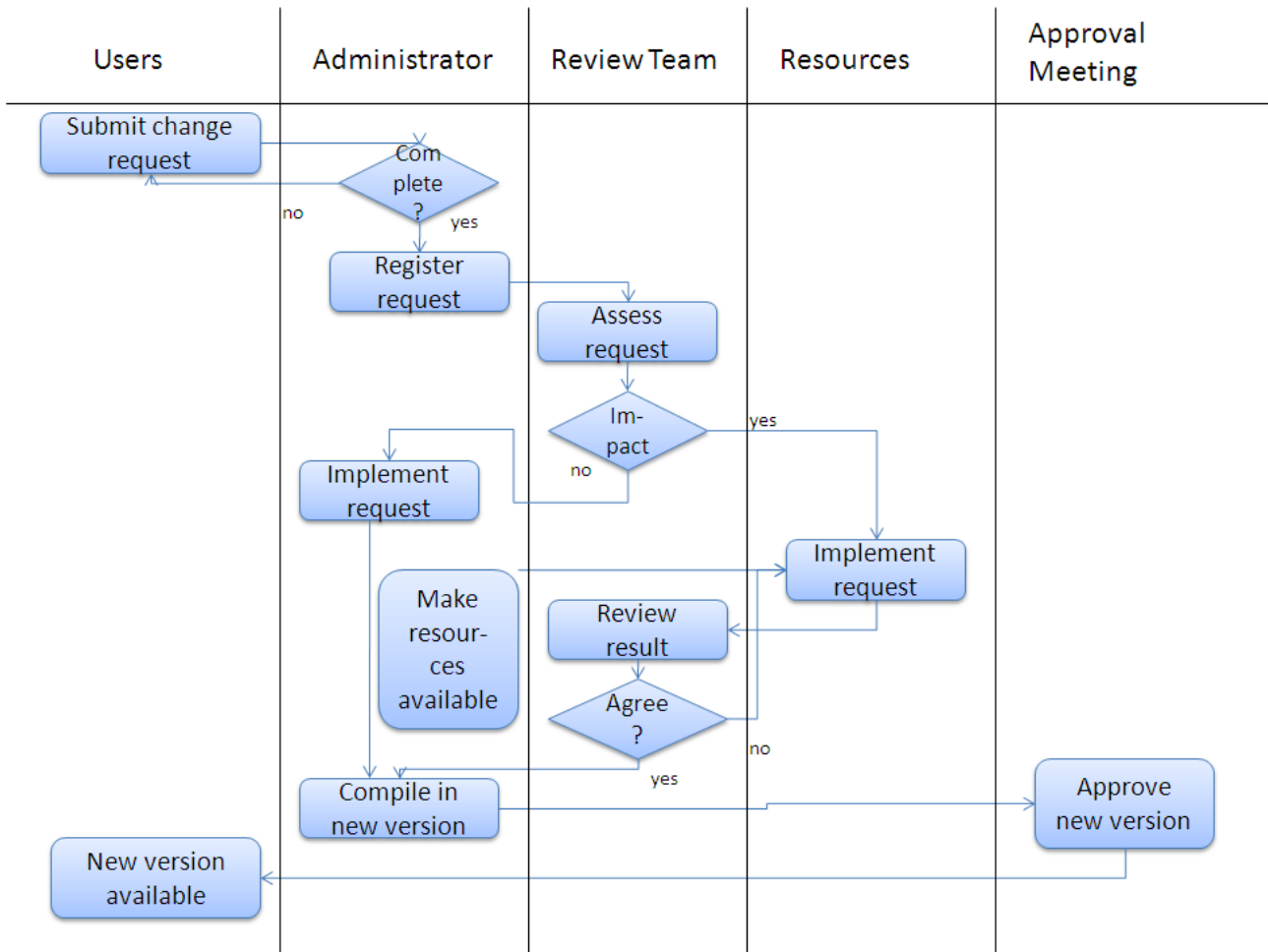
A distinction will be made within the numbering of the versions:

- Major Versions, indicated by the first digit in the version number preceding the dot. Publication of a Major Version is only expected to occur once per year and shall always concern major changes or expansions.
- Minor Versions, indicated by the digits in the version number after the dot. Publication of a

Minor Version is expected to occur several times per year and shall always concern minor changes or expansions.

The Approval Meeting formally approves the new version. Following approval, the new version shall be made available for all users via www.nictiz.nl/ziekenhuis.

The diagram below shows the progress of changes, reviews, approvals and publication of a new version.



H-5 Conclusion

By publishing version 2 of the Domain Reference Model for Hospitals, the authors and their organizations have intended to offer a useful and acceptable basis for potential users of the model. Many critical questions can be asked, for example about the choices that have been made in the process of defining the information domains. Many expansions, changes and modifications are possible to this model. That is true for both the model itself and the expansions that link the model to other existing models. Some examples of these potential expansions are:

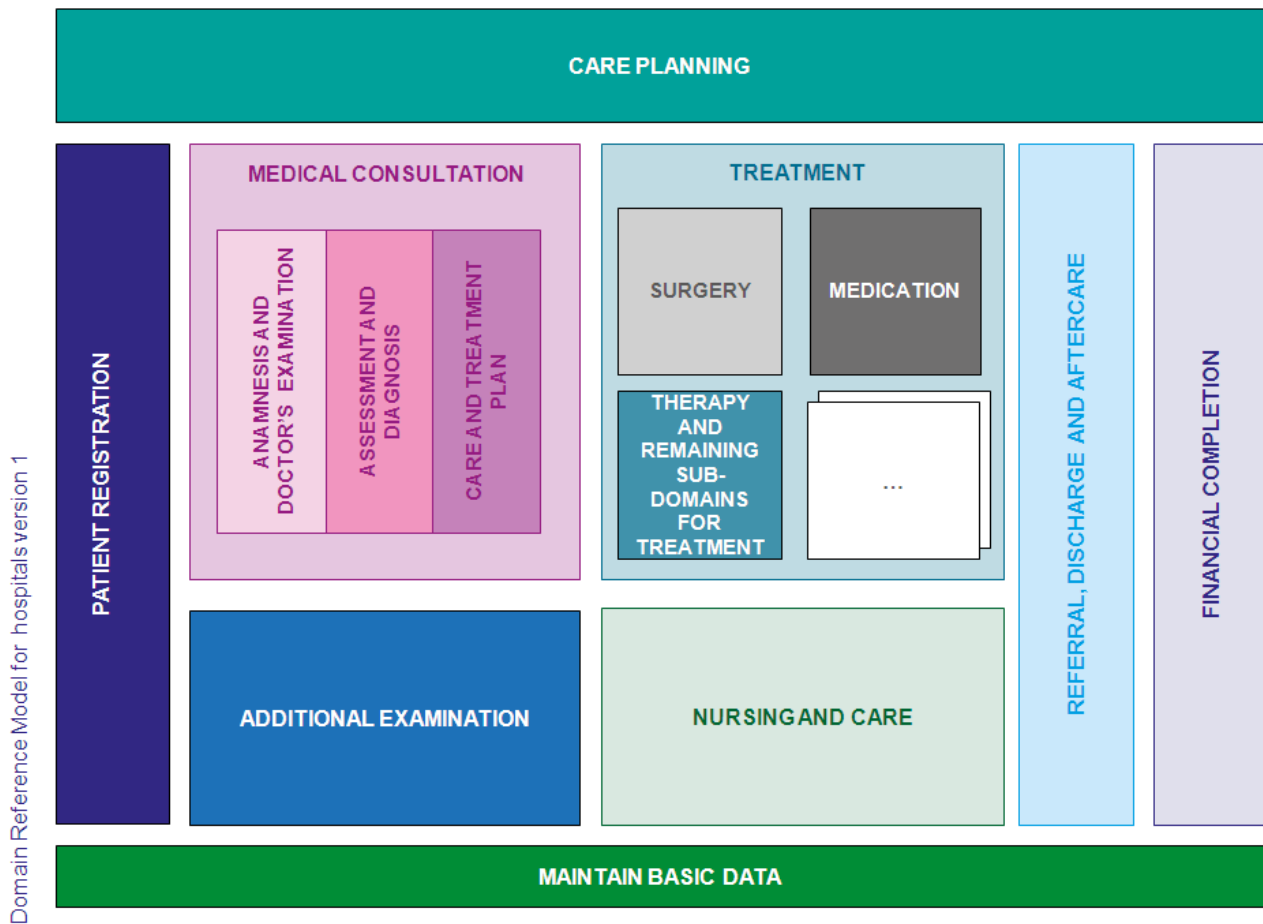
- Expansion of the model to other information domains than those related to the direct care process.
- Linking the model to other, existing models, such as the EHR-S Functional Model or the EPD-Maturity Model of HIMMS-Europe (EMRAM)
- The use of the Domain Model as a basis for a generic set of requirements for an Electronic Health Record (EHR) application. As an initial step, this can be achieved by clustering existing requirements for EHR's in hospitals to the information domains.

Similar to version 1, the success of version 2 of the Domain Reference Model for Hospitals is highly dependent on the acceptance and the use of the model in daily practice. For this reason, a maintenance and change process is available from the moment of publication. In addition, users of the Domain Model are invited to contribute to the optimization of the model. The primary target groups of users of the Domain Model are information architects from hospitals and (commercial) parties (suppliers) who support the hospitals in the organization of information technology. Following publication of version 2, the primary target group of users shall be approached and invited to discuss the model and its use, including optimization of the Domain Model.

It is now down to the hospitals to use the Domain Reference Model for Hospitals, to apply the model and, as a result, submit changes, expansions and

improvements to the model. After all, the Domain Reference Model is specifically for and driven by the hospitals.

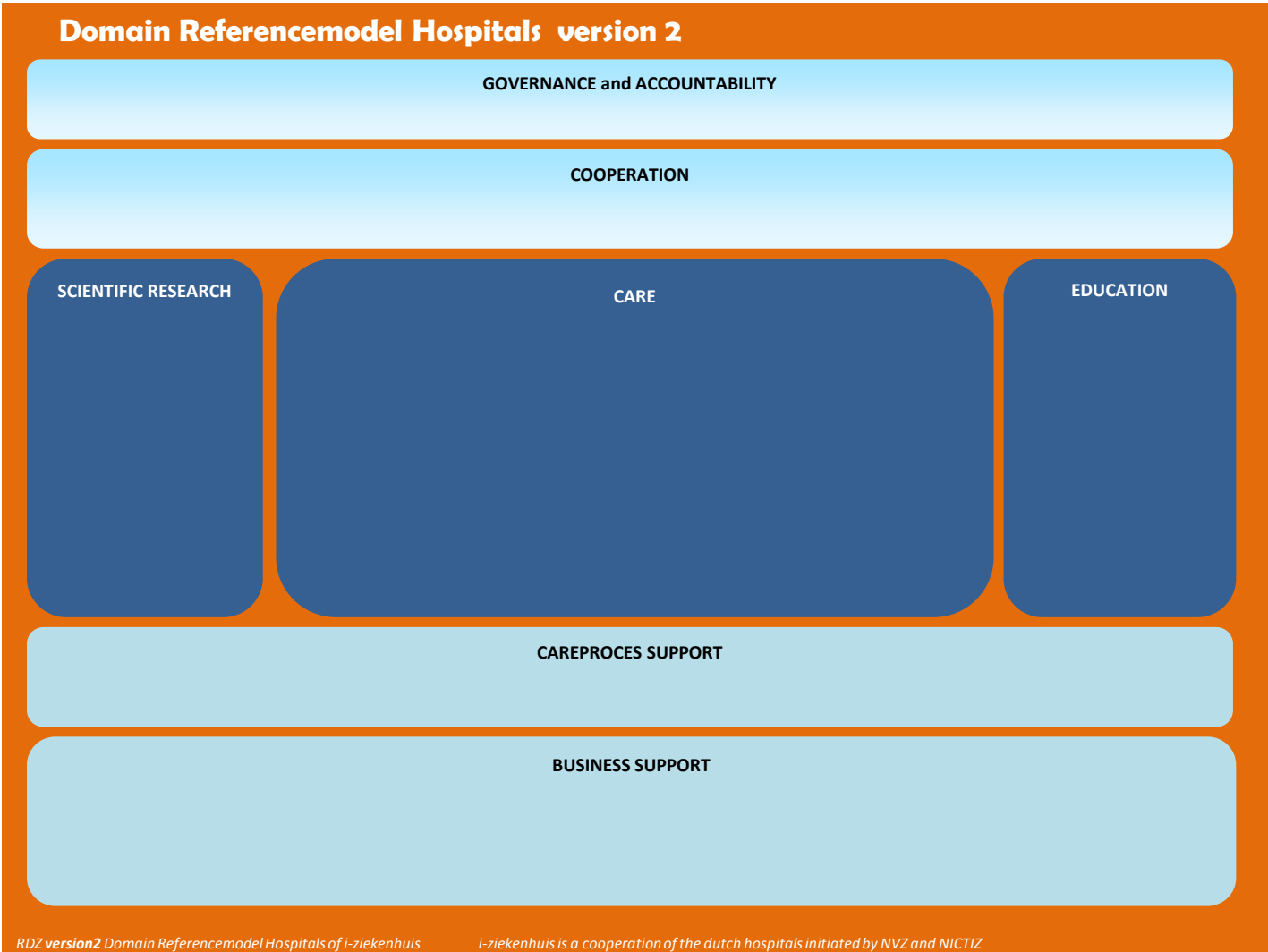
Annex 1. Domain Reference Model v1

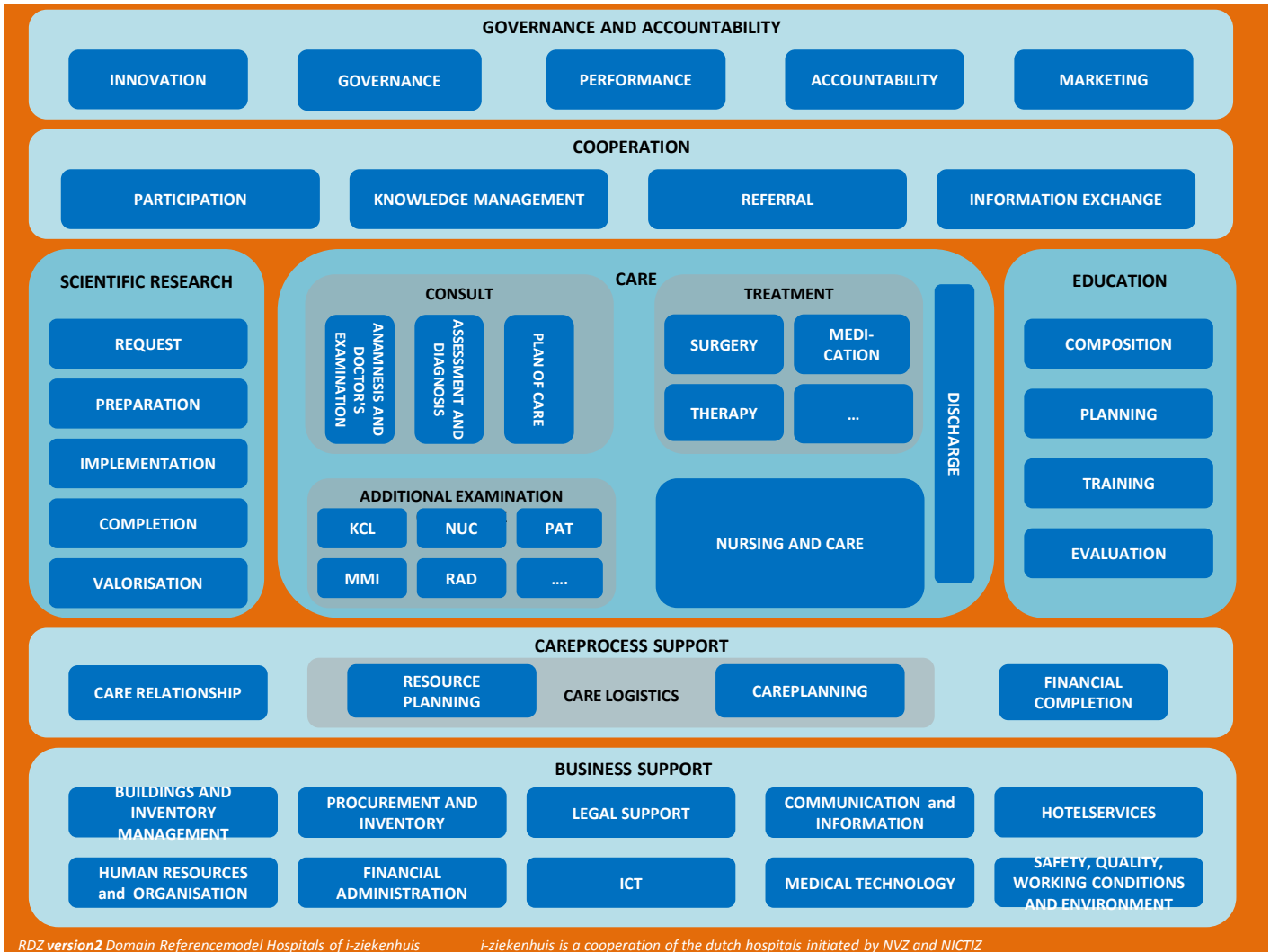


Scope: direct care process

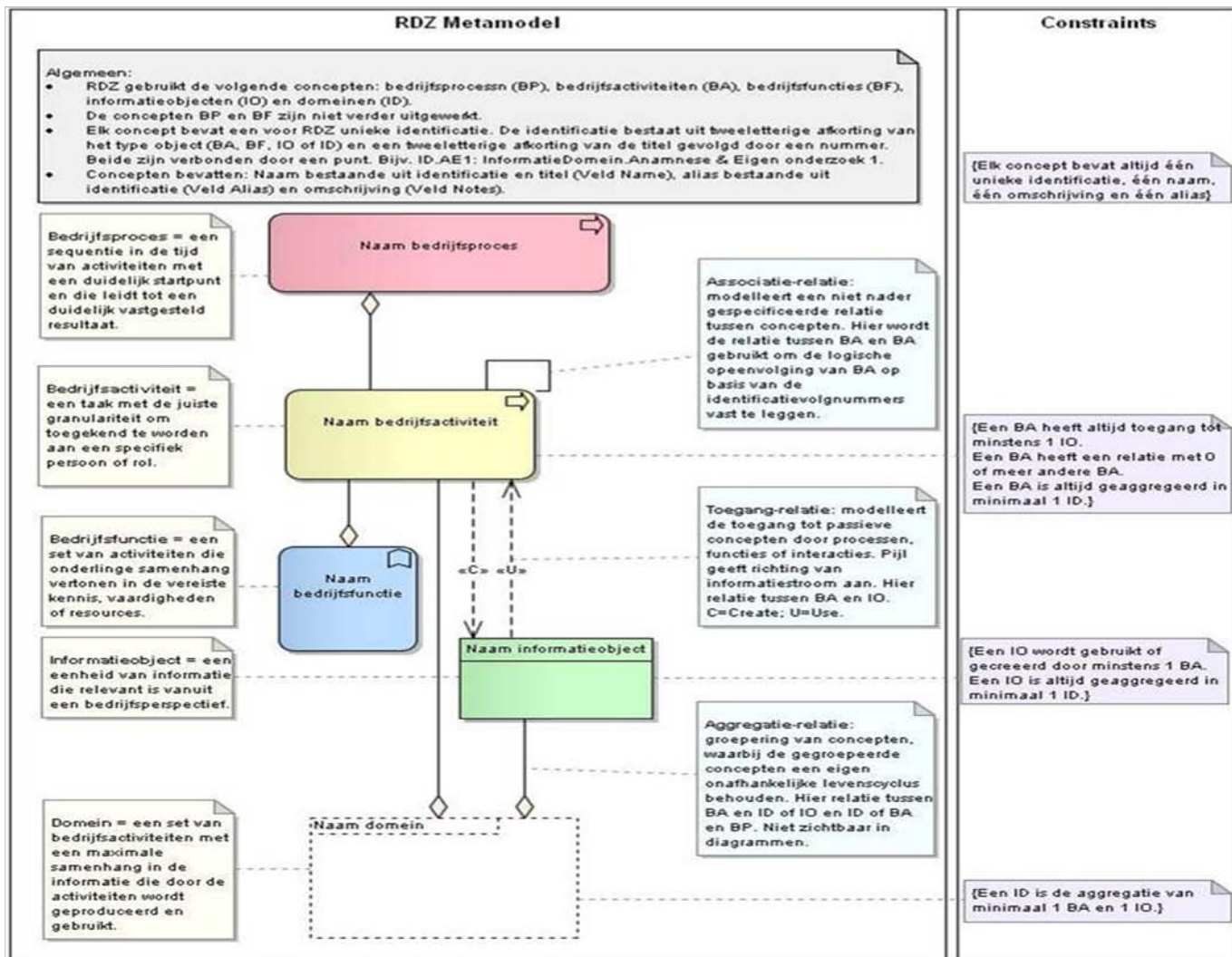
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Annex 2. Domain Reference Model v2





Annex 3. Metamodel DRH v2



Figuur RDZ Metamodel

Annex 4. List of Business activities

What follows is a list (table) of the business activities within a domain. This list is a copy from the spreadsheet.

Level 0 aggregation	Level 1 aggregation	DRH Domains	uID	Business activity	Description	
GOVERNANCE AND ACCOUNTABILITY		Governance			Located in this domain are the activities for defining mission, vision, strategy and policy including activities for the organization and management thereof.	
			101	Determine mission and vision	A mission statement defines the raison d'être of an organization and answers the question: why we do what we do? The mission is timeless. A vision is a consistent look to the future and provides the desired situation.	
			102	Develop strategy	The strategy describes how goals described in the vision will be reached. The strategy also provides a coherent set of policies for maintaining the continuity of the organization in the longer term.	
			103	Determine policy	Determining the hospital and/or division policy and specific policy plans such as medical, nursing, departmental, SLQE (safety, labor, quality and environment) etc., at strategic, tactical and operational levels.	
			104	Design and control of policy	Organization of the hospital governance (distribution of tasks, duties, responsibilities) needed to make good decisions. This includes monitoring the functioning of the organization, the optimization and maintenance of the planning and control cycle, drafting and monitoring budgets, giving advice to the board and management, information management, process management	
		Performance				In this domain are the activities related to creating, measuring and acting on performance indicators.
			105	Make production agreements with insurers	Aligning and making production agreements with healthcare insurers	
			106	Measure and control on KPI's	The activity with which the performance of the organization is governed with the ultimate aim of realizing the strategy of the organization. (Performance Management)	
		Accountability				In this domain are the activities for which the hospital is accountable to its environment.
			107	Accountability KPIs and production agreements	Being accountable to the extent that the organization is compliant with the required performance	
			108	Monitoring compliance with legislation and standards	Being accountable to the extent that the organization is compliant with the laws and regulations	
		109	Social accountability	Being accountable for social issues, like sustainability, mobility, aging		
		Marketing				This domain contains the activities necessary for optimal alignment between supply and demand, hospital and patient with the aim of providing as much value as possible to new or existing hospital

COOPERATION					services.	
			110	Perform market analysis	Research into factors that determine or influence supply and demand	
			111	Bringing together supply and demand	Aligning the health services supply with the demand within the region of the hospital	
		112	Maintain contacts	Maintain contact with partners and stakeholders with the aim of bringing attention to the existing services and to get feedback about the services offered		
		Innovation				This domain includes activities for developing existing and new services.
			113	Develop products and services	Development of (new) care products and services and product management.	
			114	Determine Innovation Agenda	Determine what innovations must take place to support the existing products and services and to support new developments	
			115	Develop Enterprise Architecture	Develop (expand) Enterprise Architecture on business processes, information objects and information technology guided by innovations	
			116	Program management	Develop and maintain a program plan in order to realize goals; includes project portfolio management and project management.	
	Participation				The participation domain includes the activities needed for the patient to manage his/her own care process.	
		117	Receiving patient's "self-management" information	Receive information (for example measurements, diaries, findings) from the patient about his/her own care process, both digital and on paper.		
		118	Offer care-specific information to the patient	Provision of medical or care process information to the patient by care providers or care assistants, both during a regular consultation and via alternative ways, like a digital forum, patient associations or e-consultation. This can also take place at the initiative of the patient (for example access to medical file)		
	Referral				The activities and information objects for referral from and to other care providers.	
		119	Receive and process referral	Receiving and processing or issuing a request, both digital and on paper, from a patient or a care provider to involve another care provider in the care process of the patient.		
		120	Refer patient	Providing advice to a patient in need of help or care to switch to a healthcare professional. This also involves the transfer of a patient to another healthcare provider and/or organizing aftercare.		
	Information exchange				This domain includes the activities for exchanging information between care providers	
		121	Provide or receive patient information from external healthcare providers	Upon request, providing or receiving patient medical information, digital or on paper, to or from external care providers.		
		122	Transfer patient information	Provide information to external parties (e.g. family physician) involved in the care of a patient, at the moment of patient referral or discharge.		
Knowledge management				This domain includes activities for managing the exchange of information between knowledge providers and		

CARE					knowledge customers	
			123	Publishing and managing knowledge	Providing and updating content such as protocols, manuals, instructions, quality documents, process descriptions, research publications and educational material research)	
			124	Identifying and making available knowledge	Identifying and making available knowledge and information, including personalization and notification	
	CONSULTATION	Anamnesis and doctor's examination				Taking anamnesis and conducting doctor's examination. This includes consultations of physiotherapists, dieticians, injury specialists, etc.
			125	Register basic medical data	Registration of various data related to the medical characteristics and condition of a person/patient (see information object 249).	
			126	Evaluate referral	Taking note of the nature and background of a referral, assess whether the treatment is appropriate and can be delivered.	
			127	Take anamnesis	Compiling information regarding care history and complaints through targeted questions.	
			128	Conduct physical examination/physical inspection	Observing/measuring certain bodily functions such as breathing, blood pressure, heart rate, temperature, fluid balance, reflexes or other aspects of bodily functions.	
			129	Request additional examination	Request additional examination such as, for example, order LAB, X-ray.	
			130	Request peer consult	Request to a fellow care provider for a specific judgment/opinion on diagnosis or treatment.	
		Assessment and diagnosis				Assess results of examinations and determine diagnosis
			131	Assess result of peer or external consult	Become acquainted with and assess the findings made in a consultation and involve this in the diagnosis and care and treatment plan.	
			132	Assess result (additional) diagnostic test	Take note of the results of (additional) examination and involve this in the diagnosis and care and treatment plan.	
	Plan of Care				Inform, draft and monitor plan of care	
		134	Carry out treatment during consult	Treatment that can be directly carried out during the consultation, for example cleaning the ear.		
		135	Inform patient and determine informed consent	Informing the patient on nature, approach and risk of an examination, treatment, or operation that the patient undergoes and, if necessary, obtaining (written) permission for its implementation.		
		136	Devise treatment plan	Decide on and establish a treatment plan so that it can be used in communicating with the patient and other healthcare providers.		
137		Monitor treatment	Assessment of effects and results of treatment and possibly adjust the			

TREATMENT			treatment plan.	
	Surgery		Surgical activities and information objects to solve a medical problem, to make a diagnosis, or to improve the quality of life	
		138	Perform pre-operative screening	Obtain information on patient's condition through examination/questionnaires, consider the need and risks of the planned surgery and determine the desired approach and method of anesthesia.
		139	Prepare surgery	Ensure logistic preparation (including ordering blood products, prostheses, etc.) and staging of necessary materials prior to the surgery.
		140	Perform surgical procedure	Perform an intervention in an operating room in a hospital, which entails incision, excision, manipulation or suturing of body tissue. Usually local or general anesthesia or sedation is needed to control the pain.
		141	Draft surgical report	Drafting a report on the progress of the surgery. Both the surgeon and the anesthesiologist usually draft a report.
	Medication			Activities and information objects to prescribe, process, dispense, prepare, administer or monitor medication
		142	Prescribe medication	Determination of necessary medication, dosage and frequency of dosage in a prescription
		143	Process prescription	Processing a medication prescription by the pharmacy to a medication order (in clinical setting) or a medication delivery (in outpatient setting). Processing can consist of substituting the existing medication, applying medication, monitoring etc.
		144	Dispense medication	Dispensing of a specific medicine by the pharmacy to a patient.
		145	Prepare medication	Prepare medicinal products: the whole product or a part of the product or packaging or labeling a medicinal product
		146	Administer medication	Provide and/or insert medication at a given time, according to specifications and method of administration (oral, anal, injection, etc.)
		147	Monitor medication	Oversee and monitor proper use of medication (e.g. proper dosage, side effects, combined with possible allergies, pregnancy, interaction with other medications).
		Therapy	148	Perform therapy
				Remaining sub domains of treatment.
	<i>[remaining sub-domains for treatment]</i>			The DRH-model enables the possibility to add specific types of treatment.
		149	Activities in other treatment sub	Performing activities from other disciplines as part of the treatment plan.

CARE PROCESS SUPPORT	ADDITIONAL EXAMINATION	Nursing and Care		domains	Activities and information objects for care and nursing tasks
			150	Perform nurse anamnesis/physical examination	Taking anamnesis by nurse. See also anamnesis (uID 127).
			151	Formulate nursing plan	Decide on and establish a nursing plan so that it can be used in communication with the patient and other healthcare providers,
		152	Nurse patient	Includes personal care, injury care, observation and reporting and specialized care.	
		Discharge			Activities and information objects at the point of patient discharge, including evaluation.
			153	Discharge patient	End of care by a healthcare provider. Discharge can include referral/transfer/death of the patient. After discharge, the patient can be transferred back to his home or can be referred to another healthcare provider
			154	Evaluate care	Evaluation after discharge of the care provided to the patient.
	155	Determination of death	Noting death of a patient and indicating reason for this, also providing official notification to authorities.		
	[per type of examination]			This domain includes additional examinations, such as clinical research, x-ray examination, microbiological research, chemical pathology, etc. Specific types of examinations, activities and information objects can be added to the model.	
		156	Perform additional examination	Systematically, according to a specific methodology or technique, obtain information about the physical or mental condition of the patient. The collection of human material and digital images are part of this activity.	
		157	Interpret result additional examination	Taking note of/interpreting the results of examination.	
	158	Draft and release result report	Establishing and releasing the result of the examination in a report		
	CARE LOGISTICS	Resource planning			Allocation of current capacity to patient groups, specialists (planning volume), resources and locations. Scheduling patient groups based on available capacity
			159	Prepare and maintain production planning	Establish, monitor and adjust production planning
			160	Schedule staff	Establish and plan required deployment of individuals
161			Schedule resources	Establish and plan appropriate deployment of resources (medical and non-medical) such as equipment, instruments, blood products, food and beds	
162		Schedule locations	Establish and plan appropriate use of locations and rooms		
Care planning			Planning for individual patients (who, when and by whom treated)		

EDUCATION			163	Schedule appointment	Schedule date/time/place, healthcare provider involved and patient for a contact/interaction time.		
			164	Schedule examination	Schedule date/time/place and necessary resources (e.g. people/devices/capacity) required for conducting a specific examination		
			165	Schedule clinical activity	Schedule a clinical activity (admission/discharge/transfer).		
			166	Schedule surgery/therapy/other treatment	Schedule date/time/place and necessary resources (e.g. people/devices/space/other equipment) required for performing surgery, therapy or other treatment.		
	Care relation					Identify and maintain care relationships, including patients, care providers and healthcare insurers	
				167	Register, identify and maintain patients and clients	Identifying patients (for example, via unique patient identifier) and maintain information of the patient	
				168	Register, identify and maintain healthcare provider	Identifying healthcare provider (for example, via healthcare provider unique identifier) and maintain information of the healthcare provider	
				169	Register, identify and maintain healthcare organizations	Identification of organizations offering care and maintaining information on these organizations.	
				170	Maintain healthcare insurance companies	Register and maintain information of health insurance companies	
	Financial completion					The activities during the (care) process necessary for collecting and registering information for invoicing.	
				171	Register medical transaction	Identifying and registering the codes to be applied for the medical interventions based on patient contact/treatment	
				172	Invoicing care product	Processing medical interventions to a defined care product and generating an invoice for these care products. This includes the validation of care products to be invoiced: e.g. check for consistency	
	EDUCATION			Composing	173	Compose education program	Draft curriculum and study program for regular (e.g. medicine, nursing, paramedical) and further education (medical and nursing specialties).
					Planning	174	Schedule
				Teaching		175	Teach
					176	Receive education	Receive education in different forms.
				Evaluating	177	Content testing of education	Individual assessment of the quality of education (sometimes quantity) based on established criteria.
					178	Evaluate	Evaluation of education and deployment of improvements

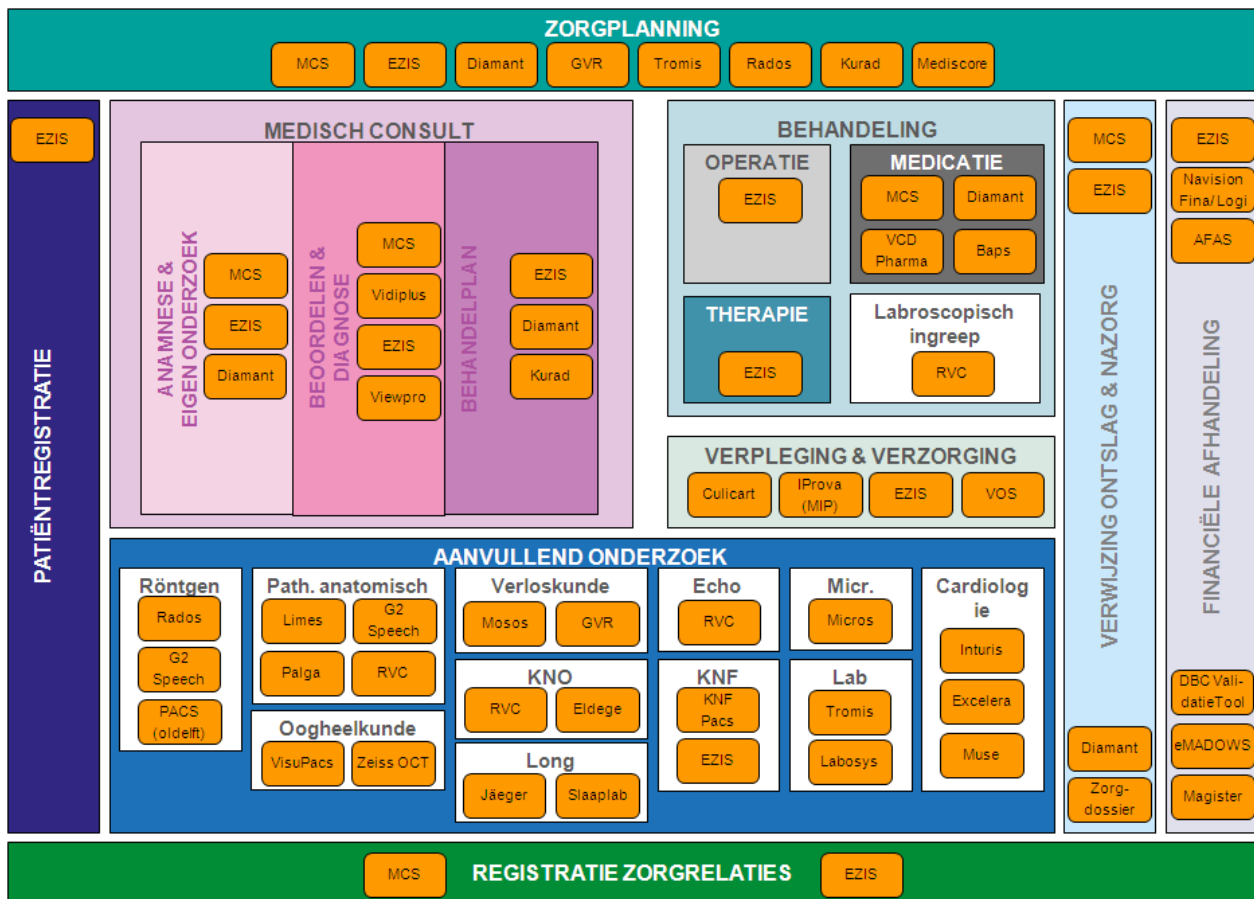
SCIENTIFIC RESEARCH		Proposing	179	Submit research proposal	Research preparation and design The researcher or the research group issues a research proposal to the committee (Committee on Research / Medical Ethics Committee).
			180	Medical, ethical review	The Research Committee / Medical Ethics Committee tests the research proposal against external and internal criteria and the relationship of the proposed research to current research projects.
			181	Draft research proposal	The researcher or research group proposes a final research proposal.
		Preparing	182	Draft research protocol	A protocol is established for the purpose of conducting the research.
			183	Request external financing	If necessary, external funding is requested.
			184	Apply for permits	If necessary, permits are requested.
			185	Develop research dataset	If the clinical research data must be collected, researchers and data managers together develop the required dataset.
		Executing	186	Patient selection and recruitment	Based on certain criteria, patients are selected and approached to ask whether they wish to participate in the study.
			187	Obtaining patient consent	If the patient agrees to participate in the study, this permission is registered.
			188	Collect research data and materials	The predetermined and required research data for the study is collected and, if necessary, material samples are also taken from the patient.
			189	Control of protocol compliance	During the study, periodic audits on the quality and proper conduct of the study are executed, either internally or externally.
			190	Operation analysis and research	Where necessary, the collected research data are processed (extraction, conversion, cleaning, organizing, etc.) to make the data suitable for analysis.
			191	Feedback of patient-relevant results to the patient	If unexpected relevant findings are made during the study for an individual patient (e.g., an, up to that time, undiagnosed illness), they are reported to the patient or the clinician.
		Completing	192	Publish research results	The results and analysis of data from registers during the execution of the project are compiled into a final report (publication, thesis or presentation).
			193	Include publication and publication list	Completed publications are included in a list of publications.
	Valorization	194	Valorization of research	The newly developed knowledge derived from research is made accessible to third parties so that new combinations of knowledge can lead to innovative solutions and thus be useful for society.	
		Manage buildings and inventory			Domain for activities and information objects related to managing, operating and advising of building and inventory.
	195		Management and maintenance of buildings and inventory	Inventory of supply and demand on usage of space, in order to develop a multi-year housing plan to reach an efficient and flexible use of space, property and land.	
	BUSINESS SUPPORT				

			196	Building operation	Manage building on technical and functional quality, preparation of a multi-year maintenance plan and budget, monitoring and control of maintenance activities, cleaning, maintenance and security
			197	Advice regarding building and inventory	Preparing, planning and supervision of new construction and renovation
			198	Manage technical installations	Managing and commissioning technical installations, infrastructure, energy (saving)
			199	Manage transport	Management of all vehicles and other transport (e.g. bicycles owned by hospital) leased or owned
					Activities and information objects for procurement and goods logistics
		Procurement and stock management	200	Procurement strategy	Selecting suppliers who may provide goods or services, at what price and purchasing conditions.
			201	Operational procurement	Place orders for regular products and services within the purchasing conditions. It also covers monitoring the delivery and keeping in contact with the supplier to ensure that the goods are supplied at the requested time, place and quantity.
			202	Manage stock	All activities aimed to maintain or test stocks at a desired level.
					The activities and information objects necessary for good human resource management
		Human resources and organization	203	Support recruitment	Recruitment supports the activities aimed at approaching candidates. Selection involves selecting the right candidate and the subsequent appointment.
			204	Support through flow	Managing the organizational structure and staffing, staff assessment, career development and competency
			205	Support outflow	Support for employee departures due to pension, voluntary or forced resignation, death.
			206	Administer staff information	Includes personnel registration, time, absence and leave registration, HR costs and profitability.
					The activities and information objects for legal advice, legal support and legal policy.
		Legal support	207	Provide legal advice	Advising on the application of legal policy e.g. regarding ethical issues and legal support in the handling of complaints and objections.
			208	Draft and review legal policy	Drafting of legal policy, such as privacy, and securing compliance with the policy on the basis of existing legislation.
					The activities and information objects for the financial administration of the hospital
		Financial administration	209	Manage financial administration	Manage accounts receivable, accounts payable, general ledger, invoices and perform financial transactions. Also includes financial settlement with insurers.
			210	Manage payroll	Payroll takes place based on the personnel administration. It includes gross/net calculations, pay slips and control of the process of adjustments and garnishments for individual staff members.
			211	Manage capital	Activities aimed at the preservation of capital and achieving the desired result. Includes the set-up of the liquidity forecast, alignment of long-term housing plan, attracting the

			(necessary) funds, managing the working capital, determining the interest income and managing the funding ratio on the balance sheet.
Safety, Quality, Working conditions, Environment (SQWE)			Activities and information objects related to monitoring and optimizing safety, quality, working conditions and environment within the hospital.
	212	Monitor quality and safety	Activity that focuses on optimizing the quality and safety of a product, production, service, medical equipment or the hospital. Also includes advice, risk management, patient safety, information security and clinical physics.
	213	Monitor working conditions	Advising on and managing risks in respect to working conditions. Also includes company emergency, prevention, inspections, absenteeism and reintegration.
	214	Monitor environment	Enforcement, advice and inspection of permits and regulations regarding the environment. Also includes registration of hazardous substances, noise and thermal environment.
Hotel services			Provision of hospitality services to patients, visitors and employees.
	215	Offering hotel service	Providing and registering a desired service such as parking, meals, catering, stores, (meeting) room, telecom facilities, mobility equipment, waste, sterilization, reprographics, mail, etc. Includes, amongst others, improving existing services and handling malfunctions.
	216	Reservation hotel service	Requesting and registering a desired service
Communication and Information			Activities and information objects for communication and information to patients, visitors and healthcare professionals
	217	Provide internal and external information	Composing, gathering and providing information about and to patients, visitors, healthcare professionals, students, researchers, staff, press, etc.
	218	Complaints mediation	Receiving and administration of complaints and monitoring the handling of complaints.
	219	Fundraising and sponsorship	Acquisition of additional funds and maintaining sponsor relationships.
ICT			All activities and information objects for developing, managing and supporting the ICT supply and ICT services.
	220	Develop ICT	Developing and testing services based on customer requirements, so the customer gets what he/she needs. This activity includes change management, engineering and IT projects.
	221	Manage and operate ICT services	The activity(ies) to support existing ICT services. This activity includes infrastructure / application / functional management, helpdesk, user support. ICT services include presentation aggregation (Portals), search engine, business intelligence (BI) services, tools and reports, identity management, Web content management, knowledge creation and social media, email and calendars, telephone and video, voice recognition.
Medical			All activities and related information objects for maintaining, managing and

		technology		supporting medical equipment
			222	Maintenance medical equipment Technical management (preventive and corrective maintenance) of medical equipment.
			223	Support use of medical equipment Execution of and support of research and therapy (clinical physics).

Annex 5. Example model application Deventer Ziekenhuis



Scope primaire zorg

Deventer Ziekenhuis

Annex 6. Example model application Albert Schweitzer Ziekenhuis

Domain Reference Model with applications

Within the Albert Schweitzer Hospital Dordrecht (ASz) a first step has been made for an application landscape plate.

Main objective is to give insight into the IT applications used within ASz and the business functions that are supported by these applications.

Specific uses of an application landscape plate are:

- serve as talk plate in talks on information policy and architecture, both within the own organization as with suppliers or cooperation partners
- insight in size, complexity and diversity of used applications
- discovering functional dubbelingen or white spots in IT support
- determination of the starting situation (As-Is) for a target architecture
- support roadmaps/phase ring to come to target architecture

Method e

The Reference Domain Model is used as a framework to format and visualize the application landscape.

Of all the applications has been established to which information domain which belongs.

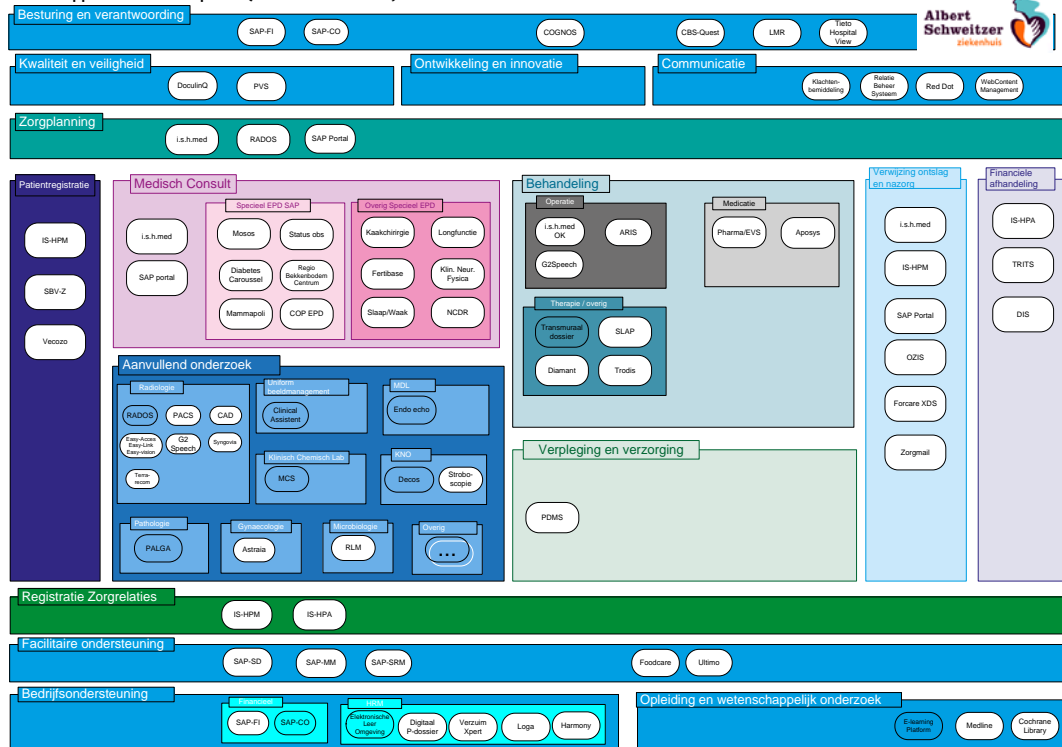
ASz wanted a total overview. That is why, in addition to the direct care where the Domain Reference Model in this first version is limited to, other domains (supportive domains) are included in this mapping of applications.

Notes and experiences

As a large organization, ASz has a very diverse and extensive application landscape. It is impossible to identify this at once and all mutual linking. The aim of this exercise was to deliver a first step, not to completeness.

Therefore, the focus was on the most important and business critical applications, which play a role in conducting business activities and business processes. Important criterion to be included in the mapping was that an application could be related to a business activity identified in the Domain Reference Model.

Aanzet applicatielandschap ASz (under construction)





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