# END-USER INVOLVEMENT IN HOSPITAL BUILDING DESIGN

A CASE STUDY ON INFORMATION MANAGEMENT AND

DESIGN PROCESS

MASTER THESIS MANAGEMENT IN BUILT ENVIRONMENT

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# PREFACE

This report is the result of my graduation research in my master studies at the TU Delft, Management in Built Environment track. Throughout my career as an architect, I have observed many times that successful environments are created only by integrating diverse perspectives. The information exchange and being exposed to different views during the design process has a big impact on the designed product. I worked for different type of stakeholders during my professional life, including the client, the designer or even for the facility management teams and I had the chance to interact with many types of users. This experience helped me realize the different perspectives of users and other stakeholders. I noticed that the design itself is a complex balance of considering different stakeholder views and managing different type of requirements .This is the project and stakeholder management side of design, in which I have a strong interest.

With this research I aimed to understand the hospital design process and user interaction. I have a particular interest in user involvement, since their participation is crucial in building projects like hospitals. I hope that my study can provide new insights and helps professionals to manage the design process successfully and enhance user participation. In complex design projects, creating supportive environments can be only be achieved by user participation.

My education period was exciting and intense while being challenging at the same time. Through this research, I had the opportunity to gain a lot of interesting knowledge and meet with inspiring people without whom my graduation thesis would not be what it is now. First, I want to thank my mentors Clarine Van Oel and Jelle Koolwijk for their time, feedback and support. In addition, I would like to thank to Liesbeth Van Heel from Erasmus MC Rotterdam for taking her time to supervise me and to provide me with key information and feedback. Furthermore, I want to thank to my friends Aysu, Hannah, Orcun and Seda who motivated me and made my education enjoyable. My family especially my partner deserves a particular note of thanks; their endless support always served me well.
I hope you enjoy your reading.

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# ABSTRACT

**Keywords:** user involvement, end-users, design process, healthcare design.

**Aim:** The purpose of this research is to gain insight into the design process in healthcare building projects, more particularly into the way the end-users groups like the medical caregivers and the design team exchanged information and participate on developing the design. This gives a better understanding about information management, end-user and stakeholder management in healthcare building design and planning.
**Research question:** In hospital building projects, how does the project organization translate the end-user information into design?

**Methodology:** By performing a single case study, data was collected through context analysis, document analysis and in-depth interviews about end-user involvement, information flow and decision-making process in healthcare projects. Ten interviews were conducted with different members of the project organization including project managers and leaders, design experts and also external advisors. The data was analyzed using Atlas ti.

**Findings:** There are three main findings of this research:
1-End-users from different groups were involved in the design and decision-making process and the level of involvement was different in each stage. There is mainly a consultative form of user involvement which evolved into a co-design form in the technical phase of design. User representatives and designers were members of technical design teams: TOTs in this phase looking for design solutions together.
2- Two groups had key roles during the process: User Coordinators and the Building Expertise group. User Coordinators ensure the gathering of user information and engagement of end-users during the design, and they are the information exchange link between the end-users and the design team. The Building Expertise group in this project had an intermediator role acting in different boundaries of the organization.
3- Design decisions are based on continuous consultation with end-user representatives which are linked to the project organization in all levels. There was a transparent and informed decision-making process. Review matrices were decision making support tools used by different groups including different end- end-user groups
**Limitations of the Research**: There are some limitations of this research. Information is gathered from the interviews are dependent on respondents' reliability and accuracy and case is completed more than three years ago, and the interviewers recall of memory may be inaccurate and subject to biases.

**Practical Implications:** This research describes various forms and levels of user involvement. On the other hand, it explains the methods and tools used for user involvement, design evaluation and decision making during the design process .This can provide insights on project management and how to organize the information exchange and the team interactions during the briefing and design process in building design projects.

**Scientific relevance:** This research presents and analyzes design and user involvement activities and interactions in a building project organization. By analyzing the interactions between the end- users and the design team, valuable information about the design management as well as stakeholder management can be gained. This research can be useful for researchers working both on management and design on healthcare facilities as well as healthcare professionals working in healthcare facility development.

**Originality /value:** There is not many literatures found in the literature related with project management in the healthcare building design.

# GLOSSARY

Building Design Process: The process or series of actions and steps taken in order to find solutions for client requirements and specifications. The aim is to create a set of instructions for the realization of a building product. It varies from project to project however it tends to follow a series of established stages.

Building Expertise Group: It is the expert group leading the building design and process management in Erasmus MC new building project. For the consistency between the interviews and documents this term is used throughout the report.

End-Users: In the context of the building projects end-users are the stakeholders who will ultimately be using the facility. End-users are defined as those who occupy the building; they are not experts in managing it, but have knowledge and opinions, nonetheless, about its performance in relation to their own objectives (Kaya, 2004; Lai and Yik, 2007). In the context of this research end-users represents medical employees like medical care givers, including nurses, doctors and medical technicians.

User involvement: User involvement is defined as observable behavior of users in the development process, and their participation in product or system development and implementation activities (Barki, H& Hartwick, 1989)

Project Organization: A project organization is a structure that facilitates the coordination and implementation of project activities.

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# INTRODUCTION

# 1. INTRODUCTION

## 1.1. Introduction & Problem Statement

Design in healthcare architecture is a complex process, which includes mutual exchange of knowledge between various stakeholders (Elf, Fröst, Lindahl, & Wijk, 2015).There are many end users and stakeholders participating the design in hospital projects like design consultants, medical staff, housing department and end-users with specialized knowledge about the care process. End-users like medical experts have high impact on the design and decision making. Different experts and advisors related to the medical care and special equipment are highly involved in the process which is not the case in other type of building projects. User involvement is essential in hospital design and create collaboration issues and information asymmetry which are barriers in communication and information exchange in healthcare projects (Pemsel, 2010).

User involvement in the healthcare design process can help designers to understand how their activities are performed and gather valuable information from users. It is critical to understand how the physical environment support or is a barrier to human interaction, safety and effective delivery of care (Hamilton, Orr, Raboin, 2008) Furthermore, user involvement in early design, when changes are more feasible, can assist designers in capturing real needs of users (Damodaran, 1996; Jensen, 2011; Kujala, 2003).

User participation in the design process can align the design of the building with the given services. End-user involvement in hospital design can generate value and create environments that contribute to the well-being of patients and help their recovery, which in return lead to high quality care (Caixeta, Bross, Fabricio, Tzortzopoulo, 2013). On the other hand, poor healthcare architecture and a building not supporting the end-user activities and disrupt the operations and often have negative outcomes, such as patient falls, disorientation, healthcare-associated infections and patient dissatisfaction as researched by Ulrich [Ulrich, 2008].

## 1.2. Research Aim

The purpose of this research is to gain insight into the design process in healthcare building projects, more particularly into the way the end-users groups like the medical caregivers and the design team exchanged information and participate on developing the design. This gives a better understanding about information management, end-user and stakeholder management in healthcare building design and planning.

## 1.3. Research Questions

*Main research question:*

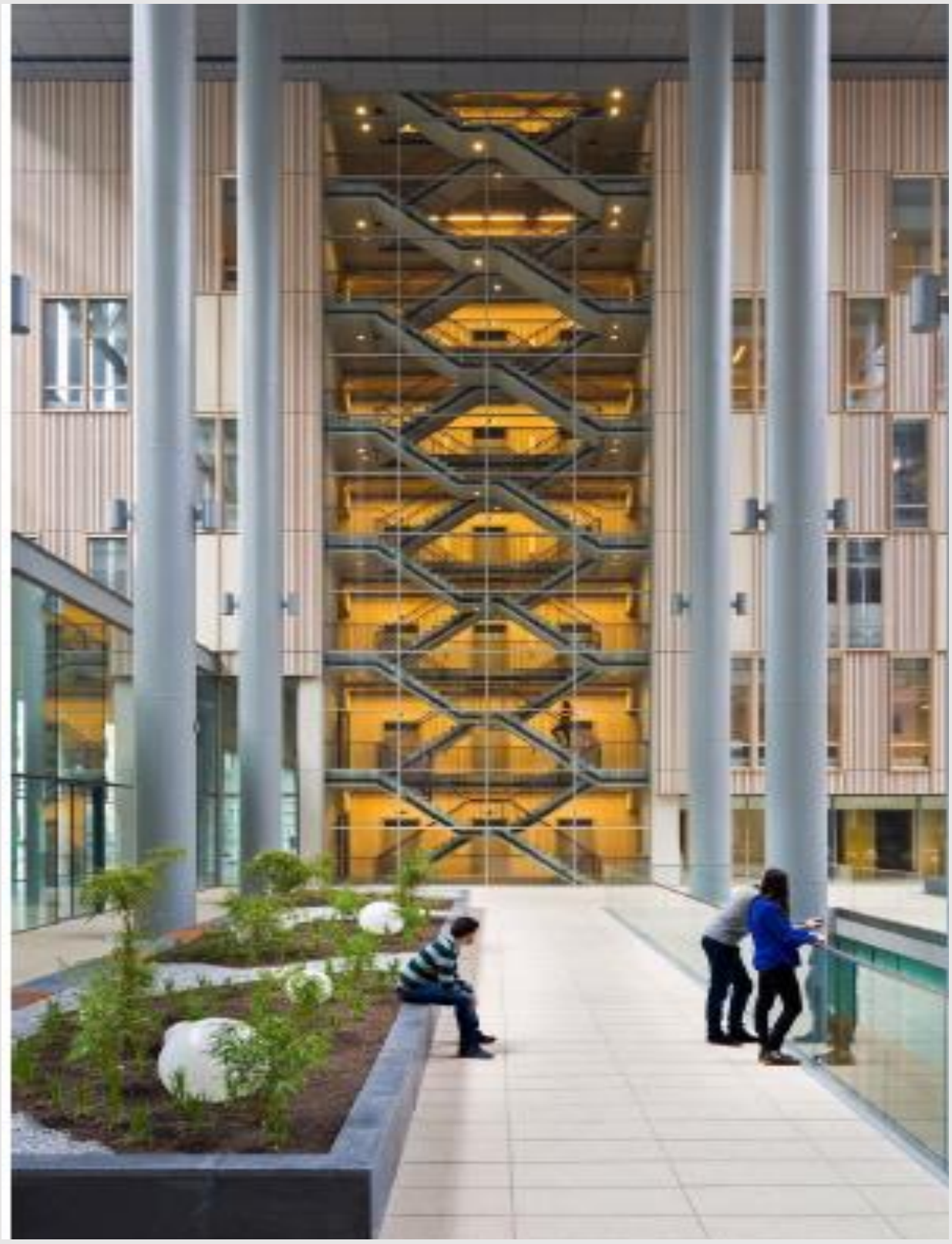
*In hospital building projects, how does the project organization translate the end-user information into the design?*

*Sub Questions:*

1- *How did the project organization involve end-user groups in different phases of design?*
2- *How did the project organization manage the information exchange between the involved end-user groups and design experts?*
3- *To what extent were the end-users and stakeholders involved in decision making?*

The following chapter provides a background information and literature review of the relevant concepts and generate a better understanding of the design process in hospital building projects.

# BACKGROUND



# 2. BACKGROUND

In the context of management in the building environment, translating end-user information into design represents two different but interlinked processes. The first one is the briefing process where the information is collected, shared, and analyzed. The second one is the design process where the design plans are prepared and evaluated by different groups.

Hospital building design requests intense **stakeholder and user involvement**. Adopting a proper user involvement strategy, choosing the right tools, and involving many users at the same time can be challenging in complex projects like hospitals. Every management approach requires different methods and tools, and it can be difficult to choose the right tool and method.

Large amounts of information have to be obtained and processed during a large-scale building design project. This requires organizing the **information flow &management** in different phases of the design within a multi-disciplinary team.

End-user needs and requirements are discussed in different groups and they may be represented directly or indirectly in different levels of organization. Their **representation** in design meetings, and decision-making moments is crucial since medical organizations may consist of thousands of end-users.
Thus, translating end-user needs into healthcare design is related with three general concepts: end-user involvement, end-user representation and information management. All three main concepts are interrelated with each and they are represented with a flower model below.

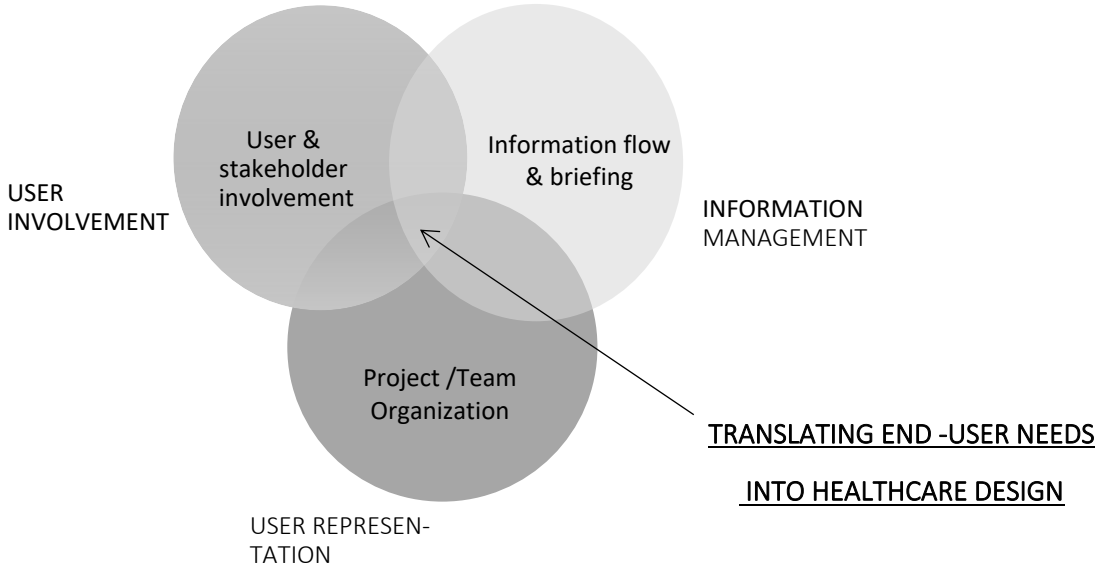



*Figure 1: Representation of the main concepts (own ill.)*

The concepts wills be explained in the next chapter in the following four sections:

2.1. Design & Briefing Process in hospital projects

2.2. User involvement in building design

2.3. Stakeholders & end-users in healthcare organizations

2.4. Information management & exchange in healthcare building projects.

In the first section, the design process in hospital projects and design development and briefing in building projects will be explained. The following section focuses on different levels and forms of user involvement with methods, tools, and boundary objects in participatory design. The third section describes the different user groups in healthcare organizations. The last section gives explanations about the information exchange as well as design and decision-making criteria in building design and particularly in hospital projects. The background chapter will end with a conceptual model.

## 2.1. Design & Briefing Process in Hospital Projects.

### 2.1.1 Design process in hospital projects.

The design process works different in hospital projects due two main reasons. The first reason is the fact that many special experts and advisors related to the medical care and equipment have to give input and evaluate the design. The second reason is the difference in decision-making, the design decisions are filtered by many groups before the design is finalized. This brings additional complexity to the design process, which can be explained, in two ways.

1-Involvement of non-professionals: in the hospital projects, the building client have specific requirements. Different kind of experts and end-users who have specialized knowledge on the care process and special equipment give information about their need and requirements. As a result, non-professionals like medical staff are involved in the design process. For this reason, it is advised that end-users such as nurses need to be involved in different phases (Reiling, Hughes, & Murphy, 2008).

2-High number of stakeholders: Besides the medical experts, different groups of stakeholders like board members, the facility management team, and administration are included in decision making process in hospital design projects. It is important to consult and have their ideas about the design to understand the complex structure of the hospital. The project management team gather information from many stakeholders across different disciplines before the final decisions are made.

**Different phases in building design**

Design development of a building project is divided into stages or phases. This can be helpful in establishing milestones for the design, the preparation of information for approval, and in arranging client gateways ( Designing Buildings, 2020 ). Gateways are key decision points, which the design is assessed and it is decided whether to progress to the next stage or carry out revisions or further work. In the scientific literature there is a great deal of ambiguity between definitions of stages. The name and the description differ across countries and are differently used in the practice and guidelines.

For the purpose of this study, a distinction between three different design phases is used, based on the description of the Royal Institution of British Architects (RIBA), such after the study of Fronczek-Munter (Fronczek-Munter,2016). These design phases are:

1) Concept design
2) Developed design
3) Technical design

The Concept design phase generally takes place after feasibility studies are done and a program of requirements (PvE) is prepared. In this phase, design activities may include the preparation of drawings and other studies. The concept design represents the design team's initial response to the PvE , and outlines function and form. Generally, zoning plans are prepared in this phase.

Developed design is the phase during which all the main components of the building and their integration are described. By the end of this phase, the design is developed in different desifindgn teams.

The last phase is the 'technical design' phase  where the technical aspects of the design are further developed. In this phase the design by different specialists are fully incorporated into the design, before the works are contracted and construction begins.

### 2.1.2. Briefing/Architectural Programming

Briefing, also called architectural programming is usually considered to be one of the first phases of a building project, before the design activities start (Fronczek – Munter, 2016). The general definition is that briefing is a stage that ends with producing the brief or the program of requirements documents which contains the client ‘s requirements for the building. This definition reflects the traditional view on briefing and recognize the brief as an endpoint. However, more and more, briefing is also seen as continuous and iterative process.

In the traditional process view, the brief is prepared by experts and handed over to the design team, in order to be translated into a design. From the traditional project management perspective, the briefing is rather document based, static and non-inclusive project phase. This view is challenged by several researchers.

Van Meel and Stoerdal for instance consider briefing a continuous process, and in alignment with development of the design (Van Meel & Stoerdal, 2017). They thus consider briefing as an ongoing process where information collecting, processing and translating the information into design plans are interrelated.

In complex building project design, a continuous and inclusive briefing approach is recommended (Jensen, 2011). Different studies emphasize the importance of involving users in the briefing and programming (Jensen, 2011, Van Meel & Stoerdal, 2017). This is essential in a hospital design project where the usability and operations are critical and brings along many requirements to obtain and process. This can be only adequately dealt with in a continuous briefing process. Indeed, given the complexity of the assignment, in complex building projects like hospitals, there can be many briefing documents.

Van Meel and Stoerdal identified three main brief documents: strategic, technical, and functional briefs (Van Meel & Stoerdal, 2017). Technical and functional briefs are widely used in the practice.

## 2.2. User Involvement in Building Design

The term user involvement is commonly used in the design and building management literature and it is also referred as user participation. The word 'participation' implies that people are involved, but it does not indicate which persons, nor their degree of participation. Participation is multidimensional and the level of user involvement is one of the key dimensions for its understanding (Kirby & Sinclair, 2003).

### 2.2.1. Level and Form of User Involvement in Building Design

There are various forms of participation, both in terms of the way people are involved, as well as their degree of involvement. The term 'direct participation’ is used when all end-users participate in the design or planning process. If only a select group of representatives of the end-users are involved, the term 'indirect participation' is used.

In the literature, end-user involvement is often classified into four groups: informative, consultative, participatory and co-design (Damodran, 1996 & Caixeta, 2019). This classification represents the level of participation and relationship between the users and designers and provides information on user interaction.

Table 1 gives a description of different levels of user involvement and explains their characteristics.

| **Informative**<br>• Users provide information about their requirements, needs and preferences | **Consultative**<br>• Users can give their opinion on a set of predefined design options | Focus: Promotion of democracy<br>**Participatory design**<br>• Refers to a broad movement started in Scandinavia, in which users can actively involved throughout the design process. | Focus: Building operability<br>**Co-design**<br>• Users act as members of the design team and co-design solutions with the other members, such as architects and engineers |
|---|---|---|---|
| Source: Damodoran (1996) | Source: Damodoran (1996) | | Source: Sanders and Stappers (2008) |
| **LOW** | **INTERMEDIATE** | **HIGH** | **HIGH** |

*Table 1: Levels and forms of user involvement in building design (own ill. after Damodran (1996), Sanders & Stappers (2008), Caixeta et al. (2019))*

This classification and distinction are useful in understanding the reason of interaction between the users and the designers and explain the process.

At the first level of involvement, users provide information about their requirements, needs and preferences and receive information on the design and process from the design team. The level is called 'Informative' and accepted as a lower level of user involvement (Damodaran, 1996).
The second level is 'Consultative', in which users can give their opinion on a set of predefined design options and it is the intermediate level (Damodaran, 1996).
The third or the highest level is divided into two types, namely participative and co-design. The division is based not only on the level of involvement itself, but also on the type of demanded participation.
Co-design is the form where users act as members of the design team and co design solutions with the other members, such as architects and engineers (Sanders & Stappers, 2008)
Within the context healthcare projects co-design is the most relevant, given its emphasis on building operability. In healthcare, the design focus is on the usability and operability; users are involved in the design at a high level but not as a means to induce a democratic design process.
Different levels and forms of user involvement can be applied in design processes, which may be chosen according to design demands, user profile and building type. In different phases of design, users can be involved in changing forms and levels.

### 2.2.2. Methods, tools and boundary objects in participatory design

Most users are not able to understand the intended results in a participatory design process and therefore tools are used important to promote user involvement. There are several methods and tools for user involvement mentioned in literature. Storvang (2012) explained and classified some of them. The table below summarized key tools and methods (Storvang, 2012). The methods and tools on the left side of table 2 represents commonly used ones.

| | |
|---|---|
| Benchmarking<br>Desk research<br>Flow analysis<br>Focus groups<br>Functional analysis<br>Human factors i.e. critical incident<br>Study<br>Interviews<br>Market analysis<br>Observations<br>Occupancy studies<br>Personas<br>Photographs<br>Registers, records of data<br>Statistics<br>Survey<br>Video recording | Brainstorming<br>Design games<br>Design lab<br>Dialogue<br>Drawing<br>Idea development and co-creation<br>Lead users<br>Mind mapping<br>Mock-up<br>Model tests, mock-ups<br>Narratives, storytelling<br>Observations<br>Picture diagrams, associations, cards<br>Prioritizing<br>Rapid prototyping<br>Role playing<br>Scenarios<br>Simulation<br>User meetings<br>Video recording and discussions<br>Virtual reality<br>Walk through evaluations (use tool, POE)<br>Workshops |

*Table 2: Key tools for user involvement in building design projects (Storvang 2012 and Fronczek-Munter,2016)*

These tools can be considered boundary objects. They are defined as problem solving means that assist in translation (Star & Griesemer, 1989).
Boundary objects are also referred to as a media of communication between communities. They can be abstract or concrete objects that arise over time from durable cooperation between the participants. Clarke& Fujimura, 1992 described boundary objects as things, tools, artefacts and techniques, in addition to ideas, stories and memories of community members (Clarke & Fujimura, 1992). From the literature it appears that BO are commonly used during briefing and design processes and they can be divided into the following categories:

- Repositories (i.e. cost databases, parts libraries),
- Standardized forms and methods (i.e. drawings, handmade sketches, lists of problems, questionnaires),
- Objects, models and maps (i.e. slideshows, CAD 2D-3D, fishbone chart, mock-ups),
- Discourses (i.e. questioning situation, typical action situation),
- Processes (i.e. prototyping, visiting other departments)

The applicability and usability of the boundary objects and tools can differ in every project, according to the number of involved users and the project context and most importantly the reason for involvement. In complex and big scale building like hospitals, BIM, brief builder and share-points are common tools that help communication and information exchange.

### 2.2.3. Stakeholders and End-Users in Healthcare Organizations

The term ‘user’ indicates a single person or a well-defined group of people from the stakeholder group. Stakeholders are defined as a group or individual who can affect or be affected by the achievement of a project (Hannan & Freeman, 1984). Users are accepted as internal stakeholders (Winch,2009)

The users of the built environment are categorized together with stakeholders in the literature. Different classifications on users and stakeholders in building design projects are summarized in Table 3.

| APPROACH | Fronczek – Munter (2016) | Jensen (2011) |
|---|---|---|
| *USER / STAKEHOLDER GROUPS* | 1-Patients and Relatives<br>2-Medical Staff<br>*3-Client organization (managers, facility managers, architects)*<br>*4- Support staff*<br>*5-External consultants (architects, engineers, designers)*<br>*6-Society, government, media, potential patients* | *1-Building client(mediator)*<br>*2-Owner*<br>*3-Investor*<br>*3-Managers*<br>*4-Employees*<br>*5-Visitors*<br>*6-Architects*<br>*7-Engineers*<br>*8-Contractors*<br>*9-Material suppliers*<br>*10-Service providers* |

*Table 3: The classification of stakeholders and users in building environment and healthcare projects (own ill. after Fronczek-Munter 2016 and Jensen 2011)*

The categorization on the left side of the table distinguish the users together with stakeholders of the built environment in general. In this classification Jensen (2011) distinguished stakeholders and users by their roles. He explains that the building client is a mediator between the demand side; owner, investors, managers, employees, visitors, and the supply side: architects, engineers, contractors, material suppliers and service providers. According to Jensen, the mediator or the client plays a key role in translating the needs of the demand side into service levels or requirements, to the professional language used by the providers at the supply side (Jensen, 2011). This categorization is based on a supply chain approach.

On the other hand, the classification of Fronczek-Munter is specific for hospital projects and she based her classification on the characteristics of their involvement in the hospital design process. The users and stakeholders in healthcare projects are classified in the centric model, because the involvement changes the character. Figure 2 below gives an illustration of the user groups in hospital buildings

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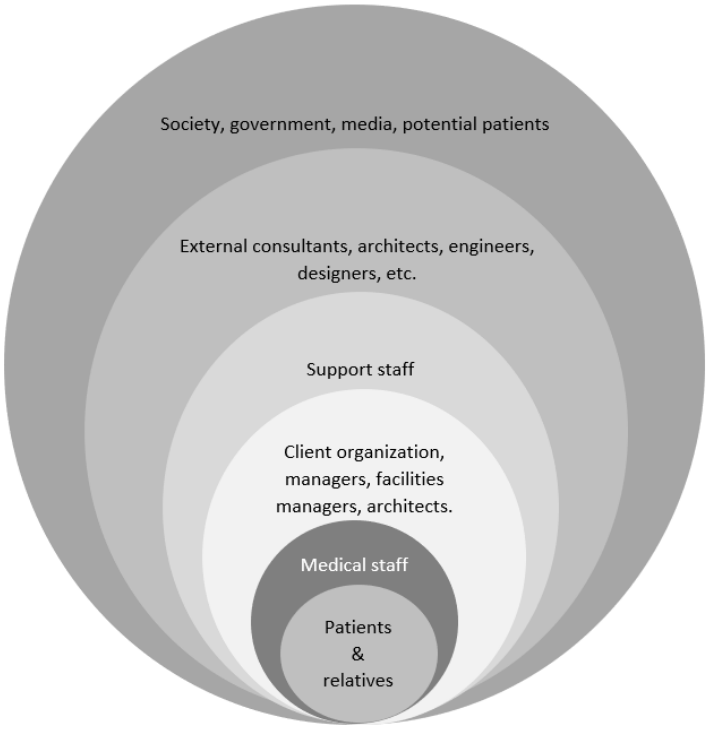



*Figure 2: Stakeholders &users in hospital buildings* Fronzcek-Munter *(Fronczek-Munter 2016)*

In the figure 2, internally positioned user groups are more involved in the specifications of requirements and decision-making. The more external the placement, information gathered from them is more static, with exception of external consultants, who are co-creating the solutions with the more central users, as patients, doctors and client organization.

Classification of stakeholders and users in building projects varies depending on the project, the organization, their management, and ownership and contextual factors related to every design project.

**End-Users**

In this research, the focus in on the end-users. A user can also be defined as an end-user. End-users are the users those occupy the building; they are not experts in managing it, but have knowledge and opinions, nonetheless, about its performance in relation to their own objectives (Kaya, 2004; Lai and Yik, 2007). Within the limits of this study end-users represents the user groups categorized as the medical staff, and the support staff by Fronzcek-Munter. This group includes medical caregivers like doctors and nurses as well as medical technicians who operate or use special medical equipment and the services like cleaning or maintenance.

Users groups include the patients, patients' relatives, and visitors to the hospitals within the context of this research. Generally, they are rarely systematically included during the design process. Their opinion or point of view is usually represented by other end-users such as the staffs and clinicians, and they are not included in the design process, therefore the focus of this research is end-users especially the medical staff and their participation in the design process.

The end-user and user classification showing different groups within the context of this research is represented below:

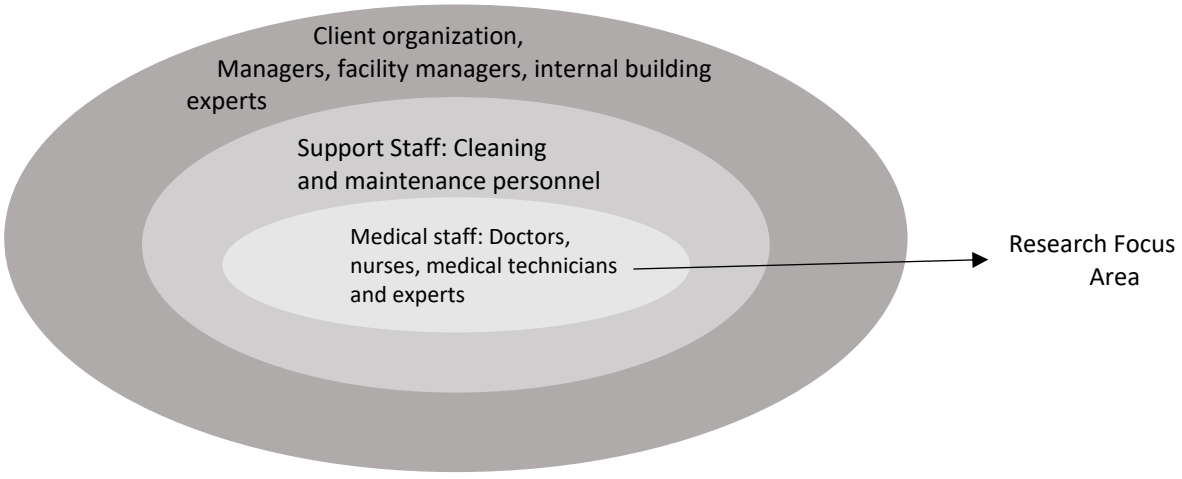



*Figure 3: End-user and user groups in hospital environments (own ill.)*

The figure illustrates three different user groups. The medical staff and the support staff are representing the end-users. The group involving the, facility managers, internal building experts and managers are the not defined as the end-users of the building, since they are experts on managing based on the definition of to Lai and Yik (2007).

## 2.3. Information Management

The building design often requires knowledge and expertise, which is scattered amongst different experts from various fields such as architectural, structural, mechanical, electrical and building physics and acoustics. During a participatory design process, design is developed in a multidisciplinary team setting to deliver integrated information gathered from different disciplines and users.

Teams from diverse disciplines work on co-ordination and integration of a great deal of complex information. The structure and composition of the project organization may change through different design phases; some users might be involved only briefly, bringing specialized knowledge about a special equipment, whilst others, may be involved for longer periods. Information gathered from different users and medical experts in different phases should be integrated in the design in a systematic way in different project documents and design plans.
Project management team facilitates the information exchange and generally use technological tools for information management.

**Information exchange and flow in building design projects**

During the development of the design, designers, consultants, and advisors generate huge amounts of information. Effective information management facilitates the building design project and ensures that the right parties have sufficient information, enabling them to make the right design decisions (Designing building, 2020)

A recent study about design iterations in construction projects emphasize that the design phase of any construction project involves several designers who exchange information with each other. Importantly, they mention that information exchange most often happened in an unstructured way throughout the design phase, and in an interdependently way (Mujumdar & Maheswari, 2018). With the exchange of information, the building design project is created in a cyclic, repetitive and evolutionary manner based on different inputs.

Considering the scale of information and the size of the design project teams in hospital building design projects, the information management and communication can be challenging. There are different ways and tools to create integrated information and maintain the effective flow in building design processes.

There are a number of ways of information exchange between teams depending on the subject and the expertise of the designers. The aim is to collect and share the information. Information sharing systems and software can be used or share-points can be created as the single source of information to provide integrated information flow. This is used to collect and share the information and manage information exchange.

Depending on requirements, some stakeholders may also have rights to access or input information during the project. Stakeholders like users can give input to the design team and collaborate with designers when there is a participative design process. One of the known characteristics in the hospital design process is related to information asymmetry. According to the literature that there is often a asymmetry of skills or knowledge, between the design team and clinical users working in a collaborative setting that requires highly nuanced communication(Kim, Shepley, & Journal, 2008). Tools like 3 dimensional drawings, BIM, VR and mockups can be being used by designers and building experts to explain and communicate the design information, but are barely understood by lay persons, including clinical users.

## 2.4. Decision Making Process in Healthcare Design

Decisions concerning the healthcare architecture are critical because it affects people and work processes for many years and requires a long-term financial commitment from society. The decision-making process in healthcare projects is different from other type of buildings. There can be regulations and criteria guiding the design decisions. At the same time there are different decision-making bodies in the project organization and end-users may participate in the process at different levels.

Another difference impacting the decision-making process in healthcare projects is related to Evidence Based Design. Evidence-based design is defined as the process of basing decisions about the built environment on credible research to achieve the best possible outcomes (Hamilton& Watkins, 2008). Design decisions can lack credibility in the eyes of healthcare clients and users when the decisions are not based on evidence. Accommodation of different perspectives derived from research and evidence on decision making process in a user group setting can successfully result in practicing evidence-based design (Kim et al., 2008). Different views from the research and end-users and experts can be included in organizational strategic plans.

It is emphasized in the literature that design decisions have to be reviewed together with the users, in order to provide effective design outcomes. Evaluation is an important part of the design process in hospital design and it is a way to get understand their perspective during the decision-taking process. However, evaluation of design by end-users breaks traditional conventions of design and communication and information exchange (Lam, 2000; Senaratne, 2008).

### Design Criteria

Different sets of criteria can be used in a hospital design process based on different evidence gathered from the users or other resources like completed projects or related research. Some requirements related with the care process are critical in the hospital design and they can guide the design decisions that requires different decision-making procedure and process.

BNA (Royal Institute of Dutch Architects) and STAGG (Architectural Research on Healthcare Buildings Foundation) are the two organizations from the Netherlands that make research and publications on evidence-based design in the healthcare sector. STAGG has developed an instrument that helps incorporating the patient or client perspective in building plans for health care projects. The instrument “Bouwen aan ziekenhuizen vanuit patiëntenperspectief” serves as a checklist for the following design criteria: safety, autonomy, self-sufficiency, territory, social contact, freedom of choice, orientation, privacy.

The Dutch Academic Hospitals Client Council (CRAZ) uses another version of this instrument to assess the development plans of healthcare projects like hospitals.
BNA is the Royal Institute of Dutch Architects and, they have a publication on the evidence-based design in healthcare. This publication summarized research into the performances on which hospitals building environments are evaluated and distinguished two different areas, namely user performance and building performance. For user performance, selected criteria are patient satisfaction and well-being, patient safety, staff satisfaction, staff efficiency, visitor satisfaction.

For building performance, the following criteria are selected by BNA: flexibility, operating costs, durability. Table 4 illustrates different sets of criteria suggested by different organizations.

| Design Criteria for healthcare design (STAGG) | Design Criteria for healthcare design (BNA) |
|---|---|
| • Safety<br>• Autonomy<br>• Self-sufficiency<br>• Territory<br>• Social contact<br>• Freedom of choice<br>• Orientation<br>• Privacy | <u>User performance</u><br>• Patient satisfaction and well-being.<br>• Patient safety.<br>• Staff satisfaction.<br>• Staff efficiency.<br>• Visitor satisfaction<br><u>Building performance</u><br>• Flexibility.<br>• Operating costs.<br>• Durability |

*Table 4 : Design Criterias for healthcare facilities according to STAGG and BNA (own ill.)*

Different set of criteria about the performance of the users and buildings can be used in design or planning of a healthcare design and may guide the decision making. Goals of the organization related to design are generally communicated in different documents like the strategic brief at the beginning of a design project and can include a combination of aforementioned criteria.

## 2.5. Conceptual Model

Against the preceding background, a conceptual model was developed that summarized the main elements in the way the project organization 'translated' the end-user needs into the design.

In this study, the Input-Process-Outcome (IPO) model is used. In classic systems models, inputs lead to processes that in turn lead to outcomes (Ilgen, Hollenbeck, Johnson, Jundt, 2005). In the model in figure 4, the input relates to user information representing the needs of end-users and requirements. It refers to end-users giving direct or indirect input to designers and interact with them so that design decisions are formed.

The second part represents the process in the model and shows the design development in steps adopted from the usability process model of Fronzcek-Munter. There are different phases of design where user information is transferred from one phase to another and information is exchanged between users and designers.

The third part is the output. It regards the building design decisions, which are derived by the receiving and processing of user information. This output represents user information incorporated into design decisions.

The fourth part in the model are the variables affecting the process. Different types of form, level, and methods can be used to involve user, and this determines the user involvement and shapes the information flow, design development process as well as user-and designer interactions. This variables on different types of form and level is derived from the studies of Damodran (1996), Van Meel &Stoerdal (2017) and Caixeta et al. (2019)

The conceptual model in Figure 4 provides a starting point for the case study and explains the interrelations of concepts.

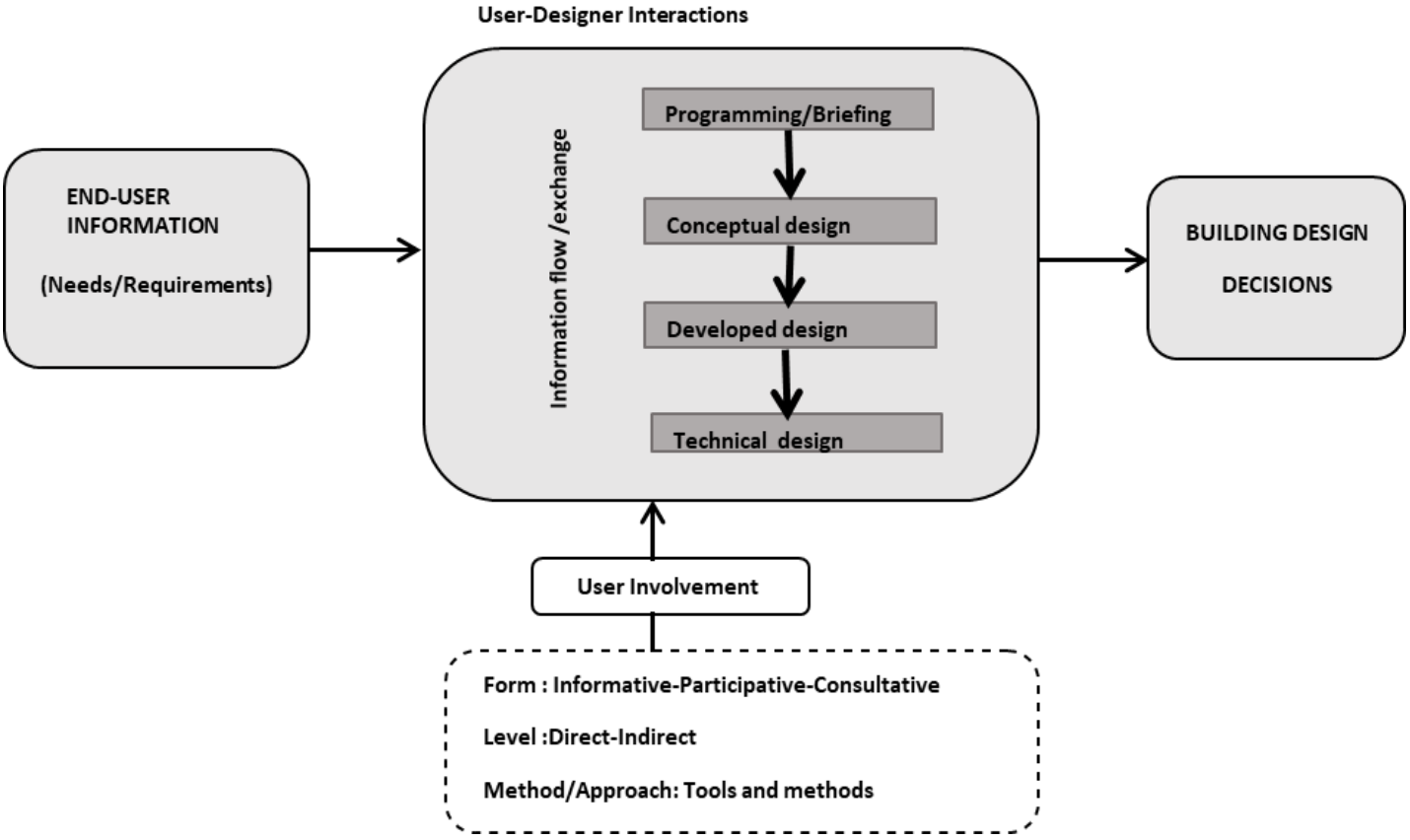



*Figure 4: Conceptual Model (own ill.)*

# METHODOLOGY

# 3.METHODOLOGY

This chapter describes the research strategy, research design, methods and analysis techniques to collect and process data.

## 3.1. Qualitative research strategy

In this empirical research, a building design project is analyzed by conducting a single case study. The case study is undertaken as a means to understand the participatory approach by focusing on the interactions between the users and the design team. This can be achieved only by conducting interviews. A qualitative research strategy is adopted by collecting the stories and developing the narrative about the subject.

Qualitative research methodology is relevant as the emphasis is here on the interactions and information exchange. The interpretivist approach implies that social properties are outcomes of the interactions between individuals, rather than phenomena "out there" and separate from those involved in its construction (Yazan, 2015)

In this study, a mixture of deductive and inductive reasoning is applied. The deductive approach constitutes the use of the conceptual model in figure 4 as sensitizing concepts. These will be used as an approach while taking care not to frame the outcome in a certain direction. The approach will keep an open eye towards new concepts appearing from the data. The latter has been also referred to as indicative reasoning. In the conceptual model the concepts from the study of Fronczek-Munter (2016) and Damodran (1996) are combined into a conceptual model.

## 3.2. Single case study research design

Bryman (2012) describes research design as a framework for collection of data analysis. In this research, a single case is used. A case study uses a case as an object of interest, the researcher aims to provide an in-depth examination (Bryman, 2012). In a single case study this can be done by detailed and in-depth analysis.

For this research a hospital design project was selected, meeting the following conditions:

(1) The project is about healthcare building design.

(2) The project is completed.

(3) Users were involved at least one whole phase of the design.

(4) The healthcare organization is open for data collection of through interviews and document analysis.

(5) External as well as internal participants were available for conducting interviews.

## 3.3. Processing data

In this study, grounded theory and sensitizing concepts are applied to process the collected data. Grounded theory is a research method in which a cyclical way of collecting and analyzing data is used. Sensitizing concepts are starting points that give direction to further research (Bowen, 2006).

According to the grounded theory, categories found in the data can be categorized by means of coding. By coding the interviews, co-occurrence and connections between codes can be detected and they can be

grouped and analyzed as a whole. In this research, interview transcripts are coded following on the concepts represented with the conceptual model in figure 4.

Developed main group codes are:

- User involvement
- Briefing /Programming interactions
- Decision making

Additional codes used in conjunction with the main codes are:

- Needs/requirements
- Design phases (SO, DO, VO)
- User groups
- Project organization
- Information flow
- Design criteria

An important is code is change management, which emerged from the exploratory interview. Other group codes which have been developed based on the theoretical background to support this study are:

- Roles of the key actors & teams
- Evaluation of (conceptual, developed and technical) documents.

## 3.4. Research Methods

Main research methods used in this study are context analysis, in-depth interviews and document analysis.

### 3.4.1. Context Analysis

A context analysis is the starting point for all research methods. In this research, the case study will start with a detailed description of the project, including the brief history and a timeline. Furthermore, information about the scope of the project and project organization will be given to outline the teams/groups and stakeholders involved in the project.
Organizational schemes illustrate the different groups and stakeholders participated in the project. To ensure the privacy of all members, names of the team members are kept anonymous.
For the context analysis, general information is collected through the Project documents, and additional information is collected via online communication. Project and presentation documents about the design and the process was provided by the healthcare organization, which provided the case for this research. Missing information is collected by contacting the interviewees.

### 3.4.2. Sample selection strategy

Project management and design professionals who participated in the design and planning process both from the internal and external stakeholders' group are selected for interviews. Internal participants from multiple levels of the client organization are chosen. Both internal and external stakeholders from the project organization are interviewed. The internal stakeholders from the project were chosen from multiple

levels. A mix of purposeful sampling is done by selecting parties that were engaged in the process at different phases and that played different roles in various design teams working at different stages during the design.

| **Interviewees** | **Expertise /Role in the project** | |
|---|---|---|
| PROGRAM SECRERATY | Manager of the Project's Building Expertise Group * | Internal |
| PROJECT ADVISOR | Technical Consultant | Internal |
| INFORMATION MANAGER | Information Manager | Internal |
| TECHNICAL CONSULTANT | Technical Consultant | Internal |
| PROJECT LEADER 1 | Team Leader technical design areas 1 | Internal |
| PROJECT LEADER 2 | Team Leader technical design areas 2 | Internal |
| CONSULTANT/ARCHITECT | Architectural designer | External |
| CONSULTANT 1 | Program manager 1 | External |
| CONSULTANT 2 | Program Manager 2 | External |
| CONSULTANT 3 | Project Manager/Expert | External |
| *The project secretary had a double role in the process.She was the project secretary of the project management at the same time she was the manager of the consultants and the information manager within the building expertise group. | | |

*Table 5: List of interviewees (own ill.)*

### 3.4.2. In-depth interviews

In-depth interviews are open and semi structured interviews. This provides insights into a specific topic or answer to a specific question while making it easy to follow the thread. These interviews were conducted within a selected group of 10 people half of them face to face and half of them online. The interviews were loosely structured, to engage the interviewees and to provide maximum input while the interviewer listens rather than talks.
Interviews were conducted with related members of the building development project team, as well as group of external stakeholders. Open questions about user involvement and design approach, information flow and design decisions were asked together with questions about the role of the interviewee during the project. Table 6 is the guideline for conducting the interviews. The detailed questions can be found in the appendix B. The aim is to determine how the end-user information is collected and shared and turned into design decisions and in which ways the users are involved and represented during the design process.

| Questions about end-user needs (design approach, end-user involvement) | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| Question about information exchange (briefing, information flow) | |
| | |
| 1 | |
| 2 | |
| | |
| Question about representing the end-users (decision making process) | |
| 1 | |
| 2 | |
| 3 | |
| | Question about roles/responsibilities (project organization) |
| 1 | |
| 2 | |

*Table 6: In-depth interviews guidelines (own ill.)*

The interviews lasted around an hour, depending on the interviewee's time and given information. All interviews were transcribed, and analyzed using the Atlas.ti software, using the coding mentioned before.

### 3.4.3. Document analysis

Document analysis is a form of qualitative research in which documents are interpreted by the researcher to give voice and meaning around an assessment topic (Bowen, 2009). By analyzing and coding documents, coding was grouped into similar themes and the findings were combined with the findings of the interviews

Fourteen different documents were analyzed for this research. Six documents gave information about the roles and responsibilities of different groups within the project organization, explaining the process with assigned tasks. Another generic document outlines responsibilities within the project organization in different phases. Four different spreadsheets about design evaluations regarding of two different areas gave information which parties were involved in design.

### 3.4.4. Validation

After analyzing the collected data from the interviews and the project documents, an online meeting with the external supervisor who was in the project secretary role in the studied case done in order to validate the findings and the details about the design and decision making process.

## 3.5. Research Process

In this research, first, the literature review was completed to understand concepts related with the subject. Afterwards an explorative interview was performed to understand the subjects related to the case. The concepts were grouped to make a conceptual model related to the main subjects. Main research question and sub questions were formed. After conducting the rest of the interviews and collecting additional data and document analysis, research questions were improved. After case analyses, findings and conclusions are drawn to answer the main research question.

The research process is illustrated in the figure 5.

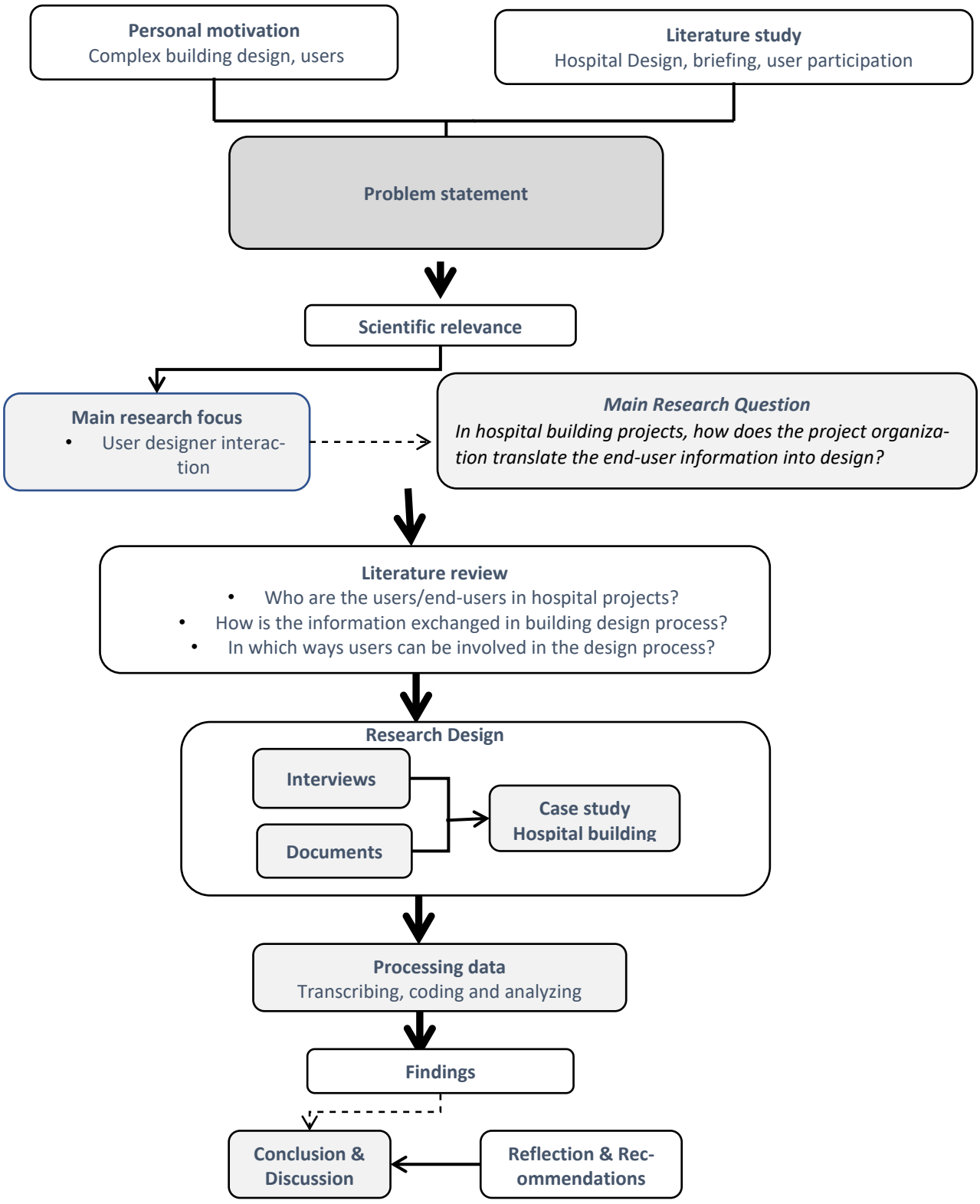



*Figure 5: Research Process (own ill.)*

# CASE DESCRIPTION

# 4. Case description

The case is the re-development of a Dutch hospital building. The building is connected to an existing medical center, which is still being developed together with other educational facilities and other specialized healthcare buildings. The facility consists of many buildings and different type of areas including public spaces, open and closed greenery, emergency, day treatment, operation rooms, in and outpatient clinics etc. The medical center is the largest of the seven university medical centers in the Netherlands, both in terms of turnover and number of beds.

*Figure 6: Erasmus MC Rotterdam aerial view (EGM, 2020)*

## 4.1. History and Timeline

Academic hospital Rotterdam (AZR) merged with Daniel de Hoed cancer center in 1995 and a new building was needed to accommodate the cancer center and the old faculty building. First concept and the plans were prepared in 1998. Different teams of design, consultants and construction were brought in, to re-develop and realize the new building. The building is planned and organized in different phases which took many years from approvals to commissioning and realization. The start of the construction was in 2009 and the first part was ready in 2013. Since 2018 major parts of the building are in use. The center is 450.000 square meters the hospital covers an area of 240.000 square meters which makes the EMC largest University Medical Center in the Netherlands. Figure 7&8 illustrate the timeline and the phases of the project.

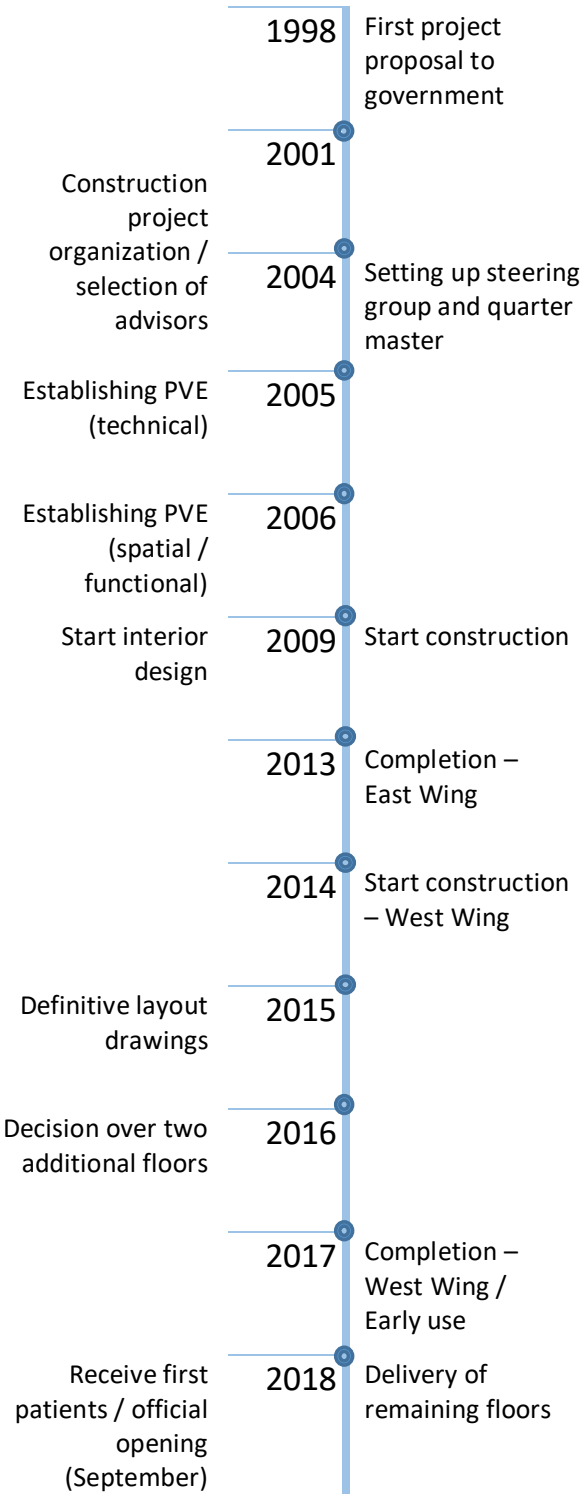
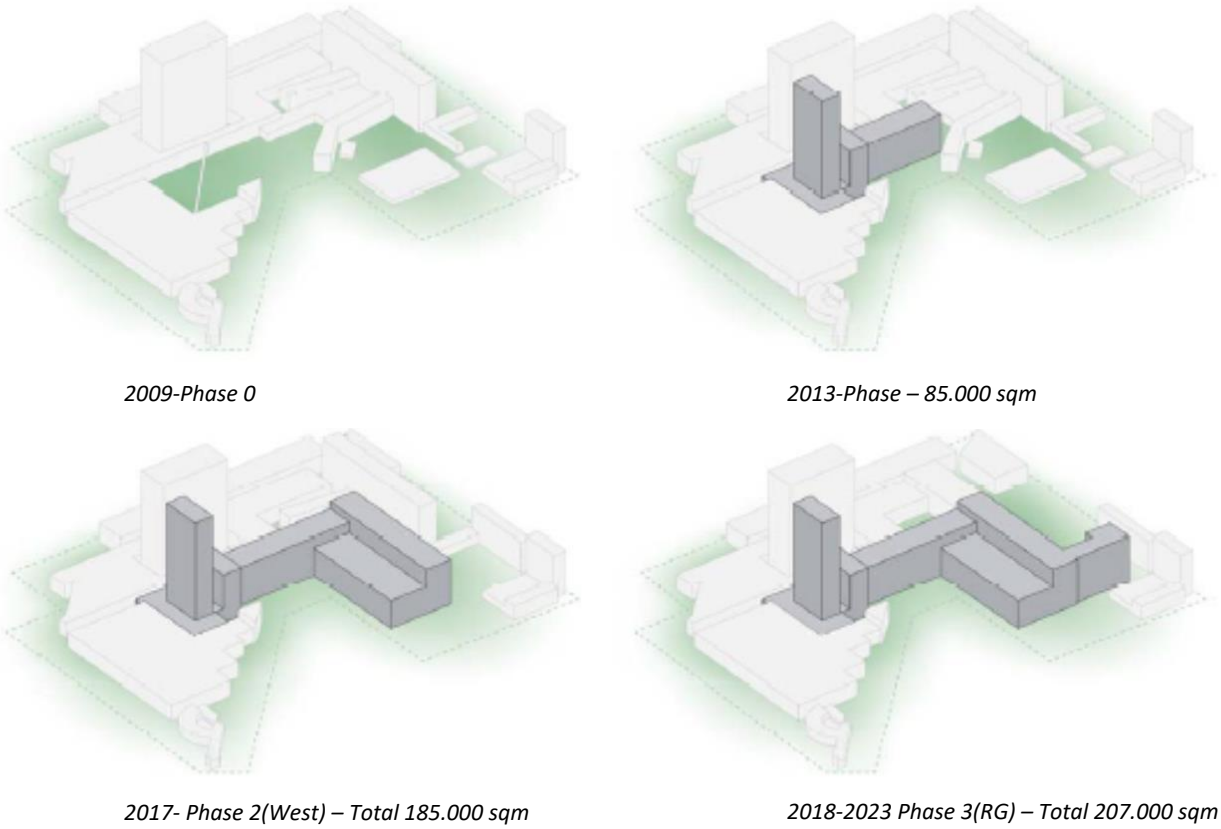



*Figure 7: Timeline of New Building Erasmus MC project*



*2009-Phase 0*

*2013-Phase – 85.000 sqm*

*2017- Phase 2(West) – Total 185.000 sqm*

*2018-2023 Phase 3(RG) – Total 207.000 sqm*

*Figure 8:New building project realization phasing (EGM, 2020).*

## 4.2. Program and project scope

The new building project is a part of a larger change program, which includes other projects like new ways of working and digitalization of patient files.

The new building project is being developed, realized and delivered by three sub-projects:

1- Project inrichting (Fit out)
2- Project realisatie (Building realisation)
3- Project inventaris & inhuizing (Inventory & relocation)

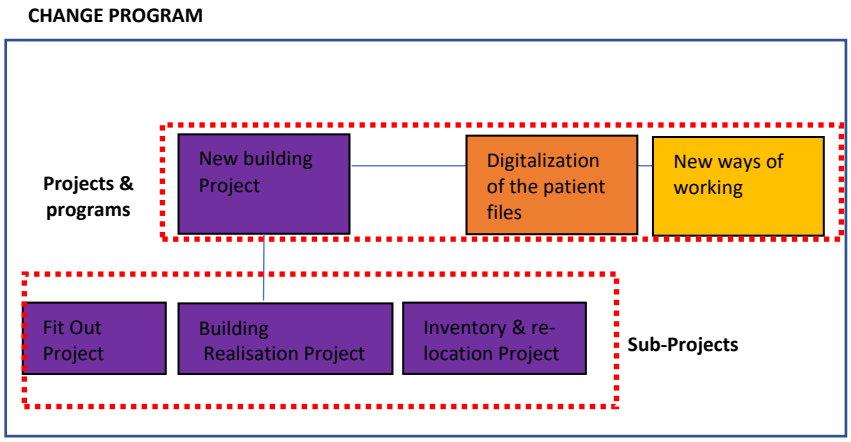



*Figure 9:* Illustration on the program and projects (own ill.).

## 4.3. Medical care and design concept

Policy and vision documents proposed to the government suggested a patient focused care concept and sustainable hospital plan from the very beginning. The business case and the design concept were developed by a team of management, real estate and technical consultants, which was brought into the medical organization (Van Heel, 2020).
Existing and traditional department structures were transformed into patient-based themes by means of the Change program and the new Building realization program:

*"Instead of thinking about a hospital based on a traditional department structure, from orthopedics, and plastic surgery, and internal medicine, and gastroenterology, and so on, (we) looked at a themed approach, patient themes, groups of patients, not out of the blue but also because of the distinguishable locations that we had"( Program Secretary).*

The building design concept is based on flexibility connecting different areas in one large-scale building:

*The initial thought is that three themes will be assigned space in the first part of the new building, but not in separate sections of the building, as this would impede knowledge transfer. It is precisely these fringe areas that offer opportunities to accommodate growth, shrinkage or new developments in the future. The design team therefore presents a model of a single large building complex with connected building sections and covered atriums that reinforces the cohesion between the themes. This model is, to this day, the basis for the new hospital (Future Proof buildings, 2016).*

The themed approach enabled flexibility during the design and the delivery of the building:

*"And it's more compact than this image as you see here, but these connections also make sure that one department can grow, and the other can shrink, and we can accommodate that within the building, and that concept has worked over time because-as late as 2013, and the first part of the building was already in use, we added the thorax theme, because it was a separate building" (Program Secretary).*

It is mentioned in the project documents that functional layering will enable patients to easily find their way. Use of similar material and colors will help in identification and way finding. The functional layering system with vertical connections will help rapid navigation of the patients arriving to the new emergency department at street level towards intensive care and operational units located at different floors (Future Proof buildings, 2016). The image in figure 10 illustrates the how the themed approach was translated into conceptual plans.

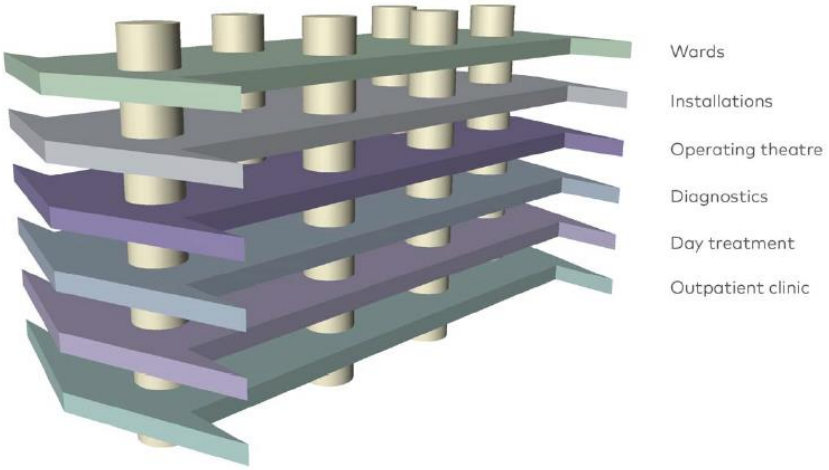



*Figure 10: Thematic lay-out showing the functional layering. (Future Proof buildings, 2016).*

Standardized interiors were created so they can be used by various specialisms and enable flexible use:

*"Our motto is 'Standard where possible, specific where necessary'. It goes without saying that the radiation bunkers of the Radiotherapy department, for example, required a special design. This also applies to the hybrid ORs, where traditional open surgery and less invasive (keyhole) surgery can be carried out simultaneously. Preparations have already been made in the Radiology department and at the OR level for later changes. These includes additional floor reinforcements for equipment that may be procured in future" (Future Proof buildings, 2016).*

It can be said that new medical care model and building design concept aims to achieve standardization and flexible use of space and enable possible changes in the layout. Additional infrastructures allow adoption of latest technological equipment and alteration on project during the design and even delivery of the building.

## 4.4. Design Criteria and guiding principles

The vision about the patient focused care and state or art healthcare delivery are conceptualized by the following leading design principles.

*An important guiding principle during the design process was 'Patient-centered care'. One of the first documents related to the new hospital project states that, despite the size of the complex, the 'human scale' had to be taken into account. Our aim was to develop a healing environment and a safe and sustainable building (Future Proof buildings, 2016).*

Healing environment was one of the most expressed design concepts about the building facility. It was explained by the following design characteristics (Van Heel, 2020):

1- The use of color and materials
2- Natural light, patient rooms with views.
3- Controllable room temperature and attention to noise levels


*Figure 11: Erasmus MC Operation theaters with natural light (EGM, 2020)*

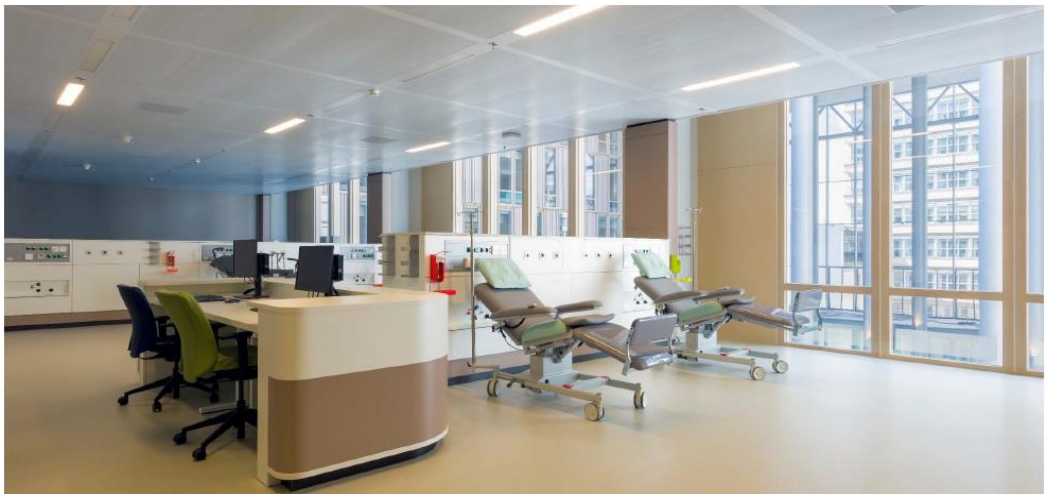


*Figure 12: Erasmus MC Dialysis center with large windows (EGM, 2020)*

There were three main guiding principles in design & decision making and these were actually prioritizing different ambitions of the medical organization.

1. Safety first,
2. Healing is leading
3. Sustainability is cheaper.

They are translated into the design solutions in many ways which can be understood as:

Safety first: Single patient rooms, Compartmentalization of IC-units.

Healing is leading: Creating restorative spaces like roof gardens, attention to daylight, smooth way-finding, the use of soothing colors, additional space for patient needs, reduced noise, patient control over room and attractive views of nature by wall paper, sky windows.

Sustainability is cheaper: Environmentally sustainable solutions aiming reduction of energy use and water consumption by using wastewater cleaning filters for chemicals and specific hospital waste.

*Figure 13: Erasmus MC single patient room (EGM, 2020)*

*Figure 14: Erasmus MC roof gardens with access from the patient rooms (EGM, 2020)*

## 4.5. Design and Delivery Strategy of the building

The design was divided into two main parts: shell and the interior in order to realize a building that is equipped for latest technology.

*"We now know that the decision in 2004 to separate the development of the shell and the interiors of the new buildings was crucial to the coming in use of an ultramodern hospital in the early months of 2018. The interior design and division of functions will remain flexible, leaving enough room for future innovations." (Future Proof buildings, 2016).*

The interior design was prepared after the design for the exterior of the building was completed. This approach enabled designing an up-to date building using the latest technology and equipment.

*"If the new hospital had been designed entirely in 2007, we would have found ourselves with an old-fashioned hospital upon completion. I sometimes say: we're actually renovating the building. The shell had been completed by the time we started designing the interior." -Corina Schols- (Future Proof buildings, 2016).*

Since the building project is the re-development of an operational healthcare facility, the construction project was divided into seven construction streams to manage the large construction site and the extensive construction period (Future Proof buildings, 2016). The building was delivered in two main parts, east and west wings.

## 4.6. Development of the fit-out project

The development of the fit-out project is divided into four main stages in process documents (HV.PON.51087).

1- **Zoning plans**: Allocation of areas according to determined functions and sizes in sqm
2- **PvE:** Description of functional and spatial needs of end-users.
3- **Layout drawings**: Drawings in which PvEs are developed into layouts and floor plans
4- **Coordination drawings:** It is the elaborated layout drawing that contains the coordinated input of user, architect and installation consultant. It is a contract document between the Real Estate Department and the users.

There were many inter-relations between the fit-out project and the other sub-projects. The relations between the sub-projects and the information and responsibility transfer moments are shown in the figure below, also illustrating different steps in the design process.

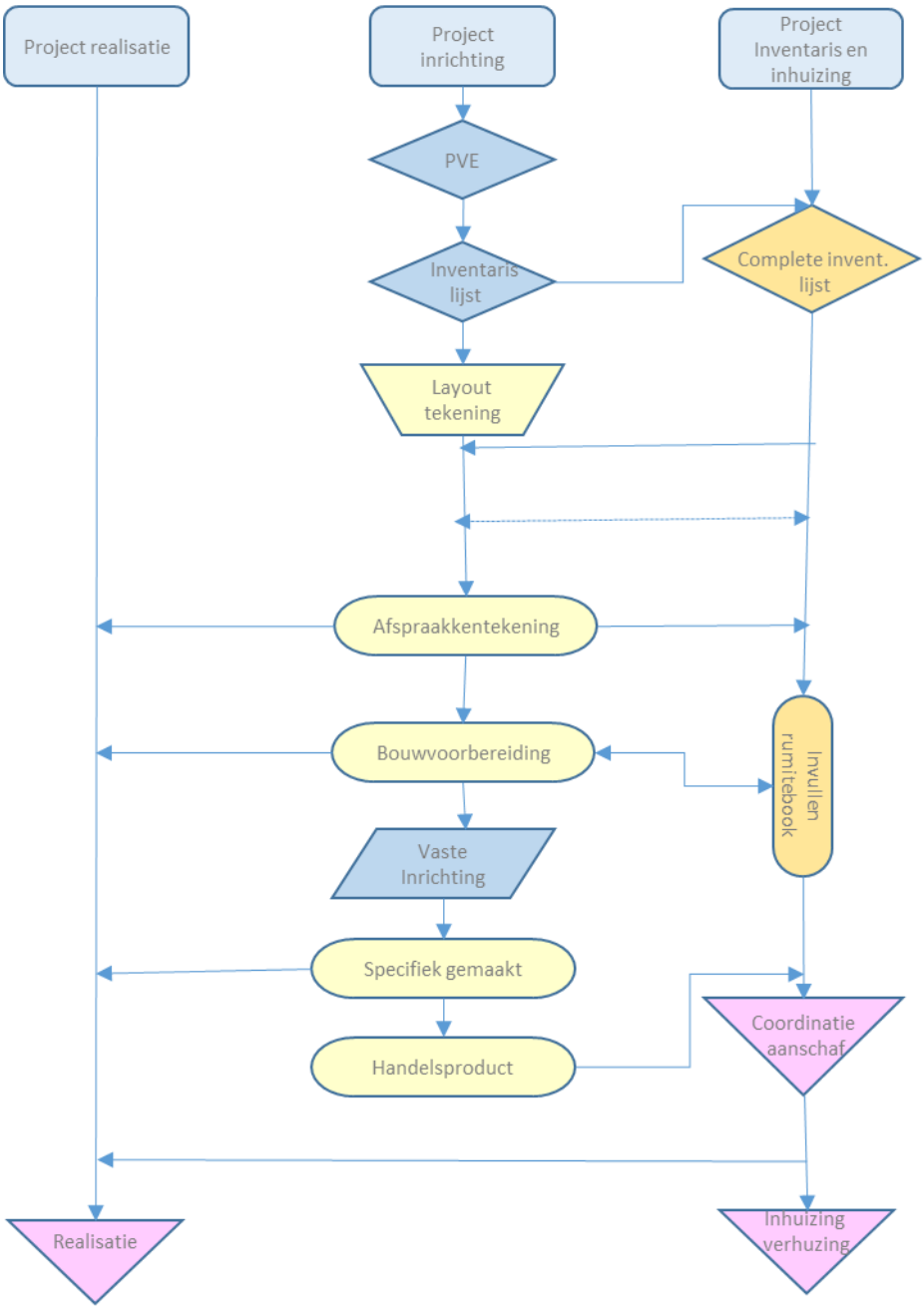



*Figure 15: Illustration of building projects, their inter-relations and steps of the design process (HPV.PON.51087)*

## 4.7. Program and project governance

The organizational scheme below gives information about the governance of the program and the sub-projects

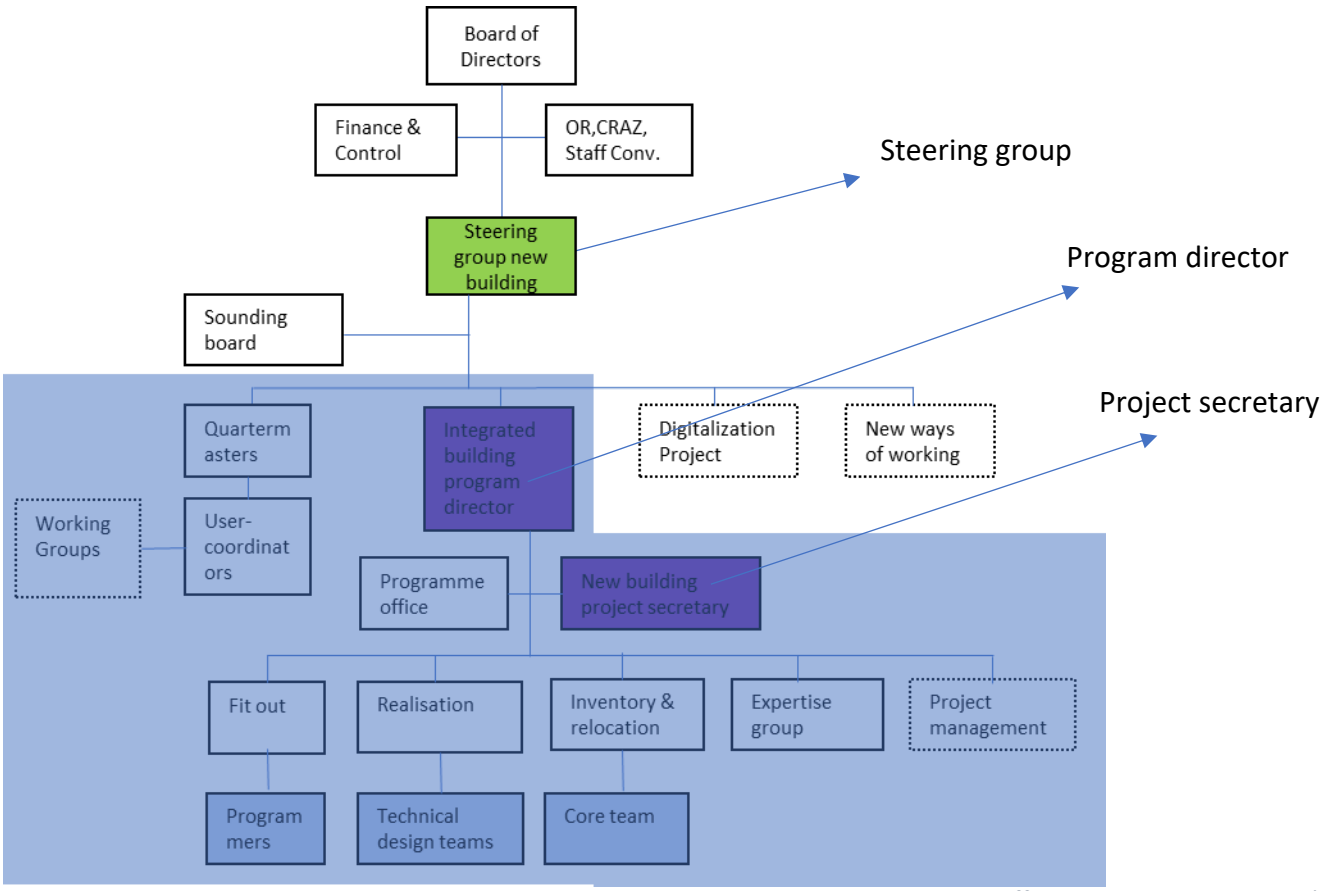



*Figure 16: Organizational scheme illustrating the program and sub-project organization and different management levels (own ill.)*

The building program and sub-projects are supervised by the program director. There is a steering group giving decisions and advising on related projects and the program. The project secretary is heading the expertise group and coordinating decision making process; managing the information; and PR and communication (Van Heel, 2020). There are different project leaders under the building realization and fit-out projects.

In the process documents of the fit-out project, various user groups (quartermasters, user-coordinators, department heads) are defined as the demand side of the project organization (HV.PON.27375). On the other hand, the supply side of the project organization include external building and design advisors, and project leaders.

The organizational scheme above illustrates the project governance after the development before the technical design phase of the project which dates to 2013. Other projects within the change program; digitalization project and new ways of working established on different timeframes. The internal organization related to the new building realization planning has expanded during the technical design phase.

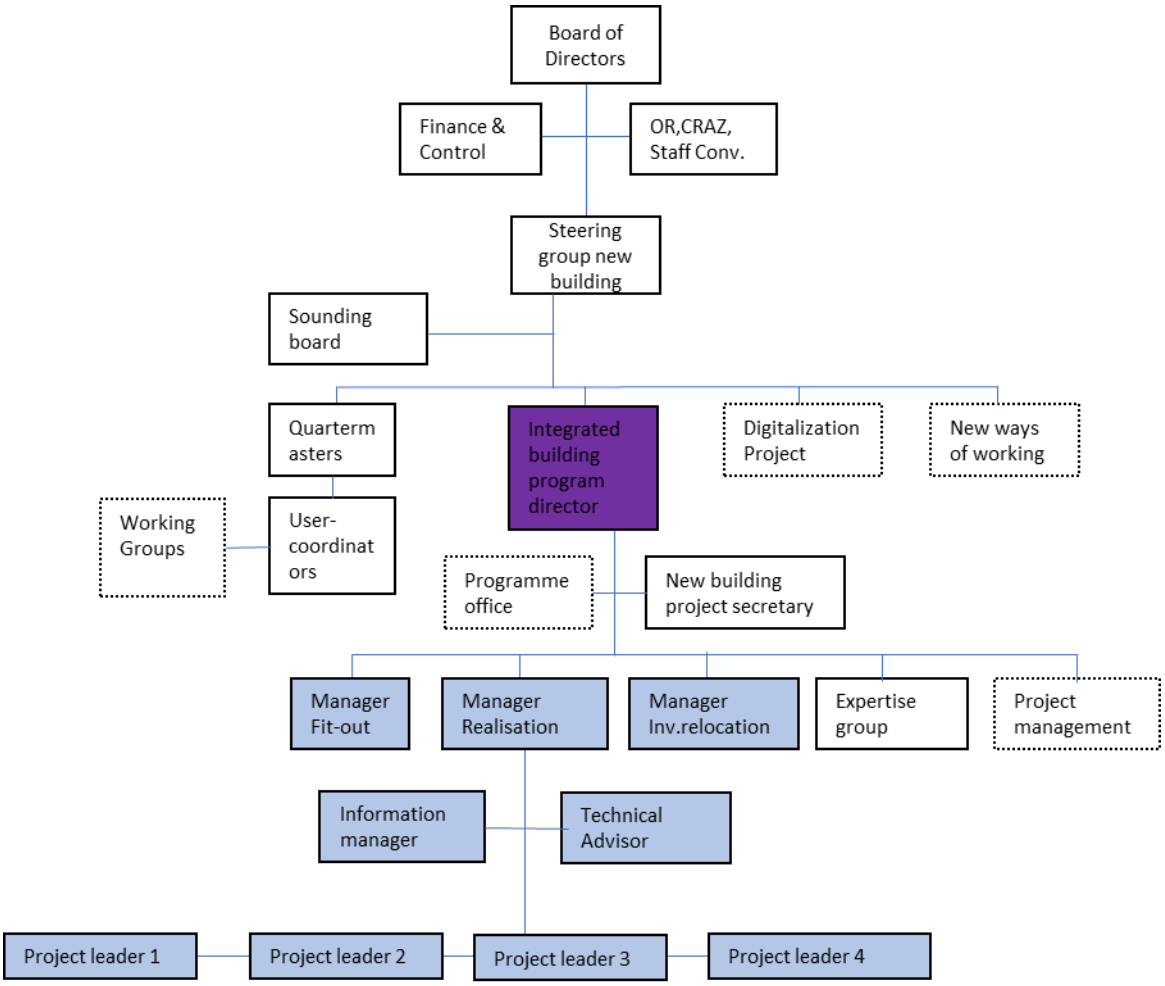



*Figure 17: Organizational scheme illustrating the project governance in technical design phase (own ill).*

## 4.8. Stakeholders

**Classification**

There are many internal and external stakeholder groups described in the project documents.
Some of the internal stakeholder groups and members participating the process are listed and described below.

1-Executive Board
2-Sounding board
3-Steering committee
4-Portfolio holder
5-Real Estate Management Directorate
6-Building Expertise group
7-Fit-Out project group
8-User Coordinators
9-Working Groups
10-Quarter Masters
11-User Council
12- Technical Design Teams (TOTs)

They participate in the process by contributing to design planning by producing, testing, advising, or approving on program of requirements and drawings.

**Task and responsibilities**

Many stakeholders participate the design and decision-making process. Tasks and responsibilities of various groups and members were outlined in the process documents. Responsibilities were described in detail and depicts interactions between different groups. Different group interactions give explanations as to how users are involved and represented within the organization, and the information exchange.

EXECUTIVE BOARD
They are ultimately responsible for the entire new building and a decision-making body. The executive Board seeks advice from the Works Council, the Staff Convention and the Client Council when appropriate (HV.51087).

SOUNDING BOARD
This group discusses the new building issues, and their opinions are taken into account in the decision-making and/or advice of the Steering Committee towards the Board of Directors (HV.51087). There are some end-users in this group like nurses, doctors and students, but also representatives from the organization's formal advisory boards.

STEERING COMMITTEE
This is the policy and decision-making body for the new hospital. The portfolio holder chairs the group (HV.51087). The Quartermasters are members of the Steering Committee, as are the project director and the directors of Facility Management and Patient Care

PORTFOLIO HOLDER
The portfolio holder is the responsible member for the new building project within the Executive Board. He/she supervises the Real Estate department on behalf of the Executive Board in monitoring the progress of the project and determines the starting points and frameworks of the project. This stakeholder is the project's ambassador with external contacts (HV.51087).

BUILDING EXPERTISE GROUP:
This is an internal advisory group within the Real Estate Department, managing the program, design together with programmers and some other groups. They support external program managers for in process management, coordination of programs of requirements and layout design and monitoring the project (HV.PON.51087). This group involves the project secretary, project manager and technical consultants as well as the information manager. This group guided the design and decision-making by providing policy and giving advice to the portfolio holder, board of directors, Real Estate Director and the management.

USER COORDINATOR GROUPS
User Coordinators are appointed by the departments and they represented the end-users. They are selected from the department middle managers layers of the medical organization. They work on clear tasks and report to appointed bodies (HV.51087). There was more than one coordinator for each theme.

QUARTERMASTERS GROUP
They are responsible for the creation and approval of the PvE, layout and approval drawings for the functions that will be performed by the theme they represent. They are selected from the higher managers layers of the medical organization the quartermaster is assisted by a user coordinator. Together they are responsible for a 'good new hospital'. (HV.51087).

WORKING GROUPS

This is an end-user group consisting of four to six end-users doing dedicated work. For every theme there are working groups with subject matter medical experts. They work on clear tasks and report to appointed bodies (HV.51087)

USER COUNCIL

This council functions as the steering group within each of the (patient) themes. Discussions are held in user council meetings in order to better express the requirements of the users into the new building, and to allow the strategic decisions to better penetrate into the organization. The program of requirements was established in the user council by approval of the department heads, the user coordinator and the quartermaster (HV.27375).

TOTs (technical design teams)

Technical Design Teams (TOT) work on the detailed engineering of changes caused by bringing in third parties because of the need for medical equipment. TOTs were formed during the technical design phase (Van Heel, 2020) and they include project leaders and technicians involved in the project. Their roles appeared from the interviews as well as other process documents

## 4.9. End-User and building expert groups

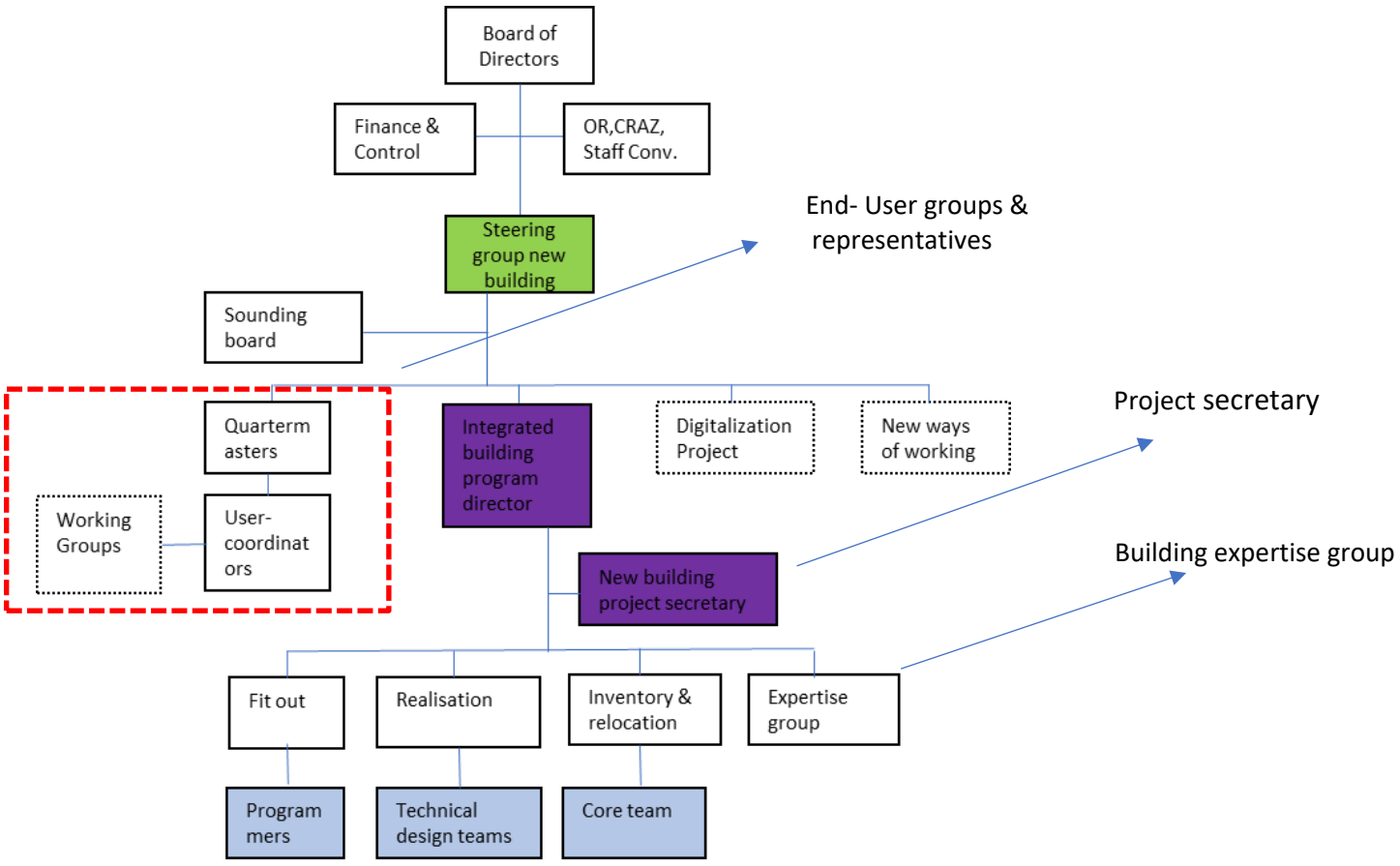



*Figure 18: Organizational scheme illustrating the user groups and expertise group (own ill.)*

There are different end-user groups and a building expert group actively involved in the process. The user coordinators and quartermasters are involved in programming, design and decision-making process in different levels and they have specified roles within the project organization. The user coordinators are the primary responsible members to share information and they have an operational role in the design and briefing. They become active members of the technical design teams during the technical design phase.

The quartermasters have an administrative role and were managing the process and approving the plans. They were defined as the process owners. For each theme, the quartermaster set up a user council with the following members:

- Quartermaster
- User coordinator
- Department heads that are based on the theme
- Other department heads relevant to the theme

. The building expertise group consisted of the project secretary, a building project manager, as well as an external program advisor. This group supported the management by providing policy documents and advice to the portfolio holder, the board of directors, the Real Estate Director and the management of the new building projects. It is an internal advisory group within the RE Department, responsible for managing, programming, project support, building installations, communication and planning. This group supports program managers in process management, coordination of program of requirements (HV.PON.51087). The project secretary prepares the procedure and process documents which outlines the roles of different end- user groups and listed the members of the groups by their names.

## 4.10. End-user representation

Selected end-users are represented at different levels of the project organization. They are represented in three levels (board, management and operational). Throughout the design process, users are linked to the design project organization in three levels and they are represented in two different groups (coordinator, quartermaster) and in the sounding board. This approach linked or connected different users at the managerial level with end-users in operational level.

> *"We had the levels of input control and decision-making, which were connected with each other, not only from the program team or the project team, but also from the organization itself. The users were linked over three levels, and also the team was linked over three levels." (Project Advisor).*

The organization scheme in figure 19 represents the user representatives in different levels.

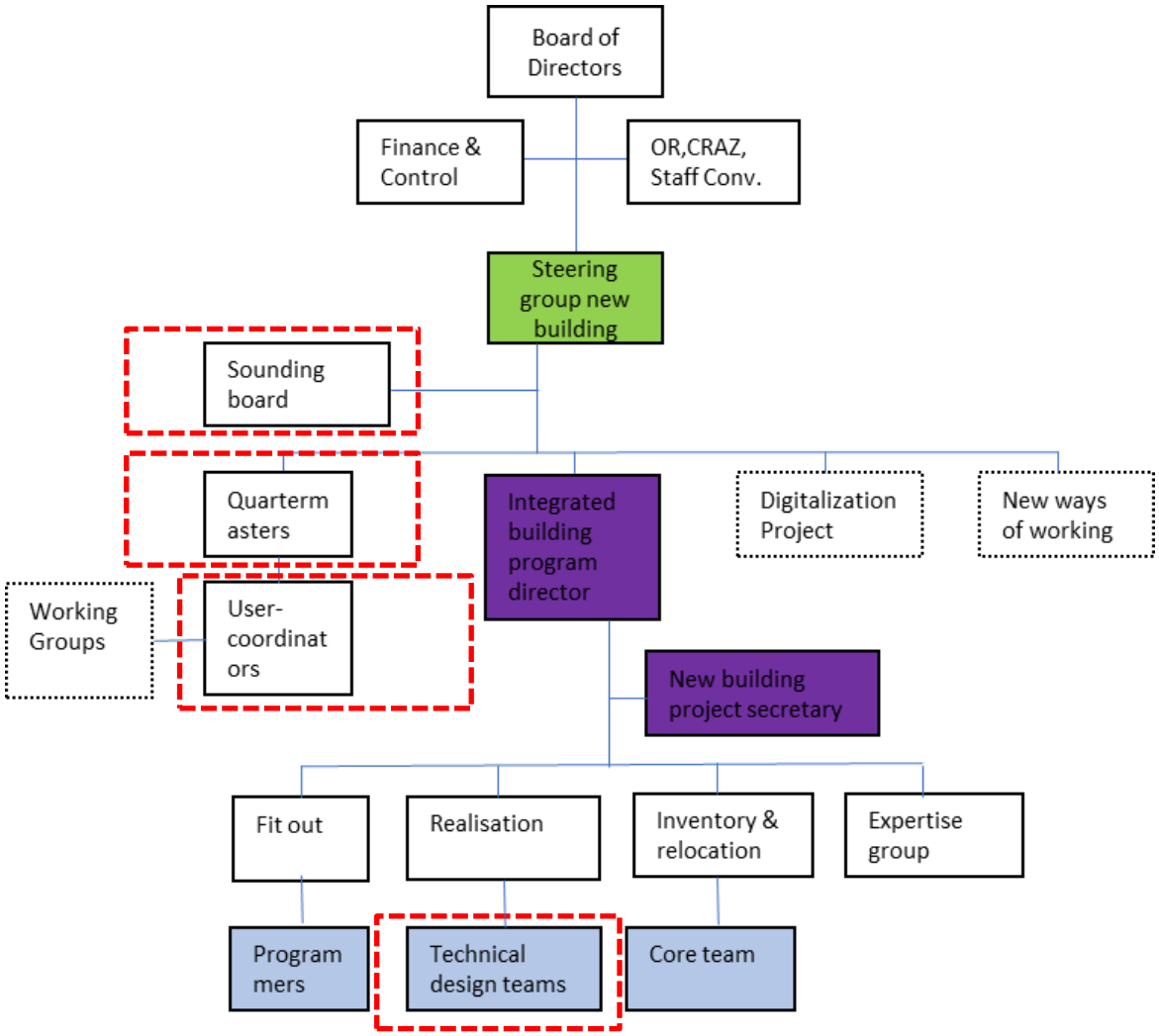



*Figure 19: User representatives at different levels (own ill.)*

## 4.11. Design documents and development

The process documents (HV.PON.51087- HV.PON.27429) and the information gathered from the Project Secretary describe that there are many steps to prepare project documents for decision making. PvE documents are co-production of different groups. The development of the PvE follows the following steps:

1. Agreement on the content of the (PvE) by the end-user groups

Following several meetings between programmer and working groups a final draft of the PvE is presented to the users, and their written consent is taken.

2. First review

Parallel with the 1 step, the programmers check the draft PvE Afterwards other checks are performed by the 'co-producers'. Three groups evaluate the PvE based on the aspects listed below:

a. the Expertise group: m2 allowance, translation of functional and technical principles.

b. the Directorate of Patientcare: care principles

c. the Directorate of Facility Management: delivery of service spaces and elements

3. Phase-document'

Their input and remarks are integrated in the draft PvE by the programmer. The user group is asked to confirm changes made; remarks that cannot be resolved at the level of user group and programmer are part of the 'phase-document'. This is a project document and a report used for further approvals. The 'phase-document' is the 'end-stage' report regarding the programming of the functional requirements for a department. This document is also like a note to the decision makers from the project-manager / programmer regarding the PvE document.

4. 2nd Review

The Expertise group, maintenance department, the directorate of Information & Technology, the directorate of Facility Management and different safety Experts including experts of ergonomics, environment, unit Infection Prevention, mobility and Security) evaluate the PvE. Their remarks receive feedback from the programmer, and remaining issues are mentioned in the 'phase-document'. The quality assurers receive a copy of the feedback on their remarks. The format for this was the review matrix, but and the matrix was an attachment of the phase document.

The project documents are presented in the steering committee for approval. Depending on the impact of the decisions it can be decided that the Executive Board itself has to confirm the decisions, and the advice of the organization's formal advisory bodies like the medical board, works council and the client board, also has to be taken.

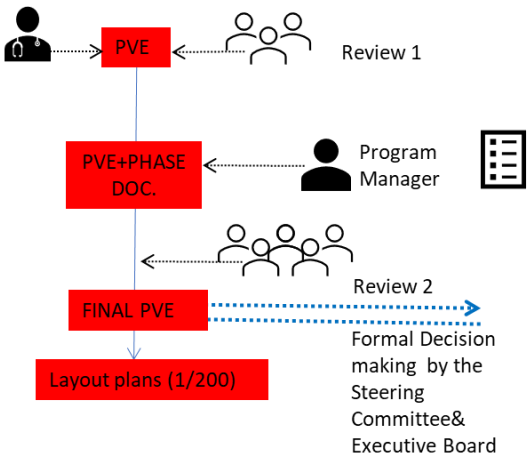



*Figure 20:* PvE evaluation and development (own ill.)

The final version of the PvE document, the phase document, with the matrix as and the decisions of the steering committee and the executive board were the documents that was given as input to the designers to develop the design and plans further.

In the following design phases, the drawings are reviewed by the same groups in a collaborative way.  It is explained in the documents that the layout drawing is reviewed by approximately 10 different groups. At the same time and all comments are combined in a review matrix.

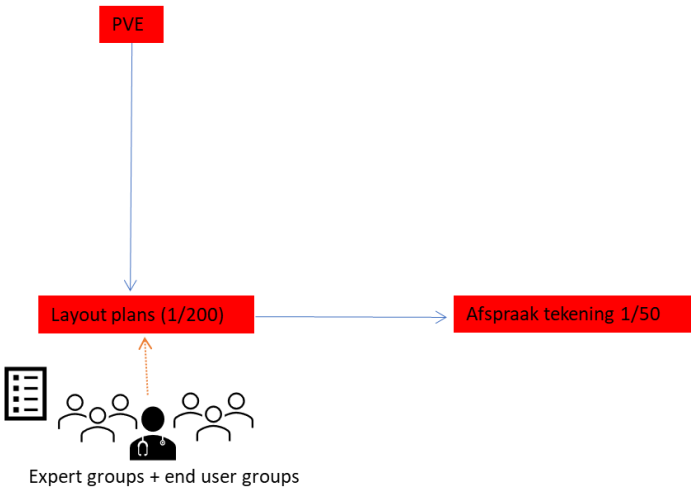



*Figure 21*: Design evaluation (own ill.)

The analysis outlines how the design is developed and evaluated. The program of requirements was developed by going through different filters with the involvement of many end- user and expert groups. Furthermore, drawings were communicated and tested collaboratively with more stakeholder- and expert groups by the help of review matrices.

# FINDINGS

# 5. FINDINGS

This chapter builds on the case description of Erasmus Mc with a qualitative analysis. In the first section, the design process is analyzed by explaining the design development in different phases and illustrating user interactions. Key end-users and expert groups are identified through their roles in design and information exchange. The second and the third section analyze user participation and decision making to identify which end-users were involved in the design and decision-making process.

## 5.1. Design Process

The design process is analysed in four different stages: First stage is the programming stage, second is the concept stage, followed by the developed design. The fourth stage is final one: the technical design.

The programming phase is the pre-design phase where the programs of requirements for different parts of design. This evolves simultaneously with the development of the conceptual plans into layouts. In this phase, working groups collaborate with User Coordinators to provide input to the programmers.

*…So, we made zoning for the wards. And we described that in the program…. I was responsible to write a program of requirements in collaboration? with the users.( Program manager 2)*

In the concept design and developed design phase, layouts were developed into coordination drawings. According to the interviews, users evaluated the design by means of review matrices. Additional document analysis revealed that Users Coordinators evaluate the design on behalf of the end-users whom they represent. Review matrices are also referred as decision matrices.

*…We had a large toetsings [review] matrix, so a decision matrix, in which all those users could fill in their remarks, and then we would come together with the design team again and see if we could afford it, if we have space for it, if it was some things were contradictionary, so we had to make choices. So I think that was a good thing in the design process that after each phase of designing, all those end users were invited to give their remarks, and then we, as a design team, made the choices which we could and could not change. (Architect)*

For the purpose of this study, two review matrices were analyzed in greater detail, and it appeared that six to eight different expert groups had evaluated the design including the User Coordinators during the developed design phase. Numbers in the graph illustrates the amount of comments given by the evaluators. Review matrices are in the form of spreadsheets and a template can be found in appendix A with example comments from different groups.

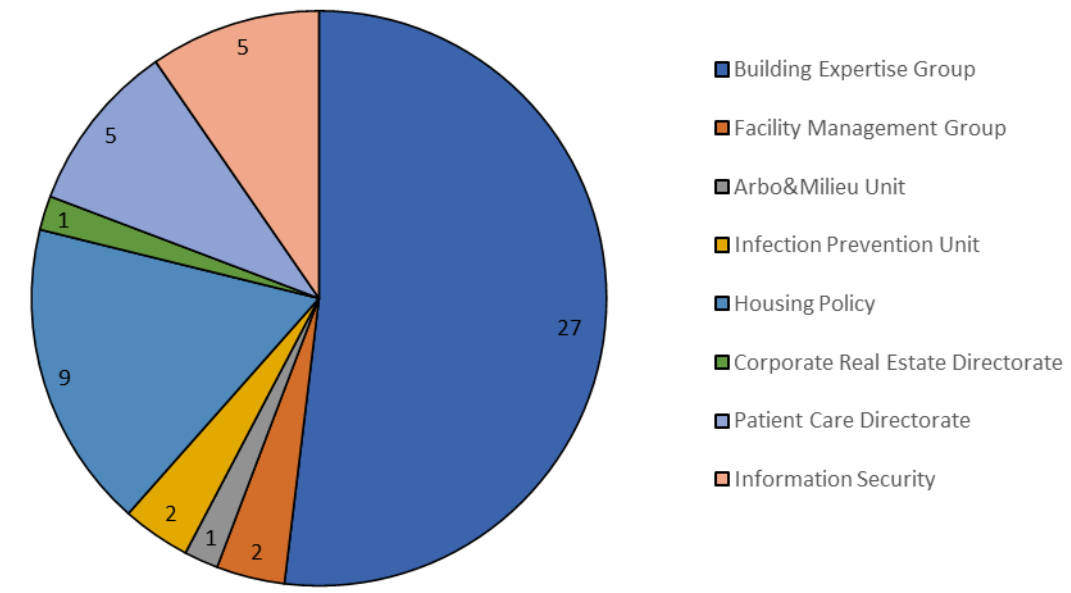



*Figure 22: Different groups evaluating the layout of radiology and number of reviews* (own ill.)

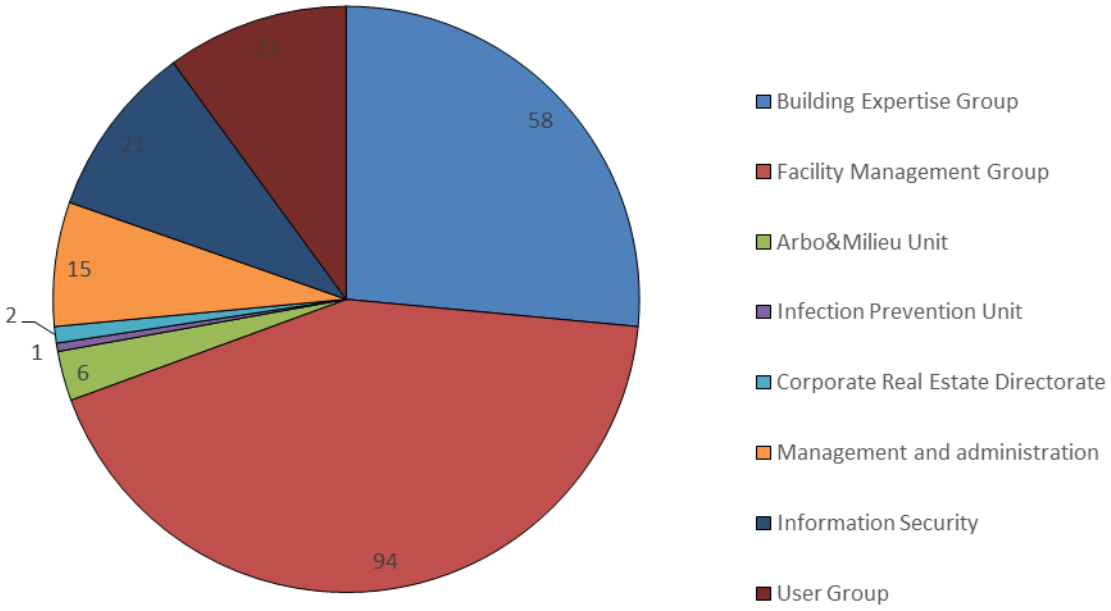



*Figure 23: Different groups evaluating coordination drawings of Thorax and number of reviews (own ill.)*

The analysis of the review matrix can be followed in figure 22& 23. Figures show that the expertise group gave more comments than any other group, it can be said that they have influence on the layouts, in other words, during the concept design phase.

In the fourth, stage, so during the technical design phase, the design had to be finalized and this required that all details had to be discussed. Here the user coordinators worked together with the design experts, as the user coordinators were also part of the Technical Design Teams (TOT):

*"So in the end we sit again with the TOT. How do you call? The operation( technical) design team. They're the last phases, the last changes- how do you say that?The new insides and the new way insights and the new way of working just before the reconstruction, the drawings for construction. So that's was the last phase when end-users could involve in changes (Project leader J)".*

It is mentioned by the project secretary that during the technical design of some areas like Radiology , instead the User Coordinator him/herself some end-users like clinical technicians, who are selected by the user coordinator represented the end-users and was a part of TOT.

Based on the interviews and document analysis, user interactions during programming and design can be summarized in the following scheme (Fig. 24).

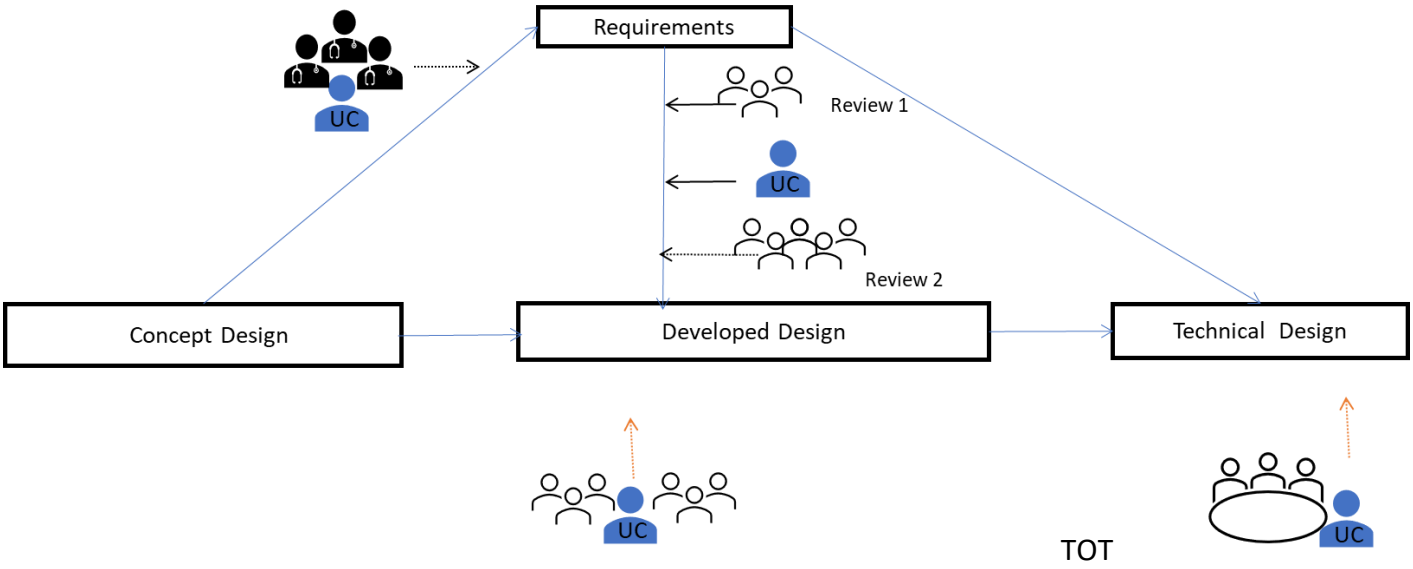



*Figure 24: Interactions between the end-users and expert groups (own ill.)*

As illustrated in the scheme in Figure 24, there are different end-user and expert groups interacting with each other during the process. In the first phase working groups (selected end-users per department resulting in thirteen groups of four to six people) gave input and communicated their needs and requirements to the programmers. In later phases, the design is evaluated with the help of review matrices by the User Coordinator, and the medical and building expert groups as well as by administrative groups. In the last phase, User Coordinators work together with designers and building experts on the technical details of the projects in TOT teams. One of the project leaders mentioned TOTs were very efficient.

*"We sat together with the advisors and the end users and the GC, to decide what exactly would be the layout of this afdeling. So it was mostly meetings and workshops.*
*We call it TOT. Touch screens, so we could make drawings on the touch screen, digitally. And actually, they were really, really good, these workshops. Because everybody could say what he wanted to say.*
*That was a big room, we call it the iRoom. I like iPhone, we call it the iRoom. Two very big digital touch screens, and I think 20 or 30 people could sit there. And this was like the epicenter of the visions.*
*So everybody could look at the screens, to the drawings. If there was some remarks of drawings, somebody went to the screen and make the remarks on the screen. One touch of a button, their remarks are saved, and they were emailed to everybody. So they were very efficient workshops. (Project leader M)".*

During the development of the plans different members from the building expertise group like the project advisor and the technical advisor was always in play; at the same time the programmers were still involved if needed to explain discussions from earlier phases.

**KEY GROUPS IN THE DESIGN PROCESS**

Regarding the design process analysis, it can be said that there are three groups with important roles. User coordinator, programmer and the Building expertise group.

**User Coordinator**

User Coordinators have a key role in communication and information exchange. They are dedicated end-users chosen by their themes.

*And we called them the user coordinators. So they were key, and we met with them two weekly throughout the project. And they were the key to making sure that we were talking to the right experts from the departments, that all the right people were involved in the design process. (Program Secretary)*

They are the contact persons for the theme they represent, and they engage with the end-users of their themes to generate input for the design process.

*"I only communicated with the User Coordinator. Because there were too many end-users to talk to, so we had this dedicated gebruiker coordinator, that we communicated with." (Project leader M)*

*So we can only speak to those users. So on behalf of all other users. The decisions I made [were] agreed with others, we called it gebruikers coordinators. (Project leader M)*

*"The gebruikers coordinator was our first contact person, when we have a, for example, a discussion or a problem within the user group or we thought we need more knowledge then from a specific department, for example, we first go to the gebruikers coordinator and discuss with him or her, who should we involve? How are we going to organize this discussion with them? So, it was our first contact person. And on the other hand the gebruikers coordinator was also the contact with the steering committee, so when we were ready with something or we had a question, or a problem which we cannot solve within the user group we go to the gebruiker coordinator and they discuss it with the steering committee." (Program manager 1)*

The User Coordinator's role in communicating the wishes and needs of end-users was emphasized in multiple interviews.

*He was also responsible for the wishes and for the information that we got from end users (Project leader M)*

*They ( end-users) have to go to gebruikers coordinators for their wishes and the changes, but the gebruikers coordinator is a very intermediar (Project leader J)*

They take into account the opinion of the end-users and take decisions on behalf of the end-users they represent.
*They were responsible for bringing us wishes of all the themes, all the afdelingen [departments]. The things we agreed with Gebruikers Coordinators (GC) we written down, so in a later stage we could say, this were the decisions we made with the GC, so this is what you get in your new hospital. Maybe the professor or the nurse would say, it is not quite what I want, and I would say no, I talked this through with your gebruiker coordinator; I talked with her or him and this is what we decided. (Project leader M)*

Their other role was to explain and communicate the design progress and the decisions with end-users. They present the design on behalf of the design experts and receive feedback from the group after each design phase.

*And so, in this Design Café we had a presentation and also the gebruikers coordinator explained, "Well these were the steps that we made, and this is the product that we have at this moment." And anyone could ask questions or make complaint (Information manager)*

The User Coordinator's role in connecting different groups is explained in the process documents and it was mentioned that they attended two weekly meetings on behalf of the theme they represent and communicated issues related to other departments and themes with other user coordinators and the projects management.

*"They form an important link in the preparation of decisions in the New Building Steering Committee and their feedback and translation to their own work environments. They bring the right users into contact with the programmer/architect, oversee the supply of information and materials required for the design process, and jointly coordinate the approach to department- or cluster-overarching issues. (HV.51087)*

It can be concluded that User Coordinators have three main roles in communication. The first one entails exchanging information between end-users and design experts. The second one is exchanging information between different end-user groups and the third one is exchanging information between the steering group and the end-users.

**Programmer**

There were external program advisors involved in the process. Four program managers were working together with building expertise group. They are also called hospital planners in some countries like UK. Their main responsibility was preparing the PvE and to discuss and communicate the requirements with the designers and the end-users in the working groups. They also had other roles as appeared in the interviews.

*I was responsible to write a program of requirements in combination with the users,…… and then to check if that was translated into the design. And that was my role, and when that was finished, so everyone was satisfied with the design then the next stage was there, and that was more the technical design about the outlets and that kind of stuff. (Program manager 2)*

*…So, we made zoning for the wards. And we described that in the program of requirements, and then we checked all these items if they were also incorporated in the design that we received (Program manager 2)*

*so we discussed the design together with the architect and the users. My role was to coordinate this discussion and to see that everything that was discussed was written down in the minutes of meeting, and that all the wishes were in line with the program of requirements. (Program manager 2)*

Another role of the programmer was guiding the design process.

*So, I did the program of requirements of many departments on the wards. And I also guided the process during the first design stage, the preliminary design, to see if in the design all the requirements that were in the program of requirements as agreed with the end users are also translated in the design (Program manager 2)*

Based on the interviews, it can be concluded that the programmer is responsible for coordinating the communication between the end-users and the designers about the requirements, where at the same they checked whether the user requirements were indeed integrated into the design.

**Expertise group**

The building expertise group is managing the design, program and leading the project and the process. They support the program managers during the delivery and coordination of PVEs. In the project documents it is explained that this group guided the design process through preparing policy and procedural documents. Furthermore, during the design they evaluate the PVE and other design products on different aspects. At the same time, they were responsible that sufficient information was gathered from end-users and made available to the design experts.

*..for the new building there was this team, this expert team ( building expertise team), to inform the architect and the Erasmus MC about the choices they've made for the new building. (Architect)*

*We had a ( technical) project team wiith the expertise team, and with the architects, and, what do you call it, the insulation consultant as well. They decide, "We want to have more input on that," or, "We need to ..." We are expertise, and we are actually the guardians of a lot of that things. Is there enough input, or are we sure about this, or do we need more input on certain subjects, or do they need to have the possibility to say yes or no to the design? (Project Manager R)*

The information manager is a part of this group and she was responsible for receiving the comments and evaluations on design products and in putting these remarks into the review matrices.

*My role was ….more of the coordination of all appointments, all documents, that they would go to the right people. The review of documents, sending it out but also gathering all the responses from reviewers. Putting it all together in documents and making sure that the programmer responded to all the responses and the review. So that it would be a continuous chain of the information, from start to development to finish from all the planned products. (Information manager)*

In the process documents it was mentioned that the project organization was divided into two groups, supply and the demand side (HPV.PON.51087). The end-user groups were on the demand side and the design experts were on the supply side. It is expressed that building expertise group have a pivot or center

position between those two sides in process documents. This groups plays a key role in coordination but also translating the needs of the demand side into service levels or requirements, to the professional language used by the designers at the supply side or the other way around. The Information manager writes down all the comments in the review matrices so that different groups communicate the design issues in writing.

It can be said that the building expertise group ensured the existence of a continuous chain of information. During the development and the implementation of the design their role on information exchange is substantial, since they were connection between the supply and demand sides of the organization.

## 5.2. End-User involvement

There are different groups of end-users involved in different phases of design.

Different type of end-users and expert groups were involved in the programming phase including expert groups from the Corporate Real Estate department, medical care providers, as well as maintenance and logistics workers.

*…. So, all the users, all the different kind of users were always at the table. Therefore, you don't have user participation only with logistics or only with the nurses. You have to discuss all these topics together because the wish of one user can have implications for the other one. Therefore, it's needed that they are all at the table, and if not then it was my responsibility to involve them as soon as possible about a topic before any decision was made. (Program Manager 2)*

*And we make a sort of little team (working group) with whom we discussed the program of requirements, and with whom we discussed the design at the end. And within that team we made sure we had doctors, we had nurses, but we also had people from logistics or from the Real Estate (Corporate) department to make sure that everybody's knowledge was rightly incorporated within the design. (Program Manager 1)*

Medical care providers were mainly involved in the programming phase by participating in these working groups.

*…they were involved from programs of requirements until the design. And their involvement was very ... How do you say that? Very intense. So, they were involved in every discussion, and in every meeting, we had, it was always, well we tried to have the same doctors there, so we had one team which were involved. And to make sure that it's not the idea of one or two persons, we also organized meetings with a broader team of the (specific department like) OR. (Program Manager 1)*

*They were involved during the functional requirements that they had to make with the programmer, I do not know the word in English. And that led to the afspraak tekening. And that was the main involvement from them. And then if there were questions about some devices they got, ask how those works, and what kind of utilities they need. That was the main involvement with end users. And then at the end when the department was ready, constructed, then they asked to control, to check if everything was made according to their requirement and then they signed for agreement with these requirement. (Project Leader J)*

In the technical design phase, end-users with special knowledge in operating medical equipment were involved in TOT meetings for technical detailing.

*The end user responsible for the CTs was also at the table. There's a third end user that is our -beheer-. It's our own maintenance department. Our own maintenance department was not at the table. They were at*

*the table way, way before that. They were not there. The only end users were the technical end user of that specific room, and the user of the process (Technical Consultant).*

A general list of end-users who were involved in different phases of design is represented below.

| | PRE-DESIGN | DESIGN | | |
|---|---|---|---|---|
| | Programming | Concept design | Developed design | Technical Design |
| END _USER GROUPS INVOLVED IN DESIGN | • User Coordinators<br>• Working groups | • User Coordinators | • User Coordinators | • User Coordinators<br>• Medical technicians. |

*Table 7: End -user groups involved in different phases of design (own ill.)*

The figure shows the end-user groups involved in design by giving or collecting input during the design development. The figure exhibits that User Coordinators were involved in all phases, whereas working groups were only involved in the programming phase.

## 5.3. Decision-making process

The decision-making process was described and explained in detail in the process document (HPV.PON 51087). This document gives information about the responsibilities of different groups in the organization at the same explains the approval procedure of project documents, which was outlined in a RACI matrix (Responsible, Accountable, Countable, Informed).

The matrix gives an overview of the expert groups and stakeholders participating in the decision-making process, while explaining the steps in design development. Based on the matrix, it can be deducted that there are different pathways for decision making for various design products. The Steeeting Committee is the decision-making body; the building expertise group is the evaluator and the advisory body for all design documents and products.

The RACI matrix suggests that User Coordinators are not part of the decision-making procedure. From the interviews and the analysis on the design development it appears that the user coordinators is involved in the production of the design documents and projects, and they give their approval on the documents before the formal decision making procedure start. The RACI matrix is illustrated in figure 25.

*Figure 25: RACI matrix (HPV.PON 51087)*

schema besluitvormingsroute
28-5-2010

## PLANONTWIKKELING: BETROKKEN PARTIJEN BIJ PLANPRODUCTEN EN FASEDOCUMENTEN

| | intern | | | | | | | extern* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| planproducten/fasedocumenten | Producent | Toetsing/ advisering | directeur huisvesting | portefeuillehouder nieuwbouw | stuurgroep | klankbord-groep | RvB | verzekeraars | CRAZ* | Cbz* | bouwge-machtigde | VWS | Gemeente R'dam |
| **Algemeen** | | | | | | | | | | | | | |
| beleid/richtlijnen | EN | EV | b | b | v | a | B | i | a | | i | | |
| functieverdeelplannen | IP | EN | b | b | v | i | B | a | a | | i | i | |
| basisprogramma (complexbreed) | IP | EN | b | b | v | i | B | i | a | | i | | |
| financieel programma (budgetboek) | EN | DS | b | v.b. | i | | B | i | | i | i | | |
| m2 boek | EN | | b | v.b. | a | i | B | | | i | | | |
| overall-planning | EN | | b | v.b. | i | i | B | | | i | i | | (i) |
| integrale voortgangsrapportage | EN/DS | | b | v.b. | i | i | B | | (i) | | i | | |
| communicatieplan | EN | | B | i | i | i | | | | | | | i |
| technisch PvE | EN | EV/adv | b | v.b. | i | a | B | i | i | i | i | i | i |
| algemeen/functioneel PvE | EN | EV/adv | b | v.b. | v | a | B | | (i) | | i | | |
| standaardfragmenten lay out | OT/IP | EN | b | b | v | a | B | | | i | | | |
| vlekkenplan lay out | OT | EN/IP | b | b | v | a | B | | a | i | i | | |
| **Inrichting** | | | | | | | | | | | | | |
| programma's van eisen (inrichting) | IP | EN | b | v.b. | i | | B | | | | i | i | |
| Lay-out tekeningen | IP | EN | b | v.b. | a | i | B | | i | | i | | |
| Coördinatietekeningen | IP | EN | b | v.b. | a | i | B | | i | | i | | |
| afsprakentekeningen | IP/OT | EN | b | b | v | i | B | | | i | | | |
| **Inventaris & Inhuizing** | | | | | | | | | | | | | |
| Aanschaf | KT | EN | b | b | a | a | B | | a | | | | |
| Inhuizing | KT | EN | b | b | i | i | B | | | | | | |
| Verhuizing | KT | EN | b | b | i | i | B | | | | | | |
| Uithuizing | KT | EN | b | b | i | i | B | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **v** | vaststellen | **v.b.** | voorgenomen besluit | **a** | advies |
| **b** | besluit doorgeleiding | **i** | informatie | B | besluit |
| | | **(i)** | beperkte informatie | | |

EN = Expertisegroep Nieuwbouw*
EV = Expertgroep Veiligheid
adv = architect en adviseurs
DS = Directiestaf
IP = Inrichtingsprojecten
OT = Ontwerpteam
KT = Kernteam I&I
AG = Adviesgroep I&I
G = Gebruiker

* de Expertisegroep Nieuwbouw coördineert de raadpleging van relevante deskundigen vanuit andere afdelingen binnen de directie Huisvesting (bv. Vastgoedbeheer) en daarbuiten (bv. directie Informatie, directie Patiëntenzorg, directie Facilitair Bedrijf, Arbo & Milieu e.d.) Veelal zal een presentatie worden georganiseerd rond de vraag over een planproduct te adviseren, teneinde het adviestraject te faciliteren.

There is a hierarchy in the decision-making. The steering committee and the executive board are decision-making bodies in the organization and the position of the user coordinators is to assist them. They evaluate and advise on design while it is still in progress and preparing decision making.

*We had the decision matrix, of course, as a tool to get the input but there was a larger hierarchy of decision maker teams with the steering board and so on. (Architect)*

*"The user coordinators assist the steering committee in developing the future housing of their own theme and/or specific functions within it, achieving coordination, promoting the synergy between the development of theme transcending aspects, and learning each other's experiences. Last but not least, they are involved in preparing decision-making in the Steering Committee.*
*(HV.PON.51087 ONE project)*

*And the gebruikers coordinators. They were the advisors, but the end-decision-makers were the Steering Committee, the program board. (Information Manager)*

The Sounding board tested design decisions in different stages before the design is finalized and sent for further approvals. There are representatives from different end-user groups providing their opinions before the decision-making bodies approve the decisions.

*But we had a sounding board -And there were representatives from various themes, but also from the people's... staff representatives, and the medical board, and the students even. And we used them to sound out whether general principles or conceptual ideas about how to do outpatients consultations in future or how to develop the inpatient wards, how they thought about that, and we consulted them on the color scheme.(Program Secretary)*

Decision-making bodies are taking decisions based on the information and input provided from the end-users.

*And the decision is not in the hands of the end-users, it's in the hand of another ... Other, the part of the organization that has the responsibility to make a decision, and the end users are not in the responsibility to make decisions. They are only to give information and you need to discuss that well with them, so that in the end the decision maker can make the right decision based on every information that is needed. (Program Advisor 1)*

From the process documents (HPV.PON 51087), it was understood that all design products are approved by the Quarter masters and the department heads before being send for approval to the higher decision-making bodies. User Coordinators are responsible for the approval of the PVE as well as the coordination drawings.
RACI matrix in table 25 suggest that, users and User coordinators do not participate in the decision-making process. However, project information documents and interviews mention that the user-coordinator is involved in the development of the PVE and drawings. After approvals of different user groups and User Co-ordinators, the decisions making process starts, to have an external or formal support.

The figure below illustrates the end-user groups involved in design approvals and the path for decision making.

| | PRE-DESIGN | DESIGN | | |
|---|---|---|---|---|
| | Programming | Concept design | Developed design | Technical Design |
| END USERS APPROVE DESIGN/PVE | • User Coordinator<br>• Quartermaster<br>• Department Heads | • Department Heads<br>• Quartermaster<br>• User Coordinator | • Department Heads<br>• Quartermaster<br>• User Coordinator | • Department Heads<br>• User Coordinator |

*Table 8 : End-users groups participating decision making (own ill.)*

To summarize; there is a hierarchy in the decision-making process. Steering committee and sounding board reviewed the design and decisions before the final decisions were made by the board of directors. User Co-ordinator groups were involved in the decision-making processes by giving input with the help of the review matrices. They approve the PVE and their main role is limited to assisting Quartermaster on the approval of design plans.

**Decision making criteria**

Three main principles are guiding the design. They relate to patient safety, well-being of the patient and environmental sustainability of the building and installations.

In the interviews, it was emphasized that these were accepted as important guidelines / rules that drove the decisions and choices.

*You got the safety first, healing leading and what was is it? Duurzaam. Sustainability? Sustainability were the three main rules. Every change we have, we applied three rules and then it's okay (Technical consultant)*
*Interviewer: How were those principles received within the project team?*
*Respondent: Like a dogma- How do you say? It's like a mantra (Technical consultant)*

The design and decisions were tested and measured by those three principles which also supported decision making.

*Every question you ask yourself in the design were measured by these three, two concepts. So, it's, there's always, in your back of your mind away if we choose this, then this fails, but you also try to compromise (Technical consultant)*

Applying these principles helped providing consistency in decision making and coherence of design.

*We stuck by these principles throughout the whole process. We were, I think, in the late '90s, they started planning this hospital and, in the beginning of 2000, they already had these principles. And throughout this whole process they stuck to these principles. With every design and every... Just, like you said, prioritizing and that helped to make it also coherent. (Information manager)*

The principles were prioritized. Safety indicates prevention of errors and adverse effects to patients associated with health care and it was the number one priority.

*But patients, the patient safety was always on top. So that was, I don't think that there were many things that changed if it was... bad for the... if it was a bad consequence for the patient safety ….it was prioritized (Information Manager).*

To summarize, there were three criteria in group decision-making in the project organization:

1-Safety 2- Healing environment 3- Sustainability

Those principles helped making coherent design decisions during the process.

**Design and decision-making approach**

The prioritized principles emphasized the request for a patient centered design and high-quality medical care. In some cases, design principles overruled the needs of end-users. Several interviewees mentioned the dissatisfaction of nurses about their new work environment. It was mentioned that the design did not meet their social needs and after project delivery a new design was being prepared at the time while the interviews were held.

*The main thing, we underestimated, the social interaction between nurses and doctors. There were, I call it hiding halls, but okay no thoughts. They are, the room were nurses talk, talk, talk, and then in the new building it is not. They miss it very much. So, we are making it again because they're complaining. I think that was the biggest mistake. Underestimating of the interaction (Project leader J).*

*The patient is king, patient central, everything about the patient; lots of the decisions made were in favor of the patient, you think hospital, but it's also asks changes of the personnel and there are some changes they do not want to make. (Project leader J)*

*What you see is that, that concept is not quite correctly implemented which caused for example the nurses at the ward have little, how do you say? Spare time space, to drink coffee for example. When you ask me now is that good? No that's not good. We had a clear vision, but the vision was not correctly implemented, and our nurses have too little room to drink their coffee, that's not ok. That's where the balance more went to the concept and it did not quite work out yet. (Program manager 1)*

Based on the interviews it can be said that some design decisions were taken not in the favor of medical care givers like nurses and doctors. During the interviews, this topic was mentioned as a major lesson learnt and emphasized by interviewees that needs of medical staff should not be ignored and their opinion should be more valued. This example highlights the importance of decision-making criteria; what they represent and whether or not they reflect end-user perspectives and needs.

In another interview, it was mentioned that the flexible design concept did not respond to end-users needs.

*The advantage of what is flexible, is that you build less rooms, because you can use them more efficient. But when the ... Sorry. When the finish of the project came in sight, all the themes said, "No, I want my own rooms, my own rooms." Sorry. So that was a change. The concept was good. -But it didn't work out- No. And that is still a problem today. (Project leader M)*

Flexibility was a design criterion determined by the management and in this case, and it was conflicting with the needs of some end-users. It can be said that there is a trade-off between the objectives of management and end-users and therefore it might well be that design decisions mainly reflect the perspective of the management.

**End-user representation**

Based on the analysis of decision making it is understood that the end-users role in decision making is limited to giving input and assisting. In one of the interviews the reason for their limited representation was explained.

*It was the executive board that made decisions, because you shouldn't have that as a democratic process. (Program Secretary)*

This interview mention that the reason for involvement is not their equal representation or participation but to test the decisions as to whether the design is usable and functional / working.

It can be said that many end-users were informed and consulted directly and indirectly about the decisions. There was a participative and informed design and decision making process.

# SYNTHESIS OF FINDINGS

# 6. SYNTHESIS OF FINDINGS

This chapter presents the synthesis of the findings of this research. First, findings on user involvement strategy are explained. This provides a detailed overview of the end-users involved in the design and decision making and outlines their participation. Second, significant roles of key groups are described and their importance on information management is explained. And last, the decision-making process and impact of user participation on decision making is clarified.

## 6.1. User involvement strategy

The analysis of the design process and the user participation in the previous chapter provided explanations about the user involvement approach in the Erasmus MC case.

The analysis reveals that there was mainly a representative approach on end-user involvement. Assigned representatives and end-users participated directly in the design. Three different groups, User Coordinators, Quartermasters and Department Heads were representing the end-users throughout the process and participated in decision making process. However, the User Coordinators, end-users in the working groups and the sounding board directly participated to the whole process and some of them collaborated with program managers and technical design teams.

User Coordinators are the most active end-users, and they are one of the key players in briefing. According to the interviews, they voice the needs of end-users and they are an important link connecting the end-users and other parties by collecting and delivering information. They worked together with the working groups in the programming phase to phrase their requirements and in later design stages they check if the design was consistent with the requirements, together with the external programmers that were assigned to ensure that end-user needs were taken into consideration throughout different design phases.

The table below outlines the involvement of different groups in different phases and their participation on design

| | PRE-DESIGN | DESIGN | | |
|---|---|---|---|---|
| | Programming | Concept design | Developed design | Technical Design |
| INVOLVED GROUPS | • User Coordinators<br>• Working groups | • User Coordinators | • User Coordinators | • User Coordinators<br>• Medical specialist (technical end-users) |
| PARTICIPATION | • Collecting Input,<br>• Giving input | • Evaluating design | • Evaluating design | • Making design<br>• Making design |

*Table 9: User involvement and design participation in different phases (own ill.)*

Table 9 discloses that User Coordinators are the most significant end-user group throughout the whole process and highlight that they are a key player in the design process. In taking up their role, this study showed that there were different interactions and various forms of user involvement across the different phases of design.

Different forms of user involvement have been described in the literature and is also described in the background information. Damodran (1996) considers the informative form of involvement when users provide information on their needs and requirements, as was the case in the programming phase of the

studied case. Working groups gave input for the development of the design documents like PvE in this phase and they were involved in the design using an informative approach.
The consultative form is described as an approach when users give their opinion on the design documents (Damodran, 1996). This compares to the User Coordinators evaluating the design and express their opinion in matrices in the concept and the developed design phase.
The user involvement is taken to the next level in the last design stage when User representatives join the TOT teams and act as members of the design team. The user involvement in this phase takes the form of co-designing alongside the User Coordinators and the designers. This TOTs compare to the design workshops that have been reported in the literature. Jensen (2006) presents examples of this kind of design workshops, where particular complex layout problems with many contradictory user requirements should be solved to achieve an optimal solution with acceptable compromises (Jensen, 2006).
The different forms, methods and characteristics of user involvement in different phases are outlined with the table below.

| | PRE-DESIGN | DESIGN | | |
|---|---|---|---|---|
| | Programming | Concept design | Developed design | Technical Design |
| FORM OF USER INVOLVEMENT | CONSULTITATIVE (User Coordinator) | CONSULTITATIVE (User Coordinator.) | CONSULTITATIVE (User Coordinator.) | CO-DESIGN (User Coordinator.) |
| | INFORMATIVE (Working Groups) | | | |
| CHARACTERISTICS | UC provide information on needs and requirements of another different theme | UC give their opinion(evaluate) design documents | UC give their opinion(evaluate) design documents | UC act as members of the design team. |
| | Work Groups provide information on their needs and requirements | | | |
| METHOD OF INVOLVEMENT | PVE EVALUATION (User Coordinator) | DESIGN TESTING (EVALUATION MATRIXES) | DESIGN TESTING (EVALUATION MATRIXES) | DESIGN WORKSHOPS (TOTS teams) |
| | FOCUS GROUPS (Working groups) | | | |

*Table 10: Form, methods, characteristics of user involvement in different phases (own ill.)*

Table 10 shows that in the programming phase there is an informative and consultative form of involvement, whereas in later stages end-user involvement is mainly consultative when different groups and User Coordinators evaluate the design. In the last phase, there is a co-design approach as User Coordinator joins the TOT teams and attend regularly to the design meetings of TOTs.

This section of the report explained which end-users were involved in the design and briefing process and what kind of activities they performed and therefore answers the first sub question: *How did the project organization involve end-user groups in different phases of design?*

The answer to this question represents the first major finding of this study: the user involvement approach was adapting to different design phases. Overall, there is a representative approach on user involvement.

In the initial design stages, there is mainly consultative and informative form of user involvement. Then, in the last design phase, user involvement developed into a co-design process with user representatives and designers being members of technical design teams (TOTs).

## 6.2. Information management

The analysis and findings on the user involvement strategy give insights into the information exchange as well as the information flow. It is apparent from the interviews and the project documents that, the User Coordinators, building expertise group and the program managers are important members of the organization maintaining the information exchange across different levels and throughout subsequent phases.

The User coordinator obtains and delivers information throughout the whole process. Programmers collect information and the building expertise group evaluate and process the information in different phases. Their roles related to information management on different phases of design is summarized in Table 11.

| | PRE-DESIGN | DESIGN | |
|---|---|---|---|
| ROLE/PARTICIPATION | Programming | Concept + developed design | Technical Design |
| USER COORDINATOR | • Obtain information from end-users<br>• Help Programmers & expertise group to collect information<br>• Exchange information with other user coordinators<br>• Inform Quartermaster<br>• İnform End-users | • Exchange information with user coordinators<br>• Exchange information with program managers& designers<br>• Inform Quartermaster<br>• İnform End-users<br>• Exchange information in Decision matrix | • Exchange information with user coordinators]<br>• Inform Quartermaster<br>• İnform End-users<br>• Exchange information in Technical design team (TOTS) |

*Table 11: Role of User Coordinator in different phases of design (own ill.)*

Table 11 shows that the User coordinator informs and exchanges information with end-users in first design phases and exchange information with design experts in the last phase.

As concluded from the analysis, the building expertise group facilitates the information exchange, and they guided the process and ensured there was a continuous chain of information. They obtained and delivered information and acted at different levels of the organization. They regularly inform the higher management about the design development and assisted decision making through the preparation of documents. Their role in information management is listed in Table 12.

| ROLE | SUPPLY | DEMAND |
|---|---|---|
| BUILDING EXPERTISE GROUP | • Obtain information from UC<br>• Inform-Management/Board<br>• Evaluate information<br>• Facilitate the information Exchange (decision matrix)<br>• Guide/Ensure information flow. | • Deliver information to the Design team<br>• Deliver feedback from the design team to the management if necessary. |

*Table 12: Role of Building Expertise Group in the organization (own ill.)*

The Building Expertise group is at the center of the project organization. They reach out to both the supply and demand side of the organization, as well as to the upper management and the larger project organization. The Building expertise group also reach out to the designers and the management levels. They inform the board of director and the steering committee about the design development, and the progress and pass on the opinion and the decisions of the management to the design professionals.

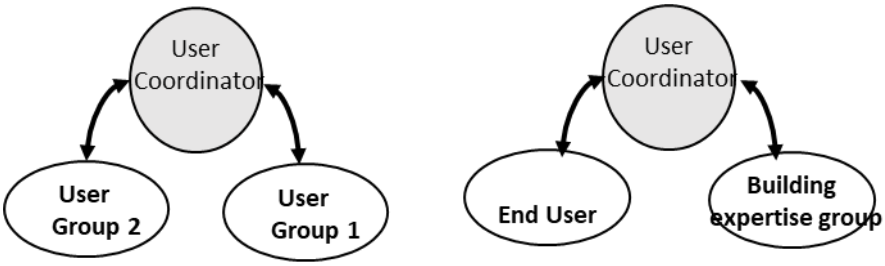



*Figure 26:: Information exchange via User Coordinator (own ill.)*

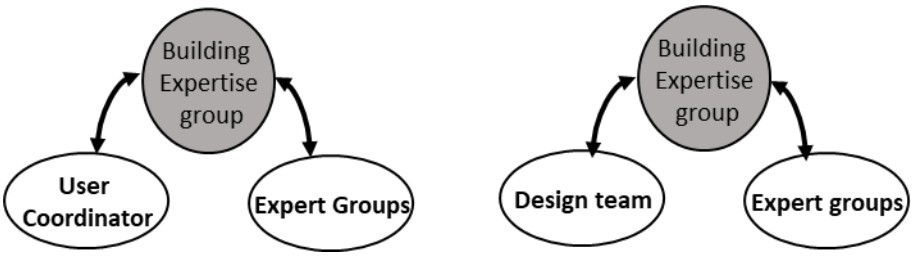



*Figure 27: Information exchange via Building Expertise Group (own ill.)*

The illustrations in Figure 26 and 27 explain how the information is exchanged between different groups the organization. It can be said that information is managed with the help of two groups: User Coordinators and the building expertise group.

An interesting finding about the information exchange is the use of tools in this case. Review matrices are collaborative information management tools and facilitate design discussion. They are jointly used by the Building expertise group, the User Coordinator and many groups in the project organization like the facility

group and the groups od people representing the needs of support services like cleaning and maintenance. There were more than hundred matrixes used in different design phases and it shows similarities with the way BIM is being used in complex projects.

These findings answer the second sub question of the research: *How does the project organization manage the information exchange between the involved end-user groups and design experts?*

It can be concluded from the analyses, that the building expertise group is responsible for managing and facilitating the information exchange between the end-users and the design experts. Importantly, they used matrices as means to exchange information and collaborate with end-user representatives and experts, much like nowadays BIM is used in complex projects. The building expertise group inter-mediates between the supply and demand sides of the organization and sub-projects and acted across different boundaries of the organization.

## 6.3. Decision making

The project documents and interviews provide information on the decision-making process in the Erasmus MC case. The RACI Matrix (Figure 21) in the analysis section gave information about the groups that have a role on the decision-making process. From the interviews and documents some of the groups facilitating the decision making are listed below in the table 13.

| PVE | Fit-Out Design drawings | Role |
|---|---|---|
| Building expertise group | Building expertise group | preparing documents, supervising process |
| Dedicated portfolio holder | Dedicated Portfolio holder | supervising the input |
| Sounding board | - | |
| Director of corporate Real Estate | Director of Corporate Real Estate | supervising the process |
| Steering Committee& Executive Board | Steering Committee& Executive Board | decision making bodies |

*:*

*Table 13:Groups and members facilitating formal decision-making process and roles (own ill. based on the RACI matrix)*

It is mentioned by the Project Secretary that depending on the type and the impact of decisions, different stakeholders are involved in the process and there are different pathways for decision making. For instance, the technical PvE is also approved by the Medical Board and the end-user representatives in the Sounding Board. At the same time, there are other stakeholders participating in decision making for different PvEs and design plans and the RACI matrix does not distinguish between the generic PvE or dedicated, functional PvEs. The decision-making process for the PvE of patient wards was more severe than the PvE for one theme or specific area (i.e. Radiology)

There was a different decision-making route for the design drawings and the PvEs. The process differed based on the impact of the decisions, and different stakeholders was part of the decision making. The decisions were taken by the Steering Committee. Depending on the impact of a PvE it can be decided that the Executive Board itself has to affirm the decision of the Steering Committee

None of the user groups were involved in the formal decision making according to the RACI matrix. However, the User Coordinators and Quartermasters were both responsible for the PVE, and they give their approval before it goes to the formal decision-making bodies as understood from the interviews. In the decision-making process of design drawings, User Coordinators were involved in the decisions by giving input using the review matrices. Many end-user and expert groups evaluated the design in different moments which shows the reflective and iterative character of decision-making process in the Erasmus Mc case.

Literature says that in healthcare design decisions are made in inter-professional design settings and the process is non-linear, iterative, reflective, involves many players, with outcomes passing through a series of filters or frames to a final solution (Becker and Carthey, 2007), which is in line with the findings of this study.
The last main finding of this study answers the third sub-question of this the research: *To what extent were the end-users and stakeholders involved in decision making?*

Informed decisions about the new building project design are taken by the steering committee and the executive board with continuous consultation of end-users in Erasmus MC. End-user groups are not participating formally in decision making procedures, however there is a transparent decision making process and by many end-user and expert groups participate the decision making process by being included in different rounds of reviewing activities.

# CONCLUSION & DISCUSSION

# 7. CONCLUSION &DISCUSSION

User involvement in the healthcare design process can help designers to understand how their activities are performed and gather valuable information from users. It is critical to understand how the physical environment support or is a barrier to human interaction, safety and effective delivery of care (Hamilton, Orr, Raboin, 2008). Furthermore, user involvement early in the design, when changes are more feasible, can assist designers in capturing real needs of users (Damodaran, 1996; Jensen, 2011; Kujala, 2003).

The conceptual model showed that there are different ways to involve end-users in a design process and also makes clear that end-user participation during design processes can occur at different levels of involvement. In healthcare projects, participation of medical experts and other end-users enables designers to understand the perspective of the users and integrate end-user information efficiently into the design.

In order to find out the different approaches on user participation and interaction in healthcare building projects, a qualitative research strategy was used to answer the following main research question:

*In hospital building projects, how does the project organization translate the end-user information into design?*

A single case study was conducted in order to analyze the design and decision-making process and the user involvement strategy. Information obtained through interviews and project documents gathered from the project members was used to understand the design development and interactions between the users and the design team.

Findings showed different forms and levels of user involvement, key roles in the organization and information exchange between different levels and across boundaries. Three main findings are:

- The form of User Involvement and their level of involvement evolved during the design process; at early stages end-user were involved in the process in consultative and informative forms, whereas in the last stage of the design end-users were included in TOTs and co-designed together with the technical design teams.
- Two groups have key roles on information management: Building expertise group and User Coordinators. Importantly, at a time BIM was not available, review matrices were used in a very similar way to develop an information exchange trail.
- Design decisions are given based on continuous consultation with end-user representatives who were linked to the project organization in all levels. Users are not part of the formal decision-making process, however there is a transparent and user informed decision making process.

The first finding illustrates the different forms and levels of user involvement found in different phases of the design. In the pre-design phase, end-users in working groups directly participated in the planning of PvE in an informative way. In following phases, medical experts evaluated the design together with user coordinators in a consultative way. In the last phase user coordinators develop design solutions together with the technical design teams, in a co-design form. In different studies, co-design is seen as the highest level of involvement and it is used in first stages of design. In the Erasmus MC case, however this is applied in the last design phase. This might be related to the size of the project and the design approach.

The new building project is a large-scale redevelopment project, the design and realization were done in different phases. Some parts like the building's shell were already constructed while the fit-out design continued. As a result, some design decisions were generic, and they had to be overviewed during the last design phase. These decisions were changed if needed and they required high level of user involvement in the last design phase.

The second main finding provides explanations about the information management and expose the roles of two important groups in the project organization: The User Coordinators and the Building expertise group.
User coordinators are representatives of end-users and were the linking pins in the organization. They comment and take decisions on behalf of end-users and they reach out to between different groups of end-users and the designers. This group has an important role to engage users and in ensuring that all the needed end-users participate into the design and briefing. In that respect, they have the responsibility to coordinate the end-users. The user coordinator role is key for information management as this is an important link to transfer knowledge. They obtain the necessary information from their end-user group and communicate it with other groups. In return they inform the end-users about the design. To conclude, the user coordinator group has a key role in coordinating the user interactions and exchanging information during the process.

The second group is the building expertise group. They have a significant role during the design process and in stakeholder management. They defined the tasks and responsibilities of important stakeholders and end-user groups. The building expertise group also outlined and described the process in many policy and procedure documents. The building expertise group has a central position in the organization, and they are the intermediator between the end-users (demand) on the one side and the design team (supply) on the other side. At the same time, they ensure the information exchange between sub-projects that were operating under the new building program or different boundaries. Boundaries in an inter-organizational collaboration represents interfaces that must be crossed which can restrict knowledge exchange and communication (Pemsel et al, 2011).

The function of the building expertise group requires acting between different boundaries of the organization. They work with different groups in different parts in the organization and facilitate communication between sub-projects as well as the supply and demand side of the project organization both for the realization and fit-out project. The building expertise group prepared and shared process and phasing documents and informed the stakeholders and building experts about sub-projects. They work between different boundaries. It can be said that this group act as boundary spanner during the design process.

The building expertise group performed different boundary spanning activities for the management of inter-organizational communication. According to the literature, a *boundary spanner* provides communication linkages between theorganization and its environment by facilitating and filtering information and the spanner mediates, i.e. negotiates, between the organization and its environment (Pemsel et al, 2011)

My findings on the intermediator role of the building expertise group show similarities with that of Jensen's in another case study. In this study, he analyzed the briefing process of a Media center project in Denmark (Jensen, 2006) and also reported this role. He mentions that the mediator role specifies the needs from the demand side and translate them into requirements or service levels, which is in accordance with the professional language of the providers from the supply side. He also highlights the need for such mediators in building projects due to the complexity and specialized character of the building project. It

can be said that intermediator and boundary spanner roles of the building expertise group helped to deal with the complexity in the new building project of Erasmus MC.
An illustration on the different boundaries in the organization and the different roles of the building expertise group is depicted below:

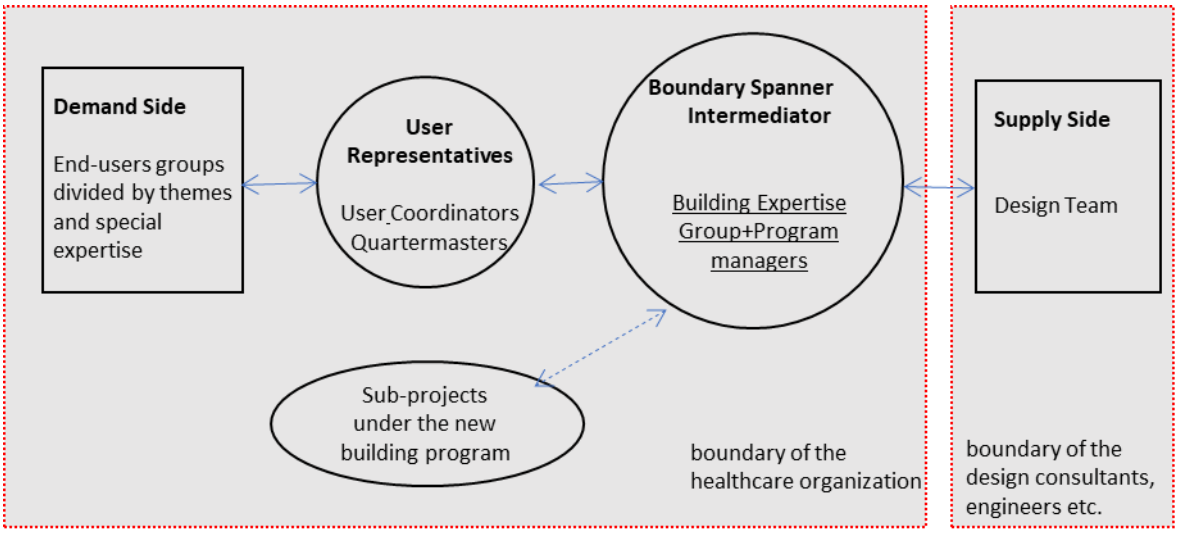



*Figure 28: Findings on roles of the building expertise group and boundaries in Erasmus MC (own ill. Based on Jensen, 2011)*

The third finding is about the user influence on decisions. The end-users are represented by different groups and they are linked to the project organization at three levels. End-users were also represented in the sounding board. They were involved in decision making process through their evaluations of the design. The analysis on decision making brings out that design principles were overruling individual or end-user design requests in some situations. This is a consequence of the three main design principles (safety first, healing is leading, and sustainable is cheaper) which reflects the strategic goals of the organization. The most important principle, safety first and imperative for the primary process in a hospital, was prioritized over the other two design principles when there were conflicting design solutions. These principles were prioritizing the patient perspective representing the values of the organizations and perspectives of the patients.

The conclusion is of this research is that; the project organization involved different groups of end-users into the design and decision-making process. User participation was in different levels and had a representative character. In the early design stages end-user involvement was informative and consultative in lower levels. In the technical design stage selected end-users contributed directly to design and highly involved in the design. There was a transparent and informed decision-making process including reviewing activities performed by many end-user and expert groups. Furthermore, coordinator roles of the user representatives and the intermediator role of the building expertise group as well as their boundary spanning activities were key in translating the needs into requirements and to manage the information exchange between the end-users and designers.

## Discussion

Involving users in a building design process has a number of consequences. Information and communication management as well as decision making with many stakeholders becomes more complicated. In order to organize the information exchange during the design and decision-making process, different of methods and tools can be used. In the following section different methods and tools used in the Erasmus MC case

will be explained and the project management and briefing approach will be discussed together with the impact of change management on the design process.

Methods & tools on information management and decision making

This study indicates that review matrices were powerful tools for information exchange, and they facilitate user involvement in the design process. During the process there were many groups and experts evaluating different parts of design using spreadsheets, which they call test or decision matrices. These matrices are important input documents, for the designers and support shared decision making.

The information manager writes down the comments in a standard spreadsheet and initiates the communication between the user representatives, medical experts and building experts. Accordingly, communication and information exchange are facilitated and different comments by many groups are gathered in one document in a structured way. Representatives give their feedback after they evaluate the design within the groups. After a round of testing, the document is delivered to the designer so that they can develop the design and come up with the optimum solution. The design team takes into account the feedback from different groups and ultimately reach a decision based on shared information and comments made by different groups. The analyses on review matrices about the thorax coordination drawing disclosed that eight groups evaluated the design, twenty-seven users and experts gave more than two hundred comments.
Without such a tool, it would be very difficult to integrate their comments and the information of that many end-users and experts into design solutions. It is clear that review matrices reduced communication difficulties between the designer and the users. This tool enhanced communication of different groups across different boundaries. Indeed, the matrices functioned as boundary objects, and the use of boundary objects is known to overcome collaboration and communication issues (Latartou, Minel, Pompidou &Perry, 2015) and facilitate interconnections, i.e. translating, between organizations by bridging boundaries temporarily (Pemsel & Widen, 2011).

Methods & tools on stakeholder management

Stakeholder management was a critical part of project management in this case. In the interviews, it was mentioned that more than thousand end- users gave input to the design and many of them participated in the design and planning. Their systematic involvement enabled collection of input and design evaluations during the process in a structured way.

Different project management tools were used in this case. PRINCE 2 was used at later stages of the project. Before PRINCE 2, the information was shared via non-standard forms and documents. The project and the process were managed by a group of real estate and building professional from the internal organization. Different process and phase documents were prepared by this group. The building expertise group was part of this larger group. Phase documents explained the design decisions why they were taken and the also the next steps in the process

After each phase, documents were published and shared with different stakeholders as well as involved users and sub-project stakeholders. In this way, different groups became aware of the process and they came to / or could interact with each other in a collaborative way. At the same time, decision matrices identified and classified the groups and end-users participating the process. Different documents like the phase documents, process documents and the matrices helped building a mental model about the project also a common understanding about the project organization and the process.

The case study showed that information exchange supported by guidelines enabled systematic involvement of users, which made stakeholder management feasible. A good distribution of roles within the project organization was also important in enhancing the feasibility. The roles and the process were clear and explained in the same way in the interviews and the project documents. It was possible to study these even after many years of happening in such a big project organization. Both interviews and documents support the conclusion that the case provides a good example of stakeholder management with clear roles and responsibilities outlining the boundaries in the project organization. In the literature the need for clearly identified roles and activities is emphasized which bridge boundaries and allow a more productive collaboration between actors during building projects (Pemsel et al,2011).

Project and process management was led by the client in this case and managing it from the inside was a deliberate choice as discussed with the project secretary. Without such an approach it would have been very difficult to organize such an extensive stakeholder management process, as it requires the process owner to be acting from inside the organization to manage its interrelations with other projects as well as dealing with large numbers of end-users.

Briefing process

It can be said that, in the Erasmus MC new building project there was a continuous and inclusive briefing process. Project documents reveal that the project is developed with repeated feedback and evaluation by different end-user groups based on non-standard documents. The project illustrates an example of a dynamic briefing process .Dynamic briefing is explained in the literature as integrating growing insight of all parties involved like the client, and designers within the borders set in the static starting documents during the design process (Prins, Koolwijk, Volker, Wamelink 2006).

There are various brief documents such as technical and functional PVE s in this case. From the analysis it is clear that there is a continuous, iterative and reflective process to understand requirements. The design and briefing are integral parts of the same process, which is in line with the view that the briefing is almost a continuous process.

Change Management

In the Erasmus MC case, the new building project was part of a change program. One of the program managers mentioned during the interviews that detailed information about the new work process and the new organization was given to the involved users. This maybe one of the reasons for intense user involvement in this case. Involving end-users can overcome the impact of different interests and organizational changes as well as changed business environment and achieve commitment to the project (Whelton, Pennanen, & Ballard, 2005).

Change management is seen as one of the variables that affects the briefing in the literature (Yu, Shen, Kelly, Hunter, 2008). Representatives and end-user groups are assigned considering the existing medical organization but also the organization in the future. As a consequence, more end-users and stakeholders are involved in the briefing as well as design and decision-making process.

It is mentioned in the exploratory interview that some end-users are not content with a few design solutions and they relate their dissatisfaction about the change on work process with the new environment. They “blame the building “since they are still not comfortable with the new work processes and the building. The medical organization is conducting a Post Occupancy Evaluation about the new building to get feedback from the end-users and to understand more about the dissatisfaction of end-users.

# RECOMMENDATIONS

# 8.RECOMMENDATIONS

This chapter includes the recommendations that are the outcomes of this research. They are based on the conclusion and discussions and consist of recommendations for practice and future research.

***Recommendations for practice***

*Identifying roles and responsibilities*
In building design and realization projects where there are many stakeholders, one of the biggest challenges is unclear and/or overlapping roles and responsibilities within the project organization. Project information documents describing the key groups and giving clear explanation about the responsibilities of each group shared within the organization can build a mental model about the organization and the process and enable collaboration. Producing and sharing such documents in the beginning of every significant phase of the project are useful for different stakeholders and groups which can have changing roles and responsibilities in different stages.
Another recommendation is to define at the beginning of the project the inputs and roles of each group and in the decision-making process.

*Transparent Decision-making process:*
When end-users are involved in the design process their participation in the decision-making process is recommend and necessary. However, their involvement in the design does not require real influence on decisions. They can be informed about the decisions and indirectly participate the decision-making process by their representatives. Different project documents like phasing documents and periodic end-user and user information meetings (like the design cafes in Erasmus MB case) can be organized to explain how and why decisions were given.
At the same time use of decision supporting tools such as matrices, and phase documents may improve the process and create transparency and highly recommended.

*Use of boundary objects and methods:*
There are many boundary objects and methods that can be used for user involvement. Building client and the management of project organization can investigate and select the methods and boundary objects which will improve communication between the end-users and the building experts and designers. In the beginning of the project, it can be defined how and when will the method and tool or object will be used.

*Systematic involvement and representation of end- user groups.*
Involving different end-users systematically would enhance their engagement and help capturing various needs. At the same time, making a classification of different end-user groups at the beginning and analyzing their roles and functions can be useful for their engagement.
Another recommendation is about the power relations between the end-users and the influence of different groups of end-users. The interviews disclosed that the doctors have more influence on design decisions then other medical care givers. Their engagement and involvement should not be based on their power and influence as a common stakeholder management approach. Affect and importance of different end-user groups in the given care process can be analyzed to organize their involvement.

*Higher level of user involvement in technical design phase*
End-users are generally more involved in the first phases of design where there is a need to understand their needs and identify different requirements. In later stages they are involved in design to validate the usability of the design. Co- design form of user involvement with high level of participation is recommended in technical design phase as applied in the Erasmus MC new building project. Design workshops and meetings in a team setting can be used in order to create solutions in a collaborative way. In building

design projects, where technical details are work process and user dependent this approach can shorten the project development time.

***Recommendations for future research:***

- Other healthcare design projects can be analyzed to identify different forms and levels user involvement and to extend the knowledge on methods & tools on information management. This can increase the validity of the findings. Healthcare design projects with different characteristics can be selected to find out different project management approaches. Other type of big scale design projects can be also analyzed to find out the similarities and differences in user involvement and information management between healthcare projects and other types of projects.

- Different end-user groups are involved in the design process in various levels and forms in the studied case. It can be researched further if end-users are satisfied about the form and level of their involvement and representation. This can give insights about their satisfaction on their environment as well.

- Furthermore, it can be interesting to analyze more review matrices in the case. It could be assessed which expert groups have more influence on design during different stages. It is also recommended to analyze which different expert groups have more influence on different designed areas.

# REFLECTION

# 9. REFLECTION

***Graduation Process***

My interest in design and process management developed during the early phases of my master studies. In the first year of the program, understanding and learning more about complex projects and design management were special interest to me. Practicing design and construction management on different scale projects gave me the opportunity to interact with users and helped me to understand the added value of involving end-users into the design process. When I started searching for a suitable graduation lab, I wanted to focus on a "user-related" subject. A research about user involvement in hospital design was suggested by my first mentor and it resonated with my interests. After a short research, I found a PHD study about user needs and briefing in hospital design Fronczek-Munter (2016) and a previous master thesis done in the Design and Construction management graduation laboratory by Syed (2017), Jon (2019) and Bel (2018). The master thesis explored design, process and project management in hospital projects. The research of Bel (2018) focused on the information and collaboration between project teams, client and end-users by the use of BIM. Previous studies were very helpful for this research and the PHD study of Fronczek-Munter (2016) was a good starting point for further research.

***Research approach***

After the literature review and P1, I decided to focus on design process and conducted an exploratory interview. In the beginning, I wanted to make a research based on two hospital cases. After the P2, it was clear that it not possible to find and analyze another case due to time limitations. In consultation with my supervisors, I decided to make my research on a single case.
As soon as I started making the interviews, I noticed that the selected case was particular in terms of project and stakeholder management. There were many areas to analyze in regard to user involvement / participation. During the interviews I realized that some end-users, like nurses, were not satisfied with the finished building product and alterations on the finalized building were being done, so my first research questions were about end-user needs. During the data collection, the epidemic outbreak started, and I could not make interviews with user representatives and ask questions about needs of different user groups like nurses and doctors as I planned. Therefore, I decided to change the direction of the research and conducted additional interviews with external consultants and focused on the user interactions participation in the process more than the end-users themselves. As a result, the questions and the research are more about the interactions and less about the end-users. I am very happy with this change since it gave me the opportunity to study the design development and information exchange and management in more detail. I also conducted interviews with consultants who contrasted the studied case with other cases which I did not research and gave valuable insights.

*Literature*

One of the challenges regarding literature review was the lack of clear definitions on user involvement. Although it is a studies topic in design and building management, the term still lacks a clear definition and different models describe diverse involvement levels. At the same, the terminology about user and end-user is not consistent in the literature. In the studies related with facility and building management, "end-user" lacks clear explanation, whereas design literature mostly refers to the "user".
Another challenge was the attempt to connect the theory and practice in an early phase. Without a detailed analysis and second review of the literature, it was not possible to find additional concepts and make connections between concepts in detail and draw conclusions.

*Interviews & Observations*

In-depth interviews were a good approach to understand the user- design team interactions and the information exchange activities during the process. I was able to reach and interview with the project leaders, information manager and program manager as well as project advisors who was directly interacting with many end- users and managing the process which provided maximum input. For some interviewees it was difficult to explain the process and the organization in English, I asked them to use Dutch terminology if they prefer.

Their different views highlighted the important roles and interactions during the process and helped me to understand the design process as a whole. The exploratory interview conducted before the P2 helped me to understand which concepts in the literature are more relevant for the case and also make a basis for the in-depth interview questionnaire.

Before starting with the data collection and interviews, I made an exploratory interview with one member of the project organization who was a part of the whole process and I visited the completed hospital project. This also gave me the opportunity to observe the end-user behavior and their use of their new environment.

After the P2, my intention was to complete the research in the organization by physically visiting the real estate department and conducting the interviews in the building. I was able to make the interviews and meet some of the members of the real estate team only two times because of the epidemic outbreak. Those visits helped me to gather additional information and understand the project organization better but was not enough. I made many online conversations with my supervisor in the company to understand the details about the project.

*Processing data*

Processing the collected data was the most challenging part of this research. The interviewees could not remember and explain the organization and the process, since their view and participation on the process and their knowledge about the different processes were limited and the project was completed a while ago. I needed additional information so reached out my supervisor in the Erasmus MC. I made online meetings with my supervisor in the organization and asked for additional information. Additional project documents were very helpful to make an in-depth document analysis.

Analyzing documents helped me to understand the interviews and draw conclusions and incorporated my coding content into themes and structure my analysis and findings. Before the document analysis, I could not make a clear unit analysis and the research lacked a focus. After processing the additional information gathered from the documents, I focused on the differences between the phases and it became apparent that there are different type of user involvement approaches and user interactions on different phases of design.
Making the in-depth document analysis before conducting the interview facilitated a more efficient data processing and reduce the time I spent.

*Validation*
The findings and conclusion are linked back to theory and validated by additional literature.

***Research topic***

*Position within graduation laboratory and Management and the Built Environment (MBE)*

Design and construction management and the real estate management courses in the MBE do not explain the user involvement in design and participatory design practices in detail, hence it is not a subject that is analyzed in the graduation laboratories. There is different research on design teams and different roles as well as project team collaboration, but the role of users in a participatory process is not studied. My research fills that scientific gap and contributes to the design management by looking at how the users and the information exchange in complex design projects can be managed and it fits well in master track MBE and in the master program MSc Architecture, Urbanism and Building Sciences.

***Dissemination***

*Social relevance*

This research emphasizes the benefits of inclusive design and planning process and the importance of end-user perspectives. Overlooking their view, needs and requirements may cause dissatisfaction on the building environment and affect the quality of the healthcare and eventually create financial and operational risks. Healthcare is a special service and there are lives at risk during different operations and care given by certain end-users like nurses and doctors. It is crucial that the building supports the care they provide. Thus, end-users and including them in the process and integrating their information into the design is crucial in hospital projects.

*Professional relevance*

The aim of this research is to gain insight into the design process in healthcare building projects, more particularly into the way the end-users groups like the medical caregivers and the design team exchanged information and participate on developing the design.
The research may contribute to the way users can be involved in design and planning of complex buildings and describe information management, user and stakeholder management in health care building design and planning practice. The outcome of this research could be useful for design and building experts and real estate managers as well as healthcare professionals.

*Scientific relevance*

The findings of this research can be useful for research studying on user involvement in building design and briefing as well as participatory design in the building environment particularly in healthcare facility planning.

*Transferability*

The conclusions of the case study cannot be directly applied on other design projects as the design scope and approach, project organizational structure and medical organization structure differ for every project. However, use of tools and methods on user involvement and the project can be applicable for other types design projects.

*Validity*
An external validity was applied by sharing and validating the findings with the project secretary. The information gathered from the interviews were supported and verified by using the additional information gathered from the project documents whereby an internal validity was achieved.

Furthermore, additional research on the key terminology was done. Explanations on key concepts was discussed with mentors in order to use clear definitions about end-user groups, levels and forms of involvement.

***Reflection on the impact of COVID***

Large part of this report is written during the pandemic outbreak and inspired me reflect on some of the topics mentioned in the report.

During the design of Erasmus MC new building project, Unit Infection Prevention (UNIP) had a very dominant role in defining the hospital hygiene criteria, following the 'safety first' principle and reviewing the project documents and the designs. The provision of 100 % Single patient room accommodation is a result of this approach.

During the first wave of COVID-cases, no healthcare workers were infected by patients in Erasmus MC which may be a result of a high-quality care and an environment. It is possible that intensive involvement of the infection prevention unit on design reviews has proved the worth, together with the single room accommodation and all the thoughts that had been given to safety. This example highlights the role of medical experts and added value of involving medical end-users especially the experts highly in the design and decision-making process.

The standardized layout plans made it possible to swap patient wards around the building, to clear one floor for COVID-patients. Temporary ICU units were prepared very quickly. Part of a regular ward, that had telemetry monitoring infrastructure already installed for flexibility reasons, could be refurbished in 2 weeks' time into a surge ICU with 40 beds.

Additional infrastructure and flexibility in the infrastructure in the building was advantageous. The pandemic underlined the importance of flexibility in the functional and technical design in hospital projects. Flexible design solutions did not fit for needs of all themes or end-user groups and caused some dissatisfaction and alterations in different areas in the beginning, but it paid of later and provided additional intensive care units.

*Figure 29: Standard ICU  Erasmus MC (EGM,*

*Figure 30 &31: COVID ICU Erasmus MC and telemetry infrastructure ( Van Heel, 2020)*

# REFERENCES

# 10. REFERENCES


Barki, H., and Hartwick, J. (1989) "Rethinking the Concept of User Involvement." MIS Quarterly, Volume 13, Number 1, pp. 53-64.

Becker, F., & Carthey, J. (2007). Evidence-based design: Key issues in a collaborative process. *Proceedings of the W*, *92*, 23-26.

Bel, M. (2018). BIM as a communication and collaboration tool for the design and operation phase of hospital buildings, MSc. Thesis Delft University of Technology

Bowen, G. A. (2006). Grounded theory and sensitizing concepts. *International journal of qualitative methods*, *5*(3), 12-23.

Bryman, A. (2012). *Social research methods*( 4th ed.). Oxford, Oxford University Pres.

Caixeta, M. C. B. F., Bross, J. C., Fabricio, M. M., & Tzortzopoulos, P. (2013). Value generation through user involvement in healthcare design. In Proc. 21st Ann. Conf. Int'l. Group for Lean Construction (IGLC), Fortaleza, Brazil.

Caixeta, M. C. B. F., Tzortzopoulos, P., & Fabricio, M. M. (2019). User involvement in building design–a state-of-the-art review. Pós. Revista do Programa de Pós-Graduação em Arquitetura e Urbanismo da FAUUSP, 26(48), e151752-e151752.

Clarke, A. E., & Fujimura, J. H. (1992). What tools? Which jobs? Why right. The right tools for the job: At work in twentieth-century life sciences, 3-44.

Damodaran, L( 1996). "User involvement in the systems design process - A practical guide for users"Behaviour and Information Technology, v. 15, i. 6, p. 363-377, 1996.

Design Phase (2020). *Designing buildings*.Retrieved from https://www.designingbuildings.co.uk/wiki/Design_phase

Elf, M., Fröst, P., Lindahl, G., & Wijk, H. (2015). Shared decision making in designing new healthcare environments—time to begin improving quality. *BMC health services research*, *15*(1), 1-7.

Fronczek-Munter, A.(2016). Usability Briefing for hospital design: Exploring user needs and experiences to improve complex buildings. Department of Management Engineering, Technical University of Denmark.

Hannan, M. T., & Freeman, J. (1984). Structural inertia and organizational change. *American sociological review*, 149-164.

Hamilton, D. K., Orr, R. D., & Raboin, W. E. (2008). Organizational transformation: A model for joint optimization of culture change and evidence-based design. HERD: Health Environments Research & Design Journal, 1(3), 40-60.Ilgen, D. R., Hollenbeck,

Hamilton, D. K., & Watkins, D. H. (2008). Evidence-based design for multiple building types. John Wiley & Sons.

Ilgen, D. R., Hollenbeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in organizations: From input-process-output models to IMOI models. *Annu. Rev. Psychol.*, *56*, 517-543.

Information management (2020). *Designing buildings*.Retrieved from: https://www.designingbuildings.co.uk/wiki/Information_management

J. R., Johnson, M., & Jundt, D. (2005). Teams in organizations: From input-process-output models to IMOI models. Annu. Rev. Psychol., 56, 517-543

Jensen, P. A. (2006). Continuous briefing and user participation in building projects. adaptables 2006: International Conference on Adaptability in Design and Construction, Eindhoven University of Technology.

Jensen, P. A. (2011). "Inclusive briefing and user involvement: case study of a media centre in Denmark." Architectural engineering and design management **7**(1): 38-49.

Jon, S. (2019). The Emergence of Shared Leadership in Project-based Integrated Design Teams, MSc. Thesis Delft University of Technology

Kaya, S. (2004). Relating building attributes to end user's needs:“the owners-designers-end users” equation. *Facilities*.

Kim, D. S., & Shepley, M. M. (2008). Healthcare architects' professional autonomy: interview case studies. HERD: Health Environments Research & Design Journal, 1(2), 14-26.

Kirby, p., Lanyon, c., Cronin, k., Sinclair, R(2003). Building a Culture of Participation: InvolvingChildren and Young People in Policy, Service Planning, Development and Evaluation: A Research Report.London: Department for Education and Skills.

Kujala, S. User involvement: a review of the benefits and challenges. Behaviour and Information Technology, v. 22, i. 1, p. 1-16, 2003.

Lai, J. H., and Yik, F. W. (2007). Perceived importance of the quality of the indoor environment in commercial buildings. Indoor and built environment, 16(4), 311-321.

Latortue, X., Minel, S., Pompidou, S., & Perry, N. (2015). Integration of end-user needs into building design projects: use of boundary objects to overcome participatory design challenges.

Lam, A. (2000). Tacit knowledge, organizational learning and societal institutions: an integrated framework.Organization studies, 2; 1(3), 487-513

Mujumdar, P. and J. U. J. A. e. j. Maheswari (2018). "Design iteration in construction projects–Review and directions." **57**(1): 321-329.

Whelton, M., Pennanen, A., & Ballard, G. (2005). Knowledge emergence and adaptive management: An exploration on the co-production of project needs and requirements by client-specialist groups. In Knowledge *Management in the Construction Industry: A Socio-Technical Perspective* (pp. 251-275). IGI Global.

Prins, M., Koolwijk, J., Volker, L., & Wamelink, J. (2006). Programming: Static or Dynamic? In Proceedings of the joint CIB, Tensinet, IASS International Conference on Adaptability in Design and Construction. Eindhoven University of Technology, Netherlands.

Pemsel, S., Widén, K., & Hansson, B. (2010). Managing the needs of end-users in the design and delivery of construction projects. *Facilities*.

Pemsel, S., & Widén, K. (2011). Bridging boundaries between organizations in construction. *Construction Management and Economics*, *29*(5), 495-506.

Reiling, J., Hughes, R. G., & Murphy, M. R. (2008). The Impact of Facility Design on Patient Safety. Patient Safety and Quality: An Evidence-Based Handbook for Nurses. Agency for Healthcare Research and Quality

Senaratne, S., and Sexton, M. (2008). Managing construction project change: a knowledge management perspective. Construction Management and Economics, 26(12), 1303-1311

Star, S. L., & Griesemer, J. R. (1989). Institutional Ecology, `Translations' and BoundaryObjects: Amateurs and Professionals Berkeley's Museum of Vertebrate Zoology, 1907-39. Social Studies of Science, 19(3), 387–420

Storvang, P. (2012). *Brugerinddragelse i byggeriet* (Doctoral dissertation, Ph. d. dissertation, University of Southern Denmark).

Syed, F. (2017) Increasing team collaboration by implementing shared Leadership, MSc. Thesis Delft University of Technology.

Ulrich, R. S., et al. (2008). "A review of the research literature on evidence-based healthcare design." HERD: Health Environments Research & Design Journal **1**(3): 61-125.

Van Heel,

Van Meel, J., & Størdal, K. B. (2017). *Briefing for Buildings: A Practical Guide for Clients and Their Design Teams*. ICOP.

Winch, G. M. (2009). *Managing construction projects*. John Wiley & Sons.

Yazan, Bedrettin. "Three approaches to case study methods in education: Yin, Merriam, and Stake." *The qualitative report* 20, no. 2 (2015): 134-152.

Yu, A. T. W., Shen, Q., Kelly, J., & Hunter, K. (2008). Comparative Study of the Variables in Construction Project Briefing / Architectural Programming. Journal of Construction Engineering and Management, 134(February), 122–138.

Project Documents

1. Van Heel, M.E. (2014) Lessons learned on innovative design concepts and project management. Presentation
2. Van Heel, M.E. (2020) Creating a successful hospital building environment. Manuscript
3. Erasmus MC (2016) Our New Erasmus MC: Future proof buildings.
4. HV.PON.51087 ONE PROJECT – Project repository Erasmus MC.
5. HV.PON.27375 ONE PROJECT – Project repository Erasmus MC.
6. HV.PON.27429 ONE PROJECT – Project repository Erasmus MC.

# APPENDICES

# APPENDICES

## Appendix A

## Review Matrix Template ( based on Van Heel, 2020)

**Review / Quality Assurance Matrix**

**Date:**

| Drawing No: | category<br>subject / projectteam | Remark by the reviewer | Remark made by: | | | | | | | | | | Feedback programmer / project manager (will the remark lead to a change in the reviewed document? Will a comment be passen on to the design team to address in a next phase? Is a remark not taken into consideration due to prior decision making or accepted standards? etcetera) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | RE HB&A | RE VGB | SB Facilities | SB Arbo | UNIP | SB Quality | SB I&T | User Coord. | | | |
| | | | | | | | | | | | | | **RE HB&V:** functional advisor, technical advisor, workplace expert, (internal) hospital planner from corporate real estate department<br>**RE VGB**: teamleader / MT-members of the maintenance organization<br>**SB Facilities:** user coordinator collecting input from the logistics department, cleaning, hospitality, mobility & security<br>**SB Arbo:** Ergonomics & Environmental (*)<br>**UNIP**: Unit Infection Prevention (*)<br>**SB Quality**: user coordinator providing input from quality advisors in the themes on policy, patient care and the quality information system<br>**SB I&T:** Information & (Medical) Technology<br>**User Coord.:** peers in the same role from other themes and functions<br>**(*)these units are the Safety Experts and they can have a formal responsibility for quality assuring in some organisations** |
| | | | | | | | | | | | | | |
| | Sanitary | Sufficient space must be available in front areas near washbasins for hanging a towel dispenser and waste bin | | | XX | | | | | | | | this is the standard configuration; in areas where there is insufficient space next to the washbasin, there is always room on the side wall for hanging |
| | | | | | | | | | | | | | |
| | Guardpost | Desk is place not facing the door. Doesn't work well (you want to be able to see who is entering space). | | | | | | | XX | | | | This comment is submitted to the architect. Incidentally, it should be noted that in principle this is not a area where staff will sit for a long time as they move in space. |
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Appendix B
Interview Questions

Interviewee Background

- What was your role in the project? What kind of responsibilities you had within your position?

Stakeholder & End user management (and involvement)

- Can you tell me about the end user involvement in the design process?

Probe: What kind of stakeholders (neighbors, students, staff,) involved?
Regarding … (name one stakeholder that interviewee named)
What stage they were involved and how were they involved?
Did they make suggestions to the design and what were they?
Was the user involvement approach different in different phases?

Processing the end user needs (Briefing and user involvement process)

- What was the initial idea, the vision (or criteria) about the project?

Probes: How did the idea develop?
How was it received in the project team?
Could you tell me how those ideas are translated into the building?

- Who managed information flow and who was responsible to what extent?
- How was the communication flow obtained within the team?

End user Representation (Decision making & Project team organization)

- Can you tell me about the decision-making process?

  Probes: Did you feel like you have to negotiate during the decision-making process?
  Could you give me an example what was negotiated?
  Was there a strong support in this decision?

- Was there a different decision-making approach on different parts of design?
- Who represented or voiced the needs of end users during the decision-making process or how were users represented within the design team?
- According to you to what extent the needs of end-users impacted the decision making.

Evaluation questions

- According to you how well is the initial ideas (vision etc.) were used? How was it intended and how was it designed and built and how did it work out?
- Would you apply the process the same way in another hospital project?
- What lessons you learned from the process? Do you think stakeholders (or maybe end users?) should be involved in a different way the next time?
- Was there a balance taking into account of needs of different userpha groups you think?
- What difference involving the users made? What is the yield of involving stakeholders you think?
- Can you talk about the Change Management process?

Probe: How did change management process impacted the ONE project?

Project Management Approach in Erasmus MC (Additional questions for external advisors )

- What are the differences in the design process in other projects you were involved and ONE project?
- What do you think about the Erasmus MCs approach on project management? Can you talk about the differences about the project management in Erasmus MC compared to other projects/organizations?

  Probe: Why do you think this difference occurs?