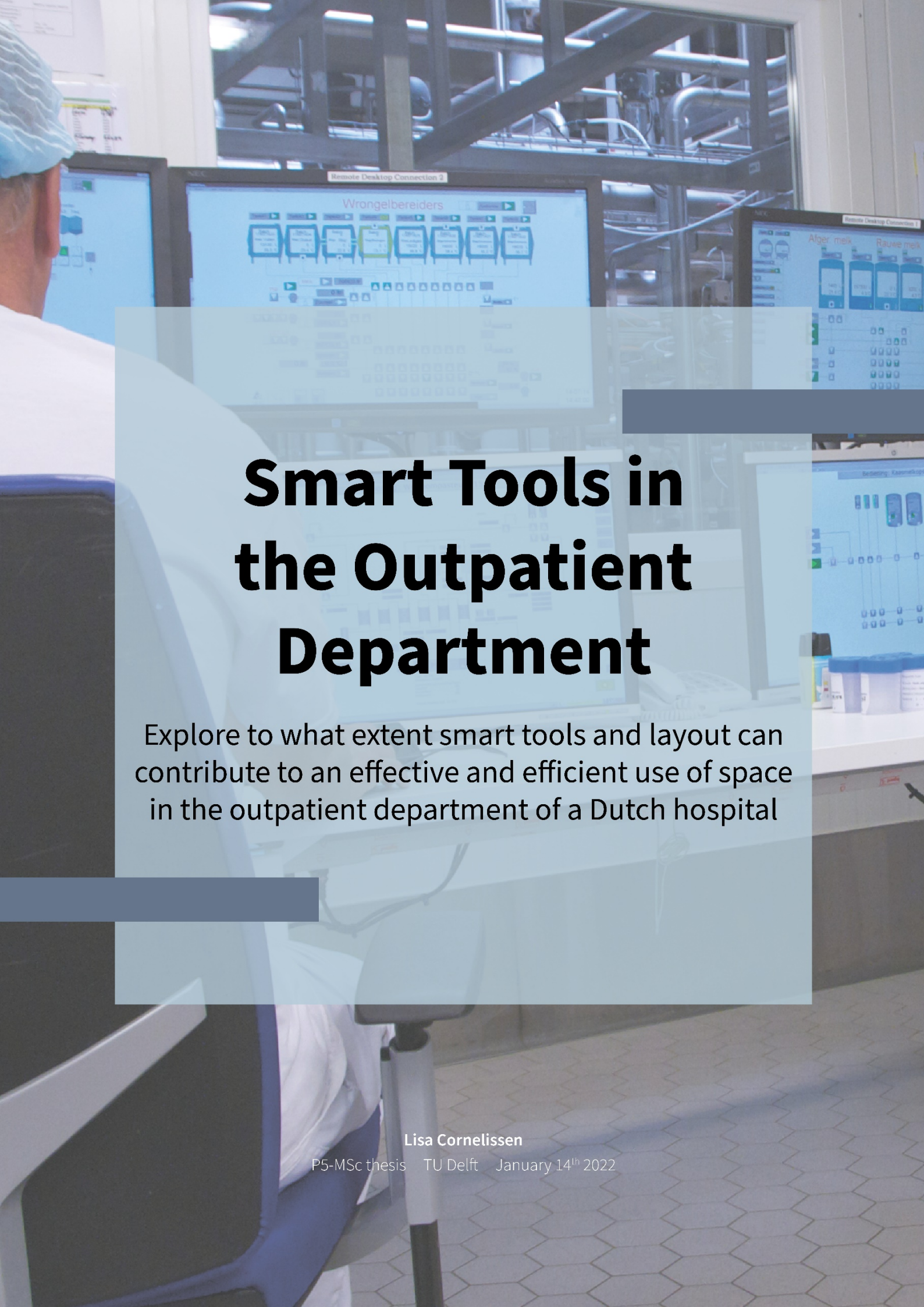

Smart Tools in the Outpatient Department

Explore to what extent smart tools and layout can contribute to an effective and efficient use of space in the outpatient department of a Dutch hospital

Lisa Cornelissen

P5-MSc thesis TU Delft January 14th 2022

~ Smart technology is a means to an end, but not an end in itself ~
(Thijs Wichers in Redactie Contentmarketing, 2021)

MSc3 AR3R010 Graduation Laboratory
Management in the Built Environment, Delft University of Technology
2020/2021

P5 Report

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Master: Architecture, Urbanism & Building Sciences
Master track: Management in the Built Environment
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Preface

Dear reader,

You are about to read the P5 master graduation thesis, written to fulfil the MSc track Management in the Built Environment. This track is positioned in the MSc programme Architecture, Urbanism & Building Sciences at the Delft University of Technology. Within this research the possibilities of the implementation of smart tools in the real estate strategy of the outpatient department of a Dutch hospital is investigated.

The past year I have dived into the two worlds of healthcare real estate and smart tools, I was lucky enough to try to combine these two topics for which I have both a fascination. The digital world fascinates me, how the technology has evaluated over the 25 years that I live is amazing, and it makes me wonder what is to come for the next 25 years. I also look with great wonder at hospital real estate, such a complex building that has to accommodate a complex organisation who has to carry out complex work processes. It is amazing to see what due to medical-technical and ICT developments is possible in diagnostic treatments. During the MSc track Management in the Built Environment my interest in Real Estate Management especially was stimulated. Particularly, the alignment between the four perspectives; organisational, financial, physical and functional based upon the stakeholders, when developing a real estate strategy. By conducting this research I hope to contribute to society, by allowing the hospital to focus on its main task, providing high quality healthcare and improve the experience of the patient.

I would like to express my gratitude to several people for guiding me through the process. First of all both my mentors from the TU Delft, Prof.Dr.Ir. Alexandra Den Heijer and Prof.dr. Paul Chan. Thank you for the valuable feedback and encouragement throughout the process. Thank you for taking the time explaining and repeating yourselves even though that may have seem inefficient sometimes, I appreciate it. Your expertise and guidance have been of great value and will be towards P5. In addition, I would like to thank the team HVG from AT Osborne and especially my mentor Robin Rudolphie, for their interesting insights in the field of hospital real estate management. Thank you for showing me examples from practice and thank you for opening up your network. Thirdly, I am grateful for all the interviewees who have provided valuable input for this research.

To conclude, it has been an interesting process and I look back at a turbulent ride with many ups and downs. I would like to thank my family and friends for the unconditional love and supporting me during the rollercoaster of emotions. The only thing left to say, I hope you enjoy reading this P5 thesis!

Lisa Cornelissen
Delft, November 2022

Abstract

The transformations the healthcare sector is undergoing can be divided into three types of changes; gradual change, sudden change and expected change. The ageing population represents the gradual change. The ageing population brings an increased demand for care, while also an increasing need for cost control and a decrease in available capacity is noticeable in the healthcare sector. The Covid19 pandemic is an example of a sudden change, an unexpected change on which needs to be acted fast. Digitalisation is a representative for an expected change in the healthcare sector. Especially since the recent Covid19 pandemic there is a growing interest among hospital organisations in digitalisation. To be able to maintain to deliver the highest quality of care under the current circumstances, new innovative strategies and lean processes need to be developed. To accommodate these transformations the real estate of the hospital will have to change. Due to the pressure on hospitals to reduce costs and improve health service accessibility, there is an increasing demand for outpatient services. With the growing interest among hospital organisations in digitisation and the lack of research on a real estate strategy for hospitals that includes smart tools, this research focuses on to what extent smart tools can optimise the use of scarce resources in the outpatient department of the hospital, taking into account the layout of the outpatient department. The following question is formulated to be answered: "To what extent *can smart tools and layout contribute to the efficient and effective use of the scarce resources in the outpatient department of a Dutch hospital?*"

To be able to answer this research question, a qualitative approach is chosen to work with. Research on the use of smart tools in the outpatient department of a Dutch hospital is still very rare, therefore a qualitative approach is recommendable. The literature review acts as the backbone of the research. The case study and semi-structured interviews are derived from the network of AT Osborne. To validate the research a project visit of a newly built smart outpatient department and an expert panel has been conducted.

The main goal of conducting this research is to find a solution for the facility and department managers of the outpatient department of the Dutch hospital to cope with the scarce resources, so the hospital can focus on its main goal 'the delivery of high-quality healthcare'.

Keywords

Hospital real estate, Outpatient department, Space utilisation, Smart Tools, Patient Journey, Future Hospitals, E-health.

Executive Summary

1. Introduction

Context

In 2006 the Dutch healthcare system became a market party with the implementation of Cutler's healthcare reform. To ensure fair competition the healthcare system was divided into three markets; the healthcare delivery market, the healthcare insurance market and the healthcare trade market. Just as in any other competitive market in terms of price-setting, transparency in the quality and type of the products delivered is key. In 2005 the Diagnosis Treatment Combinations (DTC) system was introduced to ensure this transparency in the healthcare products and to encourage an efficient way of healthcare delivery by the healthcare supplier (Van der Zwart, 2014). The insurance company is the most important financer of the hospital in the Netherlands and agrees upon a production budget which results in a production incentive for the hospital (Bouwhuis, de Rooij, & van den Berg, 2021).

The organisation of a hospital is rather complex. A lot of different stakeholders are involved, who all have their own needs and demands. These demands can be divided into four main categories of demands; the high quality of healthcare for the patients, good accessibility for the patients, a good work environment for the employees, and a financially healthy business organisation. To safeguard the continuity of the hospital, a good performance towards the patient should always be adhered (Bouwhuis, Speet & Herngreen, 2021). Real Estate adds value when it attains to the organisational objectives, which then results in the ability of the stakeholders to achieve their goals and purposes (van der Zwart, & van der Voordt, 2015).

Problem statement and scope

The healthcare sector is undergoing transformations, every few years visions on healthcare delivery change (van der Zwart, & van der Voordt, 2015). As of now three big changes are noticeable in the healthcare sector; the aging population, the Covid19 pandemic and digitalisation.

Aging comes with ailments and leads to a greater demand for care. It is precisely the care of the elderly (age 75+) that costs the most and takes the longest. Also due to medical-technical and ICT developments more and more is possible in diagnostic treatment, nursing and care. As a result, healthcare is becoming more and more complex as it requires more customization for the patient (Okkerman, 2018). Due to the Covid19pandemic the costs are higher as the Covid-care is more labour intensive and additional measures had to be taken, while the revenues are lower as most of the regular care has been eliminated. This creates a financial tension for the hospitals (Wagenaar, 2021). The support of information systems, especially in terms of process harmonisation and process digitisation, promises an improvement in quality and a decrease in costs (Afferni et al., 2018). From this, the question arises what do the above changes mean for real estate? From the increasing demand, it is expected that more spaces will be needed. But with digitisation and tele-health, this can probably be accommodated in a different way. The covid situation showed that flexibility is desirable, as well as some overcapacity.

Universities are coping with a similar kind of problem; An increased amount of students is applying, which the university has to accommodate, whilst less public funding per student is received. At the same time, there is an increase in competition with other universities which results in consistent pressure on academics to improve their performance. In addition, the requirements for the building increase every year, due to sustainability requirements, which results in an increase in investment costs per square meter. To cope with this problem, the new real estate strategy for the university includes the use of smart tools (Valks, Arkesteijn, and Den Heijer, 2018). However, the use of smart tools in a real estate strategy for a hospital is under-researched. To cope with the scarcity and challenges the hospital is experiencing, increasing demand, less financial resources, high pressure on employees and keeping up with technological developments. And to make sure the hospital can focus on its core task, providing high-quality health care, the real estate strategy should focus on

efficient use of the scarce resources. The scarce resources highlighted in this research are space in m2 and staffing. Therefore, in this research, it is being investigated how the use of smart tools can help with the efficient use of space utilisation and staff planning in the outpatient department of the hospital to be able to provide high-quality health care.

The scope of this research is on the outpatient department of the Dutch hospital. Due to the pressure on hospitals to reduce costs and improve health service accessibility, there is an increasing demand for outpatient services. And the outpatient departments form an important context within the healthcare setting (Yu, Demirli, & Bhuiyan, 2021).

2. Methodology

Research questions

Following from the problem statement there is a need to design a new accommodation strategy. There is a gap in knowledge on how to include smart tools in the management of efficient and effective space utilisation in the outpatient department. To close this gap the following research question has been formulated:

"To what extent can smart tools and layout contribute to a more efficient and effective use of scarce resources in the outpatient department of a Dutch hospital? "

In order to answer the research question, the following sub-questions have been formulated (see also figure I):

- Public Real Estate Management
  - How can the current real estate portfolio be aligned to the organisational strategy?
- The outpatient department
  - What does the outpatient department of a Dutch hospital entails?
    - *What activities take place in the outpatient department?*
    - *What are the values of the stakeholders of the outpatient department and how can real estate be aligned to these values?*
  - What is Integral Capacity Management and could this be an operating area where smart tools can be deployed?
- Smart tools
  - Which and how are smart tools used in public buildings?
  - How can smart tools be implemented in the organisation?
  - What is the influence of Big Data and IoT on the use of the outpatient department?

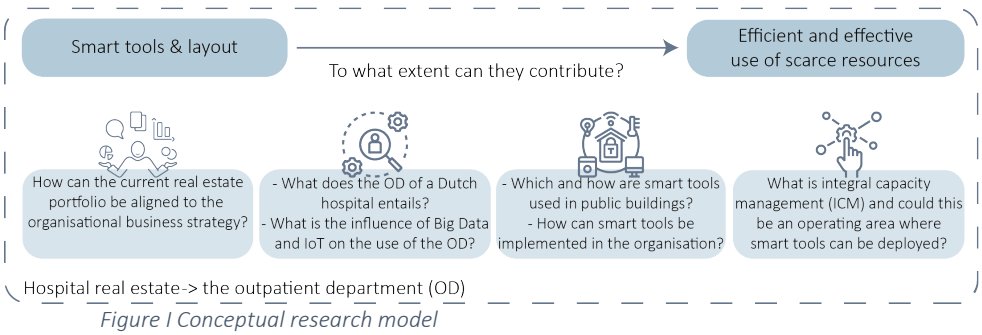


Figure I Conceptual research model

Research methodology

For this research a qualitative approach has been used. The methods used are; literature review and empirical research consisting of three case studies and 16 semi-structured interviews. The three topics, real estate management, outpatient department and smart tools were researched through literature analyses.

The cases that have been analysed are (1) WKZ in Utrecht, (2) Deventer Ziekenhuis and (3) Zuyderland in Sittard. In each of the cases the context was analysed and the organisational structure. The interviews were subdivided in the three topics; the physical outpatient department, the organisation and the use of smart tools or systems. The outcomes are validated by the visit of the newly built smart outpatient department of the Reinier de Graaf Hospital and an interview with a clinical physicist of the hospital who has been involved of the design of the project; and (2) an expert panel consisting of two professionals working at AT Osborne and one capacity manager of the HMC. *This expert panel takes place 13th December*. The selection of the cases are based upon the selection criteria as shown in figure II.

Aspect number	Aspect	Explanation
1.	Industry	The case is part of hospital real estate
2.	Project	The case is an outpatient department. The outpatient department can be part of a general hospital or can be situated in an independent clinic.
3.	Location	The project is situated in the Netherlands.
4.	Specification	Within the project real-time data is or could be measured.
5.	Specification	The hospital organisation should be willing to give insights in the current ICT infrastructure.
6.	Specification	Various specialisms are located at the outpatient department.

Figure II Case-selection criteria

3. Findings

Real estate management

Real estate has become a strategic tool for business organisation (Haynes et al., 2017). The goal of (Public) real estate management is to add maximal value to the organisation in every decision made on (P)RE portfolios (Den Heijer, 2021). According to Van der Zwart (2014) the added values of hospital real estate are: increase innovation, increase user satisfaction, improve culture, reduce costs, improve productivity, improve flexibility, support image, controlling risks, and improve financial position.

In order to align the business strategy of the hospital with its real estate portfolio, various frameworks and models can be taken into account.

- The four perspective model: by using the four perspectives model, the different stakeholders will be taken into account and the perspectives can be combined with the real estate added values.
- The DAS-frame: by using the DAS-frame demand and supply can be matched continuously. The iterative process allows for decision making in the future as well as evaluating decisions made in the past.
- The states of matter: the solid-liquid-gas model can be used to show how a real estate portfolio or part of the real estate portfolio can be managed and used. The three models are linked to each other and influence each other.

The outpatient department

A lot of different specialisms are situated in the outpatient department. These specialisms work autonomously. Integral capacity management can be used as a tool to create an integral process throughout the various subunits, to achieve coherence and consistency in decision-making and implementation at all levels in the organisation. By managing the capacities the aim is to create

alignment between supply and demand. To eventually improve the healthcare process and healthcare delivery towards the patient.

The main characteristics of the outpatient department is that of patients coming and leaving the same day. The layout of the outpatient department consist of a front office and a back office. Increasingly the front office and back office are becoming two separate units as this concept is more effective and efficient for the work process. The front office consist of areas where patients come and go; entrance, waiting area, reception, consultation/examination room, additional facilities like restroom, restaurant, etc. At the back office only the medical specialist and other staff is allowed. The back office consist of, flex work spots, concentration rooms, rooms for e-consults or phone consults, conference rooms and meeting rooms.

Values of the stakeholders of the outpatient department

The values of the stakeholder derived from the empirical research are:

- Financial perspective: reduce costs, control risks and improve the financial position. Efficient processes, so the production capacity in terms of DTC agreements can be achieved within the agreed budget with the healthcare insurer.
- Organisational perspective: efficient work processes, achieve greater uniformity in the outpatient department. Standard processes such as registration, scheduling of appointments and planning of staff and rooms should be unified and standardised. Creating more transparency between the different departments.
- Functional perspective: The users of the outpatient department are the patient and the employees; medical specialist, nurses, assistants, etc. From the user perspective, employee satisfaction and patient satisfaction are the added values. Reduce stress and decrease waiting times.
- Physical perspective: supporting the work process, making optimum use of the m2, ensuring a healthy indoor climate and achieve sustainability goals.
- And finally, flexibility is the added value of all perspectives.

Smart tools

The value of data is dependent on personal interpretation. The four levels are data, information, knowledge and wisdom. As data changes from information and knowledge to wisdom, the value increases, and so does the technological complexity. The ability to explain and predict events by analysing and combining complex datasets is called big data. Internet of Things (IoT) refers to the network of devices able to communicate to achieve smart reorganisations, process control, personal real-time monitoring, etc.

The architecture of IoT consist of three layers; sensing (data collection), network (data processing), and application (data provision). Healthcare-related IoT systems mainly focus on remote health monitoring. By monitoring non-critical patients at home instead of in the hospital, the strain on hospital resources like doctors and beds can be reduced. Smart tools are part of the sensing layer within the IoT architecture. Sensors allow the collection and processing of real-time information.

A smart tool can support the decision making process on space utilisation as it provides the user or organisation with real-time information. Most sensors applied for optimising space utilisation give the organisation insight into the occupancy of spaces or provide the user insight into how the space is used. The following type of sensors can be used to measure space use: Wi-Fi, Bluetooth, RFID, camera, infrared, use of devices, ultra-wideband and CO2 sensors.

A Hospital Control Centre is the place in the hospital where all information on supply and demand on all capacities in the hospital come together. An HCC is a means of supporting ICM. Data derived from smart tools that measure, e.g. occupancy rates, can end up in an HCC to be analysed. The organisation's foundation consists of people, and their behaviour, smart tools, HCC and ICM can support their activities.

4. Validation

To validate the research a validation project has been visited and an expert panel has been held. From the project visit it became clear that a lot is possible when working with smart tools. However, the implementation of smart tools can be limited as privacy rights must be carefully considered as well as the pleasant working atmosphere should not be endangered by the use of smart tools. During the expert panel all experts agreed unanimously to the statements. Overall, a lot can be gained in the planning issue. By generating information with smart tools, a feedback loop can be created from which lessons can be learned on how to improve. Improvement starts with creating insight and awareness, that is the most important, this will then follow by the willingness to change

The four statements are:

1. Statement 1: The primary process must become more uniform between the various specialisms. So the outpatient department becomes more of a single entity and consists of fewer 'independent islands'.
2. Statement 2: A flexible concept (separation of front office and back office & generic consultation/examination rooms) should be better utilised between different specialisms, as is already the case within the specialism.
3. Statement 3: The implementation of smart tools is more successful as the layout of the outpatient department becomes more flexible.
4. Statement 4: The Covid19 pandemic is accelerating the implementation/acceptance of smart technologies.

5. Discussion

In general, the findings from both literature review and empirical study proved to be a solid base in answering the research question.
From the findings it became clear how layout of the space contributes to an efficient way of space utilisation. However, it also became clear that just the adjustment of layout is not enough, which is why in practice the efficiency and effectiveness of the space utilisation is not yet noticeable. This can be explained by the lack of integrality of the approach to change. Providing information and insight into how space is used has proven to contribute to the efficient and effective use of space within a specialism. The next step is to apply this on the whole of the outpatient department, and create transparency between the specialisms. The research on smart tools has provided insights in possibilities to do this.

Another point of discussion is the human touch of healthcare. The patient contact is considered very important, both by the patient himself, by the medical specialist and by the secretary. This could have been better taken into account when carrying out the research.

6. Limitations

The following limitations impact the conclusion and recommendations in this research:

1. A limited number of cases have been involved in the research, due to the timeframe. If more cases could have been involved in the research, advise on the efficient use of space could have been provided per type of case.
2. The organisation of the hospital is rather complex. Decisions made on implementation of smart tools and change in space utilisation are dependent on various variables.
3. Discussing the culture of the hospital and the organisational structure is a very sensitive topic. During the interview, the interviewees were very open about change that needs to take place, however not everything that has been said can be used in the research due to sensitivity.
4. Smart tools have not yet been implemented in the outpatient departments of Dutch hospitals. Therefore to answer the question 'to what extent can smart tools contribute to an efficient and effective use of space in the outpatient department' is only based on literature and examples from other public buildings, but not yet on data from practice in outpatient department of a hospital.

7. Conclusion

From theory it can be concluded that the use of smart tools and layout can contribute to a more efficient and effective use of space. By separating the front and back office and introducing generic consultation/examination rooms, the space can be used more efficient and effective. And it is easier to facilitate the growing number of part-timers as no rooms are dedicated to one individual. In terms of smart tools, almost everything you can think of is possible. However, privacy and security risks are essential to take into account. This current research does not address this issue further. Occupancy of space can be measure by using e.g. Wi-Fi or Bluetooth. Users of the building can then be informed by the occupancy of the building e.g. through screens in central areas or by using a mobile app.

However, from practice is shown that the advantages of the layout concepts to create more flexibility and efficiency in the use of space are often not applied in practice. Smart tools as described in this research have not yet been applied in hospitals therefore the implementation in practice cannot yet been tested. All the interviewees spoken to during this research are willing to use the rooms more efficiently, because they realise that something has to change. But at the same time, they also indicate that change is very difficult within the organisation.

Here the comparison can be made to the literature. In order to realise the project, in this case the efficient use of space, a compromised solution should be made between the four perspectives. Which is exactly the goal of ICM, a department that has recently been integrated in hospital organisations. The layout of the building and the implementation of smart tools are tools to achieve the physical goal of a more efficient and effective use of space utilisation. However, to achieve the compromised solution something has to happen to the organisational goals and functional goals as well. In the case of the hospital the financial goal is hardly changeable as the healthcare insurer plays a major role in this as well as politics.

For the organisational goals to change the advice is to provide more information to the users of the spaces. And thereby, more transparency between the various units of specialisms. This transparency in information can start substantiated discussions to provide trust among the users. When this is created the final model of the hospital will consist of a mixture of the three models solid-liquid-gas .

Possibilities of optimisations that can increase the efficiency of work processes are a dashboard that includes: occupancy measured with sensors visualised in a plan, tracking of equipment to eventually be able to use function rooms multifunctional, the connection between EPD – schedule of medical specialist – room scheduling – registration kiosk/app, check-in notification of the patient (and for the patient a notification 10 min. before consultation) – reservation of rooms.

8. Recommendations

The following suggestions for future research are provided based on the findings.

1. Conduct research on the uniformity in the hospital.
2. More in depth research, zoom in on a specific area in the outpatient department
3. Cost and time of the implementation of smart tools in a hospital
4. In depth research per specialism in space utilisation
5. Change the scope of the research

The following suggestions for practice are provided based on the findings.

1. Include the users in the design process of e.g. an example
2. Conduct pilot projects with new innovations
3. Take into account security risks and privacy
4. One platform only or link the platforms
5. Be digitally independent

Glossary

The definitions and abbreviations of the subjects used in this research are shown below.

Definitions

Subject	Definition	Source
Big Data	Big data refers to the ability to track, explain and predict events by intelligently combining and analysing complex datasets from different sources.	Ottenheijm, 2015 (p.11)
Capacity	The different categories of personnel, equipment and room.	Berden et al., 2021 (p.186)
CREAM	Integrates, directs and supports the strategic alignment of all business processes and underlying business assets, including human capital, with the land, buildings and working environment of an organisation.	Haynes et al. 2017 (p.8)
Gas state	Does not exist of a fixed shape or volume, the particles are far apart of each other and can move freely in any direction from place to place.	Ryan & Norris (2014, p.11) and Ingram & Gallagher (2014, p.73)
Integral capacity management (ICM)	Planning and control of hospital resources, aimed at achieving coherence and consistency in decision-making and implementation at all levels in the organisation.	Berden et al., (2021, p.43)
Internet of Things (IoT)	Internet of things (IOT) is a network of physical objects. The internet is not only a network of computers, but it has evolved into a network of device of all type and sizes , vehicles, smart phones, home appliances, toys, cameras, medical instruments and industrial systems, animals, people, buildings, all connected ,all communicating & sharing information based on stipulated protocols in order to achieve smart reorganizations, positioning, tracing, safe & control & even personal real time online monitoring , online upgrade, process control & administration.	Patel & Patel, 2016 (p.6122)
Liquid state	It takes the shape of the container in which it is occupied, the particles are close together and are slightly able to move in any direction from place to place.	Ryan & Norris (2014, p.11) and Ingram & Gallagher (2014, p.73)
PRE	Public real estate encompasses building portfolios and land properties that serve a public purpose, that are (partly) funded with public resources – taxpayers' money – that accommodate a public function and/or are (partly) publicly accessible'.	Den Heijer, 2021 (p.16)
(P)REM	(Public) real estate management aims at adding value to performance by balancing organisational, financial, functional and physical perspectives, variables and performance criteria in every decision about PRE portfolios, matching supply and demand in time, connecting operational and strategic processes.	Den Heijer, 2021 (p.23)

Smart building	Smart Buildings are buildings which integrate and account for intelligence, enterprise, control, and materials and construction as an entire building system, with adaptability, not reactivity, at its core, in order to meet the drivers for building progression: energy and efficiency, longevity, and comfort and satisfaction.	Buckman et al (2014 p.104)
Smart tool	A smart tool is a service or product which collects (real-time) information on space use to improve the space use on the current campus on the one hand, whilst supporting decision making on the future space use on the other hand.	Valks et al. (2018, p.8)
Solid state	A fixed shape and volume, the particles are touching each other and cannot change position.	Ryan & Norris (2014, p.11) and Ingram & Gallagher (2014, p.73)
Stakeholder	An actor who (perceives he/she) will incur a direct benefit or loss as a result of the decision or project.	Winch (2010 , p.74)

Abbreviations

Subject	Definition
CBZ	College Bouw Zorginstellingen (Board for Healthcare Institutions)
CRE(A)M	Corporate Real Estate (Asset) Management
CvZ	College voor Zorgverzekeringen (Board for Healthcare Insurance)
DAS	Designing an Accommodation Strategy
DTC system	Diagnosis Treatment Combinations system
Nza	Nederlandse Zorg autoriteit (Dutch Healthcare Authority)
ICM	Integral Capacity Management
OD	Outpatient Department
(P)REM	(Public) Real Estate Management
WTZi	Wet Toelating Zorginstelling (Admission of Care Institutions Act)
WZW	Wet Ziekenhuisvoorzieningen (Hospital Facilities Act)

Graphic index

List of figures and tables.

Table of Contents

Readers Guide

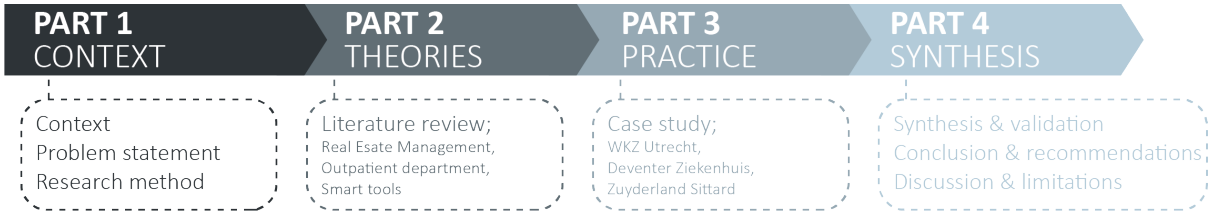
This research is divided in four parts as shown in the figure below.

In part 1, chapter 1, the context of the research becomes clear and subsequently the problem statement. After the problem statement the scope is determined, following by the societal and scientific relevance of the research. Chapter 2 the methodology is explained, this includes the research questions, research methods, data collection and data analysis, goals and deliverables and theresearch plan.

Part 2 consist of the literature review and is subdivided into three parts. First in chapter 3.1 real estate management theories are outlined, followed by chapter 3.2 in which the Dutch hospital and outpatient department are described and this part ends with a literature review on smart tools in chapter 3.3

Part 3 consist of the empirical study consisting of the analyses of three case studies; The WKZ in Utrecht, Deventer Ziekenhuis and Zuyderland in Sittard. Interviews are analysed followed by a cross-case analysis and a conclusion.

The final part, part 4 comprises the synthesis. The findings from the previous chapters are linked and the main research question is answered. The findings are discussed in the discussion and the limitations are outlined. Recommendations for further research are given and this part concludes with a reflection on the research.



1. Introduction

In this chapter, the research context is first covered, following the problem statement, the scope of the research and the societal and scientific relevance.

1.1 Research context

The content of this research entails the outpatient department of the Dutch hospital and to what extent smart tools and the physical layout of the outpatient department can contribute to efficient and effective use of space. To understand the problem statement and scope of this research, first, the context of the Dutch hospital and healthcare system is outlined. In 2006 all three waves of Cutler's healthcare reform were implemented in the Dutch healthcare system. With this, the Dutch healthcare system became a market party under the supervision of the Dutch government, as elements of competition were introduced. The primary reason for introducing these competition elements in the healthcare system is to stimulate efficiency within the hospital (Van der Zwart, 2014). To ensure fair competition, the Dutch healthcare system is divided into three different markets, which balance each other: the healthcare insurance market, the healthcare trade market, and the healthcare delivery market, see figure 1.01. At the healthcare insurance market, patients are free to choose their insurance company. At the healthcare trade market, insurance companies can efficiently buy healthcare services. And at the healthcare delivery market, patients can choose the preferred medical specialist. The competition element is a triangle between quality, cost, and efficiency. Just as in any other competitive market in terms of price-setting, transparency in the quality and type of the products delivered is key. According to Brekke, Cellini, Siciliani, and Straume (2010), it depends on the transparency of the market and the price regulations whether the competition has a positive influence on the quality of healthcare delivery. In 2005 the Diagnosis Treatment Combinations (DTC) system was introduced to ensure this transparency in the healthcare products and to encourage an efficient way of healthcare delivery by the healthcare supplier (Van der Zwart, 2014). Only a part of the product within the DTC system was freely negotiable, this percentage extended over time, from 20% in 2008 to 70% in 2012. However, the primary focus of the contract negotiations between the insurer and provider was mainly about price rather than quality. Nonetheless, hospitals in the Netherlands are not-for-profit organisations, therefore they may not be prepared to obtain a competitive advantage at the expense of quality (Roos, van Doorslaer, O'Donnell, Schut, & Varkevisser, 2018). The insurance company is the most important financer of the hospital in the Netherlands and agrees upon a production budget which results in a production incentive for the hospital. The MSB (specialist medical company) is the biggest supplier of the hospital in the Netherlands. With most of the attention devoted to these two parts of the organisation, less attention remains on other topics like new innovations or business operations (Bouwhuis, de Rooij, & van den Berg, 2021).

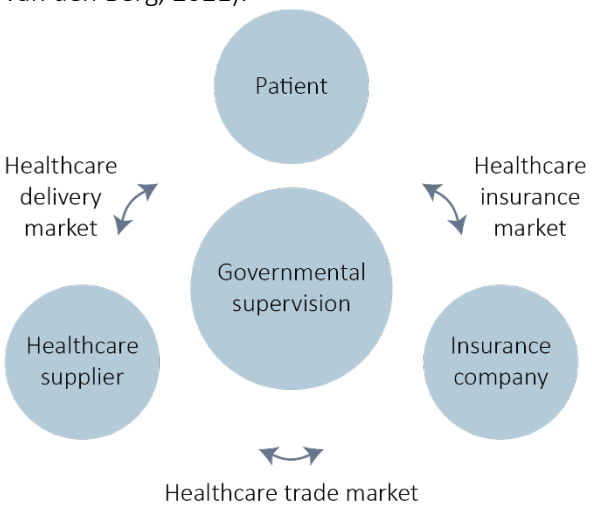


Figure 1.01 Healthcare market in the Netherlands (van der Zwart, 2014)

The organisation of a hospital is rather complex. A lot of different stakeholders are involved, who all have their own needs and demands. These demands can be divided into four main categories of demands; the high quality of healthcare for the patients, good accessibility for the patients, a good work environment for the employees, and a financially healthy business organisation. To safeguard the continuity of the hospital, a good performance towards the patient should always be adhered. To ensure good performance towards the patient the right balance between the four categories of demands before mentioned is of importance. To really make a difference as a hospital, this balance needs to be brought to a higher level (Bouwhuis, Speet & Herngreen, 2021). Real Estate adds value when it attains to the organisational objectives, which then results in the ability of the stakeholders to achieve their goals and purposes. The added value of hospital real estate can be divided into 9 types of added value, which can be categorised into three clusters of added value as shown in figure 1.02. These clusters are based upon the objectives of the organisation, which can be translated into the building. The added value of real estate is the match between supply and demand. The supply is represented by the real estate and the demand is represented by the demands or objectives of the stakeholders. It is shown that different values have priority in different phases of the building cycle; the initiation phase, the design phase, and the use phase. But that the most important values are the ones that make other values possible. Like a good financial business plan and risk control is important in attaining the other added values of real estate (van der Zwart, & van der Voordt, 2015).

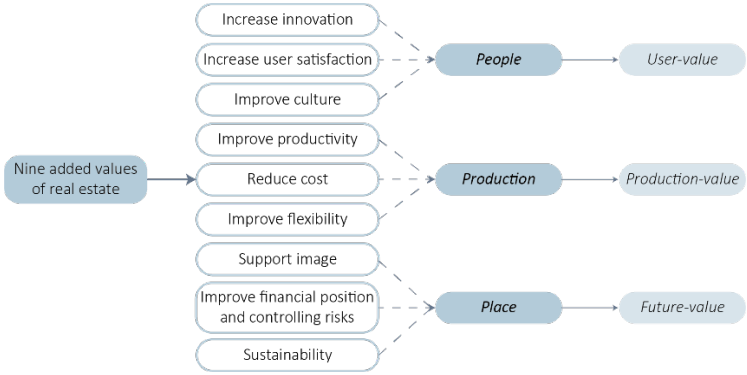


Figure 1.02 added values of hospital real estate (van der Zwart & van der Voordt, (2015)

As mentioned real estate adds value when it contributes to the objectives of the stakeholders. Den Heijer in her model (2021) classifies four types of stakeholders, which have either the focus on institution or real estate and a distinction can be made between operational or strategic level. In her research she describes potential added values expressed in indicators for each perspective that has an impact on public real estate (figure 1.03). And therefore could also have impact on hospital real estate.

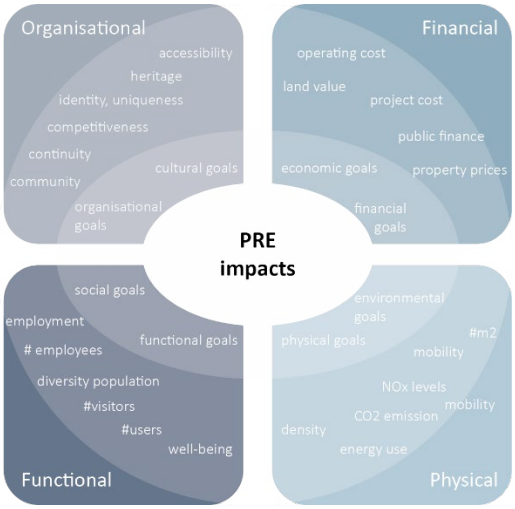


Figure 1.03 multi-perspective impact of public real estate decisions (Den Heijer, 2021)

According to van der Zwart & van der Voordt (2015), real estate is for the hospital an important resource in supporting its main purpose, namely the delivery of affordable high-quality healthcare. To achieve this main purpose, the hospital and its organisation can be looked at from two different perspectives. The production aspect and the process aspect. In terms of the production aspect, efficiency is an important concept. It is assumed by managers that efficiency, in terms of patient logistics and well-organized healthcare processes, is proved most helpful for patients as it supports customer and employee satisfaction and labour productivity. In terms of the process aspect, flexibility is an important factor. As the vision on healthcare delivery is changing with the years, the hospital should be resilient enough to cope with these changes. Within the healthcare process, four categories of patient flows are noticeable; acute, urgent, elective, and chronic, on which the building concept is based. Due to the new regulations in 2008, the hospitals became the owner of their real estate and had to organise the financing of their real estate within the existing healthcare delivery budget. As a result, investments and running costs became dependable on the production in terms of diagnosis-treatment combinations. This business-like approach resulted in a shift in focus, from maximum capacity and quality based upon maximum m2 and cost per bed, to fewer capital expenses and increasing productivity. Also, the quality/cost ratio became important in maintaining a strong market position. Health insurers have become stricter in selecting healthcare suppliers and in refunding expenses of patient's healthcare. As a result, not every hospital will deliver all types of healthcare, and collaborations between hospitals will emerge. Two types of collaboration can be distinguished. A horizontal collaboration; all top clinical healthcare is situated in one central location and in the region are several outpatient centres and day care hospitals. A vertical collaboration; to deliver healthcare in the region hospitals are building partnerships with general practitioners, home care, and elderly organizations. To facilitate the delivery of the right healthcare in the right place, real estate management is used (van der Zwart, & van der Voordt, 2015), and will be operationalised in chapter 3 and 4.

1.2 Problem Statement

The healthcare sector is undergoing transformations, every few years visions on healthcare delivery change (van der Zwart, & van der Voordt, 2015). These transformations can be divided into three types of changes; a gradual change, a sudden change, and an expected change.

The gradual change noticeable in the healthcare sector is that of the aging population. Aging comes with ailments and leads to a greater demand for care. It is precisely the care of the elderly (age 75+) that costs the most and takes the longest. (Okkerman, 2018). An increased demand for care is not necessarily the problem. The problem lies in the fact that hospitals are not allowed and cannot grow along with the demand for care. To keep healthcare affordable and to deliver it at the right place at the right time, hospitals will have to stay at the zero line, which means they cannot expand, as decided in the 'Hoofdlijnenakkoord Medisch-specialistische Zorg 2019-2022' (Het Ministerie VWS, 2018). Also due to medical-technical and ICT developments more and more is possible in diagnostic treatment, nursing and care. As a result, healthcare is becoming more and more complex as it requires more customization for the patient, the mortality rate for certain diseases has decreased, and as a chronically ill person, one can still live well with the remaining limitations. This greater demand for care causes a rise in healthcare expenditures. On the other hand, there is an increasing need for cost control and a decrease in available capacity (Okkerman, 2018). Capacity in terms of space, staff, equipment, and specialists time (Frank, 2006).

The Covid19 virus, which was declared a pandemic on the 11thof May 2020, caused a sudden change in the use of real estate of the hospital. The patients diagnosed with Covid19 had to be well isolated from other patients in the hospital to avoid them from getting contaminated with the virus. Health care personnel had to wear protective clothing in the containment zones which has to be immediately disposed once leaving this zone. Outpatients were only allowed to go to the hospital when really necessary and otherwise, a telephone or online consultation had to suffice. The entrance and exit had to be separated from each other to have a smooth patient flow and patients waiting in

the waiting room should be able to keep a 1,5-meter distance. Also, it was suggested to only use 50% of the outpatient department rooms during the day, so the next day the other 50% could be used and always sanitize the rooms at the end of the day (Lal, Sharma, Patralekh, Jain & Maini, 2020). Due to this pandemic the costs are higher as the Covid-care is more labour intensive and additional measures had to be taken, while the revenues are lower as most of the regular care has been eliminated. This creates a financial tension for the hospitals (Wagenaar, 2021).

Next to the sudden change of the Covid19 pandemic, an expected change is on its way in the healthcare sector, the change of digitalisation. According to Hufnag, Doctor, Behrens, Buck & Eymann (2019), to cope with the current challenges the hospital is facing, new innovative strategies and lean processes need to be developed in order to maintain the highest possible quality of care. To create value in the hospitals the drivers of digitalisation can be used. Through the use of information systems, a smart integration of system components, and a mindful consideration of users and all stakeholders involved, value in the hospital can be created. The support of information systems, especially in terms of process harmonisation and process digitisation, promises an improvement in quality and a decrease in costs. Afferni et al. (2018) give the following examples of the improvement of the work process at the outpatient department by using technologies; e-health, online consultation so patients don't always have to go to the hospital, registration kiosks/apps so registering at a desk is not necessary anymore, etc.

Recently, the Covid19 pandemic has functioned as a catalyst in the growing interest among hospital organisations in digitalisation and integral capacity management (ICM). Where ICM is used as a tool to match supply and demand in the best possible way. This tool is particularly aimed at planning and staff deployment, spreading consultation hours evenly throughout the week (Interview F1, 2021). A similarity can be noticed here with real estate management (REM), both focus on matching supply and demand and connect the strategic and operational processes (Den Heijer, 2021). On the other hand, there is also a difference between the two concepts. Where (P)REM focuses on the alignment between real estate and the objectives of the stakeholders now and in the future. ICM focuses mainly on the alignment between the production capacity of the organisation and the tailored production agreements with the health insurer (DTC agreements) (Interview E1, 2021). However, what do the above changes mean for real estate? From the increasing demand, it is expected that more spaces will be needed. But with digitalisation and tele-health, this can probably be accommodated in a different way. The covid situation showed that flexibility is desirable, as well as some overcapacity.

So far, we know hospital real estate has to change to accommodate the before mentioned changes (aging population, Covid19/future viruses and digitalisation) in the healthcare sector. According to Van der Zwart & Van der Voordt (2015), a key issue in the real estate design of the hospital and the management of the hospital building-in-use is supporting efficient healthcare processes. To cope with these changes the work processes in hospitals must become more efficient, to be able to accommodate the generally recognised motto "the patient is central". If not, the cost of care and real estate will become too high. In addition, in today's times of scarcity, no-shows or last-minute cancellations are very costly and impactful and thus should be avoided as much as possible. As mentioned in the research context hospitals are their own financiers of their real estate since 2008. Arcadis recommends the hospitals to spend no more than 10% to 12% of their total budget on its real estate, some hospitals are exceeding this limit. This could cause hospitals to cut staff costs (van Aartsen, 2017).

The problems hospitals are coping with described above do not only occur in hospital real estate, when comparing the research of Valks, Arkesteijn, and Den Heijer (2018), universities are coping with a similar kind of problem. An increased amount of students is applying, which the university has to accommodate, whilst less public funding per student is received. At the same time, there is an increase in competition with other universities which results in consistent pressure on academics to improve their performance. In addition, the requirements for the building increase every year, due to sustainability requirements, which results in an increase in investment costs per square meter. These problems for hospitals and universities are quite comparable. According to the

research done by Valks, et al., (2018), the new real estate strategy for the university includes the use of smart tools. These smart tools are mainly focused on the frequency and occupancy of the space use and are thereby aimed at using the space more effectively rather than efficiency. Examples of measurement methods to collect real-time date on campuses are mostly PC login and self-booking systems and in some examples sensors like Wi-Fi, Bluetooth, RFID, cameras and infrared are used (Valks et al., 2018). However, the use of smart tools in a real estate strategy for a hospital is under-researched. To cope with the scarcity and challenges the hospital is experiencing, increasing demand, less financial resources, high pressure on employees and keeping up with technological developments. And to make sure the hospital can focus on its core task, providing high-quality health care, the real estate strategy should focus on efficient use of the scarce resources. The scarce resources highlighted in this research are space in m2 and staffing. Therefore, in this research, it is being investigated how the use of smart tools can help with the efficient use of space utilisation and staff planning in the outpatient department of the hospital to be able to provide high-quality health care.

1.3 scope

The hospital organisation consists of a lot of different disciplines and departments (Bouwhuis et al., 2021). In the outpatient department, a mismatch between supply and demand can result in long waiting times or under-utilisation of resources. This is often seen as poor capacity or resource management. As a consequence of the limited resources, the expanding patient demand, and increasingly complex patient flow, resource planning and control are becoming very important in the outpatient department (Munavalli, Rao, Srinivasan, Manjunath, & van Merode, 2017). According to Yu, Demirli, & Bhuiyan (2021), for practitioners and hospital managers, the outpatient departments (OPDs) form an important context within the healthcare setting. Due to the pressure on hospitals to reduce costs and improve health service accessibility, there is an increasing demand for outpatient services. Therefore, the scope of this research is on the outpatient department in Dutch hospitals. With the growing interest among hospital organisations in digitalisation and the lack of research on a real estate strategy for hospitals that includes smart tools, this research focuses on how smart tools can optimise the use of scarce resources in the outpatient department of the hospital.

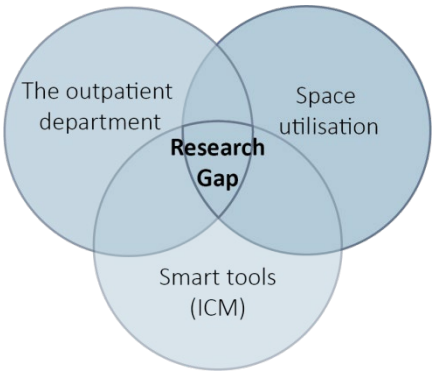


Figure 1.03 The gap of knowledge between the outpatient department, space utilisation and smart tools (ICM) (own illustration)

1.4 Societal and Scientific Relevance

1.4.1 Societal Relevance

Research into the use of smart tools in the outpatient department in Dutch hospitals has the following societal relevance.

The goal of this research is to give real estate managers of the hospital a better insight into the possibilities of using smart tools in the outpatient department of the Dutch hospital and provide them with advice to manage the square meters and staffing as effectively and efficiently as possible.

According to Bouwhuis et al. (2021) there is a growing interest in digitalisation among hospital organisations. Integral Capacity Management (ICM) is a hot topic among hospital organisations and they are becoming more interested in Hospital control centres (HCC) (Baanstra, 2021). ICM is proving especially urgent in the current Covid era we are in. Because of the pandemic, hospitals are constantly scaling up and down, in order to be able to continue regular care as much as possible. Flexibility and resilience are important concepts in this respect. How smart tools are used in the strategy of the campus will suffice in this research as an example of how it may be used in the strategy of the hospital. By conducting this research the use of smart tools in the real estate strategy of the hospital may be incentivised. Thereby, from this research it may be concluded that Integral capacity management (ICM) can be seen as a smart tool in the real estate strategy of the hospital.

A consequence of gaining knowledge on how to use smart tools in the outpatient department is to gain knowledge on to what extent smart tools in the real estate strategy of the hospital can contribute to covering the mismatch between supply and demand. By making efficient use of the square meters and staffing within the outpatient department, the patient experience can be optimised. Long waiting times or underutilisation of resources can be taken care of, and the hospital can focus on its main aim which is providing the patient with high quality and good accessible health care.

1.4.2 Scientific Relevance

Research into the use of smart tools in the outpatient department in Dutch hospitals has the following scientific relevance.
This research attempts to create a more efficient and effective use of the space in the outpatient department of the Dutch hospital by making use of smart tools. The outcome of this research may contribute to answering questions deriving from the research gaps within this related field of research.

First, digitalisation and smart technologies are concepts which cannot be ignored anymore in the healthcare sector. However, very little research has been found on the use of smart technologies in general in a hospital, only a few papers have been found on Hospital 4.0, which refers to Industry 4.0 in the health domain. Where healthcare professionals and patients are connected to the organisation, methodology and technology of Industry 4.0 (Afferni et al., 2018). Hospital 4.0 refers to the implementation of digital information and communication technologies in the healthcare sector (Tortorella, Saurin, Fogliatto, Rosa, Tonetto, & Magrabi, 2021). This research will, therefore, provide an addition to the body of knowledge on the use of smart technologies in hospitals.

Secondly, the outpatient department forms an important context within the healthcare setting. However, low resource utilisation and long waiting times are a big issue in outpatient departments. Research on how to increase resource utilisation and decrease waiting times has been done over the years. Yu, et. al. (2021) for example describe a lean transformation framework that identifies a balanced patient demand. This research may contribute to developing our understanding of how to best cope with the high variability of demand in the outpatient department.

Finally, this research attempts to identify resilient strategies that includes the use of smart tools that generate real-time data, to optimise the space use in the outpatient department and the deployment of the medical specialists. So that underutilisation of resources and long waiting times will be prevented as much as possible. By performing this research, comparisons ban be done between this research and research in the related field of research.

2. Methodology

In this chapter the research design is outlined. Starting with the research questions, followed by the research method and finally the research output.

2.1 Research Questions

As follows from the problem statement, the main problem the hospital is facing is a decrease in available capacity, in this research the focus is on space utilisation (m2) and staffing, and an increase in demand for healthcare which results in an unbalanced supply and demand in the hospital. Since there is an increasing demand for outpatient services and a growing interest among hospital organisations in digitalisation, the main research question for this thesis is formulated as follows:

"To what extent can smart tools and layout contribute to a more efficient and effective use of scarce resources in the outpatient department of a Dutch hospital? "

To be able to answer the main research question, the following sub-questions are formulated:

Question	Purpose	Method
Public Real Estate Management		
How can the current real estate portfolio be aligned to the organisational strategy?	To provide a framework on how to align the business strategy of the hospital with its real estate portfolio by using PREM	Literature review
The outpatient department		
What does the outpatient department of a Dutch hospital entails?	To get insight into what the outpatient department entails, what concepts can be applied, determine what patients and medical specialists in this department need. To be able to align supply and demand. The user journey is becoming clear.	Literature review, interviews & case studies
• *What activities take place in the outpatient department?* • *What are the values of the stakeholders of the outpatient department and how can real estate be aligned to these values?*		
What is Integral Capacity Management and could this be an operating area where smart tools can be deployed?	To anticipate current developments and hot topic in the healthcare sector.	Literature review & interviews
Smart tools		
Which and how are smart tools used in public buildings?	To get insight into what smart tools are and how they can be used.	Literature review & Case study
How can smart tools be implemented in the organisation?	To get insight into if and how smart tools can be implemented in the organisation.	Literature review & interviews

What is the influence of Big Data and IoT on the use of the outpatient department?	To anticipate changes in the near future.	Literature review

Table 2.01 Research questions (own table)

By having these categorized sub-questions, the thesis is divided into three layers: The first layer is that of the health care delivery, the second layer is that of the hospital real estate supporting the health care delivery and the third layer is that of smart tools supporting the hospital real estate.

2.2 Research method

In this section is outlined what type of study is chosen and why. It will become clear how the data for this research is selected and why a certain way to do this is chosen. To make sure a suitable answer on the main research question can be given, careful planning of this data selection is of essence. In figure 2.02 the conceptual model shows the relation between the two main concepts within this research.

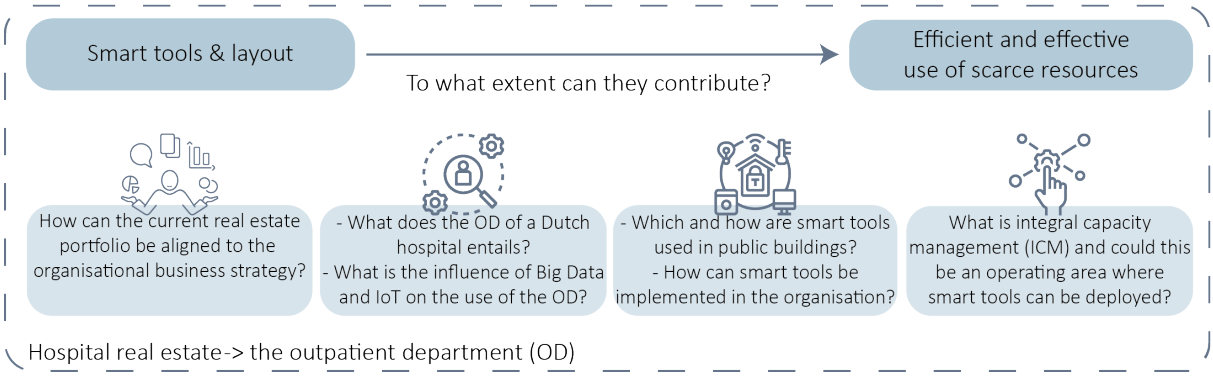


Figure 2.02 Conceptual research model

2.2.1 Type of study

According to Bryman (2016) regarding the epistemological and ontological considerations and the connection between theory and research, a research strategy can be divided into quantitative research or qualitative research. Quantitative research is generally characterised by a deductive logic of inquiry and the orientation of the research is testing of theory. Qualitative research is generally characterised by an inductive logic of inquiry and the orientation of the research is the generation of theory. The topics smart tools, space utilisation and the outpatient department have been researched separately. However, research on the use of smart tools in combination with space utilisation in the outpatient department is very rare and is yet to be addressed in the academic field. To answer the research question mentioned in the previous paragraph a qualitative exploratory research design is applied. As the intention of this research is to derive new information rather than to confirm an existing theory.

In figure 2.03 a framework of the research design for this research is shown. According to Bryman (2016), research design creates a framework on how to collect and analyse data. The research design is formed by two main methods; 1) theoretical study, and 2) empirical study. As can be seen, the problem statement and thus the reasoning for the research is mostly conducted by means of a theoretical study, the literature review. In addition, the theoretical study aimed to create a clear definition of the used concepts. The empirical study, focuses on evaluating real-case scenarios

and the further development of the literature-based framework based on what is found during the case studies. The output of both the theoretical study and empirical study is the future strategy for managers of the outpatient department on how to use the square meters most efficiently by making use of smart tools.

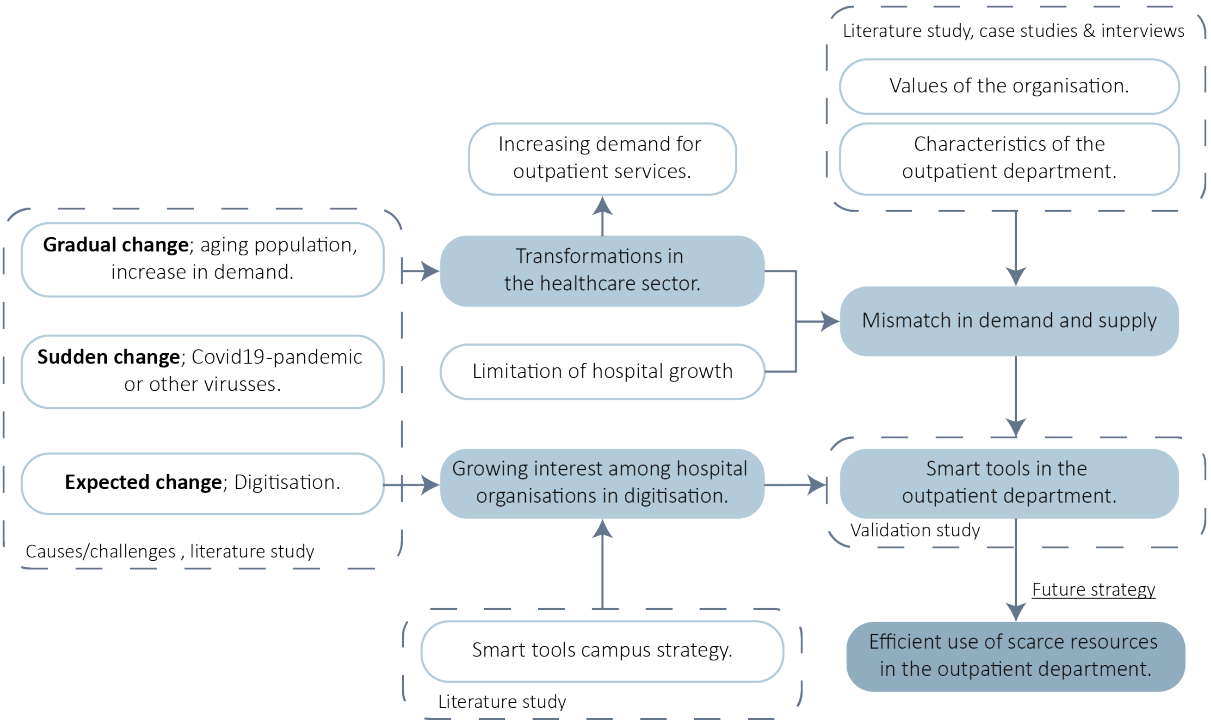


Figure 2.03 Framework research design (own illustration)

2.2.2 Methods and techniques to be used

In figure 2.04 is displayed the methods and techniques to be used for this research and the relation with answering related research questions. Chronologically the literature review is done first to create a solid base and enough knowledge, as the next step is analysing the case studies and conducting interviews. The findings from the literature review, case studies and interviews can be tested in a validation study. Finally to validate the research an expert panel is used to finalise the research and answer the research question. To ensure all necessary data can be collected in time, some flexibility in this scheme should be taken into account. It may be necessary to go back and forth between the literature review and case studies/validation study depending on the data that is collected and data that proves necessary. The different methods used in this research will now be explained in more depth.

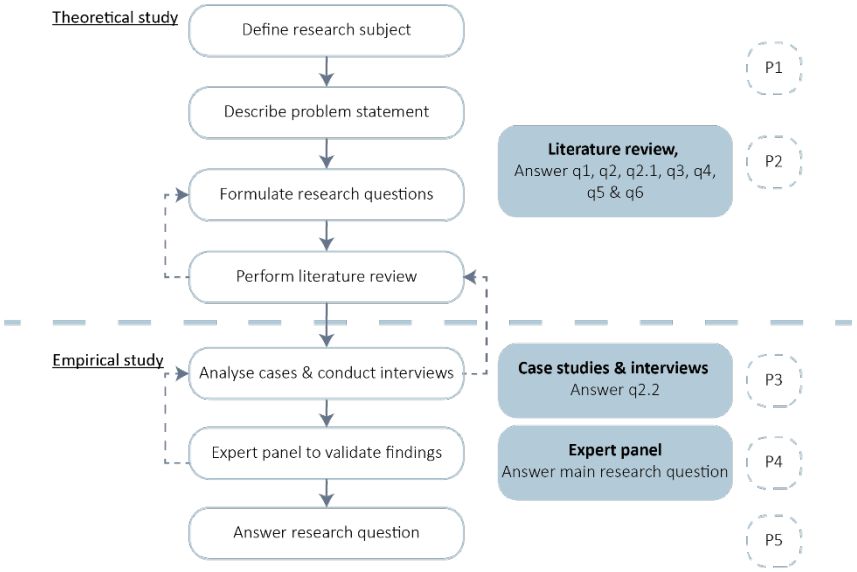


Figure 2.04 Methods and techniques to be used (own figure)

Theoretical study

The first part of this research started off with a theoretical study, which consist of a literature review. To identify the current body of knowledge on space utilisation, the outpatient department, the organisation of the outpatient department and smart tools. The gained knowledge from the literature review is used to review the main ideas after defining the research questions. In addition, the literature review is an ongoing component of the research project and not a distinctive phase in the research process (Bryman, 2016). And therefore, the literature review is an iterative process. The literature review can be found in chapter 3. The author obtained the definitions and findings from scientific journals, scientific reports, books and conferences. All of the findings have been acknowledged, but the most relevant sources have been selected and used as the basis of the analysis. To create a clear overview the literature review has been divided into three main parts Real Estate Management, The Dutch hospital and Smart tools.

Empirical study

The second part of this research consists of the empirical research. The data retrieved from the empirical research will be applied for testing the theoretical basis. The data for the empirical research will be conducted from case studies, a validation study and qualitative interviews.

Case Study

According to Thomas (2021) a case study is executed to focus on a particular aspect that is analysed across different cases in different contexts. The case study in itself is not a method but a design frame for the research. Therefore, the case study should be built around the question. A distinction can be made between a single-case and a multiple-case study design. A multiple-case study design includes a single unit of analysis which is analysed across different cases (Yin, 2018). The multiple-case study design is applied for this research. The main question is how the actual space in the outpatient department can be used more efficiently and how smart tools can contribute to this efficiency. Therefore, the main unit of analysis is smart tools and how the tools affect space utilisation. For the selection of the cases is looked at a threefold classification of different outpatient departments based on their space utilisation, as schematically shown in figure 2.06.

According to Gerring (2004), generally in depth research is preferred over scope in case study design. However, to get a full range of different ways of space-utilisation and how smart tools can contribute to its efficiency, the cases are picked accordingly a rigid space utilisation, a somewhat flexible space utilisation and a flexible space utilisation. The ambition is to touch upon a variety of

ways of space-utilisation within the outpatient department and to find a way on how to engage smart tools in creating a more efficient way of space utilisation.

To choose particular cases for the researcher different techniques can be used. At first a distinction can be made between probability sampling and non-probability sampling (Etikan, et al., 2016). As for this research particular characteristics are in mind in terms of the population, therefore a non-probability sampling technique is used. Furthermore, a non-probability sampling can be divided into convenience sampling and purposive sampling, which one to choose depends on the type, nature and purpose of the study. Convenience sampling can be used for both qualitative research and quantitative research, while purposive sampling is mostly applicable to qualitative studies (Etikan, et al., 2016). The technique used for choosing cases for this research is maximum variation sampling (MVS), which is part of the purposive sampling method. With MVS is looked at the subject from all available angles; in this case rigid, somewhat flexible and flexible space utilisation, to achieve a greater understanding.

For the cases to be representative, they should be comparable and therefore not have too many significant variables. Hence are the following aspects used on which the cases are selected: industry, project, location and two specifications. In table 2.05 is formulated the criteria for the selection of the cases:

Aspect number	Aspect	Explanation
1.	Industry	The case is part of hospital real estate
2.	Project	The case is an outpatient department. The outpatient department can be part of a general hospital or can be situated in an independent clinic.
3.	Location	The project is situated in the Netherlands.
4.	Specification	Within the project real-time data is or could be measured.
5.	Specification	The hospital organisation should be willing to give insights in the current ICT infrastructure.
6.	Specification	Various specialisms are located at the outpatient department.

Table 2.05 Case-selection criteria

The selected cases

For the selection of the cases the network of AT Osborne has been used. The following cases have been selected based upon the selection criteria mentioned above.

1. WKZ Utrecht (classic)

Source (WKZ, n.d.)

2. Deventer ziekenhuis (somewhat flexible)

Source (Talens, 2020)

3.Sittart-Geleen Zuyderland ziekenhuis (flexible)

Source (AD, 2019)

Validation study

To validate the research first the newly built smart outpatient department of the Reinier de Graaf Hospital is visited and an interview, with a clinical physicist of the hospital who has been involved of the design of the project, has been conducted. The outpatient department of Reinier de Graaf in Voorburg is opening its doors January 2022. This newly built isolated outpatient department has an integrated smart technology system of B-grid. Therefore, it is a great opportunity to test the findings on smart tools and the relation with efficient space use. As the outpatient department is only opening its door in January the actual space use cannot be measured due to the timeline of this

research, as the outpatient department is not operating yet. In addition to the project visit, an expert panel is executed to validate the research.

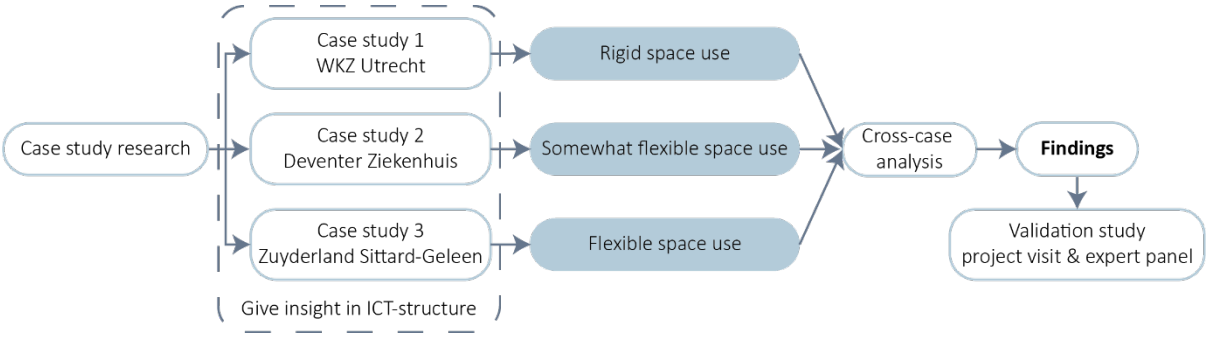


Figure 2.06 Set up case study & validation study

Interview

To retrieve more detailed data from within the organisation semi-structured interviews will be conducted. Semi-structured interviews allow for open ended data to explore thoughts, feelings and beliefs of the participants on a particular topic (De Jonckheere & Vaughn, 2019). The main goal of the interviews is to obtain an understanding of the opinion on digitalisation and smart tools from the stakeholders involved. Therefore, for every case the following stakeholders will be interviewed; the facility or capacity manager, a nurse and a doctor (figure 2.07).

Figure 2.07 Interviewees

To investigate whether the interview questions generate the answers that can contribute to the research, a test interview will be conducted first. This test interview takes place at AT Osborne with a consultant from the company who works with capacity managers and has knowledge about integral capacity management. The set up interview protocol can be found in appendix A.

2.2.3 Data collection and validation

As explained in the methods and techniques chapter, data for this research is collected through a literature review, case studies and interviews. In the table below is outlined the relation between the research questions, research method and data collection. The data collection tab mainly displays the resource through which the data was obtained.

Steps	Focus	Research Methods	Data collection
Problem definition	Problem formulation	Preliminary literature review	Scientific publications (from Google Scholar, Scopus and internet), The news
Theoretical study	What does the outpatient department of a Dutch hospital entails?	Literature review	Scientific publications (from Google Scholar, Scopus and internet)
	How can real estate be aligned to the values of the stakeholders?		
	What is the influence of Big Data and IoT on the use of the outpatient department?		
	Which and how are smart tools used in public buildings?		
Empirical study	What are the values of the stakeholders of the outpatient department?	Case studies & Interview	Document analysis, observations and semi-structured interviews
	How are smart tools already used in hospitals?		
	How can smart tools be implemented in the organisation?		
	What is Integral Capacity Management and could this be an operating area where smart tools can be deployed?		
Synthesis	How can smart tools and layout contribute to a more efficient and effective use of the scarce resources of the outpatient department of a Dutch hospital?	Validation study	Input theoretical study and empirical study

Table 2.08 relation between research questions, method and data collection

In terms of validation of the research, findings from different cases are more significant then findings from a single case (Yin, 2018). Another strategy applied to increase the validity is the execution of a test interview. Due to this test interview it is made sure off that the interview questions are accurate, that none are missing and that none are unnecessary. And finally to validate the outcomes of the research an expert panel will be set up. Next to the validation of the empirical study, the literature study has been validated by making use of more than enough sources and papers. This way of validating the research is called the triangulation of data, as multiple methods and sources are used to collect data on the same topic (Yin, 2018).

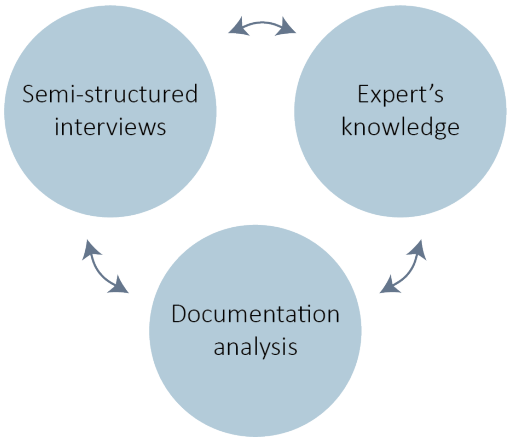


Table 2.09 Triangulation of research (Yin, 2018)

2.2.4 Data plan and ethical considerations

According to Wilkinson et al. (2016), good data management is key in knowledge integration and the reusability of data. Therefore, the FAIR principles have been drawn up, which state that scientific data should be findable, accessible, interoperable and reusable. This MSc thesis will meet these requirements in the following way:

- Findability: all data will be stored locally and once graduated the MSc thesis will be uploaded on the education repository of Delft University of Technology. This is where the thesis can be downloaded.
- Accessibility: if (raw) data, that is not included in the final MSc thesis, is desirable, the author can be contacted by email or phone number. Should there be any confidential or sensitive data, it will be prevented that third parties have access to it, this data will be blurred out. Approval will be requested from the participants of the interviews and expert panel at all times, these participants will be made anonymous.
- Interoperability: a list with references is included and the end of the thesis. The thesis will be written in a formal, accessible and broadly applicable language.
- Reusability: the data will meet domain-relevant community standards and will be described in detail.

The data collected during this research will solely be used for academic purposes. To make sure the participants in this research feel safe and there is no invasion in their privacy, the following measures will be taken.

- The participants know upfront exactly what is going to happen and what questions will be asked.
- The interviewee will sign a consent form, where they agree to the interview and confirm that the terms and conditions of the research are understood.
- All names will be left out in the thesis and the participants will be made anonymous.

2.3 Research output

2.3.1 Goals and deliverables

The primary goal of this research is to find a solution for the facility and capacity managers of the outpatient department of the Dutch hospital to cope with the scarce resources, scarce resources meaning the available square meters and the staff. Following from this two sub-goals are formulated. The first goal is to provide insight in how the layout design of the outpatient department affects the efficient use of the spaces in the outpatient department and how this influences the work process. The second sub goal is, considering the digitalisation, how smart tools can contribute to the efficient use of space in the outpatient department and how this influences the work process.

In reaching this goal the following objectives and deliverables (figure 2.10) have been set.

- To provide an understanding on the data and to create a well-structured overview on the following topics, a deliverable is the literature review on 'the outpatient department', 'space utilisation', 'smart tools' and 'smart tools in hospital real estate'.
- To gain insight in the values of the stakeholders a deliverable is a mapping of the values and objectives of the stakeholders of the outpatient department. These values are mapped out according the four perspectives of CREM. Subsequently, the current developments on smart tools are aligned with the stakeholder values accordingly the four perspectives of CREM. It is especially important to find the right balance between the use of real estate and the patient care, what might improve the real estate might be bad for patient care.
- The in-case and cross-case analysis of the outpatient department, focusing on layout, space use and smart tools, is a deliverable to complement scientific research with practical experiences.
- Insight in how the layout of the plan of the outpatient department is of influence on the efficiency of the space use and how smart tools can contribute to this efficiency. The deliverable is an advice on how to manage the space as efficiently as possible by making use of smart tools.

Phase		Method	Objectives	Deliverable
P1	Feb./Mar.	Literature review	Problem formulation	Research framework design.
P2	Apr./Jun.	Literature review	Background research on the outpatient department of a Dutch hospital current and future. Background research on types of smart tools. Background research on values and objectives of the stakeholders, outpatient journeys in four categories.	Overview of activities in the outpatient department. Overview of smart tools. Overview of values and objectives of the stakeholders.
P3	Sept./Oct.	Internship, semi-structured interviews, case study, validation study	To measure with real-time data and experience what smart tools best can be used and how. And how it can be implemented in practice.	Analysis of how smart tools can be used in a public building and how these are implemented in the organisation.
P4	Nov./Dec	Knowledge implementation	Determining how this knowledge can be implemented in the real estate strategy for the outpatient department. Taking into account values of all stakeholders.	Recommendations on use of smart tools in the outpatient department.
P5	Jan.	Finalising report	Provide new insights and incentives for further research on smart technologies related to space utilisation in the outpatient department.	Advise on how the scarce resources of the outpatient department of a Dutch hospital can be used more efficiently, by using smart tools.

Table 2.10 Research output based on the phases (own table)

2.3.2 Dissemination and Audiences

This graduation research targets mainly the actors dealing with both real estate and healthcare or real estate and smart tools. The output of this research, especially the proposed strategy on efficient space utilisation and smart tools, can be used by real estate managers to revise and/or improve their current real estate portfolio or by real estate consultants to advise their clients on their real estate and the use of smart tools.

2.3.4 Research plan

Table 2.10 as well as figure 2.11 present an overview of the research framework and the planning that is used to be able to conduct this research in time. This first semester 2,5 days a week were reserved for part-time graduating. During these first five months the research framework has been developed. This implies problem statement, research questions, a great amount of literature review and partly the research method. At the end of this first semester there is a clear framework, which serves as the backbone of this research and the methodology for the measurement approach is mostly determined. Following up after presenting the P2 presentation, the next semester has started in September, this is where the fulltime graduation period enters. After implementing the feedback from the mentors at the P2 presentation and reviewing the research framework, the empirical study starts. Through the internship at AT Osborne contacts and case studies are provided for the data collection. Collecting the data is the main focus of the first two months of the second semester. In order to present at the P3 presentation most data retrieved from interviews and document analysis is collected and analysed. The next step is understanding the data and connecting it so a strategy can be formulated. This strategy will be presented during the P4, when also the main question will be answered. Between P4 and P5 the main focus lies on finalising the research and graduating the MSc track Management in the Built Environment.

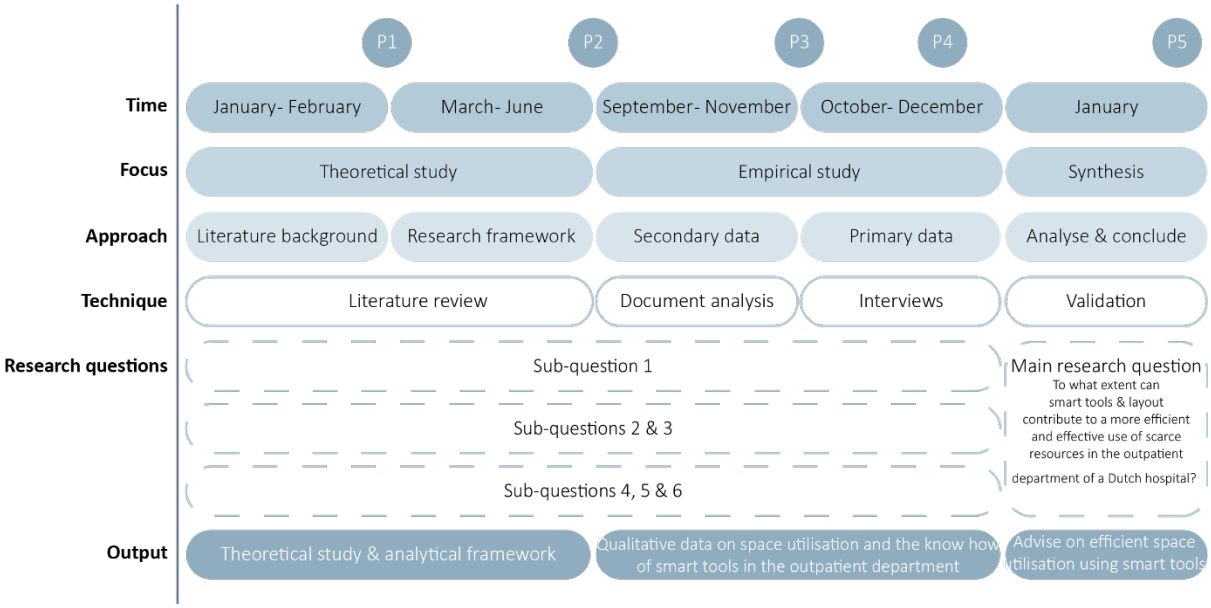


Figure 2.11 Research process planning

3. Theories (literature market research)

To better understand the concepts presented in the problem statement, a literature review on real estate management, the Dutch hospital and the outpatient department and smart tools is outlined in this chapter.

3.1 Real Estate Management

The goals of this chapter is to provide insight in real estate management frameworks that can provide the structure for the analysis of both the literature review and the empirical research.

3.1.1 Corporate and Public Real Estate Management

An organisation is located within a building to be able to carry out certain tasks for the profession they pursue. This real estate necessary to conduct business is called corporate real estate. It represents the demand side or user side of real estate (Arkesteijn, 2019). The last years the perception of real estate has shifted from being an operating necessity to board-level decision making and real estate has become a strategic tool. CRE is caught in the centre of a multi-faceted dynamic that goes far beyond facility, transaction, or project management. CRE is at the centre of a new business model that is shaped by demographics, economics, technology, talent, and sustainability. These concepts are now the drivers of corporate businesses and CRE is in the middle of where all this intersects (Haynes, Nunnington & Eccles, 2017). According to Den Heijer (2011) there are five resources that can potentially add value to the organisational performance: capital, human resources, information (and communication), technology and CRE. In adding value to the organisational performance these resources can either reinforce each other, neutralise each other or even deteriorate each other's impact. For a CRE strategy and portfolio to add value to the organisation, CRE should be attuned to the corporate performance. The range of activities undertaken to achieve this alignment, is often referred to as Corporate Real Estate Management or abbreviated CREM (Arkesteijn, 2019).

"Corporate real estate management is in charge of organising the corporation's accommodation in such a way that it adds maximal value to the corporation's businesses."
(Vande Putte, 2020)

The most crucial foundation for the existence of real estate management is the relation between real estate and the performance of the organisation. By managing this relationship, organisations aim to generate a positive added value or prevent having a negative impact on their objectives. The management of real estate can be broken down into three specialisations; (1) Portfolio management, (2) CREM and (3) Public Real Estate Management (PREM). Portfolio management focuses mainly on financial goals, this is real estate management from an investor's point of view. To add on the definition of CREM by Arkesteijn (2019) and Vande Putte (2020), CREM is executed by parties that are both owners and occupiers of their real estate (Den Heijer, 2011). CREM's first concepts tended to be focused on the private sector. CREM is now used both in the private sector and in the public sector, thanks to advancements and developments in the public sector (Haynes et al., 2017). In other words, PREM just like CREM aims to match demand and supply of space, only PREM adds public goals to this (Den Heijer, 2011). Both PREM and CREM are applicable on hospital real estate, as due to the reform of the healthcare system, the hospital has become a market party and is responsible for its own financing, but also still has public goals.

"Public real estate management aims at adding value to performance by balancing organisational, financial, functional and physical perspectives, variables and performance criteria in every decision about PRE portfolios, matching supply and demand in time, connecting operational and strategic processes."
(Den Heijer, 2021)

To understand CRE alignment, Arkesteijn (2019) refers to the four forms of alignment by Heywood & Arkesteijn (2017); (1) artefact/plan, (2) process, (3) state and (4) behaviour. From these four forms, two CRE alignment types follow: process-based and behaviour-based. As the service lives of real estate exceeds the business cycle, it is very important in CREM to understand the strategic basis and the dynamics of the organisational strategy creating process. So the alignment is more than knowing the business needs and strategy (Arkesteijn, 2019). In describing the organisational structure of a hospital, Van der Zwart (2014) refers to the five configurations of organisational structures proposed by Mintzberg (1993); (1) simple structure, (2) machine bureaucracy, (3) professional bureaucracy, (4) divisionalised form and (5) adhocracy. The organisation of the hospital can be depicted as a professional bureaucracy. Within this organisational configuration, the professionals are the core of the organisation and the quality is controlled by the highly standardised demands on the competences of the professionals. The main focus of all healthcare professionals is the relation to the patient, as is the core process of the hospital organisation. Which is why specialists have a great influence on the decisions by the organisation. As a result, a hospital's organisational structure is extremely democratic and politicised, with authority distributed among medical specialist who act with great autonomy (Van der Zwart, 2014).

3.1.2 Stakeholder management

As stated above, in managing real estate it is important to understand the organisational strategy, what are the external business drivers and forces, the internal strategic drivers and forces, strategic triggers and corporate strategy or formation (Arkesteijn, 2019). So the real estate goals should be in alignment with the stakeholders' organisational objectives. Winch (2010, p.74) gives the following definition of a stakeholder: an actor who (perceives he/she) will incur a direct benefit or loss as a result of the decision or project. Winch (2010) subdivides stakeholders into internal stakeholders, who have a legally binding contract with the organisation and external stakeholders, who have a direct interest in the project. The internal stakeholders can be further subdivided into stakeholders active on the demand side or the public side and the external stakeholders can be further subdivided into public actors or private actors. When assessing the likelihood and willingness of a stakeholder influencing the decision-making process, a power/interest matrix can be drawn up.

As mentioned, decisions on real estate can have an impact on the organisation. Den Heijer (2021) and her team state the importance of considering different perspectives on which real estate decisions can have impact, as contains the definition of PREM. The four main perspectives identified are; organisational, functional, financial and physical as shown in figure 3.1.01. The four perspectives are based on the division between the demand side and the supply side and the division between strategic and operational. Finding the right balance between the four perspectives is an important challenge for PRE-managers, and therefore negotiations between various stakeholders matching the four perspectives (figure 3.1.01) should take place (Den Heijer, 2021). Each individual stakeholder considers all views but concentrates on one or more in particular (Den Heijer, 2011).

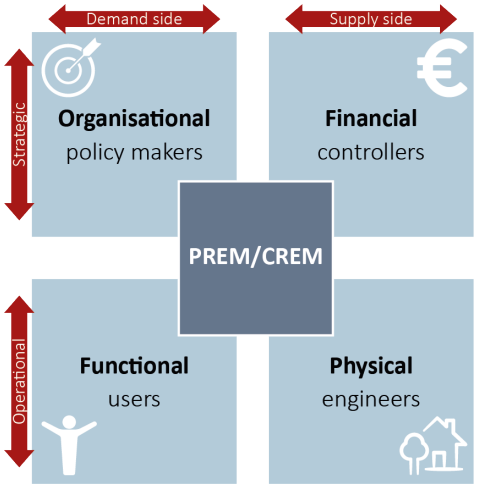


Figure 3.1.01 The four perspectives model and the stakeholders (Den Heijer, 2021)

Van der Zwart (2014) agrees that these four perspectives on real estate present an intriguing opportunity to align real estate goals to stakeholders' interest. In general, stakeholders are primarily interested in the performance of the overall organisation and tent to be less interested in the organisation's real estate. Within the hospital the users' primary interests are related to their activities. As a patient visits a hospital for treatment, the medical specialist goes to the hospital to treat their patients and the healthcare professional assist in the treatment of the patient. Therefore, Van der Zwart (2014) states that the perspectives on real estate can be formed based on the organisational objectives of these stakeholders, although these perspectives are not directly tied to the various stakeholders. This means that the four real estate perspectives must be linked to the stakeholders' organisational objectives, as explained by Den Heijer (2011), in order to connect to the stakeholders' interests in the organisation's overall performance. Having these four perspectives on real estate creates the possibility to describe an added value of real estate accordingly to the four perspectives, instead of allocating the added value to a specific stakeholder (Van der Zwart, 2014).

3.1.3 Designing an Accommodation Strategy

Managing real estate does not only involve aligning the objectives of the stakeholders related to the four perspectives. Matching demand and supply now and in the future is also an important component of managing real estate. Various models have been developed in literature to asses real estate in its changing context; matching supply and demand in the best way possible and aligning the real estate strategy to the business strategy. The DAS-framework is such a model and has been developed by the Department of Real Estate & Housing at the Delft University of Technology (Van der Zwart, 2014). The DAS-framework is short for Designing an Accommodation Strategy and it is displayed in figure 3.1.02. As illustrated in the model, DAS is a cyclic and iterative process, and therefore the process can be started at different points. The two axes that the DAS-frame moves along are from demand to supply and from current to future. Within the framework four management tasks, are distinguished, which often give structure to research projects (Den Heijer, 2021; Arkesteijn, 2019):

1. Assessing the current situation, to determine the current (mis)match between the current demand and the current supply.
2. Exploring changing demand, to determine the future (mis)match between the future demand and the current supply.
3. Generating future models, to match the future demand and future supply by designing, evaluating and selecting solutions for the mismatch.
4. Defining projects to transform, a 'step-by-step plan to realise what we want to have in the future' i.e. how to transform the current supply into the selected future supply.

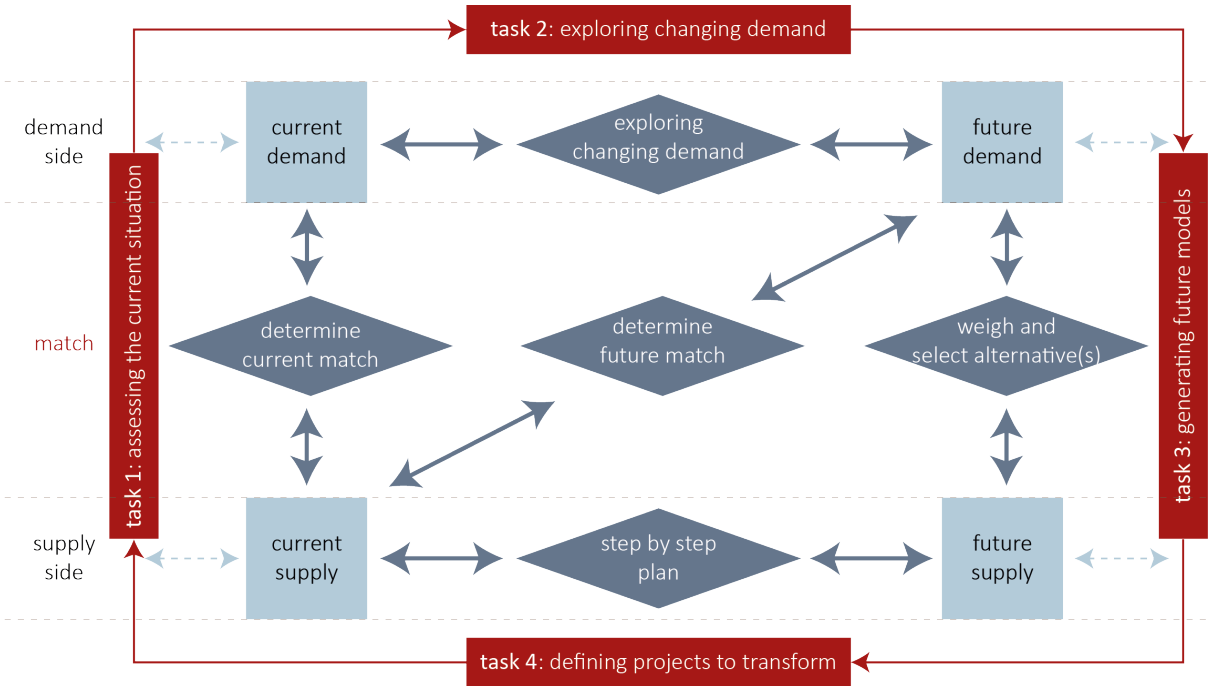


Figure 3.1.02 Process framework matching supply and demand of space (Den Heijer, 2011 adapted from De Jonge et al., 2009)

The first and second step can also be considered as the problem analysis. What is the current issue and how will it respond to the future demand? The third and fourth step can be considered as the design for the solution for example in the form of a strategy. In addition to looking into the future using this framework, it can also be used to evaluate decisions made in the past, as a backward cycle (Den Heijer, 2021). And thus the model can be used two ways; (1) to steer and support in the decision making process when designing an accommodation strategy that aligns the corporate strategy taking into account present and future demand and supply; (2) to evaluate the current strategies on real estate management concerning consistency, completeness, the alignment of organisational goals, objectives and resources including real estate (Van der Zwart, 2014).

In figure 3.1.03 tools are shown that support the four management steps as described above. These tools are developed by the Campus Research Team of the TU Delft which is being led by Den Heijer. The figure combines both the DAS-framework and the four perspectives model. In every step of the DAS-process the four perspective model is necessary. In the methods and tools column Den Heijer (2011) refers to two metaphors; the containership and the sailboat. With the containership the reference is made of a portfolio database with data that shows more stable and long-term developments; the metaphor of the sailboat refers to a type of database that can easily change course (Den Heijer, 2021).

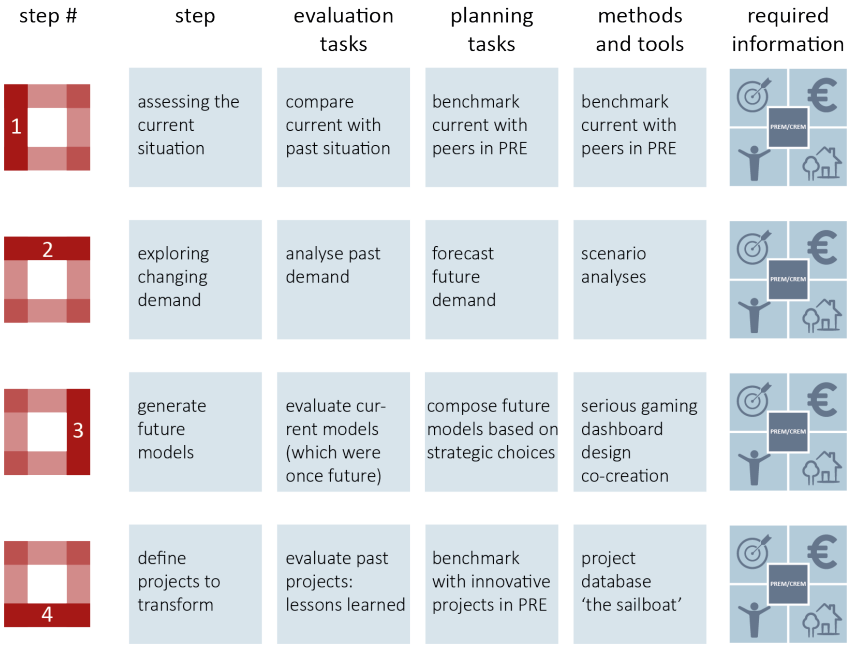


Figure 3.1.03 PREM strategy process framework (Den Heijer 2021, adapted from Den Heijer, 2011)

3.1.4 States of matter in PRE

In her research on *Managing the University Campus* and *Campus Matters*, Den Heijer shows the transition of the university and campus in three generation models. The three generations of this public building she explains accordingly the three physical states of matter. The first model (A) is traditional referred to as solid. The second model (B) is network referred to as liquid. The third model (C) is virtual referred to as gas. The states of matter is a way of demonstrating how a portfolio of public real estate can be used and managed, and how it can evolve over time (Den Heijer, 2021). The characteristics of these three models are shown in figure 3.1.04, applied on hospital real estate. In terms of physics, the solid state means that the particles are touching each other and cannot change position, this means that a solid has a fixed shape and volume; in the liquid state; in the liquid state the volume takes the shape of the container in which it is occupied, the particles are close together and are slightly able to move in any direction from place to place; the gas state means that the particles are far apart of each other and can move freely in any direction from place to place, therefore it does not exist of a fixed shape or volume (Ryan & Norris, 2014 and Ingram & Gallagher, 2014).

In nature healthcare is too stagnant, or solid, as proved by the Covid19-pandemic. The current systems are incapable of dealing with fluctuations in pressure, resulting in many countries as well as the Netherlands taking drastic measurements. During the pandemic the three states of matter in the hospital became clear; the infected patients who were in bad shape had to be treated at the ICU, this being a very solid use of the hospital. The liquid state is demonstrated by a mobile piece of real estate, where medical specialists travels to the patient with the needed equipment. The gas state is represented by online consults or remote monitoring (Hamilton, 2021).

Hamilton (2021) in her research, analyses hospital real estate through the lens of Den Heijer's framework; the state of matter. The hospital of the future will be a mixture of the three states. The solid state of hospital real estate will remain necessary, for treatment that needs to take place in sterile conditions and with the equipment necessary. And also in terms of the physical presence of both the patient and medical specialist. The architecture of solid state real estate plays an important role in the healing environment. Corridors, waiting rooms, staff rooms and foyers form the 'public realm' in healthcare spaces, and act as the spine and face of healthcare buildings. These communal areas are of significant value for the wellbeing of patients, employees and visitors and therefore for

the overall operation of a healthcare facility. However, the limitation of solid state became clear during the Covid19-pandemic as the capacity was reached quickly and the solid real estate does not accommodate flexibility.

The exploitation of space all days of the week can be achieved by consultant doctors or surgeons not having their own rooms or operating theatres but instead sharing those. This is the primary example of liquid management. Another way of using real estate in a liquid manner is the practice of doctors and surgeons beyond the walls of the hospital. The use of flexible spaces and rooms that can be used for multiple purposes may allow the hospital to better cope with fluctuations in demand.

The gas state carries this one step further, by healthcare being location independent, individual and accessible. The importance and potential of the virtual world is pressuring the healthcare industry. As of this moment the healthcare activities related to the virtual world are for the majority focused on administration actives, like patient databases, accessing information or booking appointments and since the Covid19-pandemic e-consultations or telephone consultations are more and more used. Technologies are improving rapidly and more and more data can be collected through the use of motion, environment and position sensors for example through the use of smart phones. This requires people to take more sovereignty over their own health. This type of telehealth can be used as a preventive strategy. The biggest concern however about the use of big data in terms of healthcare is the privacy of the patient. As for example insurance companies can set their rates based on the information following from these technologies (Hamilton, 2021).

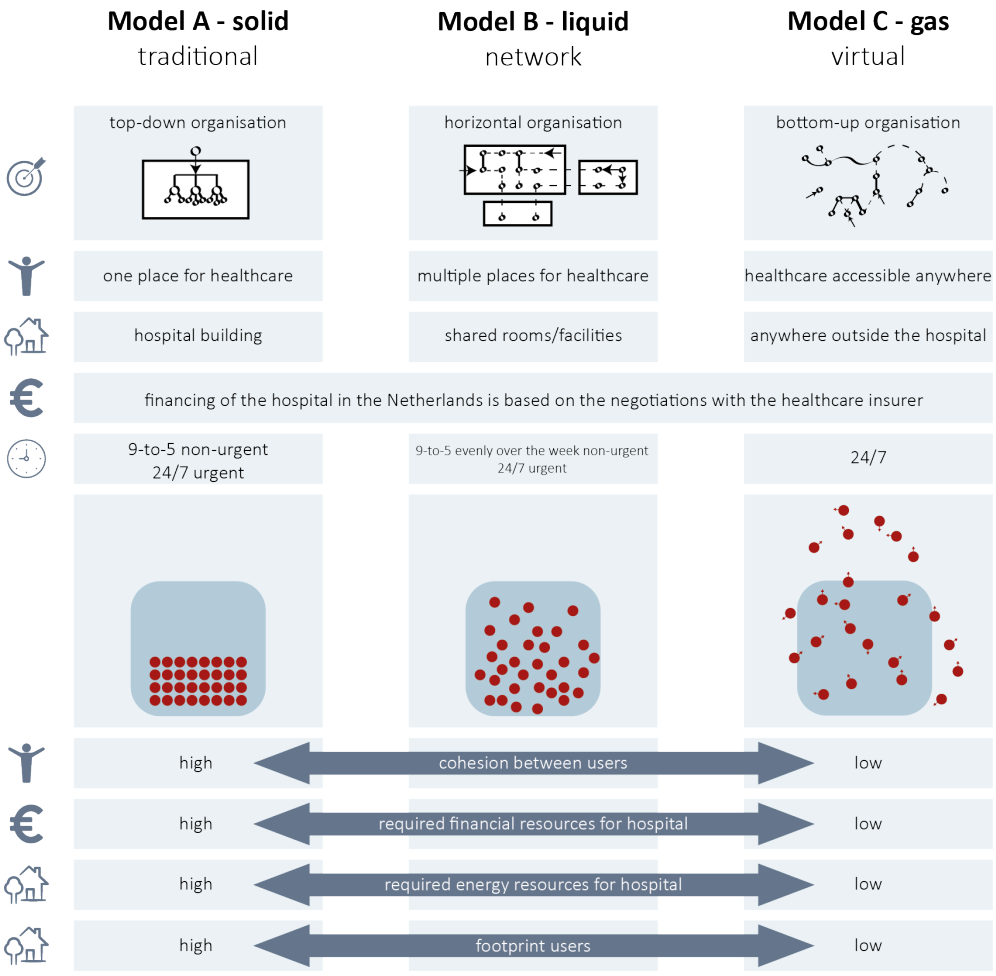


Figure 3.1.04 solid - liquid - gas, state of matter applied on hospital real estate (Den Heijer, 2019/2021 adapted by Hamilton, 2021)

3.1.5 Added value

When reading the previous sections, basically three frameworks have been explained; the four perspectives model which includes objectives of all stakeholders; the DAS-frame which incorporates the match between demand and supply both current and future; and the states of matter which incorporate three ways of managing and using the real estate portfolio. In real estate decisions every intervention or decision made, has not only impact on the stakeholder who initiated the intervention but also on the other three stakeholders. This is visualised in the switchboard by Den Heijer (2021) (figure 3.1.05). The switchboard can be used as a tool for managing real estate by the real estate manager. In reality, each perspective is represented by multiple added values, therefore each switch in the switchboard represents multiple "mini-switches" of key performance indicators that are connected to those added values. The decisions on the composition of solid-liquid-gas will be made over time and can change over time, depending on the preference. The decisions on the composition of solid-liquid-gas has an effect on the goals of all four stakeholders in the current situation and in the future situation. To achieve the desired effect, the key performance indicators can be mapped out by the use of smart technologies. The effect of changing the key performance indicators can be visualised with dashboards and tools (Den Heijer, 2021).

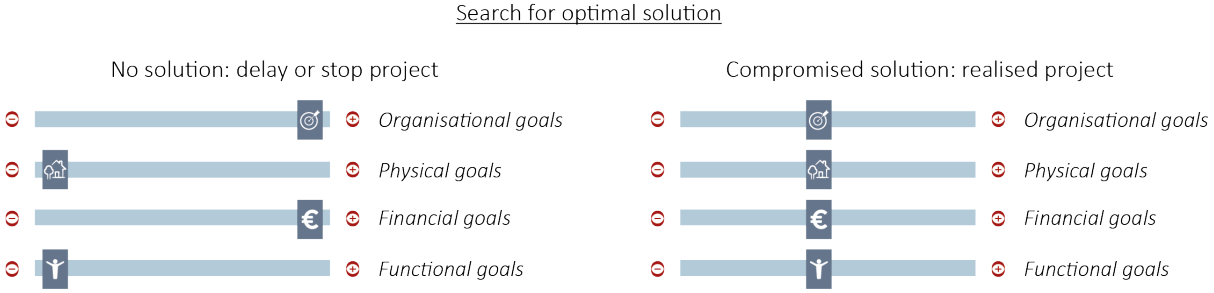


Figure 3.1.05 Switchboard in PREM (Den Heijer, 2021)

Following from the interviews held by Van der Zwart (2014) there are nine main added values in hospital real estate. Ranking them from highest priority to lowest priority, the added values are: (1) increase innovation, (2) increase user satisfaction, (3) improve culture, (4) reduce costs, (5) improve productivity, (6) improve flexibility, (7) support image, (8) controlling risks, and (9) improve financial position.

3.1.6 Conclusion on Real Estate Management

Question	How can the current real estate portfolio be aligned to the organisational business strategy?
Purpose	To provide a framework on how to align the business strategy of the hospital with its real estate portfolio by using PREM
Methods	Literature review

PREM and CREM both aim at the alignment of the real estate portfolio to the organisation's business in such a wat that it adds maximal value to the organisation. In addition to CREM, PREM has public goals and sometimes public funding. In order to align the business strategy of the hospital with its real estate portfolio, various frameworks and models can be taken into account. By using the four perspectives model, the different stakeholders will be taken into account and the perspectives can be combined with the real estate added values. By using the DAS-frame demand and supply can be matched continuously. The iterative process allows for decision making in the future as well as evaluating decisions made in the past. And the solid-liquid-gas model can be used to show how a real estate portfolio or part of the real estate portfolio can be managed and used. The three models are linked to each other and influence each other. Finally, the added values of hospital real estate are: increase innovation, increase user satisfaction, improve culture, reduce costs, improve productivity, improve flexibility, support image, controlling risks, and improve financial position.

3.2 The Dutch hospital and the outpatient department

The goal of this chapter is to provide insight into what the outpatient department entails, what concepts can be applied and determine what patients and medical specialists in this department need. Besides, to be able to align supply and demand in the current and in the future this chapter provides insight in what the future developments might be. In this chapter patient journey is becoming clear.

3.2.1 The Dutch hospital

Decisions made in the outpatient department are based on the overall business strategy of the hospital as a whole, therefore first a small introduction on the Dutch hospital and the decision making process is provided before zooming in on the outpatient department.

Inventory Dutch hospitals

In 2021, the number of hospital organisations stands at 69, of which 8 are university medical centres (UMC) (Table 3.2.01 and Figure 3.2.02). These organisations comprise a total of 114 hospital locations and 141 outpatient clinics. Due to mergers between hospital organisations over the past 50 years, the number of hospital organisations is decreasing; however, the number of locations where hospital care is provided has remained more or less the same due to the increased number of outpatient clinics. The number of outpatient clinics has increased significantly, from 61 in 2009 to 141 in 2021 (Deuning, 2021). Recently, fewer hospitals decide to merge. Instead of hospitals wanting to cooperate with each other, they increasingly focus on cooperation with other care providers in their region, such as general practitioners and nursing and care homes. The Netherlands Authority for the Consumer & Market (ACM) is also more critical in its assessment of merger applications, as prices seem to rise after a merger, while the quality of care does not demonstrably improve. As mergers have caused the number of hospital organisations to decrease significantly, the number of choices has reduced and thus (potential) competition (Batterink et al., 2016).

Dutch hospitals	Number
Organisations	69
UMC	8
Locations	114
Outpatient clinics	141

Table 3.2.01 Hospitals in the Netherlands (Deuning, 2021)

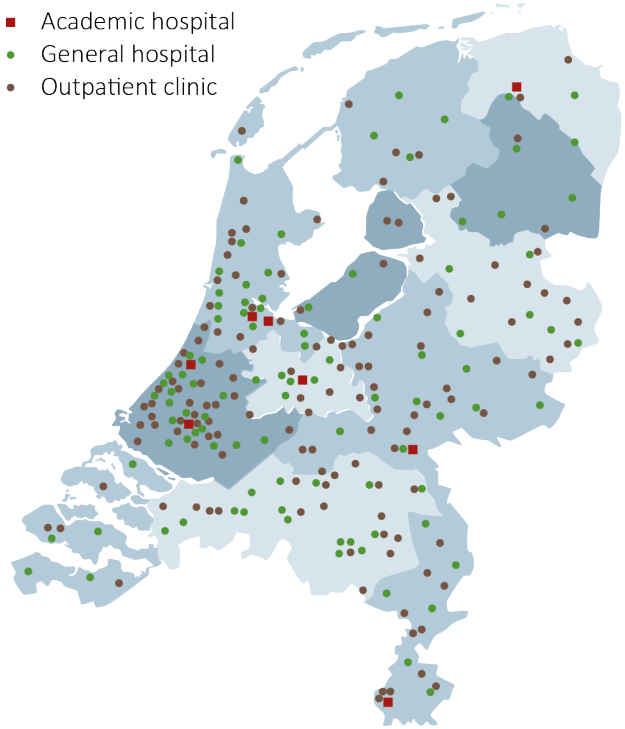


Figure 3.2.02 inventory hospitals in the Netherlands (Deuning, 2021)

History of Dutch hospital real estate

To make well-informed decisions it is good to know the history of the real estate portfolio, therefore a small timeline (figure 3.2.03) of the real estate within the healthcare sector is introduced. The transition of legislation and deregulation within the healthcare industry in the Netherlands between 2004 and 2012, caused an increase in vagueness and a decrease in uncertainties about the consequence of the new legislation for individual hospitals. The public authorities no longer took the risk and responsibilities of real estate as this transferred to privately organised hospitals (Van der Zwart, 2014).

According to Houwelingen (2017), the Dutch government and the Hospital Committee (Bouwcollege) have mainly determined the real estate history of the care sector. The Hospital committee has been established in 1947 and served as an advisory committee for questions relating to the hospital sector. In 1971 the Hospital Facilities Act (Wet Ziekenhuisvoorzieningen (WZV)) came into force to regulate efficient hospitals and other healthcare facilities. Together with this act the Board for Healthcare Insurance ('het College voor Zorgverzekeringen (CvZ)), was established. This is an independent legal entity, which among other tasks, was given the task of advising on the effectiveness of health care facilities. The next regulatory change took place in 2000 when the CvZ was transformed into an independent administrative body, the Hospital Committee (Bouwcollege). This board, existing of independent experts, has next to the advisory tasks now as well decision-making tasks. Due to the withdrawal of The Ministry of Health, Welfare and Sport (VWS) out of the Programme of Requirements and Preliminary design within the sector Hospitals and Mental Healthcare (GGZ), the Hospital Committee was entitled to issue decisions on its own on submitted Programmes of Requirements and Preliminary designs. They published the Bouwmaatstaven and Bouwkostennota. The Bouwmaatstaven included the basic requirements of quality for spatial facilities per sector and was therefore also related to spatial facilities in the healthcare sector. The basic requirements showed the construction facilities needed for care and living, regardless of the differences in legislation and/or financing possibilities. The standards accordingly the WZV were used in assessing the building initiatives. The Bouwmaatstaven capped the number of approved and funded square meters (GFA). The Bouwkostennota served as an "Estimation methodology for investment and operating consequence of planning and construction decisions". It provided a maximum indication of the standardised amount of investment per square metre. The approved number of square metres and the investment per square metre together led to a maximum amount of approved investment. The determined rental price and/or approved investment were charged to the care organisation on an annual basis, following the depreciation period of the Dutch Healthcare Authority (Nederlandse Zorg autoriteit (Nza)). The transformation into an independent Hospital Committee was completed July 1st 2001. In 2005 the name of the independent Hospital Committee (Bouwcollege) changes to 'Board for Healthcare Institutions' ('College Bouw Zorginstellingen' (CBZ)), which was a result of the replacement of the WZV by the WTZi (Healthcare Facilities Admission Act) as of January 1st 2005. The heading for termination of the construction regime by the Ministry became already clear during the discussion of the Act. As a result, the position of the Board of Healthcare Institutions (CBZ) changed fundamentally and eventually the Board was disbanded in phases. First, the construction regime in the cure sector was disbanded in 2008 and one year later the whole construction regime was disbanded in 2009. So until 2009, the government had determined what was built and how much was invested in healthcare real estate, what the Board for Healthcare Institutions took care of:

- They gave permission for buildings that met the performance requirements.
- Financing of the real estate by post-calculation on the basis of annual depreciation.
- Financing by the bank, with a guarantee from the government of repayment (through post-calculation).
- A rate for care and independently from that a cash flow for the real estate.

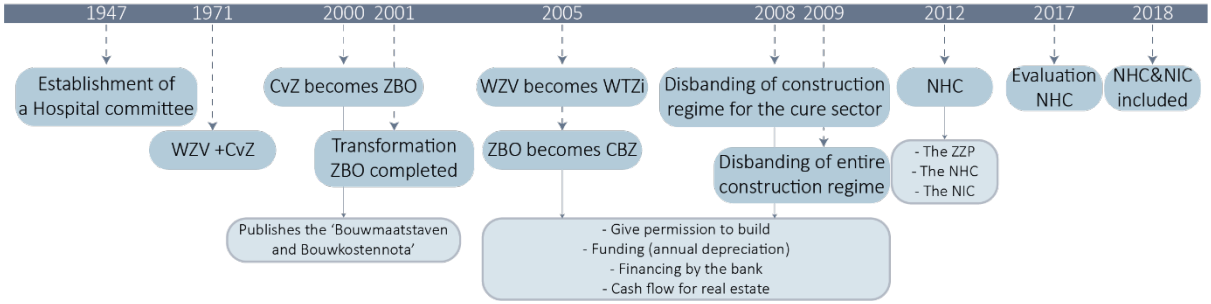


Figure 3.2.03 Timeline hospital real estate legislation (Houwelingen, 2017; own figure)

3.2.2 The organisation

The highly integrated hospital system is a complex machine existing of multiple interconnected departments/sub-units such as the Outpatient Department (OD), the Emergency Department (ED), inpatient inwards, the Operating Theatre (OT), the Intensive Care Unit (ICU)/Intensive Therapeutic Unit (ITU), diagnostic facilities like Pathology and Radiology, etc. The operational performance of each department/sub-unit individually affects the overall operating performance of the hospital system. Operational issues differentiate per department but affect the overall operational performance of a hospital system. Examples of such operational issues are bed utilisation in ICU, length of stay of an inpatient, waiting time of a patient at an ED or OD, etc. (Bhattacharjee & Ray, 2014). The hospital's real estate is vital in accommodating the primary goal of the hospital's organisation, providing high-quality healthcare. Therefore, especially since the deregulations of the Dutch healthcare sector since 2008, managing real estate is becoming more and more an integral part of the business organisation. From figure 3.2.04 can be derived how long-term decisions on the hospital's investment in accommodation are determined from political, economic, social, demographic, and technological factors. Following the new regulations, the influence of external stakeholders has changed, and hospitals have become more aware of their position in both the healthcare market and their region. (Van der Zwart, 2014)

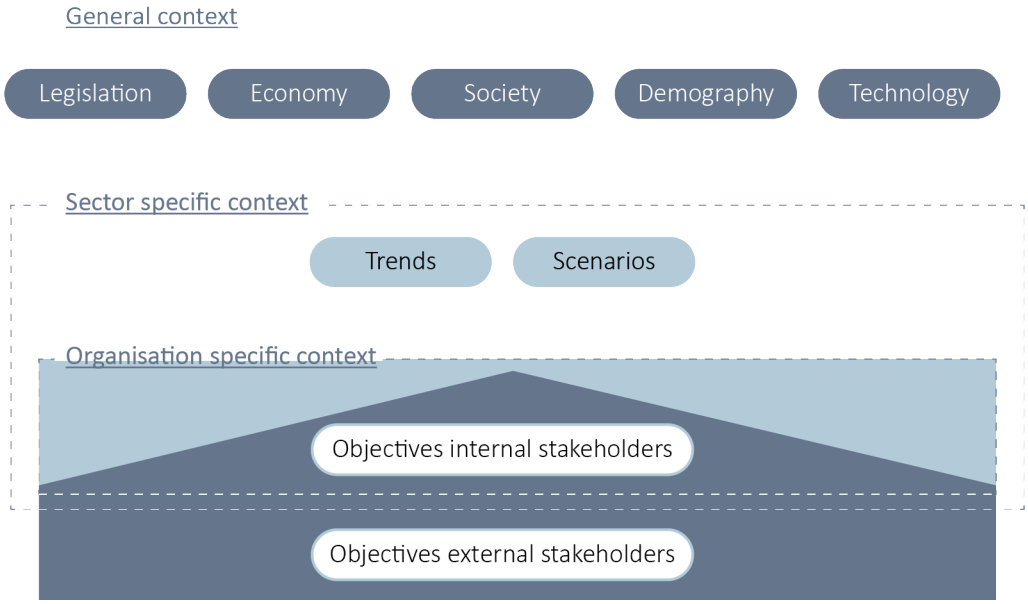


Figure 3.2.04 Context-mapping (Van der Zwart, 2014)

Stakeholders

The conceptual model of De Vries (2007) (figure 3.2.05) zooms in on organisational performance and displays how real estate, as one of the five production factors, can contribute to the organisation's overall performance. According to the model, the individual organisation has no control over the general context. The organisational context is determined by the organisation's culture, structure, and mission; these guide the input-throughput-output process, which various stakeholders then perceive. Examples of input resources in the healthcare sector are displayed in figure 3.2.05; output resources of the hospital are the number and types of Diagnosis Treatment Combinations (DTC) and the budget for acute cure stand-by obligation. The performance of the organisation is divided into distinctiveness, productivity and profitability:

- The hospital's distinctiveness can be measured by comparing the means of the proportional market, patient satisfaction, and the range of DTCs to other healthcare organisations.
- By counting the number of DTCs and the DTC price – DTC costs, the productivity of the hospital can be measured.
- The profitability can be measured by looking at the financial position and capacity of the hospital.

Stakeholders are the reason for the existence of an organisation. As shown in figure 3.2.05, examples of stakeholders in healthcare are the government, the supervisory board, investors, patients (customers) and healthcare professionals (employees), whereas the latter two are directly connected to the primary process of delivering healthcare (van der Zwart, 2014).

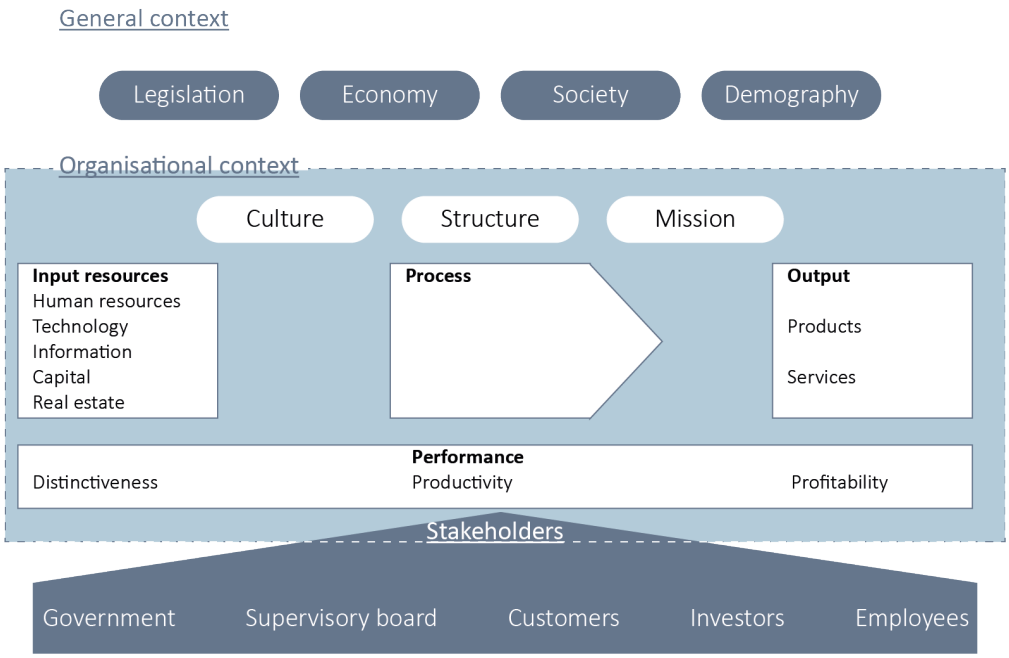


Figure 3.2.05 Conceptual model organisation hospital by De Vries (2007) (van der Zwart, 2014)

Part of the corporate-specific context of hospitals is an organisational culture with at some moments a disturbing relation between the medical staff and the board of management. Within the hospital organisation different discipline-groups existing of medical staff are more or less autonomous organisations. As a result, the executive board of the hospital has little or no influence on production decisions within such a discipline-group (Van der Zwart, 2014). A distinction is made between long-, medium- and short-term planning. The responsibility for the development and implementation of a plan is placed higher in the organisational hierarchy as the term of the plan gets longer (Berden et al., 2021). In the table below an overview of stakeholders of the hospital organisation is provided, accordingly Winch (2010).

Stakeholders of the hospital	
Internal	External
Patients	National government
Doctors / medical staff	Ministry of Health, Welfare and Sports (VWS)
Healthcare professionals / nurses	Municipality
Pharmacy	Health insurer
Facility management and ICT	Banks / investors
Hospital board	Dutch Council for public healthcare (RVZ)
Supervisory board	National Institute for Health and Environment (RIVM)
	Inspectorate of civil health (Inspectie volksgezondheid)
	General practitioners (first line healthcare)
	Elderly homes / nursing homes / homecare
	Citizens
	Patient organisations

Table 3.2.06 Internal and external stakeholders of a hospital organisation (van der Zwart, 2014; own table)

The decision-making process is formed by basic parameters, which are based upon the overall corporate strategy of the organisation. These basic parameters define the bounds of the project mission (Winch, 2010). According to Berden et al. (2021), after analysing the strategy and vision documents of healthcare institutions, the most important elements of a healthcare institution are the following:

- Value for the patient is the central issue.
- Together with the patient we measure, know, decide and act.
- To provide patients with the right care, we work together in a network both internally and externally.
- The healthcare and support processes are well thought out and supported by information technology.
- All processes and decisions are aimed at minimising the patient time flow (throughput time).
- The right capacity is in the right place at the right time with the right patient.
- The layout of buildings, workshops, equipment is adapted to the processes.
- There is plenty of competent staff who enjoy working with us.

To realise such a healthcare institution, the needs and desires of the patient should be grasped in its entirety, so that the care processes can be aligned with these. To realise these processes, specific functions and task procedures are designed, meaning who performs which tasks and which tasks together form a particular function (Berden et al., 2021).

3.2.3 Integral Capacity Management (ICM)

The business processes of client organisations can be categorised in four different types (Winch, 2010):

- Information flows
- Resource flows
- Material flows
- People flows

To define the project mission it is important to understand the flow of materials and people, as by facilitating these flows in the most effective and efficient manner, the value of the facility is generated (Winch, 2010). The layout of the building, the arrangement of equipment and resources, facilitates the flow and all this is supported by information technology. Integral capacity management is one of

the tools in realising this, it helps in the support and overall planning and organisation of the hospital. Within the hospital the following flows can be recognised (Berden et al., 2021):

- Patients (who are sometimes accompanied)
- Employees (medical specialists, assistents, etc.)
- Patient materials (blood, urine, etc.)
- Medicines
- Materials (band-aids, implants, etc.)
- Waste
- Equipment
- Visitors
- Information

These different flows (people, equipment and buildings) define the landscape of the hospital and form a network of capacity and relations. The coherence within the network is dynamic. The relations between the capacities, the relations with the flows and between the flows are constantly changing. Within the decision-making process, there must be good coordination about capacity between the various departments. Often outpatient visits are planned far in advance and then fail to continue, or within a certain period of time there is more policlinic capacity available than there is OT-capacity. These are common problems in Dutch hospitals as action is taken accordingly an open loop system (Berden et al., 2021). Because the departments within the hospitals are mostly autonomous, they can often apply their own rules. Or when there are established rules, they interpret or apply them as they see fit. Both vertical and horizontal integration in capacity decision-making is required to increase the effectiveness and efficiency of both management and the operational process (care). Despite the complexity of the organisation, a closed loop system can then be achieved. Which is necessary to achieve 'the patient receives the right care at the right time in the right place by the right healthcare professional'. Within the hospital there are three types of capacity; (1) the medical specialists, (2) support staff (nurses, secretaries, HR, etc.) and (3) resources (space and equipment) (Berden et al., 2021).

Integral capacity management (ICM) is all about continually matching supply and demand of care. The goal that is desired to be achieved by ICM is to achieve coherence and consistency in decision-making and implementation at all levels in the organisation through planning and control of hospital resources. In figure 3.2.07 the 6 steps of capacity management control cycle is visualised (Speet, 2020);

1. Strategic capacity planning: estimating the required capacity on the basis of demand for care and production prognoses/agreements with the health insurer. And drawing up an integral capacity annual plan.
2. Tactical capacity planning: the final allocation and release of capacity for the next two to three months is based on a periodic review of production, demand for care, and operational performance.
3. Operational capacity planning: integral and coordinated planning of care and capacity. Such as doctors, staff, rooms and materials.
4. Operational capacity steering: monitoring of care and available capacity, as well as early identification and resolution of bottlenecks.
5. Performance assessment: systematically monitoring and assessing the level of performance achieved.
6. Systematic improvement: searching for opportunities for optimising performance.

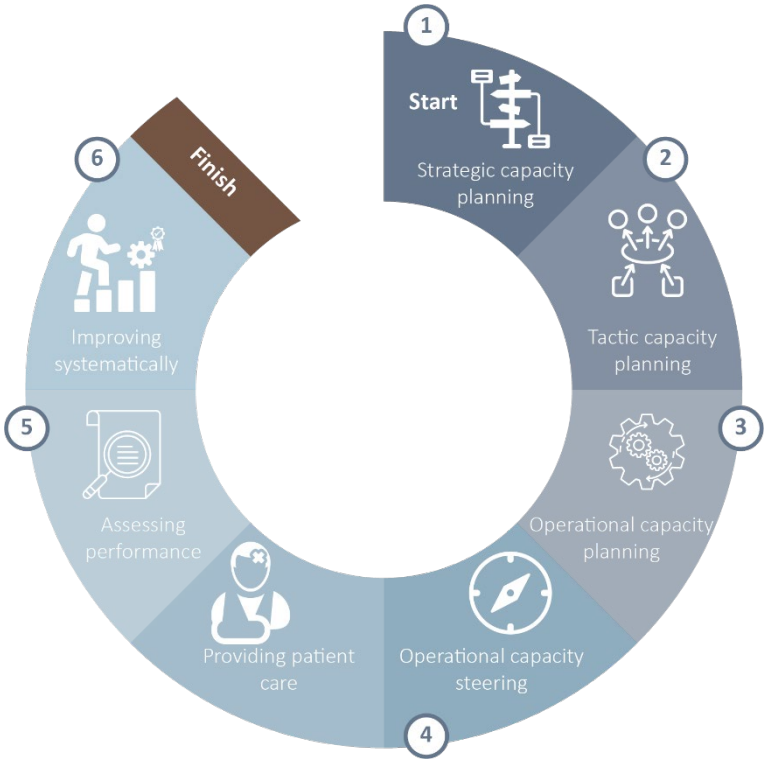


Figure 3.2.07 ICM control cycle (Speet, 2020)

The word integral in ICM is a key factor; the degree of integration determines to a large extent the success of capacity management. As quoted by interviewee F1 "*without the integral approach, capacity management is non-existing*". Interviewee F1 explained the different levels on which the integral approach can be achieved:

- Integral coherence within the hospital between the departments; Operating Theatre – Outpatient Department – Infirmary, etc. And integral coherence between the hospital – the general practitioner – care at home.
- Integral coherence between the strategic level, tactical level and operational level. This represents the connection between the strategy of the hospital and the planning on the workplace.
- Integral coherence between the four result fields, taking them into account and seek for the optimum:
    - Quality of service for care; keeping access and waiting time under control.
    - Quality of care; offer the patient the best care provider at the right time and in the right place in the hospital.
    - Quality of work environment; this determines the employees and the state of the hospital.
    - As a result a financially healthy organisation.
- Integral coherence between the various stakeholders and their demands. Within a hospital you have to deal with medical specialists working in partnerships having their own responsibility of results, and the hospital having its own responsibility of the results. Therefore, integral coherence between the two has to be managed as well.

Every intervention or decision made in achieving integral coherence has not only impact on the level the intervention was initiated for but on all the levels. This is the same appearance as explained in the REM chapter and visualised in the switchboard by Den Heijer (2021) (figure 3.1.05). An organisation in which ICM works across the full spectrum and is part of the business operations has five characteristics as displayed in figure 3.2.08 (Berden et al., 2021):

1. Aligning the agreed amount of DTC's (production agreement) with the logistic framework (access times, occupancy rates, etc.)

2. To ensure alignment between care demand and care supply for all care services, there is periodic consultation at strategic, tactical, operational and real-time level with relevant stakeholders (departments).
3. Two important tasks of the capacity centre are:
    a. The extraction and analysis of data in which the relevant key performance indicators (KPI's) regarding inflow, throughflow and outflow are real-life available at the various levels of planning (strategic, tactical, operational and real-time).
    b. Allow the organisation to make joint choices about planning at strategic, tactical, operational and real-time level by providing (change) advice, insight and guidance from an independent position.
4. Provide the 'basis' for each department by focusing on the expected production of the year, organising the department on the basis of the expected production of that year and the provision of the actual care (RIV-method).
5. Improve the (planning) processes by continuously going through the Plan-Do-Check-Act cycle, to identify wasteful and valuable process steps.

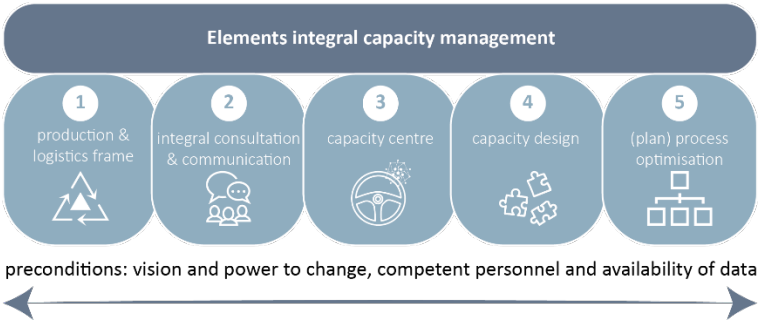


Figure 3.2.08 Elements of ICM (Berden et al., 2021)

ICM at the outpatient department

A hospital's outpatient department is an important and comprehensive aspect of the Dutch healthcare system. However, there is no one-size-fits-all blueprint for capacity management at an outpatient department. This is due to the degree of predictable and unpredictable uncertainty within healthcare. The variation in the demand at an outpatient department (how many patients will arrive with a certain disease?), the capacity at an outpatient department (how many types consultation can a hospital offer at a certain time?) and the healthcare itself (how long does a consultation last?), are examples of predictable uncertainties. These uncertainties are predictable as they can be analysed with the help of statistics. An example of unpredictable uncertainty is absenteeism of a doctor (Berden et al., 2021). Besides, according to interviewee C5, the planning at the outpatient department is the final step in the overall planning, making it more sensitive to changes in the short term. For the start-up and implementation of capacity management in the outpatient department, a step-by-step plan is visualised in figure 3.2.09. Within a capacity plan decision on service strategy, service level, aggregation level, planning period, planning system and task differentiation are made based on information from an information system. With the ongoing digitalisation in healthcare, the healthcare organisation is increasingly becoming a digital enterprise. Only those who have their enterprise architecture in order can make innovative and/or good use of IT. Healthcare organisations in the Netherlands almost never have their enterprise architecture properly set up and management of it is almost non-existent.

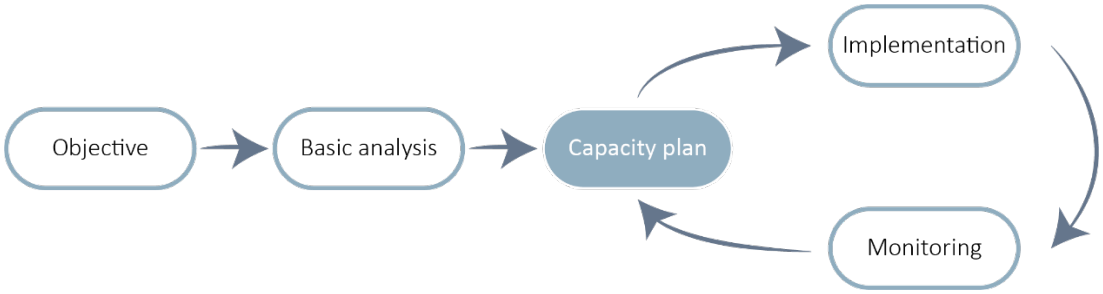


Figure 3.2.09 Steps in applying capacity management in the outpatient department (Berden et al., 2021)

When making a capacity plan, it is important to keep in mind that there will always be unpredictable uncertainty. A maximally efficient outpatient clinic is therefore undesirable; a bit of overcapacity will be important to stay afloat in the dynamic environment of the hospital (Berden et al., 2021).

3.2.4 Characteristics of the outpatient department

Until the 1970s, the hospital consisted of three main functions: the wards, the operating theatre and the new and separate outpatient department. The first generation of outpatient departments was located in clearly identifiable hospital wings. Due to the increase of outpatient services, the clear distinction between the main functions faded. The components were more or less modularly aligned and linked to a simple logistical structure, and a deliberate village atmosphere was pursued (Gmelig Meijling, 2011).

Much of what happens in the outpatient section resembles conveyor belt work: a new one immediately follows for every patient treated. The medical facility is designed to manage big crowds of individuals who are admitted and then sent home after treatment or consultation, which is the most significant characteristic of the outpatient department. Family or friends usually accompany patients. And so, the outpatient department functions as a traffic machine. The outpatient departments are by far the busiest departments of the hospital. In general, the majority of the patient's visit consists of waiting. The interaction with the medical establishment usually does not last very long (Mens & Wagenaar, 2007).

The spatial facilities required for consultation and physical examination at the outpatient department can be divided into areas accessible for patients (front office) and support areas accessible for staff (back office). The front office and back office are increasingly becoming separate entities (Gmelig Meijling, 2011). Figure 3.2.10 shows an example of a spatial layout of an outpatient department whit a clear distinction between the front office and back office. Basically, there are two ways of positioning the front office and back office (Gmelig Meijling, 2011):

1. A spatial concentration of front office and back office.
   Spatial facilities for reception, waiting, and the administrative preparation and processing of outpatient visits are arranged around the consultation rooms and form a so-called consultation unit. The characteristic of this set-up is that the consultation room is also the specialist's office, and there is a separate examination room. The consultation units are mostly clustered per specialism.
2. A spatial separation of front office and back office.
   The consultation takes place in a consult/examination room. This set-up is a strongly standardised consultation block, existing of consultation/examination rooms, a reception and multi-functional meeting rooms. The waiting areas are concentrated where possible in, for example, a central accommodation area. A striking feature of this set-up is that, where possible, the rooms are used by different specialisms, and the same applies to the back office; no medical specialist has its own place.

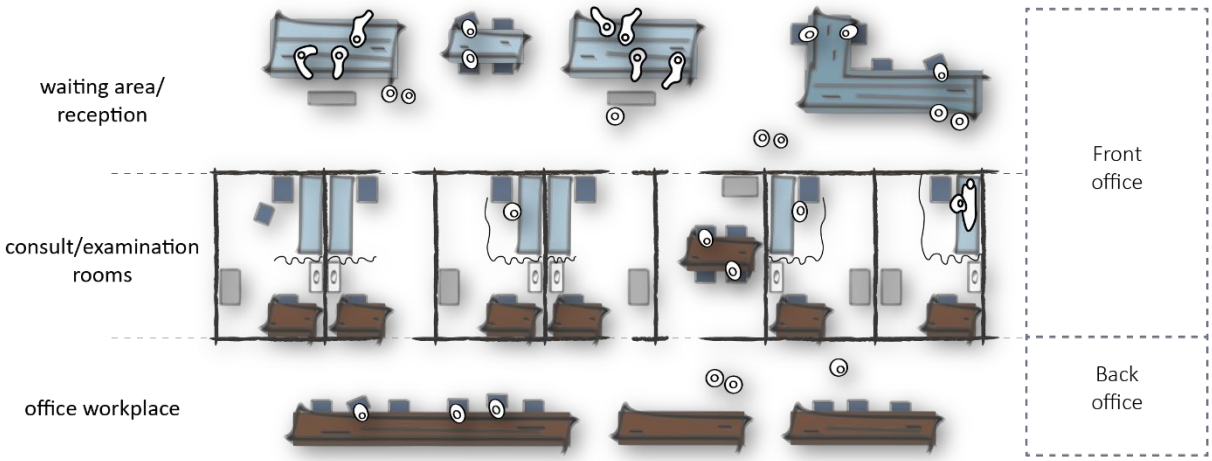


Figure 3.2.10 Spatial layout outpatient department with a clear distinction between front office and back office (Gmelig Meijling, 2011)

Separating the front and back offices and the standardization of rooms that go along with it might offer some advantages versus tailor-made outpatient departments for particular specialisms. Firstly, a higher occupancy rate is possible for both the consultation/examination rooms and the workrooms. Secondly, when a speciality does not hold consulting hours, another specialism can use these rooms. This makes it easier to facilitate a growing number of part-timers and nurse practitioners (Gmelig Meijling, 2011).

3.2.5 Patient journey

The patient journey through the system is a significant factor determining the performance of healthcare delivery processes. The patient journey defines the medical progress of a patient through the medical system. However, it also shows the patient's movement through various locations of the healthcare system from an operational perspective. Within the hospital walls, the patient starts their journey either at the outpatient or emergency departments (Bhattacharjee & Ray, 2014). In figure 3.2.11, a simple form of the patient journey concerning the capacity of the independent subsystems of the hospital is displayed. As derivative from the figure, a patient may have to do with different subsystems. A distinction is made between four patient flows: acute, urgent, elective and chronic care. Care at the outpatient department is part of the elective care. The first contact of the outpatient is in the department where the consultation takes place. From there, the patient may use one of the other departments, such as the X-ray department or the outpatient operating rooms (Gmelig Meijling, 2011). To achieve a continuous patient flow, a strong cohesion between the subsystems is of importance. The feedback function of a closed-loop system is necessary due to the dynamic relationship between available capacity and flows (Munavalli et al., 2019).

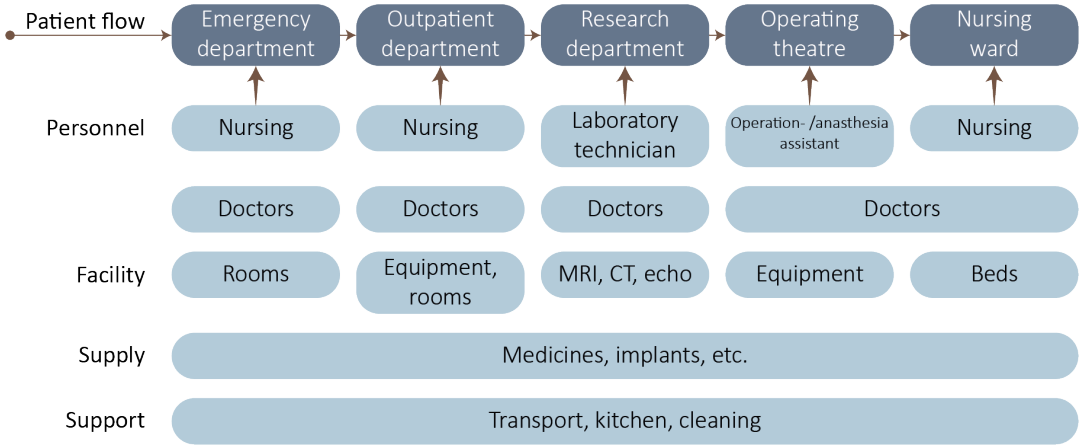


Figure 3.2.11 Relation between capacity and patient flow (Berden et al., 2021)

The steps in the patient journey indicate various procedures such as registration, consultation, and examinations when considered from an operational viewpoint (Bhattacharjee & Ray, 2014). The patient journey is visualised in figure 3.2.13. The patient's process often starts with the general practitioner by whom the patient is referred to the hospital. (1) The patient makes an appointment by telephone. The patient arrives at the hospital on the appointment date, and (2) registers at the desk. If necessary, the patient has to verify the medical file at the pharmacy. In addition, it may be desired that the patient first visits the laboratory for blood sampling or the X-ray department before the consultation takes place (Arias, Rojas, Aguirre, Cornejo, Munoz-Gama, Sepúlveda & Capurro, 2020). (3) Next up, the patient takes place in the waiting area; a waiting area can be organised centrally or decentrally. In a decentral waiting area, the patient goes directly to the waiting area located within the consultation area of the specialism. In a central waiting area, the patient first waits in the main hall where additional services are facilitated, such as shops, an espresso bar or a restaurant. Patients are kept informed about waiting times and possible delays through digital information screens in the central waiting area. Approximately 5 to 10 minutes before the consultation time, the patient is referred to a smaller decentralised waiting area at the outpatient department (Gmelig Meijling, 2011)..

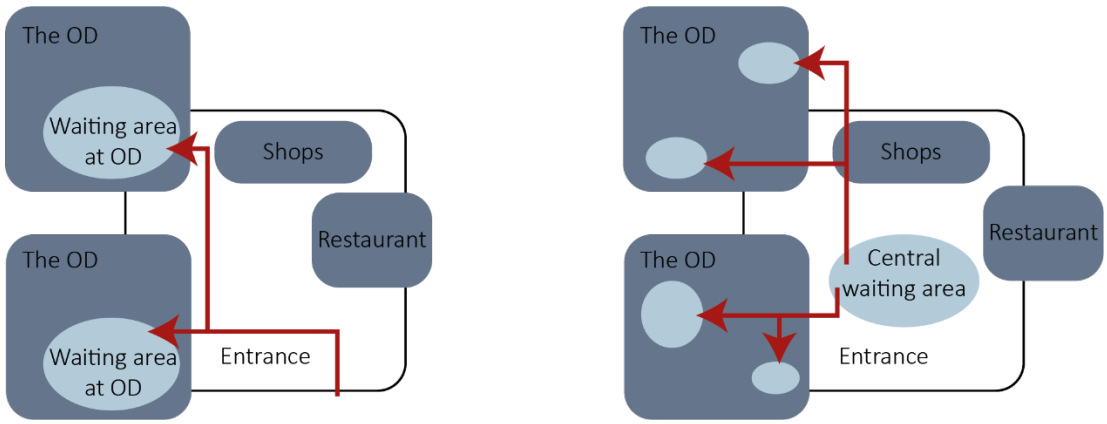


Figure 3.2.12 Concept decentral waiting area (left) and central waiting area (right) (Gmelig Meijling, 2011)

Once the medical specialist is ready, the patient is called and referred to the designated consultation/examination room. The consultation often starts with an (4) anamnesis, in which the patient tells the medical specialist about the medical history, and a (physical) examination by the medical specialist will follow. Resulting from the consultation, a (5) follow-up appointment is made (or not) by the medical assistant. This is done in the same room if possible or otherwise at the desk. (6) The patient leaves the consultation unit and the hospital. The patient returns home and may come back later for follow-up examinations or a repeat consultation. If possible the follow up consultation can be done through the use of online devices, like e-consultation or remote monitoring, and the

patient doesn’t have to return to the hospital (Arias et al., 2020). There is a need to include technology into the patient experience that can deliver information on technological breakthroughs, tools, and potentials to patients and caregivers. A patient portal system could for example provide extra information or time sensitive alerts (Borycki, Kushniruk, Wagner & Kletke, 2020).

3.2.6 Medical specialist journey

The journey of the medical specialist is displayed in figure 3.2.13. When the patient makes an appointment, it is (A) scheduled by the secretary in the medical specialist's schedule (Interviewee B3, 2021). Once the patient has arrived in the hospital and is finished with the preliminary examination, the medical specialist gets a sign (B) through the system that the patient is waiting in the waiting area (Interviewee C5, 2021). The medical specialist can prepare the consult by analysing the EPD (electronic patient dossier), which is the medical file of the patient (Interviewee B3, 2021). Then the consultation starts (C), depending on the care needed by the patient the assistant can take over and the medical specialist can move on to the next patient. Sometimes (D) multidisciplinary hours need to be scheduled for professionals to discuss the patient, then it is convenient if these professionals are situatied near eachother. After consultation hours, when there are no patients to see anymore, the medical specialist can finish the administrative work in the back office. Also if the follow-up consultation takes place through (E) e-consulting or phone call, this takes place in the back office in special rooms with the needed equipment. The back office is also called knowledge and expertise centre as this is the place where all professionals and supporting staff come together. This place is seen as the brain and backbone of the hospital (Gmelig Meijling, 2011).

Figure 3.2.13 The patient journey (own figure)

3.2.7 Hospital 4.0 evolution

The research on Hospital 4.0 is still in its early stages, and most ideas are not yet implemented in practice. Hospital 4.0 (H4.0) is a reference to the Fourth Industrial Revolution but then the implementation of digital information and communication technologies in the healthcare sector. H4.0 technologies may partake in managing the trade-off between providing custom care to patients submitted to increasingly complex treatments without jeopardising the safety of the patient. Since H4.0 relates to real-time customisation it can support the hospital in its adaptive capacity to cope with the changing environment. Recently, healthcare researchers and practitioners have shown a growing attention in resilience engineering, which concerns how resilience performance can be supported by the design of healthcare systems. If the healthcare system is resilient it may be able to perform on a required level both under expected and unexpected circumstances. The four main characteristics of resilient systems are: (Tortorella, Saurin, Fogliatto, Rosa, Tonetto, &Magrabi, 2021)

- To monitor, know what to focus on/what to expect
- To anticipate, know what to expect
- To respond, know what to do
- To learn, from past experiences (successes & failures)

H4.0 systems consist of interconnected digital technologies, microstructure technology and electronics, all of which work together to improve the efficiency of auxiliary processes and therapeutic models. The H4.0 technologies can be grouped accordingly their purpose:

- Communication, to promote interaction between actors in the healthcare chain and distribution of information.
- Sensing, to collect data on processes, patients, equipment and/or materials.
- Processing, to transform data in information.
- Actuation, to, based on the received information, move and control a system, mechanism or software.

According to Tortorella, et al. (2021) there are four H4.0 digital applications that are most likely to impact the each before mentioned resilient ability in hospitals; (1) in real-time remote consultations and development of plan of care, (2) digital non-invasive care, (3) interconnected medical emergency support and (4) collaborative sharing of patient data and information on digital platforms. However, the level of impact of H4.0 technologies on the resilience of the hospital may vary among the different departments in the hospital. Also the H4.0 implementations may imply changes in work processes (Tortorella, et al., 2021).

The research of Lopes, Braga,& Santos (2021), describes the Adaptive Business Intelligence (ABI) platform as a contribution to the evolution of Hospital 4.0. In this research as well, the implementation of smart technologies relates to the adaptability of the different sectors in the hospital to the organisation. Future possible scenarios can be identified by an ABI system as it combines predictive layers and has an optimisation base which react to existing constraints in each problem. Regarding the organisation of a hospital, such an Information System can allow real-time monitoring of the different areas.

3.2.8 Conclusion on the outpatient department

Question	What does the outpatient department of a Dutch hospital entails? *What activities take place in the outpatient department?* What is Integral Capacity Management and could this be an operating area where smart tools can be deployed?
Purpose	To get insight into what the outpatient department entails, what concepts can be applied, determine what patients and medical specialists in this department need. To be able to align supply and demand. The user journey is becoming clear. To anticipate current developments and hot topic in the healthcare sector.
Methods	Literature review

The need for outpatient services is increasing, due to the pressure on hospitals to reduce costs and improve health service accessibility. The outpatient department consist of a lot of different specialisms. Within the hospital organisation different discipline-groups existing of medical staff are more or less autonomous organisations. As a result, the executive board of the hospital has little influence on detailed production decisions within such a discipline-group. Integral capacity management can be used as a tool to create an integral process throughout the various subunits, to achieve coherence and consistency in decision-making and implementation at all levels in the organisation. By managing the capacities the aim is to create alignment between supply and demand. To eventually improve the healthcare process and healthcare delivery towards the patient.

The main characteristic of the outpatient department is that of patients coming and leaving the same day. The layout of the outpatient department consist of a front office and a back office. Increasingly the front office and back office are becoming two separate units. The front office consist of areas where patients come and go; entrance, waiting area, reception, consultation/examination room, additional facilities like restroom, restaurant, etc. At the back office only the medical specialist and other staff is allowed. The back office consist of, flex work spots, concentration rooms, rooms for e-consults or phone consults, conference rooms and meeting rooms.

3.3 Smart tools

This chapter provides background information on smartness in real estate; internet of things, big data and smart tools. This chapter provides an answer to the sub questions: Which and how are smart tools used in public buildings? How can smart tools be implemented in the organisation? and is ICM an operating area where smart tools can be deployed?

3.3.1 Big Data and Internet of Things

Big Data

When discussing Big Data and the Internet of Things, it is good to understand the concepts of data, information, knowledge, and wisdom. Figure 3.3.01 shows the so-called knowledge pyramid; this demonstrates the distinction between the concepts (Ottenheijm, 2015);

- Data: a representation of reality by raw factual records.
- Information: meaningful processed data to which an interpretation has been given.
- Knowledge: information on an aggregate level that can lead to a change in behaviour or mind.
- Wisdom: meaningful processed knowledge.

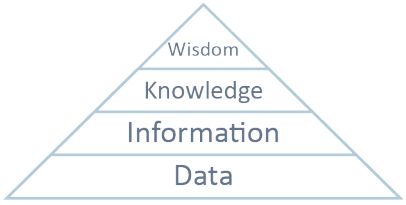


Figure 3.3.01 Distinction between data, information, knowledge and wisdom (Ottenheijm, 2015)

The distinction between the four concepts is not found in the content, structure, accuracy or utility. Rather, the key to effectively distinguishing between the four concepts is the personal interpretation of the information/data. This can be different per individual as it can be related to facts, procedures, concepts, ideas, observations and judgements (Ottenheijm, 2015).

The features of Big Data can be explained accordingly the five V's: volume, velocity, variety, veracity and value. Volume represents the amount of data that is generated. Velocity refers to the speed at which the data is generated. Variety describes the variance of data types, while the veracity represents the uncertainty of what data types may be added later. And the information gained from the Big Data set is the value (Baker et al., 2017).
The various features of data types are also reflected in the data sources of big data analysis in the healthcare sector, where five different information flows can be distinguished (Ottenheijm, 2015):

- Internet and social media; click and surfing behaviour on the internet and data interaction from social media (Facebook, LinkedIn, etc.)
- Machine 2 machine: data from sensors and other measuring devices, e.g. data from a medication dispenser.
- Transaction data: data from the declaration and financial information flows in healthcare.
- Biometric data: x-rays, fingerprints, iris scans, etc.
- Human-generated data: data entered by humans from electronic patient records (EPD), notes, e-mails and paper records.

According to Ottenheijm (2015), McKinsey has described in his study "The 'big data revolution in healthcare" (2013), which types of big data analyses can be distinguished. In the model (figure 3.3.02) they created, these types of big data analyses are organised along two axes; the value and/or impact on the x-axis and the technological complexity on the y-axis. As the data changes from information and knowledge to wisdom, the value increases with the technological complexity. The following successive levels can be distinguished accordingly the model:

- Reporting: what happened? This includes 'simple' databases like, how many operations have taken place in a hospital in a given period. This often concerns data that can be presented as useful information by dashboards.
- Monitoring: what is happening now? At this level the current situation can be compared with a benchmark or desired situation. Both recent and real-time data is used. For example to monitor (complex) stock management or the OR (operating room) planning and occupancy in a hospital.
- Data mining and evaluation: why did it happen? Data mining and evaluation concern the analyses of data with the aim of discovering certain correlations in order to find valuable information. For example discovering a relation between the occurrence of an infection and the hospital room where these patients have been lying.
- Predict and simulate: what will happen? This is the most complex level, what might happen in the future based on the current available data. IBM's Watson is an example of a technology that transfers knowledge into wisdom. Herby, personal data of a specific person can be processed and compared with the most recent scientific literature and comparable situations of other patients and the effect of their treatment. In order to make an individual tailored diagnosis and treatment advice.

Based on the previous information Ottenheijm (2015) gives the following definition to big data: *'Big data refers to the ability to track, explain and predict events by intelligently combining and analysing complex datasets from different sources.'*

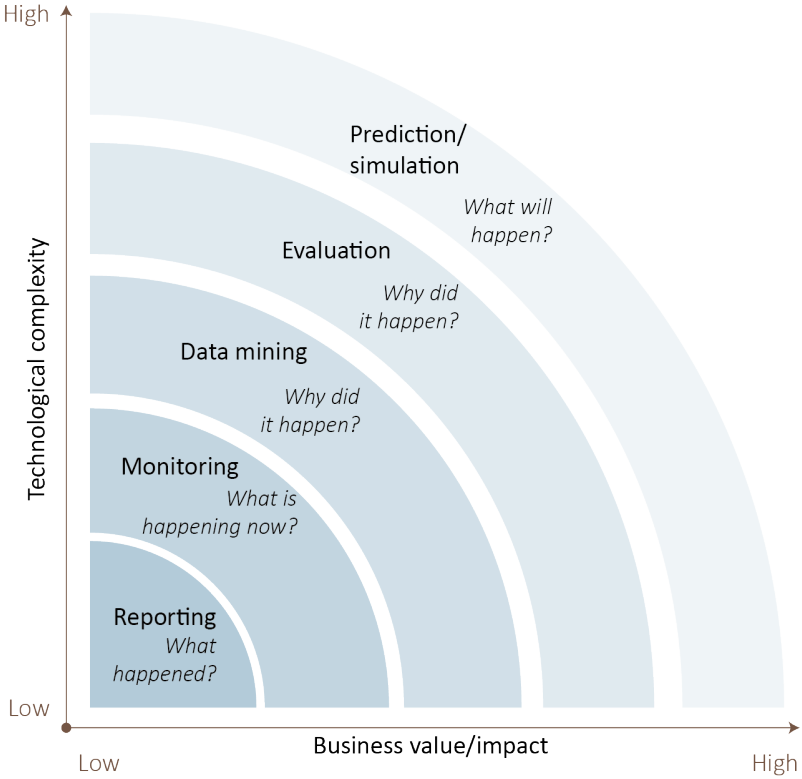


Figure 3.3.02 Degrees of technological complexity (Ottenheijm, 2015)

Internet of Things (IoT)

Patel & Patel (2016, p.6122) give the following definition to the Internet of Things (IoT): *'Internet of things (IOT) is a network of physical objects. The internet is not only a network of computers, but it has evolved into a network of devices of all types and sizes, vehicles, smart phones, home appliances, toys, cameras, medical instruments and industrial systems, animals, people, buildings, all connected, all communicating & sharing information based on stipulated protocols in*

order to achieve smart reorganizations, positioning, tracing, safe & control & even personal real-time online monitoring, online upgrade, process control & administration.'

IoT can be defined into three categories: (1) people to people, (2) people to machine/things and (3) machine/things to machine/things. The variety of things/objects are able to interact and cooperate with each other through wireless and wired connections and unique addressing schemes, to create new applications/services and reach common goals. The main goal of IoT is to connect things anytime, anyplace with anything and anyone using any service and any path/network. In figure 3.3.03 the characteristics of IoT are displayed (Patel & Patel, 2016):

- Interconnectivity: anything can be interconnected.
- Things-related services: services like privacy protection and semantic consistency between physical things and their corresponding virtual things.
- Heterogeneity: the devices in IoT can interact with other devices or service platforms through different networks.
- Dynamic changes: The number of devices can change dynamically (connect or disconnect, location, speed).
- Enormous scale: the number of devices communicating with each other will be bigger than the number of devices connected to the current Internet.
- Safety: create a security paradigm that will scale, to ensure safety of our personal data and physical well-being.
- Connectivity: network accessibility and compatibility.

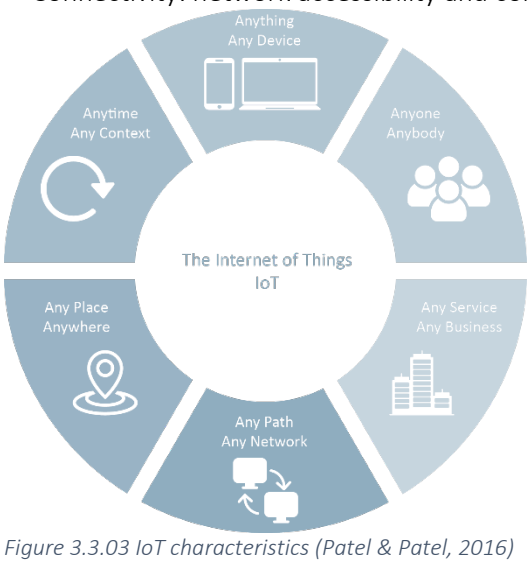


Figure 3.3.03 IoT characteristics (Patel & Patel, 2016)

The architecture of IoT is divided over three different layers of technologies; the sensor layer, the network/communication layer and the application support layer. A detailed architecture of IoT is displayed in figure 3.3.04, it illustrates the relation between various technologies. The sensor layer exists of smart objects integrated with sensors. These allow real-time information to be collected and processed and thereby, enable the interconnection of the physical and digital worlds. Sensors come in a variety of shapes and sizes, and they are used for a variety of applications. The network/communication layer is responsible for processing and the transmission of the information resulting from the generated data by the sensors. These networks can be a private, public or hybrid model, and support the communication requirements for latency, security or bandwidth. The ability to manage the information flow is known as data management. Information can be retrieved, integrated, and controlled using data management under the (management) application service layer. The application layer covers the smart environments within different domains.

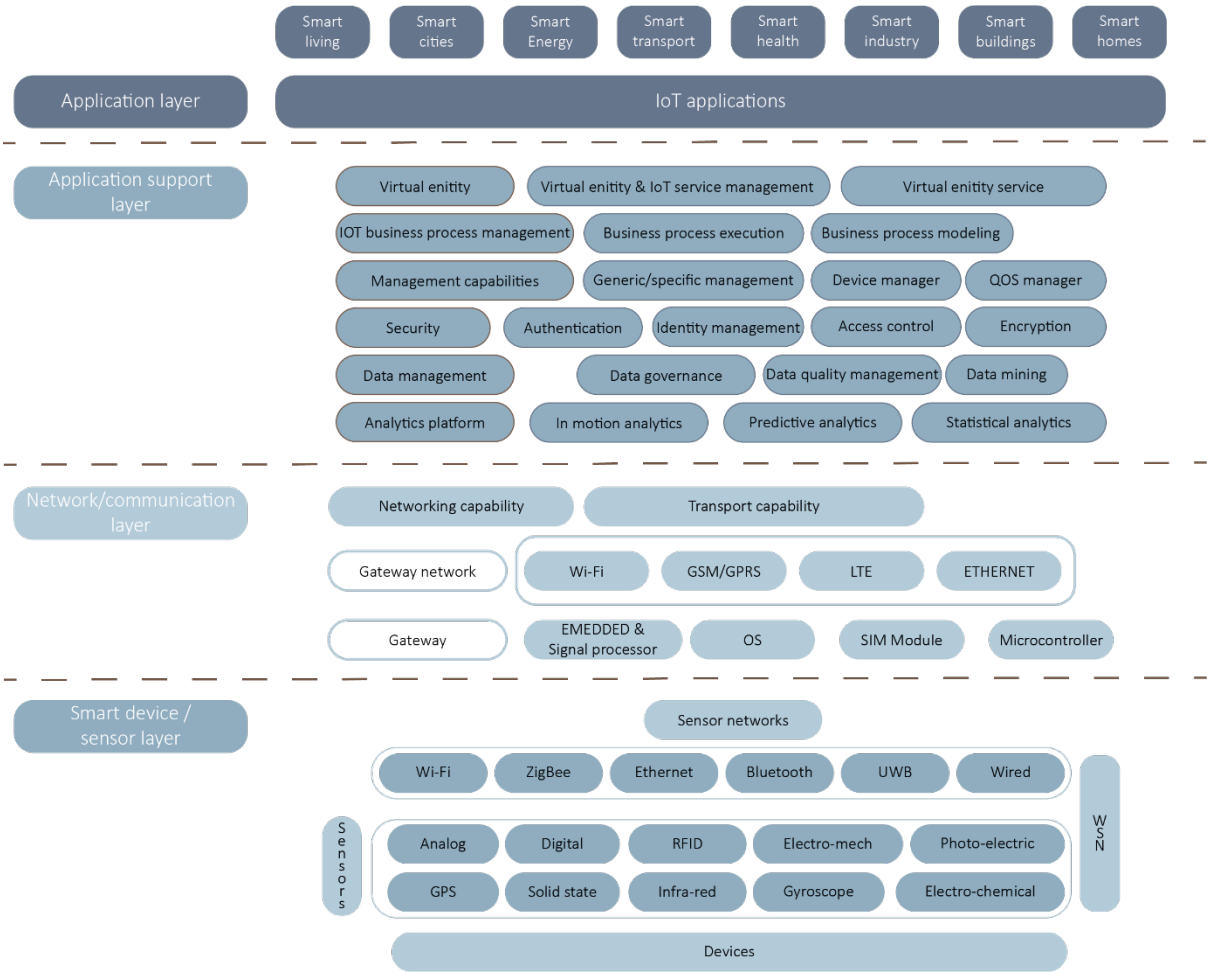


Figure 3.3.04 Architecture IoT (Patel & Patel, 2016)

3.3.2 Smart health

An IoT-based healthcare system integrates all accessible resources as a network to perform healthcare tasks such as diagnosis, monitoring, and remote procedures over the Internet. To improve the effectiveness and capability of the systems, effective strategies and methods are crucial in IoT-based healthcare systems. As a smart system deals with Big Data, it necessitates a methods of well-structured, systematic and intelligent knowledge management. Therefore, knowledge management, big data management, resource management and the development of Tele-Health subsystems are critical strategic issues (Yin et al., 2016). Accordingly, the research done by Baker et al. (2017) most healthcare-related IoT systems focus on remote health monitoring. By monitoring non-critical patients at home instead of in the hospital, the strain on hospital resources like doctors and beds will be reduced. This monitoring is mainly done by using wireless and externally-wearable sensors. Smart health service is a broad concept; it has a range from extending beyond the traditional hospital boundaries by making use of, for example, virtual care to optimising existing procedures by using advanced technologies. A smart hospital is interconnected and efficient. Real-time data connect the people, environment and systems (McBride,2020).

3.3.3 Smart buildings

According to Buckman et al. (2014), there are three types of buildings in terms of smartness. The intelligent building, which is generally reactive to the data it receives. The smart building, which has the ability to adapt its operations to events. And the thinking building, this building has the ability to predict events by making use of future technology. The development of the ‘smart building’ is

shown in figure 3.3.05. As can be derived from the figure, due to technical developments, we get to know more and more about our buildings. The buildings get more controlled and even interactive. If the real estate manager has information on the frequency and occupancy rates of the building, better informed decisions can be made on real estate investments or the operating cost can be reduced (Valks, et al., 2018). The built environment is an important part of the IoT network. Applications of a smart building require extensive resources. But the building systems (CMMS, BAS and BEMS) are evolving and through sensors and connecting multiple building system databases the indoor environment can be generated to provide building data (Gao et al, 2021). Buckman et al. (2014, p.104) give the following definition to a smart building: *'Smart Buildings are buildings which integrate and account for intelligence, enterprise, control, and materials and construction as an entire building system, with adaptability, not reactivity, at its core, in order to meet the drivers for building progression: energy and efficiency, longevity, and comfort and satisfaction.'*

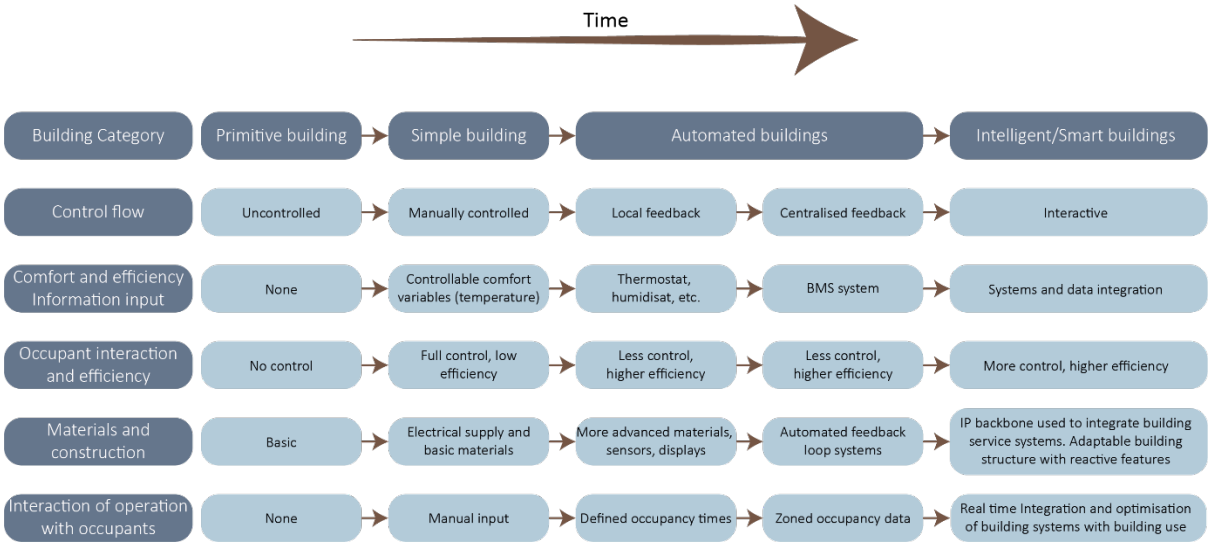


Figure 3.3.05 Development of the smart building (Buckman et al., 2014)

3.3.4 Smart tools

As explained in the previous sections, to retrieve information from the building, data can be generated. As can be derived from figure 3.3.04, the sensing layer existing of 'smart devices' provides real-time data collection (Patel & Patel, 2016). These devices are in this research referred to as smart tools. The definition of smart tools used in this research is the one of Valks et al. (2018, p.8): *'A smart tool is a service or product which collects (real-time) information on space use to improve the space use on the current campus on the one hand, whilst supporting decision making on the future space use on the other hand.'* According to this research, data on space use and the use of smart tools is to a large extent associated with the states of matter as referred to in chapter 3.1.4. According to the framework of Christensen, Melfi, Nordman, Rosenblum and Viera (2014), the way space use is measured can be distinguished in four levels, which can all be aggregated in time and space:

- Frequency; when
- Occupancy; how many
- Identity; who
- Activity; what

The gap between predicted space use and the actual use of space can be minimized by using real-time data. Thus the use of space can be managed more efficiently and effectively. Besides, the information on the use of space can help in future decision-making on the accommodation strategy. An efficient way of gaining more insight into space use is using multiple sensors or data sources (Valk et al., 2018). When deciding what type of tool to use, it is wise to look at the why what and how:

- Why (objectives): Strategic, Functional, Financial, Physical
- What (measurement): Frequency, Occupancy, Identity, Activity
- How (measurement method): Manual, Reservations, Sensors

Valks et al. (2018) give various examples of how smart tools can be used in collecting data and how this can be implemented in the real estate strategy. Examples of smart tools that can be used are iBeacons for real-time space use measurements or Wi-Fi, Bluetooth, cameras and smart cards to analyse where congestion occurs. At the universities, smart tools are mainly used for wayfinding on campus, finding other people on campus, finding a study place on campus, and optimising the comfort of that study or workplace. ABN AMRO wanted to measure the occupancy rates in its buildings to gain insight into hidden vacancies and improve employee satisfaction. This is done by the use of the sensor Wi-Fi as a smart tool. The users of the building have insight into the occupancy of the office through TV screens on every floor and an app. Microsoft had another objective, as the company wanted to shift from individual offices to team-based spaces, the company wanted to understand better the networks of people within its organisation. The measurement method they use is reservations through outlook and sensors by software data. The employees have insight into both individual and team productivity and work habits. The final example of how smart tools can be used in a public building is the Erasmus MC redevelopment. Due to the demolition of offices, the current facility needs to accommodate more employees. The end users are resistant to implementing a new workplace concept. EMC wants to cope with this problem by providing the users insight into the occupancy of workplaces, assisting them in finding a workplace and monitoring the occupancy whether additional space is required. The method used for monitoring is a login of PCs, and a dashboard is provided for the users that show information on workplaces (Valks et al., 2018).

Sensors

In the above examples, different measurement methods have been used. In his research Valks, et al. (2018) has made a list of sensors with which data can be collected. Just like this research, Valks et al. (2018) also focus on data collection on space use. However, next to the use of space, the sensors can also be used to optimise the comfort of the workplace by adapting the indoor climate as a tracking device or to maximise performance.

Type of sensor	Description of sensor
Wi-Fi	The Wi-Fi network can be used to estimate how many people are in the building and to localise users in the building. The number of people in the building can be measured two ways; (1) the number of devices connected to each access point and (2) the attempts that devices make to connect to all access points in the building.
Bluetooth	Bluetooth can transmit data over shorter distances than Wi-Fi. A method of using Bluetooth to measure space is placing iBeacons in each room. By placing multiple iBeacons in a room, the position can be traced.
RFID	The Radio Frequency Identification consist of a chip with an antenna that can receive information and a reading device. Space use can be measured two ways: (1) access control, the system granting access per person, (2) or by reading devices in doors of meeting rooms that are activated by an entrance card.
Camera	A video camera or an infrared (IR) camera can be used for the measurement of space. Video cameras can measure the number of people in the view of the camera and the number of incoming and outgoing persons. IR cameras can register objects based on the radiation (heat) of the object. The software installed in the cameras interprets the data.

Infrared	Active infrared (AIR) and passive infrared (PIR) can be used to measure space. AIR works with a transmitter and a receiver; it can measure the number of people passing at the entrance of a building. PIR can sense variances in energy in the environment. For example, when integrated into lighting systems, it can turn on the light when it detects movement. However, the measurement of space use is very limited due to the frequency and false positives and negatives. PIR sensors underneath desks or in meeting rooms can measure space use as it measures the presence of people.
Use of devices	People logging in on their devices; computers, mobile devices, pin terminals, e.g., indicate the number of people present in a building.
Ultra-wideband	UWB is comparable to Wi-Fi and Bluetooth. It can transport large amounts of data over large distances, and it is not hindered much by obstacles such as walls.
CO2 sensors	The CO2 concentration in the air can give an estimation of the number of present users in a space. The measurement is not real-time or accurate as CO2 levels rise gradually, so there is always a delay. Also, not the exact number of users can be measured, only whether there is a big group or small group present.

Figure 3.3.06 List of sensors that can collect information on space use (Valks et al., 2018)

3.3.3 Hospital Control Center

The capacity centre or hospital control centre (HCC) focuses on the operational capacity management component, step four in the ICM control cycle (figure 3.2.07). The HCC can be compared to a control tower. It is the place in the hospital where all the information of supply and demand on capacity within the hospital comes together. Besides bringing together information from the data sources, it is also where capacity managers, healthcare professionals, and managers can meet each other. With smart calculation models, analyses are made to look ahead. The system will send an alert if a bottleneck is approaching. As the warning is sent in advance by the system, this can be a few hours or sometimes even a fortnight, there is still enough time to make proactive adjustments (Speet, 2020). Having an HCC is not an end in itself but a means of supporting ICM, which is a means of achieving specific organisational goals (Baanstra, 2021).

For setting up an HCC, Berden et al. (2021) mention five essential components:

1. The manager in charge of the HCC should have a clear vision of ICM and should have the ability to engage with the board and departments on a strategic level.
2. Assemble the appropriate profiles. Besides, everyone in the centre needs to know about capacity management, and a good mix of data analysts (hard side) and process supervisors/advisors (soft side) is desired.
3. Invest in optimising the (right) collection of data. The principle garbage in = garbage out also applies to data collection for ICM. Collaborate with the BI-department as well as the experts on-the-job. These experts can test the data against the daily practice.
4. Connect with other staff functions. Consider the BI-department and staff functions that deal with Value-Based Health Care, quality indicators, and continuous improvement. As a result, these efforts will gradually become integrated into the hospital's everyday operations and organisation, rather than being distinct projects or programs.
5. Setting up ICM within an organisation is a process of change that cannot be achieved overnight. Together with the board and the care departments, formulate a step-by-step plan to successfully apply the five elements and preconditions of ICM in the organisation's business operations.

The performance of ICM requires both a top-down and bottom-up approach, where the objectives are shaped by the people's actions on the job. For the implementation of ICM and the HCC, Berden et al. (2021) relate the implementation to the Shingo model, as shown in figure 3.3.07. The combination of the top-down and bottom-up approach is supported by the Shingo model as derived from the following quote:

> *"An organisation moves closer to excellence as it achieves its desired results as an outcome of behaviours, driven by systems that can sustain not only the results but also the culture that created them" Shingo Institute (2020) (Berden et al., 2021, p.79)*

The foundation of the pyramid consists of people and their behaviour (1), followed by the processes (2), integral coordination (3) and finally, the intended result (4). This shows that an HCC is supportive of the professional performing their job. The HCC can make an important contribution to gaining insight into the supply of information across the chain. This is important for thinking from the chain's perspective instead of from the perspective of one's own process. The HCC can be seen as a catalyst for identifying chain issues, which are subsequently addressed in collaboration with on-the-job experts (Berden et al., 2021).

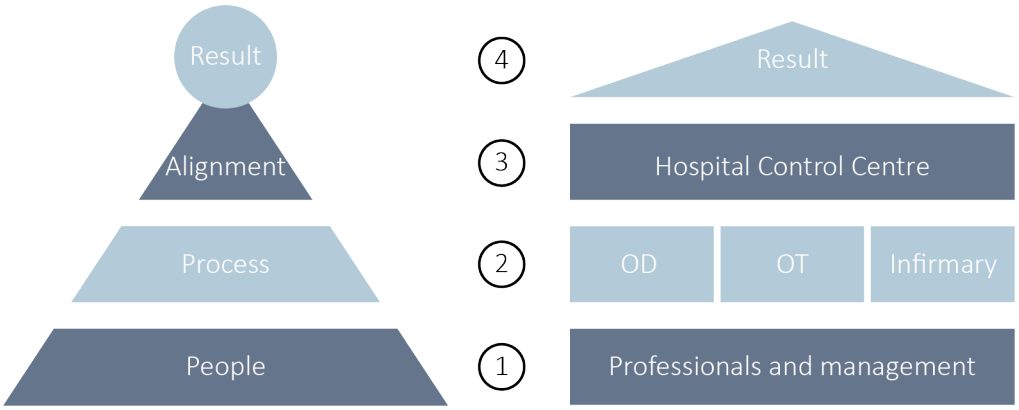


Figure 3.3.07 Implementation ICM related to Shingo-model (Berden et al, 2021)

3.3.6 Conclusion on smart tools

Question	*What are the influence of Big Data and IoT on the use of the outpatient department?* Which and how are smart tools used in public buildings? *How can smart tools be implemented in the organisation?* *Could Integral Capacity Management be an operating area where smart tools can be deployed?*
Purpose	To get insight into what smart tools are and how they can be applied for measuring space use. To get insight into if and how smart tools can be implemented in the organisation. To anticipate the change digitalisation in the near future.
Methods	Literature review

The value of data is dependent on personal interpretation. The four levels are data, information, knowledge and wisdom. As data changes from information and knowledge to wisdom, the value increases, and so does the technological complexity. The ability to explain and predict events by analysing and combining complex datasets is called big data. Internet of Things (IoT) refers to the network of devices able to communicate to achieve smart reorganisations, process control, personal real-time monitoring, etc.

The architecture of IoT consist of three layers; sensing (data collection), network (data processing), and application (data provision). Healthcare-related IoT systems mainly focus on remote health monitoring. By monitoring non-critical patients at home instead of in the hospital, the strain on hospital resources like doctors and beds can be reduced. Smart tools are part of the sensing layer within the IoT architecture. Sensors allow the collection and processing of real-time information.

A smart tool can support the decision making process on space utilisation as it provides the user or organisation with real-time information. Most sensors applied for optimising space utilisation give the organisation insight into the occupancy of spaces or provide the user insight into how the space is used. The following type of sensors can be used to measure space use: Wi-Fi, Bluetooth, RFID, camera, infrared, use of devices, ultra-wideband and CO2 sensors.

A Hospital Control Centre is the place in the hospital where all information on supply and demand on all capacities in the hospital come together. An HCC is a means of supporting ICM. Data derived from smart tools that measure, e.g. occupancy rates, can end up in an HCC to be analysed. The organisation's foundation consists of people, and their behaviour. Smart tools, HCC and ICM can support their activities.

4. Empirical research

Within this chapter the empirical research is outlined. The empirical research consists of case studies of three Dutch hospitals and a validation study of a Dutch hospital. The case studies were carried out to gather relevant information from people dealing with the outpatient department, on the current outpatient department of hospitals and how they envisage the future outpatient department accordingly trends like digitalisation.

4.1 Preparation

A preparation is necessary to execute the case study in a structured and organised manner. This preparation includes drawing up selection criteria. The selection of cases is done accordingly maximum variation sampling (MVS), which is part of the purposive sampling method. The selection of cases took place within the network of AT Osborne. A company that is specialised in project management and advisory within the public sector. The department of housing and real estate advice operates within the broad spectrum of the healthcare sector, from hospital to long-term care organisations. This includes the development of strategic real estate plans, programmes of requirements for suitable accommodation and plans for the development of complex new and refurbishment projects. As described in section 2.2.2 the selection criteria for the cases are the following:

- Industry: The projects should be hospital real estate.
- Project: The projects should be an outpatient department. The outpatient department can be part of a general hospital or can be situated in an independent clinic.
- Location: The projects should be situated in the Netherlands.
- Specification: Within the projects real-time data is or could be measured.
- Specification: The organisations of the projects should be willing to give insight in the current ICT infrastructure.

The following cases were selected based upon these selection criteria:

WKZ Utrecht
(classic hospital)

Source (WKZ, n.d.)

Deventer Ziekenhuis
(Somewhat flexible)

Source (Talens, 2020)

Zuyderland Sittard-Geleen
(flexible)

Source (AD, 2019)

The cases differ in type of space utilisation, from rigid space utilisation to flexible space utilisation. Flexible use of space means that the spaces, specifically the consultation/examination rooms, are shared within the specialism or even between different specialisms. In other words, there are no dedicated rooms to individuals.

4.1.1 Data collection

As described in section 2.2.2 for the execution of this research two ways of data collection are used as shown in figure 4.1.01; the project document analysis and the semi-structured interviews.

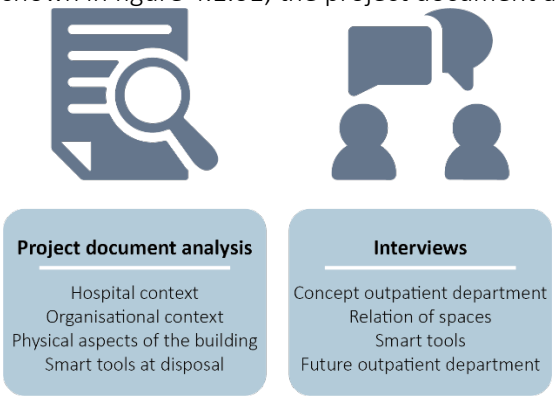


Figure 4.1.01 Data collection case study

Project document analysis

For every project as much documentation as possible was collected. The document analysis gives a clear indication of:

- The hospital context; what is the history, when was it build before or after the building regime?
- The organisational context; what is the vision and mission of the organisation and how do they envision the future of the outpatient department?
- The physical aspects of the building; What does the plan look like, how are the rooms situated in relation to each other and what is the occupancy rate?
- And the smart tools at disposal; how is the building managed? Do they base their decisions on data, are smart tools present to generate this data? What does the ICT-structure look like? This information gives an overview of the boundaries of the project and is based on the literature review conducted.

Interviews

The second way of collection of data is the use of semi-structured interviews. A semi-structured interview, in comparison to structured interviews, allows more for the point of view of the interviewees (Bryman, 2016). However, to make sure the interview does not wonder off in the wrong directions, (flexible) boundaries are set to structure the questions in the interview guide (appendix C). These questions are based upon the literature review and a test interview held at the internship company AT Osborne with consultants on the accommodation of hospitals. The participants are selected based on their functions: facility manager, capacity manager, department manager and medical specialist.

4.1.2 Data analysis

For the analysis of the data the DAS-framework is used. The interviews are based on the topics of this research; the physical outpatient department, the organisation and smart tools. For each of the topics the current situation is assessed and changing demands are explored. In the conclusions the future models are generated.

4.2 Case 1: Wilhelmina Kinder Ziekenhuis (WKZ)

Location: Utrecht Construction year: 1999 Scale: ~10.000m2

Figure 4.2.01Wilhelmina Kinder Ziekenhuis (WKZ, n.d.)

4.2.1 Context

The Wilhelmina Kinderziekenhuis was founded in 1888 under the name 'Utrechts kinderziekenhuis', translated Utrecht children hospital, when citizens of Utrecht raised money to establish a hospital for children with poor parents. It started small with a number of six beds, two years later it had grown to 25 beds. In 1897 the name of the hospital changed to Wilhelmina Kinderziekenhuis, in the hope to raise more money as Wilhelmina became queen in 1898. The hospital grows and grows, and 100 years from the opening, it houses 134 beds and has also opened an outpatient department (WKZ, n.d.).

The WKZ hospital has been situated on its current location, in the Uithof, since 1999. The same year the WKZ merged with the academic hospital Utrecht (AZU) and the medical faculty of Utrecht university (MFU). Hereby, UMC Utrecht has risen. Besides, the opening of the Ronald McDonald house takes place, and from now on the parents of the sick children could stay nearby in a homely environment (WKZ, n.d.).

4.2.2 Key figures

The WKZ is part of the UMC Utrecht (University Medical Centre Utrecht). The WKZ is one of the seven children's' hospitals in the Netherlands. To get an idea of the size of the organisation, some key figures are presented (WKZ, n.d.).

The hospital	The employees
Number of beds 220 Number of hospitalisation per year 7.500 Number of consults per year 278.772	Together with the UMC Utrecht (more then 11.000)

4.2.3 The organisation

As part of the UMCU, WKZ fully endorses the core values formulated by the UMCU and its motto: 'Connecting Worlds'. WKZ wants to contribute to the ambition of the UMCU to be a leader in the field of research and innovation on the six key points: brain, cancer, child health, circulatory health, infection & immunity and regenerative medicine & stem cells. To achieve this the following core values are formulated (WKZ, 2020):

Figure 4.2.02 WKZ core values (WKZ, 2020)

The mission of the WKZ is to improve the connection between doctors/researchers and the patients and their environment and the connection between doctors/researchers and private financiers such as companies, private individuals and private funds and foundations. To provide additional funds for scientific and innovative projects and for projects for a more comfortable stay in the UMC Utrecht & WKZ (WKZ, 2020). The organisational chart of UMCU is displayed in figure 4.2.03.

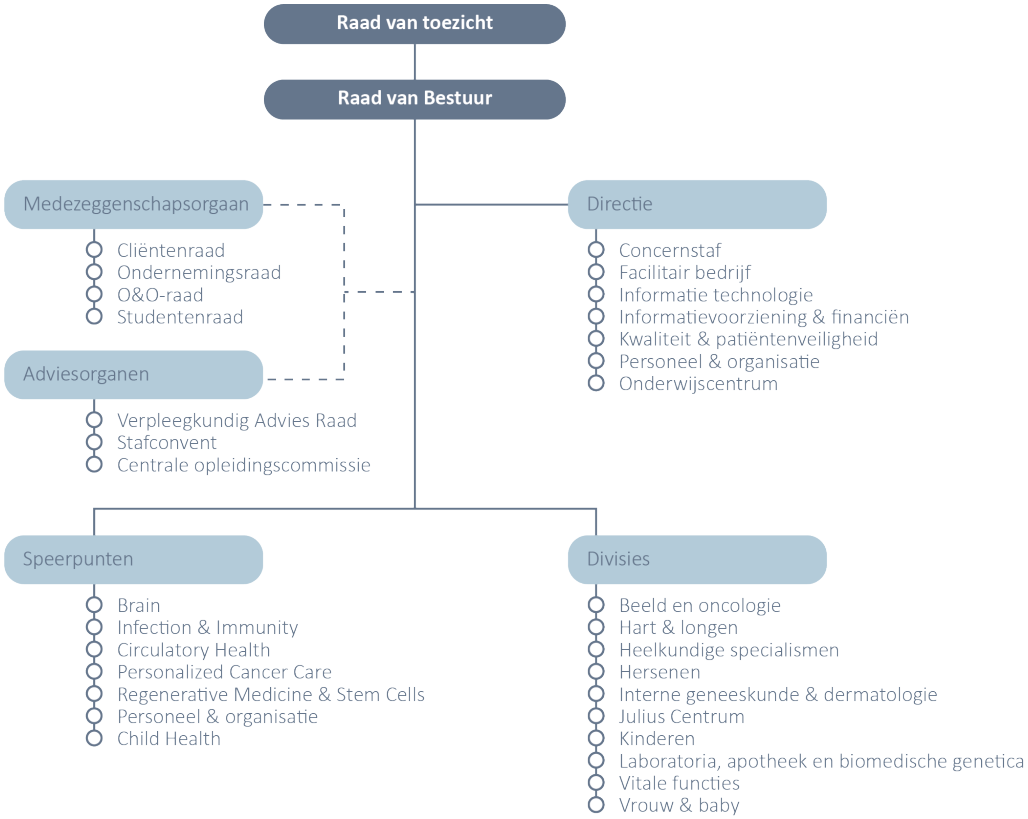
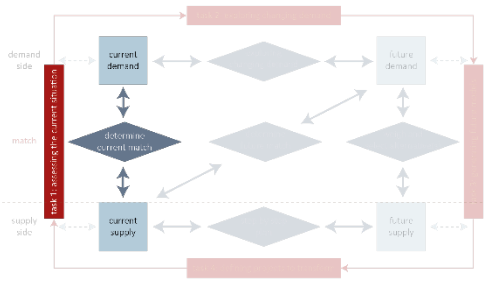


Figure 4.2.03 UMCU hospital organisational chart (WKZ, n.d.)

4.2.4 The DAS-frame

Task 1 assessing the current situation

<u>The outpatient department</u>



The interviewees were asked about the spatial concept of the outpatient department in WKZ. The outpatient department of the WKZ is situated on the first floor. The interviewees explained that the outpatient department is subdivided into three separate and independent outpatient departments. These are referred to as the three 'outpatient legs'; the yellow leg, the blue leg and the red leg. In the red leg, all the surgery specialisms are situated, in the blue leg the paediatrics, and in the yellow leg the well-known combination of cardiology and lung is situated. Each one of these outpatient legs has its own registration and reception desk and waiting area. Around this, the consulting/examination rooms are located and sometimes also dedicated function rooms. (Interviewees A1, A2, A3 & A4). Due to the division into three independent outpatient legs, it is a very solid use of real estate.

"We also have a general outpatient square, but this is not used."
[Interviewee A1, 2021]

"Patients get a letter with directions how to go from the central hall at ground level to the outpatient department on the first floor, to one of the outpatient legs where they can register."
[Interviewee A4, 2021]

In addition, the front office and the back office are spatially concentrated in the outpatient department at WKZ. At the reception in the front office, purely administrative work is done; patients are asked about certain diseases they might have had, nowadays Covid19 is a very important one. Small examinations like measuring/weighing, taking blood pressure or peeing can be executed when all of that is questioned. When that is finished, the patient can take place in the waiting area, where the doctor himself calls the patient in (Interviewee, A3). The back office consists of the staff workplaces, telephone room, coffee room. One side of the outpatient legs consists of the consultation/examination rooms (front office) and the other side of staff workplaces (back office). There is a need for good staff workplaces, and this is an internal discussion point (Interviewee A3). The outpatients' assistants make use of flexible workstations in the back office, and the medical specialists have their own office room or sometimes share it with one or two other medical specialists (Interviewee A1). According to the interviewees, the back office should be separated from the front office, and the staff workplaces can then be turned into multifunctional consultation rooms.

"Some people like it when they can just say; I want to work there now. I just need a place and don't want to reserve it in advance."
[Interviewee A4, 2021]

Nowadays, much more is done in a multidisciplinary way and much less in a mono-disciplinary way, so they try to cluster the specialisms cleverly. Historically, the WKZ was not set up for that, and so they now sometimes get into trouble; they have to work across the outpatient legs (Interviewee A3). This is also reflected in the flexible use of the rooms. Interviewees A3 & A4 state that no medical specialists have their own room.

"What is run in the morning is not run in the afternoon. There will be a whole other group then. What runs on Monday morning also runs Monday morning the following week."
[Interviewee A3, 2021]

However, Interviewee A1 states that the specialisms are very much attached to those outpatient legs, which makes shifting very difficult.

"Suppose you do have a place in the blue outpatient department, then it is challenging to realise for the cardiologist to see the patients there. Because the outpatient assistant, with a certain skill, is in the red department. Then the question arises, what are those specific tasks?"
[Interviewee A1, 2021]

Interviewee A1 answered the direct communication between the assistant at the front desk and the medical specialist when asked what works well with the current layout. However, she believes that, due to the direct communication, the assistants sometimes gets tasks that are not theirs to execute. For example, making follow-up appointments immediately after consultation, this can easily be done by the back office at a later moment.

When asked what could be organised better at the outpatient department, all interviewees answered improving the waiting experience. People must be able to get a cup of coffee from the coffee corner, for example, the facilities for the children are not in the outpatients' department but in the Ronald McDonald House or outside in the playground. There are also patients with epilepsy, for example, who should be able to choose to wait in a quiet area (Interviewee A1 & A4).

"I would like to introduce customised waiting."
[Interviewee A4, 2021]

This goes hand in hand with, for example, the introduction of registration kiosks. The hospital then knows that the patient is present and can receive a message when the waiting time is 5 minutes so that the patient can go to the waiting room close to the consultation room. That creates flexibility (Interviewee A1). This would allow minor functional examinations, such as measuring & weighing, to be included in the patient registration process. In other words, after registration, the patient himself can go to the measuring & weighing room. At the moment, this is still a real bottleneck. The assistants are performing this in between, which causes delays (Interviewee A4). In addition, the signage must be approved.

"We even put extra feet on the floor to make it easier for people to find their way because the current signposting is inadequate. I think it would be really cool to solve this via the mobile phone, for example, through smart signage using the Internet of Things. Just make sure you take into account visual or auditory impairment."
[Interviewee A4, 2021]

<u>The organisation</u>

Interviewees A1 & A2 explain in the organisation of the UMCU, there is the Board of Directors and underneath the management and divisions. The management includes the supporting tasks, such as facilities and ICT. The divisions, medical specialisms all have their own organisational structure. This makes that people work and think very compartmentalised. Also the budget is divided over these divisions, which sometimes is very complex. For example, often specialists from other divisions come work at the WKZ, so the division children pay for the supporting services, while the other division receives the money for the outpatient service.

"Hierarchy is a big theme in a hospital. Horizontal connection points will benefit the decision-making process. There is a lot of influencing to achieve things."
[Interviewee A2, 2021]

The finance department of the UMCU is responsible for the budgeting process. Managers of the various divisions do provide input regarding production capacity. But finance agrees on the budget with the health insurer, based on a production capacity. As a hospital, you are not allowed to grow anymore, so you can only achieve your production based on the previous year, and you will be reimbursed. So anything above that is not reimbursed by the health insurer (Interviewee A2).

"On the job, we have no idea what that production quota means. I don't know how many patients I have to see every year for it to be good. It might be crazy to say so, but I think it is good to know if we are on the right track."
[Interviewee A4, 2021]

According to interviewees A3 & A4, the organisational context on the job is dual management. The business manager and medical manager together lead the outpatient department. The business manager manages four team-leaders, one on each outpatient leg and one on the daycare centre. The medical manager is the representative of the medical processes at the outpatient department. The cooperation between the two managers runs smoothly. And together, they seek a win-win. From a medical point of view, there is very strong cooperation both clinically and outpatient. The fact that a lot of the work is multidisciplinary means that there is intensive cooperation between the divisions.

"For our new multidisciplinary consultations, the question on the care path is included. That's how we agree on things; the interrogation period, how much outpatient capacity we need and what other facilities."
[Interviewee A4, 2021]

According to Interviewee 2, as a result of Covid19, the consultation hours are already more spread throughout the week. However, this should be further improved as that is better for the efficiënt use of the capacities. On the administrative side, more unity could be created. For example, when sending recipes, some people do it digitally, and others still on paper. There is still a great deal of work to be done in these kinds of processes (Interviewee A1).

<u>Smart tools</u>

All interviewees explain how the Covid19 pandemic has served as a catalyst in the use of e-consults or telephone consultations. Only now does the question arise, when does it replace a physical consultation? This is also important for the declaration at the health insurer. Medical specialists say they prefer a telephone consultation as it can be done in between. The video consultation must be executed at a specific time during the day. The telephone consultations are sometimes intertwined with a physical one, so the doctor sees two physically and makes three phone calls and sees a patient physically again.

"There have been many video consultations, but all specialists want to go back to physical. They all have the facilities and the ability to do video consulting. And we have a goal of 50% remote appointment. But it's a really difficult issue, and that has to do with parental authorisation."
[Interviewee A3, 2021]

With regard to other smart tools, the EPD (HIX) is the primary source. Everything is based on this, such as dashboards that show future production figures (Interviewee A2). Furthermore, the programma Checks has been introduced. By means of this system, every week can be checked, based on the outpatient grid, the occupancy in the various rooms.

"It was thought that there was a room shortage. Once we had made things transparent and understandable, it turned out that that was not true at all and that 20% of the rooms were always available, so that has already been a really good step forward."
[Interviewee A2, 2021]

The system is mainly used by the managers at the moment, not so much by the medical specialists. They ask every morning the assistant in which room they have to be in. The secretary now puts the doctor's schedule in the Outlook calendar. So there still is a lot of manual work and matching systems involved.

"Checks provides an overview, and overall, it corresponds with the consultation hours. What I miss is the link with the EPD, so if a consultation hour is cancelled, you have to manually adjust in Checks. Of course, you want this to work one on one. And you want the doctors to look on the app instead of asking the assistant which room they should be in. That is a cultural shift."
[Interviewee A1, 2021]

Finally, Interviewee A4 mentioned the patient portal. She thinks it portrays the 'deciding together, working together' mentality. Parents can read the things she has written and are able to respond.

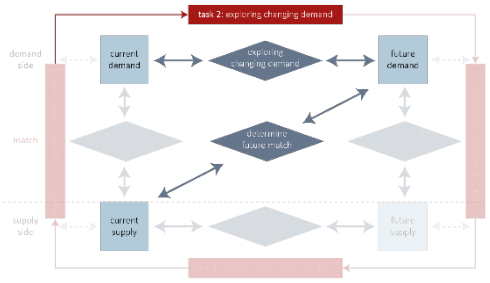
To summarise, from a physical perspective, the division between the three outpatient departments (yellow, blue & red) must disappear, waiting should be customised, and the wayfinding should be improved. Also, the back office can be situated someplace else. From an organisational perspective, it is the desire for greater unity in the processes and less thinking in divisions. From the financial perspective, the budget is set at a maximum, putting pressure on the whole hospital.

WKZ Utrecht, current supply

Welcoming, sign-up, registration	Long term waiting, relaxing	Report, Waiting for consultation	Consultation	Finalisation, follow-up
A front desk per specialism	Coffee corner / restaurant, Ronald McDonald House, outside	Waiting area per department. A big outpatient square but is not in use.	A lot of generic consultation rooms. Rooms allocated per specialism, and divided over the three outpatient arms. Generic room contains: *desk, monitors, chairs, examination table, partition and barely wheelchair accessible*	Next appointment made at front-desk right after consultation. Secretary calls patient after a certain time (14 weeks before next appointment).

Figure 4.2.04 WKZ Utrecht, overview current supply based upon the steps the patient takes through the process (own figure)

Task 2 exploring changing demand



The outpatient department

In terms of organising the consultation/examination rooms. This now is divided per specialism. According to Interviewee A3, it should be organised accordingly to the patient group. The same applies to the way consultation hours are run, this should also be planned accordingly certain patient groups. At the moment, that is not always the case. Also the waiting area should be seperated from the consultation/examination rooms.

Furthermore, the interviewees do not see a shrinking scenario of the outpatient department. Interviewee A3 does mention a possible merger, which means a decrease from 7 children hospitals to 5 children hospitals in the Netherlands. This also means that the hospital will become more specialised in particular treatments. According to the interviewees, the use of telephone consultations or e-consults will increase in the future. Some doctors can do that better than others. However, these 'digital consultations' should not take place in the consultation room but in dedicated phone cells. For this to happen, the 'digital consultations' should properly be planned in the schedule of the medical specialist.

The organisation

Interviewee A1 believes that uniformity in the organisation is very important. But also to think of the hospital more as a business, and thus also being able to steer on the production. Besides, interviewee A2 noticed that the working process have to get more efficient. The budget will certainly not increase, maybe even decrease, and the production probably increases. This means that the costs need to decrease and this can only be done by working more efficient, maybe even with less personnel. Also, interviewee A3 states, the working processes need to be more standardised and digitised.

Smart tools

When asked what kind of information would be desirable to improve the execution of the work processes, interiewee A4 answered to make the waiting time of the patient more useful. For example by showing the patient information on information on WKZ, patient information or participation and how the patient can participate in this or already sending in questions to the medical specialist. Interviewee A3 states that the registration process should take place online, instead of through letters from other hospitals.

"Of course, I now receive my signals in many different ways. I myself would also like it if a smart and clear planning were to be made for me, and I don't have to keep an eye on different platforms."
[Interviewee A4, 2021]

Interviewee A3 would like to get an overview every month of the number of consultations run or cancelled. And what that means for the production for example. On the contrary, Interviewee A1 would like to receive more predictive data so they can anticipate when a peak will occur somewhere.

To summarise, from an organisational perspective the work processes need to get more efficiënt as from the financial perspective a further decrease in money that can be spent is likely to occur. From the user perspective, a clear overview is desirable and the registration process online. And from a physical perspective space should be created where digital consultations can take place.

WKZ Utrecht, desired future supply

Welcoming, sign-up, registration	Long term waiting, relaxing	Report, Waiting for consultation	Consultation	Finalisation, follow-up
Registration kiosk or app.	Coffee corner/restaurant, Ronald McDonald House, outside	Development of care pathways. Customised waiting.	Generic consultation/ examination rooms Facilities for e-consults / telephone consults.	Automated appointments; made online or through actively made contact with the patient.

Figure 4.2.05 WKZ Utrecht, overview desired future supply based upon the steps the patient takes through the process (own figure)

4.3 Case 2: Deventer Ziekenhuis

Location: Deventer Construction year: 2008 Scale: 55.000 m2

Figure 4.3.01 Deventer ziekenhuis (Talens, 2020)

4.3.1 Context

The Deventer Hospital was formed by the merger of the two separate hospital organisations Sint Geertruiden Hospital and Sint Jozef Hospital in January 1985.

In 1472 the Sint Geertruiden Gasthuis in Deventer was a common alms-house particularly intended for people suffering from plague. At this time there were no employed doctors yet, but 'city doctors' who were available on call. From 1800 the Sint Geertruiden Gasthuis became the Sint Geertruiden Hospital and patients were admitted with a referral; one could no longer just knock on the door. In 1910 a completely new hospital is desirable, the actual realisation is in 1940. The hospital has a major role during the World War II in taking refugees. After World War II, technology increases tremendously. Doctors master more specialties and put higher demands on space, equipment and assistance. Therefore, the hospital decides to build a new complex, which is occupied in 1973 (DZ, n.d.).

The Sint Jozef Hospital opened its doors in 1875 in Deventer. The hospital was particularly for poor people who had turned their back on the Catholic faith. The first doctors working in the hospital were surgeons, who also worked at the Sint Geertruiden Hospital. The increase of medical-technical progress applies also to the Sint Jozef Hospital and the hospital decides to expand. Construction of a new hospital appear necessary to fulfil the requirements of that time. However, the new building was only realised in 1956 due to a though financial situation (DZ, n.d.).

Traditionally, the Sint Jozef Hospital and the Sint Geertruiden Hospital have been strongly committed to each other. On January 1st 1985 the hospitals officially merged, but retained their own locations. The name becomes Stichting Deventer Ziekenhuizen, or Deventer Hospital for short (DZ, n.d.). To improve organisational efficiency options for renovation and the design of a new hospital were explored. The second seemed most logical and in 1998 the initiative for a new hospital in Deventer was approved by the Dutch Ministry of Healthcare. With this new building a new vision of healthcare was developed by the Deventer hospital based on patient flows. For the new design they had the ambition of a sustainable design and saving energy. The plans were approved in 2003 by the Netherland's Board for Healthcare and the construction started in 2004. September 1st 2008 the newly built Deventer Hospital was operational (Van der Zwart, 2014).

4.3.2 Key figures

To get an idea of the size of the organisation, some key figures are presented (DZ, n.d.).

The hospital	The employees
Number of beds 371	Employed medical specialists 194
Number of operations 16.363	Other salaried employees 2.379
Number of hospitalisation per year 20.000	
Number of consultation visits per year 300.000	

4.3.3 The organisation

The Deventer hospital is part of the Cooperating Top Clinical Hospitals (STZ). This is a recognition of continuously putting energy in top clinical care, training, research and innovation. The motto behind the Deventer hospital organisation is: 'Your life, Your Deventer Hospital.' This motto is accompanied by three core values that serve as a source of inspiration and guidance (Deventer Ziekenhuis, 2018):

People-oriented *We do it for our patients* | **Open** *We do it together* | **Passionate** *We bring out the best in ourselves*

Figure 4.3.02 Deventer core values (Deventer Ziekenhuis, 2018)

The organisational chart of Deventer hospital is displayed in figure 4.3.03. As the slogan indicates, the central mission of the Deventer hospital is to organise care tailored to the personal situation of the patient (Deventer Ziekenhuis, 2018):

'This way, our organisation focuses entirely on you; Nearby and accessible, but also effective and efficient. This is how we help you to live your life to your ability and desires. Professional and eager to learn, we ensure with training, research and an active focus on innovation that we always provide the best care accordingly the latest standards. We are continually building towards an inspiring working environment for our professionals of today and tomorrow.'

Trends:

- Profound technological developments, Big Data gets more important and allows for recognition of patterns and correlations in patient data.
    - Digitalisation
    - Robotisation
    - Artificial Intelligence (AI)
- Personalised medicine

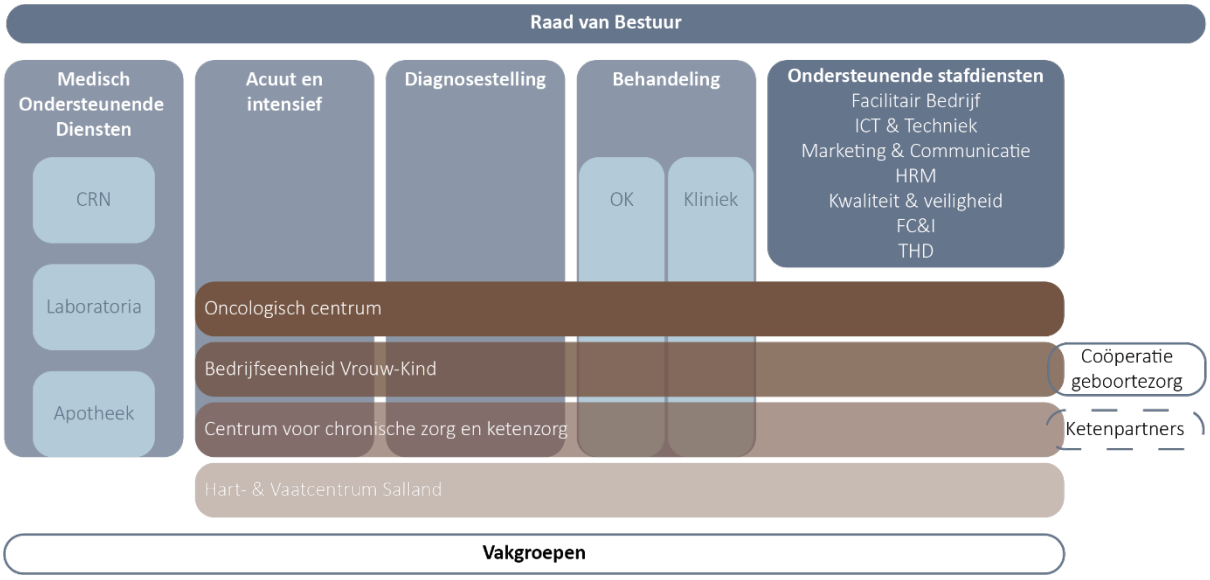


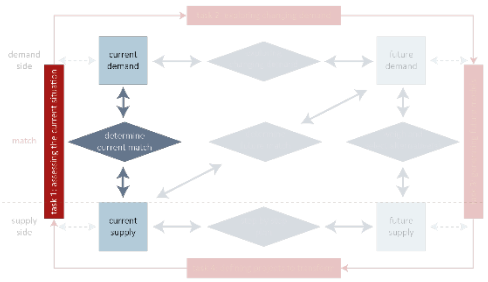
Figure 4.3.03 Deventer hospital organisational chart March 2021 (DZ, n.d.)

4.3.4 The DAS-frame

Task 1 assessing the current situation

The outpatient department

When asked what the spatial concept of the outpatient department in the Deventer Ziekenhuis looks like, the Interviewees explained that the spatial concept consists of a large outpatient square. At right angles of this square are the 'outpatient corridors' situated, and within these corridors, the outpatient consultation/examination rooms are placed (Interviewees, B1, B3 & B4).



"The corridors consist of an internal corridor and two external corridors. The external corridors are accessible to patients. And the internal corridor is only accessible to staff. On both sides of the internal corridor are consultation/examination rooms. And they are used for outpatient treatment and, depending on the type of outpatient treatment, the rooms are also furnished with additional treatment items or research material, research equipment, etc. I guess that 70% of the rooms are generic and thus interchangeable."
[Interviewee B3, 2021]

At the Deventer Ziekenhuis, they work with a clear separation of the front and back office. The front office is where patients are allowed; the registration desk, the waiting area, and consultation rooms are situated on the ground floor. The back office is located on the first floor and is accessible via the internal corridors. This is the part of the hospital where activities take place without patients. The back office is very much a part of the outpatient department (Interviewees, B1, B3 & B4).

"In the back office, we have abandoned the open-plan office principle because the users could not concentrate well there. There are now clusters per department, and these are people who work together, so in a way that's going well."
[Interviewee B1, 2021]

The consultation rooms are divided per specialism. Each specialism has its department within one of the corridors within the hospital building. There is a counter at every corridor; sometimes, the counter is per specialism, and sometimes it is shared with two specialisms. There are a few places where rooms are shared, but that is very rare (Interviewee B1 & B2).

"Near the main entrance, on the left-hand side, is the eye clinic. It is deliberately located there so that people with bad eyesight are immediately in the right place. Besides, there are many opportunities for daylight in the outpatient department, which is essential for the process.
The gynaecology and children's outpatient department is located on the first floor. That is deliberately situated there, so that the woman-child centre, as we call it, is one entity, so everything happens there."
[Interviewee B1, 2021]

According to Interviewee B2 from the department ICM, there used to be an overcapacity of rooms. So it was no problem if, e.g. the dermatology outpatient department had two rooms to spare on Thursdays, because nobody was short of anything. However, that is something of the past. Each specialism has a number of spaces allocated, which should be in principle sufficient. However, this is no longer adequate, and a dynamic solution is needed. This also has to do with the allocation of the

demand for care throughout the week, according to Interviewee B1. On Fridays and Wednesdays there is enough space available.

"We see that the sum of all outpatient departments must fit into the space we have. Only because of our way of structurally allocating spaces to an outpatient department it does not fit. And so, there is a space issue."
[Interviewee B2, 2021]

According to Interviewee B3, the allocation of the specialisms is rather fixed. The hospital has been housed since 2008, and not much has changed in the division. Now, the distribution of rooms in orthopaedics and surgery is going well, but that has not always been the case. There was a lack of space in orthopaedics a while back. At the time, there were three examinations to prove that there really was a lack of space. In the end, extra rooms were built on the patio, which was not beneficial for the spatial concept. Later on, a rearrangement took place in the corridor of surgery, the outpatient department for mamma care was moved to radiology, and orthopaedics could use the extra rooms that became available.

"I think that the relocation in 2008 it went wrong. The managers who were first and foremost and who paid a lot of attention to the distribution of space have a generously proportioned outpatient department. The same applies to the rooms for the carryover and the specialist group rooms. But there have also been managers who have been a little less involved in the spatial allocation and have been the underdog in the spatial distribution."
[Interviewee B3, 2021]

When asked what works well with the current spatial concept, Interviewee B1 replies, '*The advantages are theoretical, but we make limited use of them in practice.*' Meaning whether the space utilisation is effective or efficient depends on the way the users utilise it. In theory, the moment you have all kinds of standard rooms and a certain department has more patient supply and maybe needs some more space in a certain period, they could move to a room or rooms that are basically allocated to the other department that has less demand at that time. But that hardly ever happens. This is something they do want to move towards (Interviewee B1 & B3). Interviewee B3 does think that it is quite functional that certain specialisms are situated near each other so they can easily find each other. But it is important to anticipate growth and shrinkage. To add, Interviewee B4 thinks the structure of the two external lanes and the internal lane in the corridor are a very pleasant way of working.

The organisation

The interviewees explained the organisation of the hospital existing of basically two businesses; the medical specialists, who are united in the association of medical specialists (VSD); and the hospital itself existing of the management and supporting staff. In the primary process, there is dual management, so every business manager has a medical manager on his side. Together, they make decisions on how to manage the primary process. According to Interviewee B4, this dual management works very well.

"The nurses and secretaries are all employed by the hospital, so officially we don't have that much to do with them. But of course, because you work with them all day, you don't notice that either. It's more of a paper distinction."
[Interviewee B4, 2021]

In terms of cooperation between the departments, both Interviewees B3 and B4 mention that there is definitely cooperation. From a medical perspective, Interviewee B4 refers to the

multidisciplinary consults, when one patient sees several doctors at once. However, she mentiones that sometimes it is hard to plan multiple consulst, or a consult and an examination at the same day.

"Many people not only come for an appointment but also need an examination, that should be better coordinated."
[Interviewee B4, 2021]

And Interviewee B3 explains how, since the reorganisation in 2020, they are now striving to create more uniformity and equal interests, to get rid of the individual departments. But for example, standardise the registration process or the planning process. That the primary process is one thing, despite the fact that you are dealing with different specialisms. Interviewee B1 mentiones that in allocating the capacities both from the hospital side and the medical specialist side, they are very focused on their one area of attention.

"The medical specialists work very independently, which is logical, because they are specialised professionals."
[Interviewee B1, 2021]

According to Interviewee B2 integral capacity management is, making the best possible use of the capacities throughout the chain. In hospitals the limited factor is mostly the capacity of staff and therefore the focus mostly lies there. In the budget there is a production agreement with the health insurer, based on that they know how much staff they need to meet that agreement. This is all arranged in the strategic capacity plan. The health insurer just agrees on the sum of money, they themselves divide that money among all the departments. The division doesn't matter as long as they stay within the turnover agreement. To the question on what the turnover agreement is based the following was answered:

"On the state of politics. So there is not always a ratio behind what happens. Politics has agreed in the coalition agreement that hospitals should be on the 0 line. So we do indicate in our talks with health insurers that there is real growth in the number of patients in a number of areas, but you won't get anything extra."
[Interviewee B2, 2021]

Smart tools

Interviewee B2 continues; so the strategic goals are translated into capacities and then everyone knows how many outpatient hours they have to run. This is then monitored: is the agreement that was made actually working in practice? Any adjustment, upscaling or downscaling is done at the tactical level. The EPD is the primary source from which the data for monitoring is drawn. But the EPD is really written for medical support. For logistic parameters, capacity parameters, it's unsuitable. So the data is pulled from the EPD and through the Qliks sense system the data is translated into effective information by the BI environment.

No measurements are carried out at the outpatient department yet. HIX is their EPD and contains all information about the patient, also the patient planning. But also the schedule of the medical specialist at detailed level. So if they want to know anything about occupancy, this is where they get their information from (Interviewee B3 & B4). Measurements are thus not carried out continuously.

"The moment a question arises for expansion, we will investigate. And then we carry out that research specifically for the outpatient department in question."
[Interviewee B1, 2021]

Interviewee B3 has made the space use for her department transparant. Since then, no shortage of space has been experienced by the users. This is entered manually in Excel, and when a medical specialist drops out, this will be manually adjusted in the Excel sheet, unless it just becomes clear on the day itself. She mentiones that it would be nice to have a system that links the spatial planning, medical specialist planning and patient planning. That from the system rooms are allocated to the specialists. In order to get more uniformity in the outpatient planning, they are now integrating MedSpace, so that not every department works with its own Excel sheets.

"It's nice to retain a certain flexibility. There are always unexpected things or unexpected patients; if a patient becomes unwell, it's nice that that patient can stay in that room for a while and that the specialist can continue. Because otherwise your entire outpatient department would stagnate."
[Interviewee B3, 2021]

To summarise, from an organisational perspective the flexible concept is not used as it should be. And there is still too much thinking in boxes. From the user perspective cooperation between departments is getting better but still needs improvement. Furthermore, the alignment of schedules should be improved to improve efficiency for the patient. From a physical perspective, the concept of external corridors and internal corridor is experienced as being pleasant as is the big waiting area at the outpatient square. On the other hand a dynamic solution is desired to the problem of space utilisation. And from the financial perspective, pressure is felt because less and less can be spent.

Deventer Ziekenhuis, current supply

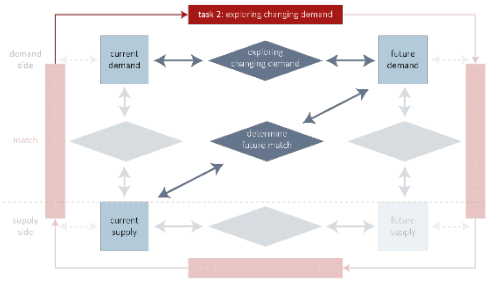
Welcoming, sign-up, registration	Long term waiting, relaxing	Report, Waiting for consultation	Consultation	Finalisation, follow-up
Registration counter and every specialism have a front desk, sometimes it is shared between two specialisms.	Coffee corner/restaurant and shops.	One big outpatient square. Waiting is near the front desk of the specialism.	70% generic consultation rooms. Rooms allocated per specialism. The generic room contains: *desk, chairs, examination table, partition*	Counter per specialism.

Figure 4.3.04 Deventer Ziekenhuis, overview current supply based upon the steps the patient takes through the process (own figure)

Task 2 exploring changing demand

<u>The outpatient department</u>

To the question whether the outpatient departmet will shrink in the future, Interviewee B2 answered; there will be a shift, certainly more consultations will become digital, but at the same time the demand for care increases as well. Certain examinations just have to take place physically, think of elderly with deteriorating eyes. They will have to physically come to the ophthalmology department.



"For us, just based on the demographic trend, it already means that over the next 5 years, we expect 20-50% more patients."
[Interviewee B2, 2021]

The comments of Interviewee B1 are in line with the comment of B2. There are many factors that influence whether or not the outpatient department will shrink. From his perspective he says, with all the innovations, more technology, more video calling and things like that, less space is needed in the long run. However, he also thinks that medical specialists would disagree. Besides he mentions:

"The right care in the right place is very nice, but as long as the finances and the financial system of healthcare do not allow it, this movement will not take place."
[Interviewee B1, 2021]

Interviewee B4 indicates that the demand for scans increases every year, as people want more certainty and do not simply accept the findings of the medical specialist. Furthermore, in surgery people will always come to the hospital with a wound, that can't be treated online. And even for online consultations the medical specialists still needs a place with the right requirements. Besides, telephone consultations does happen already but often when patients have the choice, they prefer coming to the hospital.

"And when you say there are nurses visiting the patients, that is all possible too. But that's inefficient, because if you have them all come here and you have one nurse, that's more convenient than having to go across the province to visit all these patients."
[Interviewee B4, 2021]

In terms of the registration process, Interviewee B1 believes that the registration kiosk is obsolete. He would like to see the registration process starting online at home and by using an app the patient can report the arrival. On the other hand, both Interviewee B1 & B4 mention that in terms of hospitality it is important that people have the ability to talk to someone, preferably with a medical background so the right questions can be answered. But this doesn't has to be at a counter. Interiewee B3 adds to this, it is important to take into account that not just every counter can get disposed of. The secretary has to know specific things for a specific specialism.

<u>The organisation</u>

From a capacity management point of view, Interviewee B2 is not in favour of central control in the area of space allocation. He does believe, however, that agreements must be made on how to deal with the layout in a flexible way. So agreements should be made centrally. And then everyone gets tools that can be used at the local level. So surgery can reserve a room from dermatology if it is not in use. Transparency is therefore important.

"Rules like, what has priority, within what range can you make choices. It's not first come, first served."
[Interviewee B2, 2021]

Smart tools

When asked what kind of information would be desirable to improve the execution of the work processes, Interviewee B1 believes that it would be nice if the occupancy of the rooms of the outpatient department could be measured more continuously. And then also think about clusters of departments, so several specialisms situated together. With direct monitoring of the availability of those spaces, they can be handled more flexibly.

"I think making spatial use more transparent, in data that everyone trusts, that it speeds up decision-making, it gives confidence. And then it's fine to give up some capacity for the sake of someone else. I think that would help."
[Interviewee B1, 2021]

To summarise, the interviewees don't see the number of patients coming to the hospital decreasing. From an organisational perspective more unity is desired in the primary process. As well as a better alignment between the various planning systems. From a financial perspective the budget spent by the hospital will keep decreasing. From a physical perspective, the front desks won't dissapear, however they can be clustered as well as the departments.

Deventer Ziekenhuis, desired future supply

Welcoming, sign-up, registration	Long term waiting, relaxing	Report, Waiting for consultation	Consultation	Finalisation, follow-up
Apps, online registration A counter as back up to ask medical questions.	Coffee corner/restaurant/ shops	One big outpatient square. Aligning consultation and examinations better.	To actually use the generic rooms flexible. Facilities for e-consults / telephone consults. Home-monitoring.	Automated appointments; made online or through actively made contact with the patient.

Figure 4.3.05 Deventer Ziekenhuis, overview desired future supply based upon the steps the patient takes through the process (own figure)

4.4 Case 3: Het Zuyderland

Location: Sittard-Geleen Construction year: 2009 Scale: 25.000 m2

Figure 4.4.01 Zuyderland ziekenhuis Sittard-Geleen (AD, 2019)

4.4.1 Context

The Zuyderland hospital was formed by the merger of the two separate hospital organisations Atrium and Orbis in July 2015. The merger was forced due to the aging population and the revised healthcare financing. Cost reduction, efficiency and strengthening of the competitive position, but above all: striving for even better care, made the merger between Orbis and Atrium possible. (Zuyderland, n.d.).

The former Atrium, then called De Wever, was founded in 1904 in Heerlen in a simple small building. At the time, labour was provided by the mines, which caused a growing population and the hospital expanded. For half a century the mines determined the daily life of the people in the region, until the 1960s. It also gave direction to the health care system. For example, large departments for pulmonary diseases, surgery and radio diagnostics were created. After the disappearance of the mines, the function of the hospital did not change substantially, the objective is still the same: caring for the sick is paramount. After various expansions, the hospital changed both location and its name (Atrium). The Atrium in Heerlen celebrated its centenary in 2004, historically the hospital has had a reputation to uphold in the field of medical specialist and nursing training. Many doctors and nurses in many different Dutch hospitals were trained in Heerlen. As a respected STZ hospital (Cooperating Top Clinical Training Hospitals), the Heerlen hospital makes a significant contribution to the medical world (Zuyderland, n.d.)..

The Orbis Medisch en Zorgconcern was established in 1908 in the former French monastery in Sittard. After the war the hospital experienced substantial growth. And in the early 1980s, the hospital merged with St. Barbara Hospital in Geleen at the Sittard site. The new merged hospital was named Maasland Hospital. The organisation grew, GGz (mental health care) and Home Care were also given a place within the organisation, which was named Orbis in 2000. The name refers to the chain of care that the organisation offered, from birth to death, as Orbis means circle. Patients were transferred from the Maasland Hospital in the inner city of Sittard to a brand new building at the edge of Sittard and Geleen. The new hospital was given the designation hospital of the 21st century. Up until this day, it has an exemplary function in terms of innovation. All the organisational units that were part of Orbis have moved along to Zuyderland (Zuyderland, n.d.).

4.4.2 Key figures

The Zuyderland medical centre is located at 5 locations; Sittard-Geleen, Heerlen, Kerkrade, Brunssum and Eghte. This analysis is about the location Sittard-Geleen, the most recently build. It is the largest employer in the province Limburg. To get an idea of the size of the organisation, some key figures are presented (Zuyderland, n.d.).

The hospital	The employees
Number of beds 980	Employed medical specialists 124
Number of hospitalisation per year 42.000	Independent medical specialist 297
Number of nursing days per year 170.000	Other salaried employees 4550 (fte)
Number of day clinics per year 86.000	
Number of consultation visits per year 845.000	

4.4.3 The organisation

The Zuyderland Medical Centre is one of the 26 Dutch hospitals that is affiliated to the STZ-association. This is an association of vanguard hospitals that work together for better patient care. The so called STZ-hospitals distinguish themselves by always choosing the vanguard position with patient-oriented scientific research, top clinical care and education. The Zuyderland organisation has formulated the following promise to the patient: 'Zuyderland, the care of your life'. To achieve this the following three core values are formulated (Zuyderland, n.d.):

Figure 4.4.3.1 Zuyderland core values (Zuyderland, n.d.)

As can be seen in the organisation chart (figure 4.4.3.2), the Zuyderland group can be split up in Zuyderland Cure and Zuyderland Care (Zuyderland, n.d.).

- Zuyderland Cure: Zuyderland medical centre consists of hospital at five locations, mental health care and rehabilitation.
    - Mission: '*As a top clinical academic hospital, we provide excellent, nearby and innovative patient care in a welcoming environment with a view to improving quality of life, in collaboration with our partners*.'
    - Vision
        - Patient-oriented approach and care
        - Being a pivotal player within the healthcare market of the South of the Netherlands.
        - Taking responsibility for organising care together with the health insurers.
        - Being leading in the field of quality and safety.
        - Being financially healthy and create room for investments.
        - Providing an engaging work and learning environment for our professionals.
- Zuyderland Care: Zuyderland care centre consists of seven main and several secondary locations, two hospices, Home Care and domestic care.
    - Mission: '*We stand for the best care, as at home as possible. We are there especially for the elderly, with self-direction as the basis.*'
    - Vision
        - The best care
        - As at home as possible

- With inspired and committed employees
- In a financially healthy and sustainable organisation

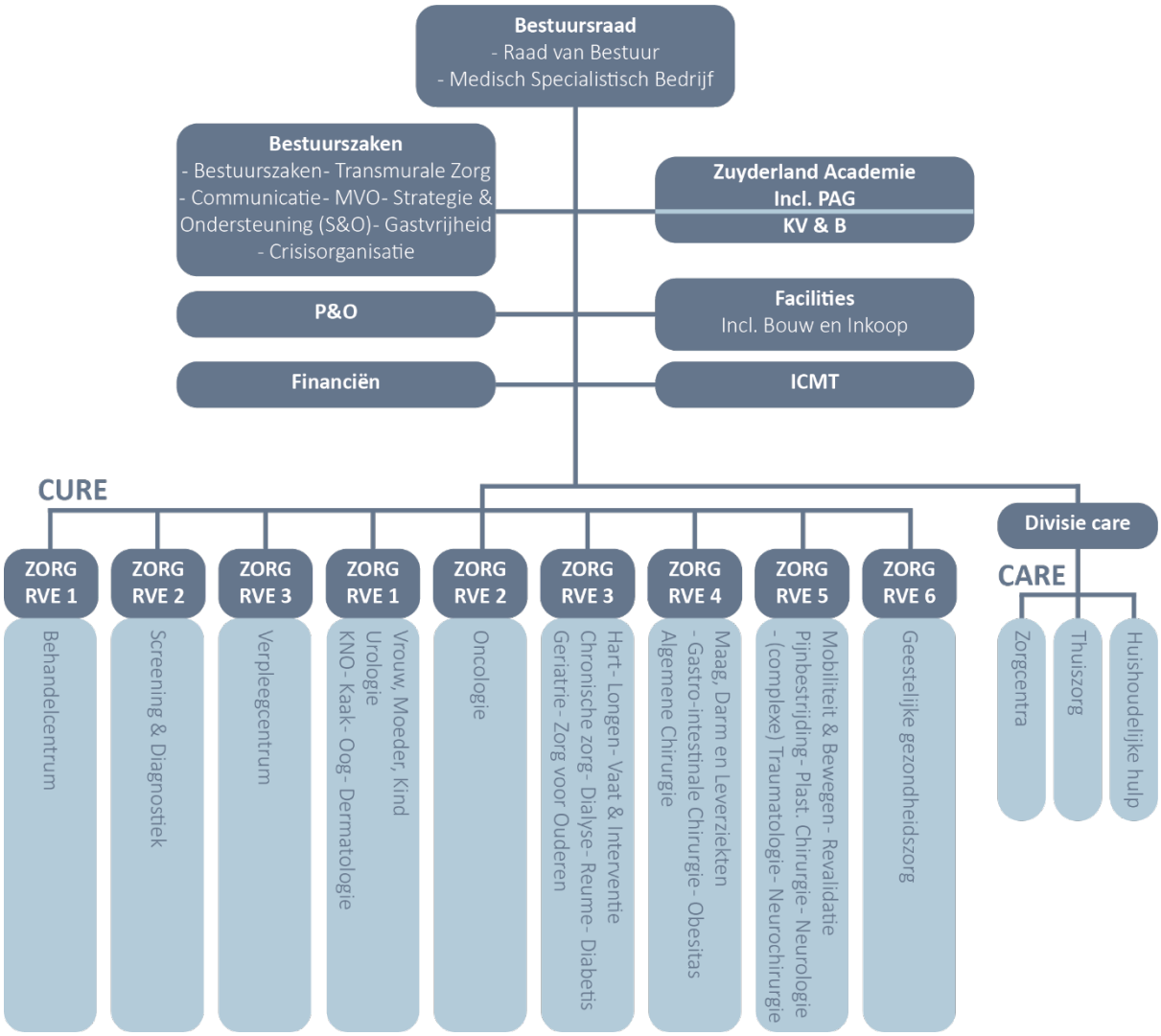


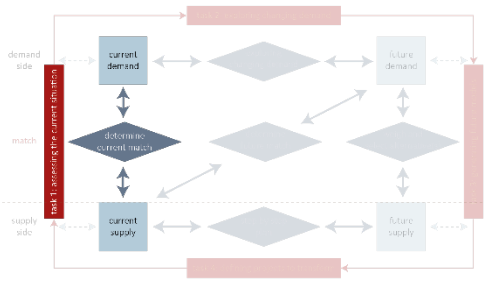
Figure 4.4.3.2 Zuyderland organisational chart January 2021 (Zuyderland, n.d.)

4.4.4 The DAS-frame

Task 1 assessing the current situation

<u>The outpatient department</u>

The interviewees were asked about the spatial concept of the outpatient department in Sittard. The spatial concept of the Zuyderland hospital in Sittard was designed to be flexible. The back office is clearly separated from the front office. The spaces, where possible, are intended to be used in a liquid matter. Most of the consultation/examination rooms are designed generically and not for a specific specialism.



"Roughly speaking, 60% of the consultation rooms are designed to be generic. The consultation room can be compared to a room of a general practitioner. It contains the following: a desk, two screens, an office chair, two chairs for the patient and a visitor, an examination table where the medical specialist can examine the patient lying down, a curtain/partition, and the room is wheelchair accessible."
[Interviewee C4, 2021]

Whether a specialism can be facilitated in a generic consultation/examination room depends on the needs of the specialism. There are specialisms like ENT and gynaecology that need special equipment and are accommodated in dedicated areas (Interviewees C4 & C3). Interviewee C2 adds that half of the rooms dedicated to cardiology are dedicated examination rooms, rooms to conduct the bicycle test, a room to perform the ECG test to check the heart's rhythm and electrical activity, a room to perform a Holter test and a room for the pacemaker technician.

"A difference is noticeable in the utilisation of the consultation rooms between diagnostic and surgical specialisms. The diagnostic specialists run consultation hours almost the whole day, while surgical specialists can be all over the hospital."
[Interviewee C4, 2021]

The outpatient department consists of a large central hall with adjoining lanes. Within these lanes, specialisms are situated who can together make use of the rooms in those lanes (Interviewees C1, C4 & C3). When building in flexibility, you should consider situating specialisms that have the same kind of processes and the same kind of pathologies, like lung and cardiology. Also, it is crucial to maintain overcapacity in terms of spaces at all times to make sure if something happens, you can accommodate this (Interviewee C4).

"At the Sittard location, we have an apparent separation of patients, visitors and healthcare professionals. I think this contributes positively to the perception of the hospital. However, the flexible concept was abandoned fairly quickly in order to divide the spaces per specialism. People have a territorial urge, so they claim their own space, area, and work system. And the fixed pattern provides confidence and a foundation. I think the dilemma is finding the right balance between a flexible and a fixed concept."
[Interviewee C1, 2021]

Interviewee C5 confirms this statement; she mentions cardiologists who prefer their own room but in principle don't have their own room. In addition, she gives the example of one consultation room that was handed over to the lung department four days a week as cardiology didn't need that room the whole week. But when it was the other way around, the demand for lung consultation decreased and the demand for cardiology consultations increased, negotiations had to take place for cardiology to be able to make use of that consultation room again.

"There are days when it is jam-packed, and we are short on rooms and days when there is hardly anyone. These are not typical days in the week. It can vary a lot. So sometimes we do get stuck."
[Interviewee C5, 2021]

At the department of ICM, due to a shortage of available consultation/examination rooms, they get more often requests to, besides the staff, look at whether the utilisation of rooms is efficient. They see an unequal distribution of production throughout the week; on Monday and Tuesday, the most appointments take place, Wednesday and Thursday are average, and Friday, the least patients are seen (Interviewee C2).

"As the outpatient department is set up so different per specialism, we have no idea in which room the appointments are scheduled. At the OR (operating theatre), we know exactly in which room a patient has been operated. In the outpatient department, this is more difficult as the processes are all mixed up."
[Interviewee C2, 2021]

When asked what works well with the current spatial concept, all interviewees experience the separation of the back office and front office as pleasant. There are short lines of mutual communication between the medical specialists and between the assistant (in the back office) and the medical specialist (in the consultation room). The back office is very supportive of the outpatient department. Interviewee C5 does indicate that she herself does not often work in the back office. For example, for telephone consultations with a patient, she finds the room unsuitable, although other specialists do use the back office for telephone consultations.

"Often I have three patients at a physical consultation, then I call two patients and later on I have physical consultations again. I don't go back and forth between the consultation room and back office. That is inefficient."
[Interviewee C5, 2021]

In terms of the registration process at the entrance, Interviewee C1 mentioned that they have introduced registration kiosks. From the registration kiosk, the patient is directed to the right waiting room and, from there, is called by the medical specialist for the appointment. According to Interviewee C3, due to the kiosks, there are no counters per specialism anymore, but counters per cluster where appointments can be made. Interviewee C4 thinks that the kiosks cost a lot of management in ensuring the right receipt comes out of the machine, and the patient is directed to the right doctor. This is still an area of improvement. Interviewee C5 mentioned that for their department, they have decided to not work yet with the registration kiosk.

"Within our specialism, different patients receive either no or different function examinations. We are afraid that things will go wrong when registering them. In addition, the secretaries say that they would not want to miss the contact with patients."
[Interviewee C5, 2021]

<u>The organisation</u>

The organisation of the hospital is divided into multiple units (RVE's) existing of various specialisms. The department managers within such a unit coordinate things like budget and an annual plan at a strategic level. However, no cooperation on an operational level takes place, such as dividing capacities (Interviewee C3). Interviewee C4 indicates that managing too large a group is not possible. That is why the different departments are created. But these different departments find it difficult to find each other and work together.

"Personally, I'm not in favour of chopping up all outpatient departments into pieces. You have to see the outpatient department as one capacity, which gives you much more unity. Then you can create a 'flexpool' of staff, but you also have insight into all consulting and examination rooms. Now everyone has only insight into their part. I do think that is a shortcoming."
[Interviewee C3, 2021]

Interviewee C2 explained, during the budgeting process, the finance department has negotiated with the insurers and set a framework of the available budget. The unit managers (RVE) indicate how much production they intend to do for the coming year, and the budget is divided over the specialisms. The ICM department is involved in the translation to the capacities needed in achieving this production, which is expressed in the number of DTC's. A DTC consist of appointments and lead to turnover.

"So we have a maximum amount of DTC's that we can acquire. This is set in a 10-year contract with the insurer, in which the demographic analyses are taken into account. The analysis shows that in the region we will have more elderly, but still, we have to shrink. Even though we would expect more patients, we have to become smaller as a hospital."
[Interviewee C2, 2021]

For the first time at the Zuyderland hospital in Sittard they are now exploring with three pilot studies of outpatient departments to translate the DTC's to capacities needed. Capacities in terms of consultation hours needed, but they don't yet translate it to the space needed.

"The outpatient departments are organised decentrally, so each specialism is responsible for its own planning. In the OR, all specialism come together and make once a year a schedule."
[Interviewee C3, 2021]

The interviewees explained that next to the division between departments into several units (RVE's), they work with dual management. So each unit has a 'business manager' and a 'medical manager'. Interviewee C5 explains that within cardiology and also other specialisms, the people are also divided over several locations. So you have to make sure that the doctors' planning, the outpatient planning, the planning of the function staff and of the secretarial support are all in sync. To make it even more complicated next to the planning of the outpatient department, they also have the planning of the examinations, e.g. pacemaker, heart catheterisation, etc.

"The outpatient department is always the final part of the planning. The higher priority tasks come first, and the remaining capacity is used to allocate consultation hours. I get frustrated when I have made a schedule, and it turns out that there is no room available, and I have to schedule the cardiologist for something else after all. That's a shame. You just have to deal with so many ancillary tasks."
[Interviewee C5, 2021]

Smart tools

To the question of whether certain measurements are taken to gain insight into work processes or space usage, Interviewee C2 says that they mainly get a lot of information from SAP, the EPD system and ORTEC, the personnel system. The Tableau dashboard software is used to create dashboards themselves, or they use Excel to make calculations: imagine we scale up this OR, what would that mean? The dashboards they make are shared with colleagues, for example, the COVID increases.

"For capacity management software, we have purchased HotFlow."
[Interviewee C2, 2021]

The Housing Department is facing a major task since, on the one hand, there are demands for expansion, while on the other hand, we are in a shrinking scenario because care must not become too expensive (Interviewee C1).

"We have now started to implement sensors in consulting/examination rooms to see what the occupancy is like. The first step has been taken"
[Interviewee C1, 2021]

Interviewee C3 explains that the whole issue of capacity around the consultation rooms; (how many do we have? how are they used?) is now done separately in Excel and per department. Some doctors are using a schedule application system called MedSpace. The interviewee mentiones that she would like to create a link between the registration columns (Logis.P), SAP (the EPD) and MedSpace. That would save a lot of work.

"We schedule our rooms simply in Excel. We look at which doctor is doing which outpatient treatment at which time, and then we assign a room."
[Interviewee C3, 2021]

And finally, also interviewee C5 explains how she created a dashboard for the cardiology department to see what the waiting time is? How many empty spaces do we have? And how can we solve it?

"Our secretary enters all this manually once a week."
[Interviewee C5, 2021]

To summarise, from a physical perspective, there is at some moments a shortcoming in the availability of the number of square meters, and at some moments during the week, there is an overload of spaces. Also, from the physical perspective, the division between the different flows in the hospital is very well organised. This division between the various flows is also experienced as being pleasant from the user perspective. From the user perspective, there is frustration about the division and availability of the rooms. Especially planning the schedules is a tough job. Also, from an organisational perspective, the autonomy of the departments creates diversification in the execution of processes. And from the financial perspective, the processes and utilisation of spaces need to get more efficient as the amount of production increases while the insurers have set a maximum on the budget that the hospital can spend. In figure 4.4.04 an overview of the current supply, based upon the steps the patient takes through the process, is presented.

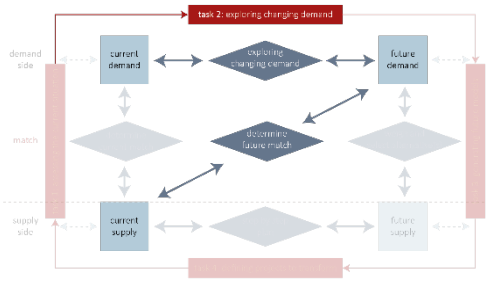
Zuyderland Sittard, current supply

Welcoming, sign-up, registration	Long term waiting, relaxing	Report, Waiting for consultation	Consultation	Finalisation, follow-up
Registration kiosk	Coffee corner / restaurant	In general, one big central waiting area.	60% generic consultation rooms. Rooms allocated per specialism. Generic room contains: *: desk, monitors, chairs, examination table, partition, and wheelchair accessible*	Next appointment made at front-desk. Secretary calls patient after a certain time.

Figure 4.4.04 Zuyderland, overview current supply based upon the steps the patient takes through the process (own figure)

Task 2 exploring changing demand

<u>The outpatient department</u>



Interviewee C4 makes the comparison with self-management at the airport, this is also going to happen in the hospital. Interviewee C1 adds to this that in the future, a counter will only have the function of being able to ask questions. But that patients will be guided to the relevant department via a registration kiosk when entering the building. In addition, appointments made with a doctor regarding repeat visits or follow-up examinations will be more automated and based on the hospital's own schedules, available schedules or the contact that is actively made with the patient.

"In the past, each specialism had its own front-desk. This will disappear. First, there will be one front desk for a group of specialisms and eventually one desk for the whole hospital."
[Interviewee C4, 2021]

In terms of the utilisation of the consultation/examination rooms, interviewee C5 would like to see all the rooms within a lane be shared together with the specialisms of that lane. So they can divide per day who is going to sit where. Flexibility from all sides is the ideal situation instead of everyone thinking in their own little box.

"Also the examination rooms should be able to used multifunctional. In a way that it doesn't take too much time to rebuild."
[Interviewee C5, 2021]

In contrast to Interviewee C5, Interviewee C4 sees the trend of specialised centres; they call them 'focusclinics'. At orthopaedics, for example, they now have the knee centre.

"The further subdivision due to these focusclinics does result in more square meters. I do see this trend increasing."
[Interviewee C4, 2021]

One of the current trends, also due to Corona, is video calling or telephone consultation. This requires that facilities in the back office are created that are suited to the purpose of an e-consultation or a telephone consultation (interviewee C3).

"In the back office, we are under pressure to reduce the number of square metres."
[Interviewee C3, 2021]

Another trend mentioned by interviewee C2 is that of monitoring at home. And certain patient groups don't necessarily need expensive medical specialist care in a hospital, but can get care in other healthcare facilities. Besides, even medical specialists are now performing e-consults or telephone consults from home if possible.

"In terms of physical space, we now see that we only do something like 2/3 physically in 2020 and 2021, and we want to keep it that way."
[Interviewee C2, 2021]

The organisation

According to Interviewee C2, the department ICM is setting up a central body called the Outpatient Department Council; within this council, all the outpatient departments will be represented in terms of capacity. With this, they hope it will give them a better picture and overview of the capacities used.

"Even though we are in a shrinking scenario, due to for example, trends in the reduction of the length of stay show an increase in outpatient admissions."
[Interviewee C2, 2021]

According to interviewee C5 a new trend within the medical field is that of outlining care pathways for specific pathologies.

"I think we need to develop even more in the area of care pathways. All appointments are planned one after the other so that patients only have to come to the hospital once."
[Interviewee C5, 2021]

Interviewee C4 sees the trend developing within the organisation that the outpatient departments are being further divided. Interviewee C1 contradicts this and thinks that patient logistics should be uniform across both locations and also on the location itself. Each outpatient department sets up its own process because that's appropriate for the specialist process, but it's not always uniform for the patient. So there is still room for improvement and development.

Smart tools

When asked what kind of information would be desirable to improve the execution of the work processes, Interviewee C2 indicates that there is a real information shortage at the moment. From the capacity management perspective, they only see the appointments in SAP, the EPD. And the problem lies mainly in which staff, doctors and rooms are needed for such an appointment. When this data is available, thinking about how to visualise it would be the next step—for example, a floor plan in which that data is processed, and each specialism can zoom in on their outpatient department.

"The integrality between the patients, the staff and the rooms is completely missing in the outpatient department. We only have production information at our disposal."
[Interviewee C2, 2021]

Interviewee C2 also indicated that it is interesting what the future of the outpatient department is going to look like and what that would mean for integral capacity management. For example, how can home monitoring and even remote work by medical specialists be included in the capacity plan? This is a significant trend to take into account when optimising the capacity plan. Interviewee C5 indicates, from the user's point of view, that patients will still come to the hospital. To prevent patients from forgetting their appointments, she would like patients to receive a reminder notification one day before the consultation.

"In order to make online appointments possible, we first need to merge the outpatient and examination schedules."
[Interviewee C5, 2021]

To summarise, the maximum budget spent by the hospital will keep decreasing in the future. Trends indicated from the organisational perspective is that of encouraging remote working and monitoring

patients from home. From a user perspective, a noticeable trend is that of the focus clinics on the one hand. On the other hand, more flexibility and unity is desired to be able to use rooms multifunctional. From a physical perspective, the front desks will disappear due to innovations.

Zuyderland Sittard, desired future supply

Welcoming, sign-up, registration	Long term waiting, relaxing	Report, Waiting for consultation	Consultation	Finalisation, follow-up
Registration kiosk & one counter for the whole hospital.	Coffee corner/restaurant	Development of care pathways.	Function rooms should also be multifunctional Facilities for e-consults / telephone consults. Home-monitoring. Focusclinics.	Automated appointments; made online or through actively made contact with the patient. Counters will disappear.

Figure 4.4.05 Zuyderland, overview desired future supply based upon the steps the patient takes through the process (own figure)

4.5 Cross-case analysis

In this chapter, first, the outcomes of the analyses of the three hospitals are compared in a cross-case analysis. This comparison allows drawing a more general conclusion on what is desired for the future supply of the outpatient department. From the cross-case analysis the conclusion of the empirical research will follow and the values of the stakeholders will become clear in answering the subquestion.

Context

In figure 4.5.1, the comparison of the context of the three analysed hospitals is shown. The first difference noticeable between the three cases is that of the construction year. Both cases 2 and 3 are relatively newly built hospitals, whereas case 1 has been situated in its building for quite some time. In case 1, they notice that they are getting stuck in the hospital's existing structure; for cases 2 and 3, this is less of a concern. Another noticeable difference between the three cases is that of serving different locations. Case 3 has to serve 5 locations, which means if a medical specialist is working at one location, he is not at the other locations. For the number of consultation rooms needed, that often means that for a hospital that has to serve multiple locations, more consultation rooms are needed (Interviewee C4). Case 1 & 2 both deal with one location; however, case 1 has a joint venture with UMCU, and thus medical specialists go up and down between WKZ and UMCU. The final contextual difference between the three cases that I would like to point out is the type of hospital. Case 2 and 3 are both STZ hospitals and case 1 is an academic hospital. Interviewee A3 notices the difference being an academic hospital often has more multidisciplinary consultations in comparison with an STZ hospital due to the complexity of the pathologies. An STZ hospital can refer a patient to an academic hospital when the care becomes too complex.

	Construction year	Locations	Type of hospital
WKZ Utrecht (1)	1999	1 location but part of University Medical Centre Utrecht.	Academic children hospital
Deventer Ziekenhuis (2)	2008	1 location.	STZ hospital
Zuyderland (3)	2009	5 locations.	STZ hospital

Figure 4.5.1 Cross-case analysis hospital context

Outpatient department

In terms of the registration process upon arrival of the patient, cases 1 and 2 both have, besides the general front desk, a desk per specialism (figure 4.5.2). In both cases, the interviewees agreed that this is unnecessary. Registration by means of a registration kiosk or app makes more sense. In case 1, the interviewees add to that, that it gives the patient more control in, for example, checking the best times for doing simple examinations. By contrast, it is very important not to lose sight of hospitality towards the patient, as mentioned by interviewees from case 2, and to add the counter function won't disappear but clustered between specialisms. In case 3, the registration kiosk is already implemented. It still requires a lot of management, but overall they are satisfied with the way it works. They even think; eventually, there will be one reception desk in the hospital and employees walking around to assist patients.

In terms of the waiting area, in cases 2 & 3, it is centrally organised. In the centrally designed waiting area, patients can still wait near the relevant consultation area as this connects to the waiting area. Within case 1, the waiting area is organised decentrally, and this is due to the historically designed building. They would like to change this, as patients do not experience this as being pleasant. Customised waiting would be ideal.

In all of the three cases, most of the consultation/examination rooms are designed generic. They also all give the example that some specialisms need specific equipment, such as gynaecology,

ENT, oral surgery, etc. The rooms are used flexibly within the respective specialism. It is still very difficult to make flexible use of them between different specialisms.

In all three cases, the follow-up appointments are made at the front desk. In case 1, it sometimes happens that the outpatient assistant makes the follow up appointment in the consultation room. All three cases indicate that they would like to be able to make the appointment online, but this still proves to be very difficult.

Finally, a spatial separation of the front office and back office is designed in cases 2 & 3. Overall the spatial separation is perceived as very pleasant. It ensures a clear separation of patient and specialist, this creates peace. However, the spatial separation is designed as more flexible use of space was desired; in practice, this should be better implemented. Case 1 works with a spatial concentration of front office and back office. Among the interviewees, they would like to see a change here to a spatial separation of the front office and back office. So that only patient-related tasks are performed in the front office.

	Registration	Waiting	Consultation room	Follow-up	Front & back office
WKZ Utrecht (1)	Front desk per specialism	Waiting area per specialism	Generic consultation/ examination rooms	With the outpatient assistant or at the front desk	A spatial concentration of front office and back office
Deventer Ziekenhuis (2)	Front desk per specialism	Outpatient square	70% generic consultation/ examination rooms	At the front desk, per specialism	A spatial separation of front office and back office
Zuyderland (3)	Registration kiosk	Central hall	60% generic consultation/ examination rooms	At the front desk, clustered of specialisms	A spatial separation of front office and back office

Figure 4.5.2 Cross-case analysis hospital outpatient department

The organisation

The organisation of all three hospitals is practically the same (figure 4.5.3). They consist of two businesses, one business represents the facilitating services, and the other business is represented by the medical discipline. Both businesses are autonomous on paper. A further subdivision exists within the medical discipline. These subdivisions are based on the processes of the medical specialisms and are quite similar between the three cases. Cooperation between the different units hardly takes place, except in case 1. This has to do with the multidisciplinary consultations. In the other two cases, however, they are now developing care pathways, which will require more cooperation as well. The different units are still very much independent islands at the moment. This is reflected in the difference in processes, such as registration. But also in the use of space. All three cases would like to see more uniformity here, which would make the work processes more efficient. All three cases do make use of dual management. This means that every unit has a business manager that is responsible for facilitating services and a manager from the medical discipline who is responsible for the medical processes. Together they make decisions and coordinate schedules.

	Organisation	Specialisms	Management
WKZ Utrecht (1)	Divided in supporting business and the medical discipline	Divided into divisions	Dual management
Deventer Ziekenhuis (2)	Divided in supporting business and the medical discipline	Divided into specialist groups	Dual management
Zuyderland (3)	Divided in supporting business and the medical discipline	Divided into result responsible units (RVE)	Dual management

Figure 4.5.3 Cross-case analysis hospital organisation

Smart tools

In figure 4.5.4, an overview is shown of smart tools used by the cases at the moment. For all three cases, the EPD is the primary source on which they base their information. The ICM department of cases 1 & 3 have purchased dashboards from HotFlo. These dashboards, however, are not so much used for capacity management of the outpatient department but for the operating theatre and the clinical department. The ICM department of case 3 has set up a Hospital Control Centre to create an overview of the capacities, flows and trends in the hospital. At case 2, the ICM department makes use of the Qliks sense system to translate information from the EPD into logistic parameters that are suitable for capacity management.

In terms of the measurement of space utilisation, all cases have recently, since a year or two, started to provide insight into the occupancy of the rooms. In all three cases, the rationale was a shortage of space. However, since the space utilisation has been made transparent, no shortage of rooms is experienced by the users. For case 1, it even showed 20% of the rooms always being available. Case 1 uses the program Checks to provide insight into the occupancy of the rooms. The data is entered manually, so if something changes in the schedule, this has to be manually adjusted in Checks. A link between the EPD and Checks is desired, as this will reduce the workload of the manager. For now, Checks is still only used by the manager, in the future the medical specialists should also start using it. In case 2 & 3, they are now starting to integrate MedSpace for every department to use. However, still a lot of departments are still working on their own Excel sheet. The same applies here; everything is filled in manually. In case 3, it is desirable to create a link between the registration columns (Logis.P), SAP (the EPD) and MedSpace; that would save a lot of work. To measure the use of space in consultation rooms, case 3 has started to implement sensors. This project just started, so they don't know yet what to expect from it.

Finally, within all cases, e-consults and telephone consultations are performed. Case 1 has set the goal of 50% remote working, case 3 has set the goal of 33% remote working, and case 2 doesn't have set a specific goal. It is important to understand when an e-consult or telephone consult substitutes a physical consult, as only then it is declarable at the health insurer. Substitutes it a physical consult then it should be included in the schedule, if not, a phone call is often made in between other tasks. Besides e-consults, case 3 also works with remote monitoring of patients.

	ICM	E-consult / telephone consult	Space allocation
WKZ Utrecht (1)	EPD (HIX)	Goal is 50% remote working	Checks
Deventer Ziekenhuis (2)	EPD (HIX), Qliks	Happens but no specific goal.	MedSpace & Excel
Zuyderland (3)	EPD (SAP), HCC	Goal 2/3 physical, 1/3 remote	MedSpace & Excel, implementation of sensors

Figure 4.5.4 Cross-case analysis hospital use of smart tools

4.6 Conclusion

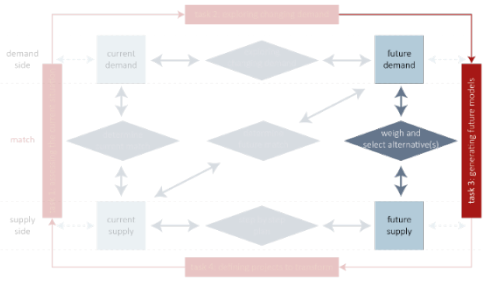
Question	*What are the values of the stakeholders of the outpatient department and how can real estate be aligned to these values?*
Purpose	To get insight into what the outpatient department entails, determine what patients and medical specialists in this department need. To be able to align supply and demand.
Methods	Empirical research; semi-structured interviews

The budget may not exceed the previous year's and may even shrink. Therefore, the financial added value is to reduce costs, control risks and improve the financial position. From a financial perspective, it is important for the processes to be efficient. So the production capacity in terms of DTC agreements can be achieved within the agreed budget with the healthcare insurer. If e-consults want to be stimulated, an incentive could be to make it declarable at the health insurer. Otherwise, there is from the financial perspective no incentive to change from solid/liquid to gas, as the hospital won't held consultations for free. To ensure the work processes to become more efficient, the greatest organisational value is to achieve greater uniformity in the outpatient department. Standard processes such as registration, scheduling of appointments and planning of staff and rooms should be unified and standardised. For that to happen, thinking in separate islands will have to disappear. Different departments will always exist; after all, they are specialists, and nobody knows as much about their field as they do themselves. But as for the managers, they can see their department within the bigger picture. And through more transparency between the different departments, they will be able to help each other out if needed. From the user perspective, employee satisfaction and patient satisfaction are the added values. The users of the outpatient department are the patient and the employees; medical specialist, nurses, assistants, etc. To achieve employee satisfaction, a certain structure is desirable, as is working in a familiar environment with one's own team around them, so they know where to go with certain questions. Providing good care always comes first. Too many different systems take time to deliver that care and are therefore undesirable. A clear platform where everything can be found for the primary process would increase employee satisfaction. User satisfaction can be achieved by great hospitality, making the patient journey as clear as possible and thereby reducing stress and of course, decreasing waiting times. The added value from a physical perspective is in the best way supporting the work process, making optimum use of the m2, ensuring a healthy indoor climate and achieve sustainability goals. And finally, flexibility is the added value of all perspectives.

5. Synthesis and validation

The goal of this chapter is to find a possible solution for the use of the scarce resources of the outpatient department of a Dutch hospital. This will follow from the final two tasks of the DAS-frame; task 3 generating future models and task 4 defining projects to transform. This will provide an answer to the research question. At the end of this chapter the validation process is described.

5.1 Task 3 generating future models



Following from the previous chapters and in particular chapter 3.1.4, where the states of matter by Den Heijer are defined, the future model can be defined accordingly three different models (figure 5.1.1).

The model 'My hospital' is based on the solid model as defined by Den Heijer (2021) (Figure 3.1.04). The structure of the oldest hospital in this research, case 1, is based upon this model. Historically, the hospitals in the Netherlands have been in a growing scenario and have had designated departments for autonomous specialists. In case 1 this is reflected in the division of three independently functioning outpatient departments (outpatient legs, as referred to in the previous chapter). Even though the physical aspect is based on model A.My hospital, from the user perspective they have already switched to model B.The resilient hospital.

The model 'The resilient hospital' is based upon the liquid model. This model is characterised by activities that still take place in the hospital but spaces are less dedicated. Both case 2 & 3 best fit within this model, case 2 is leaning a bit more towards model A.My hospital and case 3 is leaning a bit more towards model C.The healthy society. Both cases are constructed after or during the end of the construction regime. This is when a shift took place in the way of designing a hospital; from the bigger the better to the hospital becoming a strategic resource (Interviewee F1, 2021). It is noteworthy that both cases 2 & 3 have indicated that from the physical perspective, an attempt has already been made to realise model B.The resilient hospital. And case 3 even wants to go in the direction of model C.The healthy society by allowing more to take place online and also to respond to monitoring from home. In practice, however, both cases remain fairly stuck on model A.My hospital.

This can be explained by referring to the switchboard (figure 3.1.05) by Den Heijer (2021) and the integral coherence in ICM (chapter 3.2.3). If the goal of the physical perspective is changed, or switched, then something will need to happen to the other goals as well.

The future models (figure 5.1.1), can be reflected upon the patient journey, which is explained in chapter 3.2.5 (figure 3.2.13). The more the hospital model switches from A.My hospital to C.The healthy society, the more the patient becomes proactive and can determine the course of the hospital visit himself. The medical situation of the patient also influences the state of matter. The medical condition may require a patient to undergo physical treatment.

"New digital technologies have shifted our views on health. Mobile apps and sensors are providing a more holistic view of health. E-health and data mining increase the possibilities for preventive, predictive medicine and for patients as empowered, self-directed individuals.
But there are downsides too.
The overdose of online health information and the availability of health checks have led to healthy-but-anxious people. And the concept of the proactive and responsible patient does not lead to more, but rather less autonomy and self-management, critics say. A public debate is desirable about the values and norms that must be protected in the design and introduction of technology."
Van Den Brink, Hekster & Van Der Wilt, 2021

	A. My hospital	B. The resilient hospital	C. The healthy society
Organisational	The hospital consist of dedicated rooms, which are used monofunctional. No spaces are shared, except for the main entrance. The processes are organised per specialism. There is great hierarchy in the hospital organisation.	The hospital consist of mostly generic consultation/examination rooms, which can be used by multiple specialisms. Apart from specialisms in need of special equipment that is not portable. The primary process is uniform for all specialisms.	Rooms suitable for e-consults become more important. Most consultation/examination rooms are generic. Home monitoring of patients takes place in the back office. The process is very much unified, there are no different units anymore.
Functional	Specialisms are divided in units. Permanent workplaces are allocated. In very exceptional cases, multidisciplinary consultations take place	Specialisms are divided in units, but work multidisciplinary. Rooms or other facilities are no longer exclusive.	Specialists are divided along care pathways. Specialists sometimes work from home and less patients are visiting the hospital, only when required. Rooms or other facilities are not exclusive.
Financial	Same amount of resources available. Negotiations with the health insurer.		
Physical	Same number of m2. Every specialism has its own counter and waiting area. The front office and back office are concentrated in the outpatient area.	Same number of m2. A cluster of specialisms share a counter. The waiting area is customised, patients can choose the kind of area they want to wait. Front and back office are spatially separated.	Fewer number of m2, consultations are partly virtual so less patients have to visit the hospital. Customised waiting. Spatial separation of front office and back office.

Figure 5.1.1 Future hospital models based on Den Heijers (2021) state of matter and the CREM perspectives (own figure)

And so the future model of the outpatient department should on the demand side match with the future and changing goals of politics e.g. new regulations regarding e-health; the hospital organisation and the users; medical specialists and patients. On the supply side the design of front office and back office, waiting concepts, the consultation/examination rooms and the virtual world. Always considering the four CREM perspectives; organisational, functional, physical and financial.

Based on the cross-case analysis it appears desirable to use both the office spaces and the consultation/examination rooms flexibly. However, when taking into account the states of matter connected to the four perspectives (Figure 3.1.04) it means that something has to change regarding the organisational perspective and the functional perspective as the financial perspective will stay the same. As it is now, the physical perspective is converting to the state of liquid or even at some points gas, while the organisational perspective and functional perspective are in a very solid state. By providing more transparency in the occupancy of the rooms per specialism, it already proved for that specialism to be easier to make flexible use of the rooms.

The suggestion of the future model of the outpatient department is the right mixture between the three models displayed above. Most consultation/examination rooms will probably be in the liquid state, the rooms where e-consultations or remote monitoring take place will be a mixture of the liquid state and the gas state. But the rooms used by gynaecology and oral-surgery will be a solid state, but could be liquid within their specialism. However, to get there first unity within the organisation of the outpatient department should be achieved. Transparency in information between the different departments is therefore the first step to take to get rid of the independent departments. And this is where the smart tools can come into play. Not only for the managers and

medical specialist but also for the patient. When making use of technology the privacy aspect is a very important aspect to take into account.

The information dashboard

Based on the values of the different stakeholders the information desired per stakeholder is showed below. The department of ICM can in this case receive the same information as the department manager but will look at it from a broader view as the ICM manager receives the information from multiple specialisms instead of just one. Therefor the ICM manager will need to filter information to be able maintain a clear overview and to look at future trends. In terms of integral coherence, the three different dashboards might show different information, however they should be connected with each other.

<u>The department manager</u>

- Occupancy of the consultation rooms visualised in the plan of the outpatient department.
- Insight into peak moments at the outpatient department (connected to the reservation system of the patient and the EPD).
- Schedules of the medical specialists.

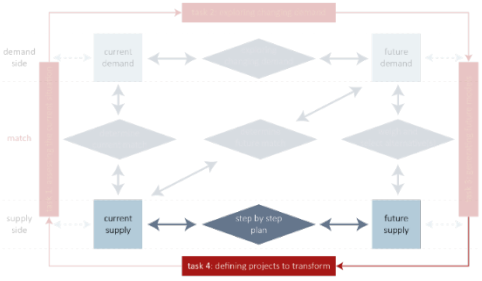
<u>The medical specialist</u>

- Occupancy of the consultation rooms visualised in the plan of the outpatient department.
- Personal schedule, including appointments with whom and where.
- A check-in notification for when the patient arrives.
- Connected to EPD
- Tracking of medical equipment (to be used in the multifunctional rooms)

<u>The patient</u>

- Registration upon entrance of the hospital.
- A notification 10 minutes before the medical specialist is ready for the consultation to take place.
- Way-finding in the hospital.
- Show waiting times for small examinations, like blood sampling (or weigh and measure at the children hospital).
- Reserve a spot for small examinations.
- Ability to make follow-up appointment if indicated by the medical specialist.
- Information on the care path.

5.2 Task 4 defining projects to transform



Task 4 of the DAS-frame; defining projects to transform can be the final step or the first step in designing an accommodation strategy. When it is the first step in the process the project is reactively defined. This implies that first a problem, relating to the use of real estate, has occurred. And in order to find a solution to this problem, the execution of the tasks of the DAS frame is initiated. Most projects start by means of the reactive approach (Den Heijer, 2011). As did this project. When it is the fourth steps in the process, the project is proactively defined. According to Den Heijer (2011) the latter is most favourable by campus managers, however due to the lack of management information, this task can often not be executed proactively.

5.3 Validation

In this section the validation of this research is addressed. The validation consist of (1) a project visit of the newly built smart outpatient department of the Reinier de Graaf Hospital and an interview with a clinical physicist of the hospital who has been involved in the design of the project; and (2) an expert panel consisting of two professionals working at AT Osborne and one capacity manager of the AMC.

5.3.1 Project visit Reinier de Graaf

The project visit of Reinier de Graaf hospital location Voorburg consisted of a tour by the facility manager (Expert 4) and an interview with a medical specialist (Interviewee D1).

Project visit

The newly built outpatient department of Reinier de Graaf Voorburg is situated outside the hospital. The system that is integrated in the building is called Bgrid. Sensors and a tablet are placed in every room. For privacy reasons, the tablet's camera and sound have been disabled. The climate and lighting can be controlled via the tablet in the rooms. The system is smart: If no movement is detected by the motion sensors, a signal is given to turn off the light; The system can recognise that if person X sets the temperature to 19.5 degrees every Tuesday morning instead of the 21 degrees like the colleague from the day before, then the system itself can already lower the temperature from 21 to 19.5 degrees on Tuesday morning. Besides, controlling climate and lighting whether a room is occupied or not can also be measured by the motion sensors. These measurements can be taken further by using trackers in, for example, an employee or patient card. The sensor can connect to the tracker and it can exactly be seen who is in the building and where. And thus also how many people and who are using a room. The tracker can be programmed so that it does not disclose names, but it does indicate whether the person is a patient, a medical specialist, etc. (Expert 4, 2021).

"If you were to give a doctor and a patient such a tracker, you could see exactly what route they take during the day. The use of trackers in this way is debatable, as it affects the working atmosphere; doctors may feel they are being watched and that is generally not experienced as pleasant."
[Expert 4, 2021]

To stay away from violation of privacy these trackers can be connected to equipment as well. So staff is able to find a specific type of equipment when needed. The system becomes smart the moment it can indicate something, for example, a waste cart must be emptied at a certain weight or if it has not been emptied for 24 hours or less. Based on location recognition, the system can see that the waste cart has not been moved and if it has been moved for more than 24 hours, the light on the cart will turn red.

"In principle, almost everything is possible with smart tools. The limitations in use are imposed by privacy and also the smart tool must not come at the expense of a pleasant working atmosphere for the employees/medical specialists. In addition, you must also avoid storing too much 'unnecessary data'. Otherwise it might happen one can't see the wood for the trees."
[Expert 4, 2021]

Interview

At the time of the interview the outpatient department is not operating yet, but will open its doors in January 2022. The concept of the outpatient department is flexible and designed from the patient flow. At the location Voorburg the entire capacity management of the outpatient department is assigned to one manager, this person determines for all specialisms how the rooms are distributed. (Interviewee D1, 2021). The interview also contains information on the Reinier de Graaf Delft location to find out what works well and what can be improved.

In Delft, there are also generic consultation rooms. The concept works well, although the layout of the specialisms is fairly fixed. The flexibility lies within some of the rooms, also known as the 'harmonica model'. The registration process takes place via registration kiosks and there are volunteers to assist people who do not understand it. Sometimes things go wrong and people forget to sign in, but in general the vast majority of patients understand the system. In Voorbug they have chosen to work with the registration desk, due to the size of the patient group, which is very small (Interviewee D1, 2021).

In terms of e-consultations, for now at the location Delft these take place in the generic consultation/examination room. The advantage is that everything is arranged, the medical workstation is there and privacy is arranged. However, these e-consultations or telephone consultations should not necessarily be held in the relatively expensive clinical space. The e-consultation room can be smaller, it should be the same as the generic consultation room in terms of privacy and workstation set up, but without the facilities to carry physical examination. For the future a ratio of one e-consultation room for every four generic consultation rooms would be reasonable, and situated at the department near the colleagues (Interviewee D1, 2021).

"I think that ultimately it is desirable that the e-consults are clustered in certain parts of the day or time slots. And the specialists take the time to take place in a designated space for the e-consult. However, I can also imagine that the specialists don't want to be situated very far from their own department, because they do want to be available for urgent questions."
[Interviewee D1, 2021]

Regarding efficient work processes, the coordination between the various specialisms could be optimised, perhaps by concentrating certain specialisms on certain days. Especially specialisms that have fewer consultation hours can for example only have consultations on Monday and Tuesday and the rest of the week perform other activities. In terms of care paths, working multidisciplinary is a trend nowadays (Interviewee D1, 2021).

"The quality of working multidisciplinary is an increase in quality of the care of the patient and the patient can combine appointments on the same day. However the logistic organisation around it gets way more complex."
[Interviewee D1, 2021]

Furthermore, the planning as it is, is rather static and that leaves little room for flexibility in planning. More dynamic planning can lead to greater efficiency. Providing insight into, for example,

consultation hours that are run can help with this. This flexibility is difficult to create because there are a number of fixed rhythms due to a number of dependencies, such as the surgical schedule that is leading (Interviewee D1, 2021).

"The point is that if different schedules interlock, all schedules become more rigid. And that's what you see happening, which also means that flexibility in outpatient staffing can be nice occasionally, but as a rule it's not used very much. Unless you can get those counter-stage movements. But in general, the stretch is in how long the consultation takes and how many consultations take place in a day."
[Interviewee D1, 2021]

In terms of schedule, the various specialisms at the outpatient department are quite standardised. This causes peak moments; everyone runs consultation hours from 08:00 to 12:30 and from 16:00 to 18:00 everyone needs an office room. The distribution in use is not such that you can flatten the occupancy in the statistics.

"You have to be carefull with the use of reservation systems. It may work for the assistants, physiotherapist and such. But if the doctors and medical specialists, the highly paid employees, also have to work with such a system, it is very costly and also very impactful when they cannot find a place."
[Interviewee D1, 2021]

5.3.2 Expert panel

To ensure the right participants, who can provide relevant viewpoints, are taking part at the expert panel a selection of criteria has been set up (figure 5.3.1).

Criteria	
1.	The panellist has experience in healthcare real estate
2.	The panellist has experience in the outpatient department of a Dutch hospital
3.	The panellist has experience with integral capacity management (ICM)
4.	The panellist has not been involved in this research or in one of the case studies

Figure 5.3.1 Panellist selection criteria

The following experts have taken part in the expert panel:

Expert	Company	Function
1.	AT Osborne	Senior Consultant Accommodation & Real Estate (Specialised in translating goals and (care) processes into organisational and spatial solutions and the transitions, at strategic, managerial and operational level)
2.	AT Osborne	Consultant Accommodation & Real Estate (Strategy and decision making in healthcare, capacity & logistics)
3.	AUMC (Amsterdam University Medical Centre)	Providing insight into actual utilisation of space and develops a tool to estimate the number of spaces required.

Set up

Beforehand an email is sent to the panellist with an introduction of the research including the main research question and a concise summary of the findings. A few days before the expert panel took place, an email was sent with the four statements to allow the panellist to prepare themselves. On the day of the expert panel, first, a concise presentation is given on the research topic, followed by statements based on the literature review and the empirical study findings. After presenting each statement, an open discussion has been facilitated in order to derive input for the research. Note: Panellists 3 could not attend the debate at the last minute. Her view on the statements was obtained later on through personal communication.

Statements

Statement 1: *The primary process must become more uniform between the various specialisms. So the outpatient department becomes more of a single entity and consists of fewer 'independent islands'.*

All experts agreed with the statement. They mentioned that the physical housing should be more uniform to create a more single entity of the outpatient department. The so-called harmonica model can be created by working with generic consultation/examination rooms and bigger entities.

"A specialism can still use the same rooms 80% of the time but can adequately use one or two or give up one or two. Regardless of whether those people ever work together or do the same thing, they can use each other's rooms."
[Expert 1, 2021]

The experts added that the primary process, mainly how everything around it is organised and planned, should be standardised and centralised. More can be achieved by planning and managing per cluster or completely centrally than when this is done independently per outpatient department.

"Indeed, if you try at all costs to organise all those specialisms in the same way in terms of profession, you will not succeed. It will lead to a lot of frustration and discussion. However, a clear overview can be monitored, and insight can be given into the processes from above. To ensure a tactical, efficient and effective organisation. This is where the capacity manager plays an important role."
[Expert 2, 2021]

Subsequently, this has a lot to do with the different levels of planning; strategic, tactic and operational. Tactical planning is often lacking at the hospital and is now being introduced by ICM. The tactical adjustment is wanted. It is the level between giving rooms away permanently and evaluating from day to day how they have been used and then making adjustments. Often the rooms are not included in the schedule of the specialists. The specialists are later on assigned to a room by someone else. As a result, the feedback loop on how the spaces are utilised is entirely missing in most hospitals. Next to aligning the schedules of rooms and staff, rules should be introduced on how the planning of the rooms should be organised. Currently, a part of the day (morning/afternoon) is allocated to someone, but no one knows how many patients this person sees or what activities are carried out.

The number of 'remote consultations' have increased during the Covid19-pandemic. At first telephone consultations took place at the consultation room in-between 'regular' consultations. The specialist would tell the patient he or she can expect a phone call within a time frame, so there is no fixed appointment. With the arrival of e-consults, meaning in this case a remote consultation with video and sound, a fixed appointment has to be made and the e-consult can replace a 'regular' consultation. Instead of the telephone consultation the e-consult has to be included in the schedule of the specialist, and a discussion was going on whether the e-consults had to be held within a specific part of the day in a specially equipped room. This is already outdated and new solutions have been formed that also have to do with having as few people as possible in the waiting room at the same time.

The future outpatient department will have a much more hybrid practice where physical and digital alternate. This will include a so-called call-room and the generic consultation/examination room. The call-room is smaller, is very well secured, has special equipment and the right set-up for the e-consultations to take place. The call-room can be situated next to the generic consultation/examination room, there will be a mix of the two at the outpatient department with a

ratio of for example 1 call-room : 3 generic consultation/examination rooms. The two will be used in a flexible manner and the specialist can change between the rooms, as happens already between two consultation rooms.

"It really is a mindset change! It is a matter of good facilitation. And in the end, with scarcity, people become creative again"
[Expert 2, 2021]

"Also bear in mind that this will only become attractive if a large part (50%) of the consultation is structurally digital. But I notice that people are not ready for that yet."
[Expert 1, 2021]

Statement 2: *A flexible concept (separation of front office and back office & generic consultation/examination rooms) should be better utilised between different specialisms, as is already the case within the specialism.*

The experts agreed to a certain extent with the above statement. If a specialism can spread the amount of work equally in a way that it can make optimum use of the rooms, then it is not a problem. However, when the specialism experiences highs and lows and therefore makes more or less use of the rooms, it is better to find neighbours with whom these fluctuations can be compensated. The moment this is well organised, the specialism has to adapt less in the process, and the 'pain' of the occupation can be shared with each other.

"When there are highs and lows in room occupancy, spaces could be shared more effectively. If the harmonica model is then used properly, the rooms are also used more efficiently."
[Expert 3, 2021]

For about 80% of the outpatient department, generic rooms can be set up; specialists such as gynaecology, ENT and oral surgery need specific facilities and cannot use the generic room. These specific specialisms will be left out of consideration for now. The highs and lows within the seasons can be considered to create more flexibility during the year. Besides, on a weekly and monthly basis, more flexibility can be created when for example, the schedule of the OR is considered.

"When specialisms look closely at each other when integrally is looked at complementary planning and patterns, less reorganisation might have to take place per specialism in terms of scheduling. But I think it starts with the realisation that this is how things are distributed."
[Expert 1, 2021]

Within various outpatient departments, often, specialisms are appropriating several rooms. This is also recognisable in the statement 'within the specialism the rooms are used flexible'. *"It is typical for doctors to say: we are very flexible; if I am not there, it is okay for someone else to use my room."* (Expert 1, 2021). This is the wrong approach. It is not 'my' room but just a room that has been assigned. To create that turnaround in mindset, the benefit and necessity of the flexible concept have to be shown. In addition, some scarcity must be created for a flexible concept to succeed.

In theory, flexibility can be implemented to such an extent that even every single day, the specialism at a particular desk can differ. However, in practice, outpatient departments do not shift location on a day-to-day basis. Simply because it is unnecessary, since every specialism has a few consulting hours every day, and it also has a social, dynamic or emotional reason for allowing people to do their work well. Some hospitals are designed in a way that every specialism has, on the one hand, a 'permanent home base' and on the other hand areas where consultation in multidisciplinary contexts can be flexibly organised.

"Then you got your future flexibility, which is desired, as you don't know yet what will be needed in 10 years time. Which specialism will grow and which one will shrink?"
[Expert 2, 2021]

Statement 3: *The implementation of smart tools is more successful as the layout of the outpatient department becomes more flexible.*

The experts described this statement as the chicken and the egg dilemma. The layout of the outpatient department has to be flexible otherwise, the smart tool can't be of great value. But the smart tools are also a prerequisite for that flexible use to be carried out well.

"What people often stumble up against is that they are afraid of the unavailability of a room or they do not want to have to search for an available room."
[Expert 1, 2021]

It is also important to understand the definition of a smart tool. As above quote can be solved by track & trace, proper monitoring, good planning and allocation; almost a kind of resource planning. This is not smart technology, however for a lot of people it still is. As example, one can say if specialist Y has its consultation, he/she needs room type B and equipment locker 2. Within the schedule this would be reserved and someone makes sure it is available. The same applies to the nurse, who may have four consults, for which room type A is reserved and equipment locker 3. And no other nurse happens to ask for equipment locker 3 at the same time, because of the reservation that has been made.

To get the (resource) planning to a higher level and achieve the optimum of the time and people of the organisation, the feedback loop is of high essence. Historical data within the feedback loop can be achieved by using smart tools as for example sensors. Nowadays, this is often missing in hospitals. Once, someone asks for extra facilities or spaces an investigation will be set up, to analyse the occupancy. Some hospitals have started with the implementation of sensors to measure real-time the occupancy of spaces in the outpatient department. When a specialism requires extra rooms, the capacity manager has immediate insight into occupancy through real-time information. And they can immediately decide whether extra space should be released or whether the specialism should spread its hours better over the week, for example.

"The space utilisation is analysed when a bit more scarcity arises. Often there is not yet information, so measurements will be taken, such as counting people entering and leaving the room."
[Expert 2, 2021]

Statement 4: *The Covid19 pandemic is accelerating the implementation/acceptance of smart technologies.*

According to the experts this statement is absolutely true. For example, in the case of the epd (Hix), some applications still had hiccups that delayed implementation, under the pressure of the corona pandemic, a kind of resilience has developed to accept and implement many things.

"In this day and age, digitalisation is embraced. This does not mean that everything is new, many applications and technologies that are now used intensively were in fact already in use, although to a lesser extent."
[Expert 3, 2021]

The care portal and other tools that allow patients to follow their own care path and where they can get information in advance of their hospital visit, is increasingly being implemented and improved. Making appointments is not yet done independently by the patient; one has to call the

outpatient department, the assistant will look at the schedule and then the appointment is in a few weeks' time.

"The control by the patient, as is now common in all kinds of other sectors, is not yet the case in the care sector."
[Expert 2, 2021]

Hospitals now often use a planning horizon of 8 weeks, which means that when a call is made for an appointment, it will take place after 8 weeks at the earliest. But if a patient cancels, no one else can get in sooner. Dynamic planning, keeping capacity partially free and planning less far ahead could be improved. So that people who call this week can be treated next week. From a historical point of view it can be revealed from the 100% of visitors, how many of them knew three months ahead that they would have to visit the hospital and how many of them made the appointment one month in advance? The hospital can adopt the statement 'we want patients to be able to visit within 1 or 2 weeks'. The repeat visits 40/50% are scheduled in the long term, these are known. What is left is the 40/50% for people who call this week and want to be treated next week. It starts with knowing the ration of repeat visits and regular consultations. And adjustments can be learned from experience; if that one week just doesn't work out, then a little more capacity should have been kept free. Hospitals find last-minute planning stressful. They do not yet dare to rely on historical data that shows that the schedule is filling up. After all, if planning is done at shorter notice, there is less uncertainty about people cancelling or forgetting appointments.

"You have to trust that with a learning system you will be able to do better and better in order not to have any idle capacity left over. And thus be able to make smart tactical and operational adjustments."
[Expert 1, 2021]

5.3.3 Summary validation

From the project visit at Reinier de Graaf hospital location Voorburg, it became clear that a lot is possible when working with smart tools. Climate and lighting can be adjusted by connecting sensors and a build-in tablet in the spaces. And occupancy can be measured by motion sensors that can detect movement. When people are carrying a tracker with them, in for example a patient or employee card, that can connect with the sensors, exact information can be provided on how many people are in a room and who these people are. These trackers can also be connected to equipment. Privacy rights and being able to secure a pleasant working atmosphere are very important when considering implementing smart tools. A system is 'smart' when it can detect patterns by analysing data that has been monitored, and also act or make decisions based on this data.

From the interview it became clear that in Voorburg it is chosen to organise the capacity planning centrally, it is assigned to one capacity manager. The concept of the outpatient department is designed flexible with generic consultation/examination rooms and the patient flow has been leading in the design. At the location Delft they are familiar with the flexible concept and the harmonica model is used between specialisms. The concept of the future outpatient department should be flexible and a distinction should be made between the generic consultation/examination room and an e-consultation room. A reasonable ratio would be one e-consultation room for every four generic consultation rooms. When the e-consultation room is situated at the outpatient department it is easier for the specialist to switch between the rooms and the specialist is close to its colleagues for urgent matters. Working multidisciplinary is a trend, which improves care of the patient but the logistic organisation gets more complex. Flexibility in the schedule of the outpatient

department is hard to create due to a number of fixed rhythms following from a number of dependencies.

Overall the experts agreed with the presented statements. They showed a lot of examples from practice to support the statements.
Statement 1: This for sure is a mindset change. The primary process, mainly how everything around the medical processes is organised and planned, should be standardised and centralised. If this is organised from a higher level more can be achieved. The capacity manager plays an important role in tactical planning and effective and efficient organisation. As of now the feedback loop is often still missing.
Statement 2: The layout of the outpatient department should be as flexible as possible in the basic sense, a little more customisation can be allowed in the design of the layout. This creates a kind of stratification: architectural uniformity, variation in the layout and customisation with as many loose furnishings as possible.
Statement 3: The experts described this statement as the chicken and the egg dilemma. The layout of the outpatient department has to be flexible otherwise, the smart tool can't be of great value. But the smart tools are also a prerequisite for that flexible use to be carried out well.
Statement 4: Due to the Covid19-pandemic there is a greater need for flexible planning and filling scheduling gaps. Under the pressure of the Covid19-pandemic, hiccups in the implementation of applications are accepted and implemented more quickly. On the other hand, as the severity of the pandemic decreases, many people revert to their old habits.

There is a lot to be gained in the planning issue and it is precisely in the planning issue that various smart tools can be used. In the hospital, you are dealing with a knowledge-intensive organisation, and you should not want to interfere with the medical processes. But the capacities can be used intelligently, and this requires clear arguments to be able to show how things can be done better. By generating information with smart tools, a feedback loop can be created from which lessons can be learned on how to improve. Improvement starts with creating insight and awareness, that is the most important, this will then follow by the willingness to change (Experts 1, 2, 3, 2021).

6. Discussion and limitations

6.1 Discussion

In this section the findings of the research are discussed. This is done two fold; first, the relation between the findings and the problem statement is discussed; second, the relation between findings from the literature review and the findings from the empirical study is been discussed.

6.1.1 Findings & problem statement

As described in chapter 1.2 the problem statement of this research includes the following; there is an increasing demand for outpatient services due to the pressure on hospitals to reduce costs and improve health service accessibility. As the costs of the hospital must reduce, the hospital cannot grow along with the increasing demand. Which then results in the scarcity of resources of the hospital. On the other hand new technologies, like e-consults or tele-health, ask for a different way of accommodating and a pandemic, like Covid19, demands some flexibility and overcapacity in the resources of the hospital. For the hospital to be able to keep delivering high quality care, it is critical to make efficient and effective use of the scarce resources, space and staff.

This study has provided insight into how layout and smart tools can be applied as a tool to contribute to the efficiency and effectiveness of the space utilisation. By plotting the journey of the patient against the journey of the medical specialist and the space allocation, it became clear what spaces are used and for approximately how long. From the findings it became clear how layout of the space contributes to an efficient way of space utilisation (chapter 3.2.4). However, it also became clear that just the adjustment of layout is not enough, which is why in practice the efficiency and effectiveness of the space utilisation is not yet noticeable. All four perspectives (chapter 3.1.2) should be taken in to account when changing an accommodation strategy. Furthermore, the research on smart tools has provided insight in which smart tools can be used in public buildings and what the objectives are (chapter 3.3.4). Providing information and insight into how space is used has proven to contribute to the efficient and effective use of space within a specialism. The next step is to apply this on the whole of the outpatient department, and create transparency between the specialisms. This research contributed to the formulated problem definition by providing insight into how a space can be used efficiently and, above all, revealed that the organisation must be open to this.

6.1.2 Findings literature review & empirical study

From the literature, it appears that a lot is possible. However, the implementation in practice sometimes turns out to be hard. Especially in a traditional organisation like the hospital. Innovations (not medical related) described in literature can be too ambitious for a hospital to take. However, it is still smart to show the organisation the possibilities that exist. In the transition towards a more innovative business organisation, small steps need to be taken first, instead of implementing all kind of tools right away. In the DAS-frame, the four perspectives are taken into account with every step taken. In addition, to the DAS-frame it would be interesting to add the implementation of the future model in the organisation.

Another point of discussion is the human touch of healthcare. The patient contact is considered very important, both by the patient himself, by the medical specialist and by the secretary. The moment a patient has to go to hospital it usually means that the patient is not in good health. These are the moments when someone would like to be helped in a pleasant way and not have to experience stress due to certain systems that are incomprehensible. People also like to be able to have a chat, as also proved by the Covid19-pandemic. And as for the employees, most of them decided to work in the healthcare sector because of the contact with people.

6.2 Limitations

Like every other research, this research has its limitations. The limitations impact the conclusion and recommendations and should therefore be taken into account.

The first limitation of the research is the timeframe in which this research has been conducted. Therefore, only limited number of cases have been involved in the research. The conclusion as it is now, is very general. The approach of selecting the cases on type of space use; rigid – somewhat flexible – flexible, has been a good choice. But if more cases could have been involved in the research, advise on the efficient use of space could have been provided per type of case.

In addition, the organisation of the hospital is rather complex. And decisions made are very much constrained by decisions in politics, especially in terms of budget. The implementation of smart tools and the organisational change in order to use space differently are dependent on many different variables. This could be a research in itself but is very important in the efficient and effective use of space and therefore important for this research.

Discussing the culture of the hospital and the organisational structure is a very sensitive topic. But also very important to how the resources are divided and used. During the interview, the interviewees were very open about change that needs to take place, however not everything that has been said can be used in the research due to sensitivity. That is a limitation of the research.

Furthermore, smart tools have not yet been implemented in the outpatient departments of Dutch hospitals. Only case 3 has recently, since 2 months, starting to implement smart tools. This indicates that there is a need for more information. However, performance of smart tools in the outpatient department can not be tested yet. And therefore to answer the question 'to what extent can smart tools contribute to an efficient and effective use of space in the outpatient department' is only based on literature and examples from other public buildings, but not yet on data from practice in outpatient department of a hospital. This is a limitation.

7. Conclusion and recommendations

The purpose of this chapter is to present a possible solution to the problem stated in the problemstatement, by answering the main research question. First, the sub-questions are answered derived from the literature study and the empirical study. The chapter closes with recommendations for future research.

7.1 Conclusion

First the conclusions of the subquestions are presented.

7.1.1 Sub-questions on real estate management

Question	How can the current real estate portfolio be aligned to the organisational business strategy?
Purpose	To provide a framework on how to align the business strategy of the hospital with its real estate portfolio by using PREM
Methods	Literature review

Definition

PREM and CREM both aim at the alignment of the real estate portfolio to the organisation's business in such a wat that it adds maximal value to the organisation. In addition to CREM, PREM has public goals and sometimes public funding.

Frameworks

In order to align the business strategy of the hospital with its real estate portfolio, various frameworks and models can be taken into account.

- The four perspective model: by using the four perspectives model, the different stakeholders will be taken into account and the perspectives can be combined with the real estate added values.
- The DAS-frame: by using the DAS-frame demand and supply can be matched continuously. The iterative process allows for decision making in the future as well as evaluating decisions made in the past.
- The states of matter: the solid-liquid-gas model can be used to show how a real estate portfolio or part of the real estate portfolio can be managed and used. The three models are linked to each other and influence each other.

Added values

Finally, the added values of hospital real estate are: increase innovation, increase user satisfaction, improve culture, reduce costs, improve productivity, improve flexibility, support image, controlling risks, and improve financial position.

7.1.2 Sub-questions on the outpatient department

Question	What does the outpatient department of a Dutch hospital entails? *What activities take place in the outpatient department?* What is Integral Capacity Management and could this be an operating area where smart tools can be deployed?
Purpose	To get insight into what the outpatient department entails, what concepts can be applied, determine what patients and medical specialists in this department need. To be able to align supply and demand. The user journey is becoming clear. To anticipate current developments and hot topic in the healthcare sector.
Methods	Literature review

The need for outpatient services is increasing. The outpatient department consist of a lot of different specialisms. Within the hospital organisation different discipline-groups existing of medical staff are more or less autonomous organisations. As a result, the executive board of the hospital has little or no influence on production decisions within such a discipline-group. Integral capacity management can be used as a tool to create an integral process throughout the various subunits, to achieve coherence and consistency in decision-making and implementation at all levels in the organisation. By managing the capacities the aim is to create alignment between supply and demand. To eventually improve the healthcare process and healthcare delivery towards the patient.

The main characteristic of the outpatient department is that of patients coming and leaving the same day. The layout of the outpatient department has the following characteristics:

- A front office and a back office, these can be separated or concentrated. The front office are the spaces where the patient is allowed. The back office is only allowed for staff and medical specialists.
- Registration kiosk or registration desk, waiting area, front desk at OD, additional facilities like restroom, restaurant/coffee corner.
- (Generic) consultation/examination rooms and function rooms.
- Office spaces, flex work spots, concentration rooms, rooms for e-consults or phone consults, conference rooms and meeting rooms.

Question	*What are the values of the stakeholders of the outpatient department and how can real estate be aligned to these values?*
Purpose	To get insight into what the outpatient department entails, determine what patients and medical specialists in this department need. To be able to align supply and demand.
Methods	Empirical research; semi-structured interviews

Financial perspective

The budget may not exceed the previous year's and may even shrink. Therefore, the financial added value is to reduce costs, control risks and improve the financial position. From a financial perspective, it is important for the processes to be efficient. So the production capacity in terms of DTC agreements can be achieved within the agreed budget with the healthcare insurer. If e-consults want to be stimulated, an incentive could be to make it declarable at the health insurer. Otherwise, there is from the financial perspective no incentive to change from solid/liquid to gas, as the hospital won't held consultations for free.

Organisational perspective

To ensure the work processes to become more efficient, the greatest organisational value is to achieve greater uniformity in the outpatient department. Standard processes such as registration, scheduling of appointments and planning of staff and rooms should be unified and standardised. For that to happen, thinking in separate islands will have to disappear. Different departments will always exist; after all, they are specialists, and nobody knows as much about their field as they do themselves. But as for the managers, they can see their department within the bigger picture. And through more transparency between the different departments, they will be able to help each other out if needed.

Functional perspective

The users of the outpatient department are the patient and the employees; medical specialist, nurses, assistants, etc. From the user perspective, employee satisfaction and patient satisfaction are the

added values. To achieve employee satisfaction, a certain structure is desirable, as is working in a familiar environment with one's own team around them, so they know where to go with certain questions. Providing good care always comes first. Too many different systems take time to deliver that care and are therefore undesirable. A clear platform where everything can be found for the primary process would increase employee satisfaction. Patient satisfaction can be achieved by great hospitality, making the patient journey as clear as possible and thereby reducing stress and of course, decreasing waiting times.

Physical perspective

The added value from a physical perspective is in the best way supporting the work process, making optimum use of the m2, ensuring a healthy indoor climate and achieve sustainability goals.

And finally, flexibility is the added value of all perspectives.

7.1.3 Sub-questions on smart tools

Question	*What are the influence of Big Data and IoT on the use of the outpatient department?* Which and how are smart tools used in public buildings? *How can smart tools be implemented in the organisation?* *Could Integral Capacity Management be an operating area where smart tools can be deployed?*
Purpose	To get insight into what smart tools are and how they can be applied for measuring space use. To get insight into if and how smart tools can be implemented in the organisation. To anticipate the change digitisation in the near future.
Methods	Literature review

Definition

The value of data is dependent on personal interpretation. The four levels are data, information, knowledge and wisdom. As data changes from information and knowledge to wisdom, the value increases, and so does the technological complexity. The ability to explain and predict events by analysing and combining complex datasets is called big data. Internet of Things (IoT) refers to the network of devices able to communicate to achieve smart reorganisations, process control, personal real-time monitoring, etc.

The architecture of IoT consist of three layers; sensing (data collection), network (data processing), and application (data provision). Healthcare-related IoT systems mainly focus on remote health monitoring. By monitoring non-critical patients at home instead of in the hospital, the strain on hospital resources like doctors and beds can be reduced. Smart tools are part of the sensing layer within the IoT architecture. Sensors allow the collection and processing of real-time information.

Implementation smart tools

A smart tool can support the decision making process on space utilisation as it provides the user or organisation with real-time information. Most sensors applied for optimising space utilisation give the organisation insight into the occupancy of spaces or provide the user insight into how the space is used. The following type of sensors can be used to measure space use: Wi-Fi, Bluetooth, RFID, camera, infrared, use of devices, ultra-wideband and CO2 sensors.

ICM as operating area to deploy smart tools

A Hospital Control Centre is the place in the hospital where all information on supply and demand on all capacities in the hospital come together. An HCC is a means of supporting ICM. Data derived from smart tools that measure, e.g. occupancy rates, can end up in an HCC to be analysed. The organisation's foundation consists of people, and their behaviour, smart tools, HCC and ICM can support their activities.

7.1.4 Main research question

Question	To what extent can smart tools and layout contribute to a more efficient and effective use of scarce resources in the outpatient department of a Dutch hospital?
Purpose	To inform the capacity and facility manager of the Dutch hospital about the possibilities of smart tools in the outpatient department, and to hand an extra tool in the decision making process. To cope with the scarce resources of the Dutch hospital and decrease the gap between supply and demand.
Methods	A qualitative research approach

The Covid19-pandemic has highlighted the need to be flexible in multiple ways. Flexibility in use of physical spaces, in way of working and in scheduling. Integral Capacity Management was an upcoming field but appeared to be of high importance in the resilience against the Covid pandemic. Steering on strategic and operational level did happen in hospitals but steering on tactical level is often missing, however this is now being more and more introduced by ICM. Steering on tactical level is often missing due to the lack of information on how the spaces are used. There is no monitoring and therefore there is no feedback loop. This mainly applies to the outpatient department of the hospital, in other departments like the operating theatre monitoring does happen more often which makes steering and evaluating easier. The reason for this could be the size of the outpatient department with its many specialisms, which often all act independently. Smart tools could be of value when retrieving information on occupancy by monitoring is desirable. Occupancy of space can be measured by using e.g. Wi-Fi or Bluetooth and users of the building can even be informed of the occupancy of the building e.g. through screens in central areas or by using a mobile app.

Within this research three different hospitals have been analysed. In terms of real estate their layout differed; the first one can be labelled as solid, the second as liquid and the third as liquid/gas. From theory it can be concluded that the use of smart tools and layout can contribute to a more efficient and effective use of space. In terms of layout, when separating the front office and back office and design generic consultation/examination rooms, the rooms can be used by various specialism and vacancy can be avoided. The consultations can take place in the generic consultation/examination room while the administrative work can be executed in the back office. With the use of this concept no one has its dedicated room and it is easier to facilitate the growing number of part-timers and newly hired employees. Together with the use of smart tools as briefly mentioned above, the spaces could be used more efficient and effective. With the insight in occupancy, the healthcare professionals can easily find or reserve a room. The capacity manager can even set a maximum occupancy rate which cannot be exceeded, by using the Internet of Things. This way it can be made sure that at any time there is a room available for the healthcare professional. However, the cases showed that in practice the advantages of the layout concepts to create more flexibility and efficiency in the use of space are often not applied in practice. Specialisms are often appropriating several rooms from the fear of having too little at their disposal. All three cases however also indicated the need for change to a liquid way of working due to the scarcity.

Two of the three cases made already use of a flexible concept, however none of the cases made use of smart tools to create insight into occupancy. This shows the relation between the smart tool and the layout to create an efficient use of space. The layout of the outpatient department has to be flexible otherwise, the smart tool can't be of great value. But the smart tools are also a prerequisite for that flexible use to be carried out well. As flexibly scheduling requires evaluation and steering based on information derived from monitoring. Besides, the need for information on occupancy a compromised solution between the four perspectives, as shown in the switchboard (figure 7.1) derived from the literature review, is also required for the flexible layout to be successful.

Which is exactly the goal of ICM, managing the integral coherence. As 'the physical slide' has been adjusted, the other three slides should also be adjusted. An example of adjusting the financial slide is to make sure e-consultations are declarable by the healthcare insurer, furthermore this slide is hardly changeable as the healthcare insurer plays a major role in this as well as politics. To adjust both 'the organisational slide' as well as 'the functional slide', a mindset change needs to happen. From acting as individual specialism to a coherent outpatient department in the primary process. Transparency in information between the various units of specialisms can start substantiated discussions to provide trust among the users. Implementing an information dashboard where al information comes together and which is the same for every specialism, creates a clear overview for the users and the organisation. Just creating awareness might not be enough to create the willingness to change. Showing the benefits of the change with substantiated arguments might be necessary. Like a percentage of rooms that should always be available, so there is no fear of missing out on available space, or an incentive to work consulting hours on a Wednesday afternoon or a Friday, etc.

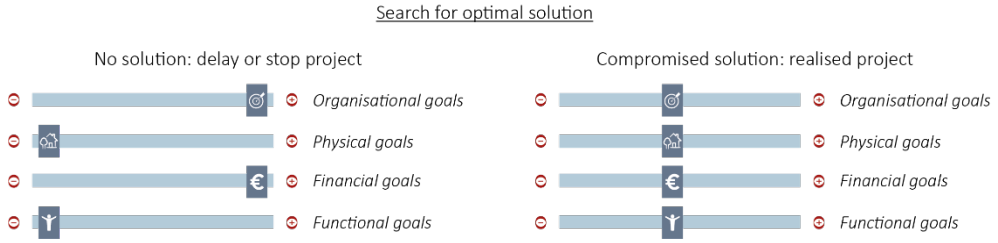


Figure 7.1 Switchboard in PREM (Den Heijer, 2021)

When the willingness of change has been achieved. The future concept of the outpatient department will be a mixture of the three models solid-liquid-gas (figure 7.2). People are attached to a kind of 'home-base', so colleagues can be easily found for urgent matters but also in terms of social-emotional reasons. Besides, also for the patient it is nice to know in which wing he/she can be expected. This home-base is 'solid'. Surround the 'home-base', generic consultation/examination rooms are situated, these rooms are not dedicated to a certain specialism. The rooms will be released on the basis of tactical steering after evaluation. These rooms are 'liquid'. For every four or three generic consultation/examination rooms an e-consultation room is situated at the outpatient department. This is where the e-consultations can take place, this room is 'gas'. The journey of the patient determines the state of matter applied, for example, the first consultation might be desired in a liquid or even solid state (e.g. making an X-ray), however for a repeat visit the gas state might suffice.

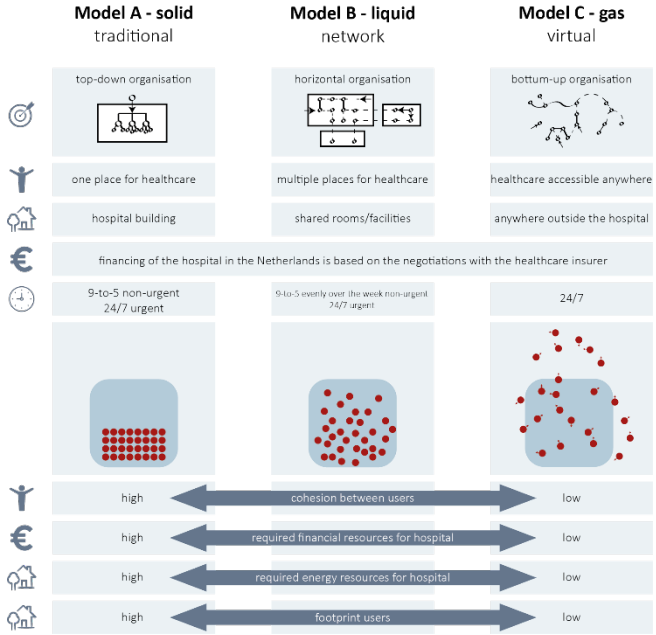


Figure 7.2 solid - liquid - gas, state of matter applied on hospital real estate (Den Heijer, 2021; Hamilton, 2021)

7.2 Recommendations

The aim of this chapter is to provide recommendations for practice and recommendations for future research. The recommendations are based upon the findings from the theoretical review and the empirical research.

7.2.1 Recommendations for future research

The use of smart tools in hospitals is at an early phase therefore, there are lots of opportunities to conduct further research. In addition, uniformity within the hospital is also an important aspect that could be the subject of more research.

Uniformity in the hospital

As concluded earlier on in the research the uniformity at the outpatient department is missing. At the operating theatre there is uniformity, why is it so hard to create it at the outpatient department as well? It would be interesting to conduct research on the things that influence the emergence of divisions and how uniformity can be created.

More in depth research

This study looked at the implementation of smart tools and the contribution to efficient space use. It could also be interesting to zoom in even more in all the specific departments of the outpatient department, like waiting area, registration desk, consultation rooms. What are the possibilities for such a specific space. This might lead to new insights or support the existing findings.

Cost and time of the implementation of smart tools in a hospital

The implementation of smart tools cost time and money. Time in terms of the users need to learn how to work with the newly implemented smart tools, how much effort do they want to put in there. Same applies to reading and understanding the data for the managers. Next to that, cost is always an important factor. The bigger the costs are, the less chance for implementation. It could be research how much the implementation costs and whether the benefits outweigh the costs.

In depth research per specialism in space utilisation

As became clear in this research some specialisms make use of dedicated rooms. It would be interesting to conduct research on each of the specialisms to see what they really need and what equipment could be for example portable. Some of the dedicated examination rooms could then also be used multifunctional.

Change the scope of the research

The hospital is very big and it could be interesting to know whether the implementation of smart tools could also be beneficial in for example the inpatient department. In addition, the logistics is also an interesting topic to conduct further research on. In two of the cases a clear separation of the patient flow, healthcare professional flow and equipment flow is experienced of being pleasant. What works best?

7.2.2 Recommendations for practice

The use of smart tools in hospitals is at an early phase therefore, there are lots of opportunities to conduct further research. In addition, uniformity within the hospital is also an important aspect that could be the subject of more research.

Include the users

Involve the users when it comes to designing a dashboard. Talk to the healthcare professional, the managers but also include the patient. What is the information they would like to see. What works well visually or auditory. Also when in cluding the users in the process it might make them embrace the project sooner and this will also help in becoming more uniform.

Pilot projects

Introduce pilot projects on a small scale. This way the users get a better idea of the possibilities.

Security risks and privacy

At the hospital is dealth with sensitive information and identification of people. Therefore, it is very important to take into account the security risks and privacy. This is something that should never be cut back on.

One platform only or they should be linked

As mentioned by the interviewees, at this moment everyone is working with their own Excel sheets. Nothing is linked, if something changes, everything has to be changed at all the platforms manually. This takes a lot of unnecessary time. Linking platform, like scheduling of rooms and employees or the registration kiosk and the EPD, will save a lot of time and may even be financial beneficial in the future.

Be digitally independent

The care processes should always be able to proceed. A power failure for example, must not bring everything to a halt. Besides, at the hospital there will always be a group of people who does not know how to use the digital facilities, like elderly or visually impaired. Make sure there is a solution for this group as well.

Learn from other sectors

There are other sectors like the aviation, who are ahead of the care sector. Therefore, it is advised to learn from those sectors instead of trying to reinvent the wheel.

8. Reflection on AR3010

8.1 Process and planning

For this research a qualitative research method has been applied. Existing of both a literature review and case studies. At first the literature review was conducted to gain knowledge about the topic. Based on this knowledge the criteria for the case study selection could be formulated. Finding suitable case studies was not a problem. And two of the cases responded right away, the final case however took a bit longer to respond which caused uncertainty as the time was ticking. But in the end it worked out well and the interviews and visit could be executed in time.

Before conducting the official interviews, a test interview had been organised. This test interview had proven to be very helpful in making sure the questions are formulated well, asked in the right order and covers the entire research. The interviewees were very enthusiastic and mentioned that the questions were very interesting and that there was nothing to add. After conducting a certain amount of interviews, I noticed that the responses were all quite similar and I could almost predict in what they were going to say. However, I had to be careful in not steering the interviewee in a certain direction as my own knowledge on the topic grew.

Transcribing and analysing the interviews has been quite a task. But also very useful as while conducting the interview specific comments could not be remembered. Once conducting all the interviews and analysing them, I looked back at the literature research. It was interesting to see, with the knowledge I gained I started understanding the literature even better. It was very interesting and fun linking the empirical research to the literature review. The validation of the results by conducting an expert panel has taken place in-between the P4 and P5.

8.2 Position within the MSc track

This research is part of the master track Management in the Built Environment (MBE) from the faculty of Architecture, Urbanism and Building Sciences at the TU Delft. The MBE track consists of three domains; Design & Construction Management (DCM), Real Estate Management (REM) and Urban Development Management (UDM).

This research is mainly conducted within the REM domain, which focuses on accommodating the users of the built environment, taking into account changing goals in society and organisations, sustainability requirements and feasibility. Furthermore, this domain is divided in six themes (TU Delft, n.d.). The themes this research relates most to are CRE alignment and campus management. The first theme focuses on the alignment between the dynamic demand and the relative static supply. Just like the outpatient department that has to change to accommodate the changing demands and the transformations as mentioned in the problem statement. According to Den Heijer (2011), the theme campus management is about information tools for campus manager to support their decision making. As decisions on campus real estate become more complex due to the uncertainty in future space demand, aging buildings, many more involved stakeholders and a decrease in public involvement and funding. As explained in the problem statement the Dutch hospital has to organise the finance of the real estate itself, with an increase in demand for care and without the ability to increase the resources, the real estate managers have to come up with substantiated arguments for their decisions.

While this research is mainly related to the REM domain, it also touches upon some aspects of the DCM domain. The DCM domain addresses control issues in the development and implementation phases of the construction process, with a specific focus on process innovation. It integrates the aspects of design management and cost-quality at the building level into the development and realisation phases (TU Delft, n.d.). It can be said that DCM does focus on innovation,

and how these innovations can be implemented. This study focuses on process improvements within the organisation of the outpatient department. The patient journey is an example from the research, where the research aligns with the DCM domain.

8.3 Personal view

During the first semester of the graduation project I have personally experienced a rollercoaster of various emotions. I liked the setup of choosing the topic and the mentors. I already had an idea of the direction of the research topic. Since I really enjoyed both the REM and DCM courses I wanted to explore those two chairs in more detail. Hospitals I have found fascinating buildings, and the healthcare sector inspires me. The topic of this research was inspired on these interest and the Covid19-pandemic. The 'speeddates' with the possible mentors made me very enthusiastic about starting the graduation period and it helped me in defining the research topic a bit better, the aspect of smart tools got added. Towards the P1 I had to find the right way of working for myself and succeeded in this with the help of both of my mentors. Which resulted in enthusiastically presenting my findings during the first presentation.

Due to personal circumstances, I lost halfway towards the P2 my motivation to actively work on the research project. Which resulted in difficulties in starting again on working on my project and caused me stress and embarrassment about my progress. Besides, going through the different rounds for acceptance for my internship took a lot of time and brought uncertainty. Being dependable on others is something I don't really like. Looking back at this period, I am satisfied with the research I have performed and the framework and literature review that has formed the basis for the next phase.

After the P2 presentation the summer holiday started. In September I was dedicated to actively start working again on the research project. However, the progress I made the first month was very disappointing. As of the summer break in-between I was completely out of the loop and had to start finding my way all over again. Then the interviews were organised and I pushed myself forward. From the interviews I retrieved a lot of energy, it was very interesting to talk to the professionals and visit the hospitals. Also by conducting the interviews I recognised the amount of knowledge I had already achieved, as I could keep up with them during the conversations.

The process from P3 towards P4 was very intensive and a lot of progress had been made within this time frame. By cleaning up the report and improving the readability the information retrieved from both the literature review and the empirical analysis became clear as well as my head. In the end, the research being really relevant during this Covid era, made me enjoy finishing the final bit of the thesis.

9. References

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10. Appendices

Appendix A: Information sheet interview
Appendix B: Informed Consent Form for Semi-Structured Interviews
Appendix C: Interview guide

Appendix A.1 – Information sheet interview

Research	MSc thesis on smart tools contributing to an efficient space utilisation in the outpatient department
Institution	Delft University of Technology
Interviewer	Lisa Cornelissen
Contact information	L.G.Cornelissen@student.tudelft.nl
Date	23/09/2021 [DD/MM/YYYY]

Dear interviewee, all aspects of taking part in this research are outlined in this information sheet. Next to this information sheet an informed consent from has been sent, you are kindly requested to fill in the informed consent form after reading this information sheet. If there are any concerns, please let me know.

Taking part in the research

This research is part of a graduation thesis from the MSc track Management in the Built Environment at the TU Delft. By participating in this research through the interview, you make a contribution to the data on efficient space utilisation in the outpatient department of a Dutch hospital and how smart tools can contribute to this efficiency. The main methods for data collection used are a literature review and the analyses of real life case studies. You work in a hospital that is one of my cases and therefore I would like to interview you to get to know more about this case. The questions that will be put forward during the interview will be related to the following subjects:

1. Your professional background and your role within the hospital and the hospital organisation.
2. Your view on the current way the space is used in the hospital.
3. Your experiences with smart tools.
4. Your experiences with integral capacity management, which in this research is seen as a smart tool.

For analysing the interview, the interview will be recorded. Please note that you are not obliged to answer all questions, besides no answers are right or wrong. If you wish to do so, you are able to withdraw from this research at any moment during the interview or once the interview has been conducted. Would this be the case, please inform me as soon as possible.

Usage of data during this research

Once the interview has been conducted, a transcription will be made of the audio recording. Information regarding your position within the organisation will have to remain explicit as this is of importance regarding the case study research. Your personal information that could identify you, such as your name, will be anonymised; you will not be traceable.

Future use and reuse of data by others

All MSc theses of the track Management in the Built Environment will be published and archived at the TU Delft education repository, so it can be used for future research. Data taken from the interview and included in the research will be part of this publication. As a participant of this research you have the right to demand erasure or rectification of personal data. If there are any questions or concerns regarding this topic please contact me through my email.

Thank you very much in advance for cooperating and contributing to this research!

L.G. (Lisa) Cornelissen

Appendix A.2 – Informatieblad interview

Onderzoek	MSc scriptie over slimme hulpmiddelen die bijdragen tot een efficiënt gebruik van de ruimte op de polikliniek van een Nederlands ziekenhuis.
Instelling	Technische Universiteit Delft
Interviewer	Lisa Cornelissen
Contact informatie	L.G.Cornelissen@student.tudelft.nl
Datum	23/09/2021 [DD/MM/JJJJ]

Geachte geïnterviewde, alle aspecten van deelname aan dit onderzoek worden in dit informatieblad uiteengezet. Naast dit informatieblad is een toestemmingsverklaringsformulier toegestuurd, u wordt vriendelijk verzocht dit formulier in te vullen na het lezen van dit informatieblad. Mochten er bezwaren of vragen zijn, dan hoor ik dat graag.

Deelname aan het onderzoek

Dit onderzoek is onderdeel van een afstudeerscriptie van de MSc track Management in the Built Environment aan de TU Delft. Door deel te nemen aan dit onderzoek door middel van het interview levert u een bijdrage aan de gegevens over efficiënt ruimtegebruik op de polikliniek van een Nederlands ziekenhuis en hoe slimme hulpmiddelen kunnen bijdragen aan deze efficiëntie. De belangrijkste methoden voor gegevensverzameling die worden gebruikt, zijn een literatuurstudie en de analyses van praktijkcases. U werkt in een ziekenhuis dat een van mijn casussen is en daarom zou ik u graag interviewen om meer over deze casus te weten te komen. De vragen die tijdens het interview gesteld zullen worden, zullen betrekking hebben op de volgende onderwerpen:

1. Uw professionele achtergrond en uw rol binnen het ziekenhuis en de ziekenhuisorganisatie.
2. Uw visie op de huidige manier waarop de ruimte in het ziekenhuis wordt gebruikt.
3. Uw ervaringen met slimme hulpmiddelen, zoals EPD, e-consult, Hix, intekensystemen, sensoren, real-time data.
4. Uw ervaringen met integraal capaciteitsmanagement, dat in dit onderzoek wordt gezien als een werkgebied waar slimme hulpmiddelen/tools ingezet (kunnen) worden (HotFlo).

Voor de analyse van het interview zal het interview worden opgenomen. U bent niet verplicht alle vragen te beantwoorden, bovendien zijn de antwoorden niet goed of fout. Indien gewenst, kunt u zich op elk moment tijdens het interview of na afloop van het interview terugtrekken uit dit onderzoek. Mocht dit het geval zijn, gelieve mij dan zo snel mogelijk te informeren.

Gebruik van data tijdens dit onderzoek

Na afloop van het interview wordt van de geluidsopname een transcriptie gemaakt. Informatie over uw positie binnen de organisatie zal expliciet moeten blijven omdat dit van belang is voor het case study onderzoek. Uw persoonlijke informatie die u zou kunnen identificeren, zoals uw naam, zal worden geanonimiseerd; u zult niet traceerbaar zijn.

Toekomstig gebruik en hergebruik van de data door andere

Alle master scripties van de track Management in the Built Environment zullen worden gepubliceerd en gearchiveerd in de educational repository van de TU Delft, zodat deze gebruikt kunnen worden voor toekomstig onderzoek. Gegevens die uit het interview zijn gehaald en in het onderzoek zijn opgenomen, zullen deel uitmaken van deze publicatie. Als deelnemer aan dit onderzoek heeft u het recht om te vragen om verwijdering of rectificatie van persoonlijke gegevens. Als er vragen of zorgen zijn over dit onderwerp kunt u contact met mij opnemen via mijn e-mail.

Bij voorbaat hartelijk dank voor uw medewerking en bijdrage aan dit onderzoek!

L.G. (Lisa) Cornelissen

Appendix B.1 – Informed consent for semi-structured interviews

This form will be sent out to all interviewees, they will have to tick all the appropriate boxes 'yes' before I am allowed to interview them.

Research	MSc thesis on smart tools contributing to an efficient space utilisation in the outpatient department
Institution	Delft University of Technology
Interviewer	Lisa Cornelissen
Contact information	L.G.Cornelissen@student.tudelft.nl
Interviewee	……
Date of interview	[mm/dd/yyyy]

Please tick the appropriate boxes	Yes	No
Taking part in the research		
1. I have read and understood the information sheet or it has been read to me [at the start of the interview]. I have been able to ask questions about the research and my questions have been answered to my satisfaction	☐	☐
2. I consent voluntarily to be a participant in this research and understand that I can refuse to answer questions and I can withdraw from the research at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves an interview which will be audio-recorded or video-recorded, transcribed and later analysed. All recordings will be deleted one year after the submission of the final thesis report.	☐	☐
4. I understand that the researcher will request for company documents to be used as secondary and supportive resources following the interviews.	☐	☐
Usage of information in the research		
5. I understand that information I provide will be used for academic purposes such as the graduation thesis, for the MSc Management in the Built Environment, research paper and thesis presentation. However, I give my consent to the researcher to use the data collected for future research publication and lectures, unless otherwise stated that specific information is confidential.	☐	☐
6. I understand that if I choose to, my company and personal identity will remain anonymous throughout the research paper and other output.	☐	☐
7. I understand that personal information collected about me that can identify me, [e.g. my name or where I live], will not be shared beyond the study team if explicitly stated by me.	☐	☐
8. I agree that my information can be quoted in the research outputs.	☐	☐
Future use and reuse of data by others		
9. I give permission for this thesis - containing the information that I provide - to be published and archived in the TU Delft education repository so it can be used for future research and learning.	☐	☐

Signatures

Name of participant	Signature	Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Lisa Cornelissen		
Name of researcher	Signature	Date

For any questions, research details or further information, please send an e-mail to L.G.Cornelissen@student.tudelft.nl

Appendix B.2 – Toestemmingsverklaringsformulier voor semi gestructureerde interviews

Dit formulier zal aan alle ondervraagden worden toegezonden, zij moeten alle passende vakjes "ja" aankruisen voordat ik hen mag ondervragen.

Onderzoek	MSc scriptie over slimme technologieën die bijdragen tot een efficiënt gebruik van de ruimte op de polikliniek van een Nederlands ziekenhuis.
Instelling	Technische Universiteit Delft
Interviewer	Lisa Cornelissen
Contact informatie	L.G.Cornelissen@student.tudelft.nl
Datum	23/09/2021 [DD/MM/JJJJ]
Geïnterviewde	……
Datum van interview	[mm/dd/JJJJ]

Gelieve de vakjes aan te kruisen	**Ja**	**Nee**
Deelname aan het onderzoek		
1. Ik heb het informatieblad gelezen en begrepen of het is mij voorgelezen [aan het begin van het interview]. Ik heb vragen kunnen stellen over het onderzoek en mijn vragen zijn naar mijn tevredenheid beantwoord.	☐	☐
2. Ik geef vrijwillig mijn toestemming om deel te nemen aan dit onderzoek en begrijp dat ik kan weigeren vragen te beantwoorden en dat ik me op elk moment uit het onderzoek kan terugtrekken, zonder dat ik daarvoor een reden moet opgeven.	☐	☐
3. Ik begrijp dat deelname aan het onderzoek een interview inhoudt dat audio- of video-opgenomen, getranscribeerd en later geanalyseerd zal worden. Alle opnames zullen één jaar na de indiening van het eindverslag van de scriptie worden gewist.	☐	☐
4. Ik begrijp dat de onderzoeker zal vragen om bedrijfsdocumenten te gebruiken als secundaire en ondersteunende bronnen na de interviews.	☐	☐
Gebruik van data tijdens dit onderzoek		
5. Ik begrijp dat de door mij verstrekte informatie gebruikt zal worden voor academische doeleinden, zoals de afstudeerscriptie, voor de MSc Management in the Built Environment, onderzoekspaper en scriptiepresentatie. Ik geef echter toestemming aan de onderzoeker om de verzamelde gegevens te gebruiken voor toekomstige onderzoek publicaties en lezingen, tenzij anders vermeld dat specifieke informatie vertrouwelijk is.	☐	☐
6. Ik begrijp dat, als ik ervoor kies, mijn bedrijf en persoonlijke identiteit anoniem zullen blijven gedurende het onderzoekspaper en andere output.	☐	☐
7. Ik begrijp dat persoonlijke informatie die over mij is verzameld en die mij kan identificeren, [bv. mijn naam of waar ik woon], niet buiten het onderzoeksteam zal worden gedeeld als ik dat expliciet heb aangegeven.	☐	☐
8. Ik stem ermee in dat mijn informatie mag worden geciteerd in de onderzoeksresultaten.	☐	☐
Toekomstig gebruik en hergebruik van de data door andere		
9. Ik geef toestemming om deze scriptie - met de door mij verstrekte informatie - te publiceren en te archiveren in de educational repository van de TU Delft, zodat deze gebruikt kan worden voor toekomstig onderzoek en onderwijs.	☐	☐

Handtekening

Naam deelnemer	Handtekening	Datum

Ik heb het informatieblad nauwkeurig voorgelezen aan de potentiële deelnemer en naar mijn beste kunnen, van vergewist dat de deelnemer begrijpt waarmee hij/zij vrijwillig instemt.

Lisa Cornelissen		
Naam onderzoeker	Handtekening	Datum

Voor vragen, details van het onderzoek of nadere informatie kunt u een e-mail sturen naar L.G.Cornelissen@student.tudelft.nl

Appendix C.1 – Interview guide

Interview guide facility manager (manager huisvesting) [naam ziekenhuis]

Door:	Lisa Cornelissen	
Interview:	Datum: 24 september 2021	Tijd: 11:00
Geïnterviewde:	Naam: [naam geïnterviewde]	Functie: [functie geïnterviewde]

De interview guide is een overzicht van het interview dat gaat plaatsvinden. De interview guide bestaat uit verschillende onderdelen. Als eerste wordt gestart met *1. Vooraf aan het interview*, hierin zal de interviewer zichzelf en het onderwerp voorstellen en wordt toestemming gevraagd voor de opname van het interview. Vervolgens zal begonnen worden aan het werkelijke interview, deze is opgedeeld in de categorieën 2 t/m 6, waar de laatste categorie bestaat uit de afronding van het interview. Om de ontmoeting af te ronden, *7. Na het interview*, zal nogmaals duidelijk gemaakt worden wat er met het interview gaat gebeuren en zal de geïnterviewde bedankt worden voor zijn/haar contributie aan het onderzoek.

1. Vooraf aan het interview

1.1 Introductie van mijzelf.

Goedendag, bedankt dat u deel wilt nemen aan dit onderzoek. Ik zal eerst mijzelf voorstellen en het onderwerp toelichten. Ik ben student aan de Technische Universiteit van Delft en volg de master track Management in the Built Environment. Binnen deze master ligt de focus op vastgoed en dan voornamelijk het ontwikkelen en beheren van de gebouwde omgeving en gebouwen. Op het moment ben ik met mijn afstudeerscriptie bezig, en doe daarom ook dit onderzoek om de laatste fase van mijn master te kunnen afronden.

1.2 Introductie van het onderwerp.

Dan zal ik nu een korte introductie geven van het onderwerp. Het onderzoek focust zich op het ruimte gebruik van de poliklinieken in Nederlandse ziekenhuizen. De laatste jaren, al voor corona maar corona heeft zeker het proces versneld, is er een verandering binnen de zorg aan het ontwikkelen. De vraag naar zorg wordt steeds groter en de middelen om die zorg te leveren worden steeds schaarser. Om deze reden moeten de beschikbare middelen zo efficiënt mogelijk in gezet kunnen worden. De reden dat specifiek voor de polikliniek is gekozen, is omdat er op de polikliniek veel onzekerheid is wat betreft de hoeveelheid zorg die nodig gaat zijn per dag en dus de capaciteit. Bij het doen van dit onderzoek wordt gekeken of smart tools kunnen bijdragen aan het efficiënter inzetten van de beschikbare middelen. Integraal Capaciteit Management (ICM) is een opkomend werkgebied. Binnen dit onderzoek zal gekeken worden of ICM een werkgebied is waar dergelijke slimme hulpmiddelen/tools kunnen worden ingezet. Het doel van dit interview is om de behoefte te inventariseren van de belanghebbende van de polikliniek. De ervaringen, behoeftes, en bepaalde zaken die zich afspelen binnen de polikliniek zijn belangrijk voor dit onderzoek, zodat daar op gestuurd kan worden.

1.3 Video opname.

Dat was de introductie, dan wil ik u nu vragen of u het goed vindt als dit interview opgenomen wordt? Ik zal dit nog een keer vragen als de opname aan staat.

2. Introductie geïnterviewde

2.1 Zou u een korte introductie kunnen geven van uzelf, wat betreft studieachtergrond, werkervaring.

2.2 Wat is uw huidige functie binnen [naam ziekenhuis]?

2.3 Sinds wanneer beoefent u uw huidige functie?

2.4 Wat zijn de werkzaamheden en verantwoordelijkheden die bij uw huidige functie horen?

3. De polikliniek

Deze sectie gaat over de fysieke ruimte van de polikliniek, het gebouwgebruik en de werklocatie.

3.1 Hoe zou u vanuit uw oogpunt de fysieke omgeving van de polikliniek omschrijven in [naam ziekenhuis]? (denk aan aanwezige ruimtes/indeling van de ruimtes; geschakeld, gecombineerd of gekoppelde spreekkamermodellen)

Figuur C 1 Spreekkamermodellen (Gmelig Meijling, 2011 en https://www.welldesign.com/portfolios/umc-polikliniek-van-de-toekomst/)

- 3.1.1 Heeft ieder specialisme of vakgroep zijn eigen deel van het ziekenhuisgebouw toebedeeld gekregen of zijn ze ingedeeld op een gemeenschappelijke polikliniek?
- 3.1.2 Wat zijn positieve punten aan het huidig ruimtegebruik van uw polikliniek en waarom?
- 3.1.3 Wat zijn nadelen aan het huidige ruimtegebruik van uw polikliniek en waarom?
  - 3.1.3.1 Hoe is bijvoorbeeld de bezetting van de spreekkamers? Staan ze vaak leeg, verschilt dit per dag, is er onderbouwing vanuit real-time metingen? Zijn de spreekonderzoekkamers persoonsgebonden of zijn ze flexibel? Zijn de ruimtes volledig multifunctioneel of dedicated/specifieke ruimten?

3.2 Wat zou vanuit uw oogpunt de meest optimale indeling zijn voor de polikliniek? (Bijvoorbeeld een vaste indeling of een meer flexibele indeling? Denk aan de volgende ruimtes, hoe staan ze in verhouding tot elkaar):

- 3.2.1 Aanmeldplein
- 3.2.2 Wachtruimte
- 3.2.3 Balie, hoe wordt deze gebruikt? Heeft elke poli een eigen balie? Of is die gedeeld? En heeft die nog toegevoegde waarde?
- 3.2.4 Front office & Back office (bespreek wat de person hier onder verstaat).
- 3.2.5 Spreekkamer / behandelkamer

3.3 Hoe zijn de huidige werkplekken ontworpen?

- 3.3.1 Welk soort kantoorontwerp is toegepast? Vast/flexibel
- 3.3.2 Hoe worden de werkplekken toegewezen?

3.4 Zijn er andere type werkplekken gewenst?

- 3.4.1 Zo ja, wat voor soort werkplekken?
- 3.4.2 Zo nee, waarom werken de huidige goed?

3.5 Wat zou vanuit uw oogpunt de meest optimale werkplek zijn?

4. De organisatie

Het volgende onderdeel gaat over de organisatie binnen uw polikliniek.

4.1 Hoe is de structuur van de organisatie binnen de polikliniek opgebouwd? Organogram/hiërarchie/samenstelling

- 4.1.1 Wat werkt goed aan de huidige organisatie van de polikliniek en waardoor komt dat?
- 4.1.2 Wat zou beter kunnen binnen de organisatie van de polikliniek en hoe kan dit worden georganiseerd?

4.2 Welke activiteiten vinden plaats op de polikliniek?

- 4.2.1 Hoe worden deze activiteiten ingedeeld?
- 4.2.2 Krijgen bepaalde activiteiten voorrang op andere activiteiten?
- 4.2.3 Ziet u de type activiteiten in de toekomst veranderen? Zo ja, hoe? En gaat dit dan van invloed zijn op de indeling van de polikliniek?

4.3 Wordt er samengewerkt tussen afdelingen binnen de polikliniek?

- 4.3.1 Zo ja, hoe vind deze samenwerking plaats?
- 4.3.2 Hoe zou deze samenwerking geoptimaliseerd kunnen worden?

4.4 Wat is de missie binnen jullie organisatie?
4.5 Wat is de visie binnen jullie organisatie?
    4.5.1 Wat voor cultuur heerst er binnen jullie organisatie?
    4.5.2 Er is sprake van grote werkdruk binnen de ziekenhuizen, hebben de werkdruk en de cultuur binnen de organisatie invloed op het efficiënt zijn van de werkprocessen?
    4.5.3 Zouden de werkprocessen binnen de polikliniek efficiënter kunnen?
    4.5.4 Hoe zou u dat voorstellen?

5. Smart tools / slimme technologieën

Het volgende onderdeel gaat over de digitale werkomgeving en de beschikbaarheid van informatie over de polikliniek.

5.1 Worden er bij u op de polikliniek al metingen uitgevoerd? (als ja ga door met de sub-vragen)
    5.1.1 Ja:
        5.1.1.1 Wat voor soort metingen zijn dit?
        5.1.1.2 Welke tools worden gebruikt voor deze metingen?
        5.1.1.3 Hoe vaak worden de metingen uitgevoerd? Interval?
        5.1.1.4 Wanneer worden deze metingen uitgevoerd?
        5.1.1.5 Hoe wordt de data gelezen? Kunnen er conclusies uit getrokken worden?
    5.1.2 Nee: wat is hier de reden voor?
5.2 Van wat voor soort digitale systemen wordt al gebruik gemaakt?
    5.2.1 HotFlo, Hix, EPD
5.3 Wat voor informatie zou u ter beschikking willen hebben om de werkzaamheden op de polikliniek zo efficiënt mogelijk te kunnen uitvoeren?
    5.3.1 Welke informatie daarvan heeft u al ter beschikking?
    5.3.2 Hoe komt u aan deze informatie?
    5.3.3 Hoe komt het dat de informatie die u nog niet ter beschikking heeft maar wel graag zou willen hebben, nog niet heeft?
    5.3.4 Hoe denkt u aan deze informatie te kunnen komen?
5.4 In hoe verre denkt u dat real-time data een oplossing kan zijn voor het opvangen van de onvoorspelbare onzekerheden die zich afspelen binnen de poliklinieken?
    5.4.1 Wat voor metingen kunnen er dan het best uitgevoerd worden? / Welke data is gewenst?

6. Beëindiging

6.1 Is er nog iets dat u zou willen toevoegen aan dit interview?

7. Na het interview

7.1 Heel erg bedankt voor uw deelname aan het interview.
7.2 Ik zal nu de opname stop zetten.
7.3 Ik zal het interview nu gaan transcriberen en mijn bevindingen zal ik opnemen in het onderzoek.

Appendix C.2 – Interview guide

Interview guide capaciteitsmanager [naam ziekenhuis]

Door:	Lisa Cornelissen	
Interview:	Datum: 24 september 2021	Tijd: 11:00
Geïnterviewde:	Naam: [naam geïnterviewde]	Functie: [functie geïnterviewde]

De interview guide is een overzicht van het interview dat gaat plaatsvinden. De interview guide bestaat uit verschillende onderdelen. Als eerste wordt gestart met *1. Vooraf aan het interview*, hierin zal de interviewer zichzelf en het onderwerp voorstellen en wordt toestemming gevraagd voor de opname van het interview. Vervolgens zal begonnen worden aan het werkelijke interview, deze is opgedeeld in de categorieën 2 t/m 6, waar de laatste categorie bestaat uit de afronding van het interview. Om de ontmoeting af te ronden, *7. Na het interview*, zal nogmaals duidelijk gemaakt worden wat er met het interview gaat gebeuren en zal de geïnterviewde bedankt worden voor zijn/haar contributie aan het onderzoek.

1. Vooraf aan het interview

1.1 Introductie van mijzelf.

Goedendag, bedankt dat u deel wilt nemen aan dit onderzoek. Ik zal eerst mijzelf voorstellen en het onderwerp toelichten. Ik ben student aan de Technische Universiteit van Delft en volg de master track Management in the Built Environment. Binnen deze master ligt de focus op vastgoed en dan voornamelijk het ontwikkelen en beheren van de gebouwde omgeving en gebouwen. Op het moment ben ik met mijn afstudeerscriptie bezig, en doe daarom ook dit onderzoek om de laatste fase van mijn master te kunnen afronden.

1.2 Introductie van het onderwerp.

Dan zal ik nu een korte introductie geven van het onderwerp. Het onderzoek focust zich op het ruimte gebruik van de poliklinieken in Nederlandse ziekenhuizen. De laatste jaren, al voor corona maar corona heeft zeker het proces versneld, is er een verandering binnen de zorg aan het ontwikkelen. De vraag naar zorg wordt steeds groter en de middelen om die zorg te leveren worden steeds schaarser. Om deze reden moeten de beschikbare middelen zo efficiënt mogelijk in gezet kunnen worden. De reden dat specifiek voor de polikliniek is gekozen, is omdat er op de polikliniek veel onzekerheid is wat betreft de hoeveelheid zorg die nodig gaat zijn per dag en dus de capaciteit. Bij het doen van dit onderzoek wordt gekeken of smart tools kunnen bijdragen aan het efficiënter inzetten van de beschikbare middelen. Integraal Capaciteit Management (ICM) is een opkomend werkgebied. Binnen dit onderzoek zal gekeken worden of ICM een werkgebied is waar dergelijke slimme hulpmiddelen/tools kunnen worden ingezet. Het doel van dit interview is om de behoefte te inventariseren van de belanghebbende van de polikliniek. De ervaringen, behoeftes, en bepaalde zaken die zich afspelen binnen de polikliniek zijn belangrijk voor dit onderzoek, zodat daar op gestuurd kan worden.

1.3 Video opname.

Dat was de introductie, dan wil ik u nu vragen of u het goed vindt als dit interview opgenomen wordt? Ik zal dit nog een keer vragen als de opname aan staat.

2. Introductie geïnterviewde

2.1 Zou u een korte introductie kunnen geven van uzelf, wat betreft studieachtergrond, werkervaring.

2.2 Wat is uw huidige functie binnen [naam ziekenhuis]?

2.3 Sinds wanneer beoefent u uw huidige functie?

2.4 Wat zijn de werkzaamheden en verantwoordelijkheden die bij uw huidige functie horen?

3. De polikliniek

Deze sectie gaat over de fysieke ruimte van de polikliniek, het gebouwgebruik en de werklocatie.

3.1 Hoe zou u vanuit uw oogpunt de fysieke omgeving van de polikliniek omschrijven in [naam ziekenhuis]? (denk aan aanwezige ruimtes/indeling van de ruimtes; geschakeld, gecombineerd of gekoppelde spreekkamermodellen)

Figuur C 2 Spreekkamermodellen (Gmelig Meijling, 2011 en https://www.welldesign.com/portfolios/umc-polikliniek-van-de-toekomst/)

3.1.1 Heeft ieder specialisme of vakgroep zijn eigen deel van het ziekenhuisgebouw toebedeeld gekregen of zijn ze ingedeeld op een gemeenschappelijke polikliniek?
3.1.2 Wat zijn positieve punten aan het huidig ruimtegebruik van uw polikliniek en waarom?
3.1.3 Wat zijn nadelen aan het huidige ruimtegebruik van uw polikliniek en waarom?
3.1.3.1 Hoe is bijvoorbeeld de bezetting van de spreekkamers? Staan ze vaak leeg, verschilt dit per dag, is er onderbouwing vanuit real-time metingen? Zijn de spreekonderzoekkamers persoonsgebonden of zijn ze flexibel? Zijn de ruimtes volledig multifunctioneel of dedicated/specifieke ruimten?

3.2 Wat zou vanuit uw oogpunt de meest optimale indeling zijn voor de polikliniek? (Bijvoorbeeld een vaste indeling of een meer flexibele indeling? Denk aan de volgende ruimtes, hoe staan ze in verhouding tot elkaar):
3.2.1 Aanmeldplein
3.2.2 Wachtruimte
3.2.3 Balie, hoe wordt deze gebruikt? Heeft elke poli een eigen balie? Of is die gedeeld? En heeft die nog toegevoegde waarde?
3.2.4 Front office & Back office (bespreek wat de person hier onder verstaat).
3.2.5 Spreekkamer / behandelkamer

3.3 Hoe zouden volgens u de ruimtes binnen de polikliniek zo efficiënt mogelijk in gezet kunnen worden?

4. De organisatie

Het volgende onderdeel gaat over de organisatie binnen uw polikliniek.

4.1 Hoe is de samenstelling van de medewerkers binnen de organisatie in de polikliniek opgebouwd?
4.1.1 Wat werkt goed aan de huidige organisatie van de polikliniek en waardoor komt dat?
4.1.2 Wat zou beter kunnen binnen de organisatie van de polikliniek en hoe kan dit worden georganiseerd?

4.2 Welke activiteiten vinden plaats op de polikliniek?
4.2.1 Hoe worden deze activiteiten ingedeeld?
4.2.2 Aan welke activiteiten wordt de meeste capaciteit besteed, capaciteit in vierkante meters en personeel.
4.2.3 Krijgen bepaalde activiteiten voorrang op andere activiteiten?
4.2.4 Ziet u de type activiteiten in de toekomst veranderen? Zo ja, hoe? En gaat dit dan van invloed zijn op de indeling van de polikliniek?

4.3 Wordt er samengewerkt tussen afdelingen binnen de polikliniek?
4.3.1 Zo ja, hoe vind deze samenwerking plaats?
4.3.2 Hoe zou deze samenwerking geoptimaliseerd kunnen worden?

4.4 Wat is de missie binnen jullie organisatie?
4.5 Wat is de visie binnen jullie organisatie?
4.5.1 Er is sprake van grote werkdruk binnen de ziekenhuizen, heeft de werkdruk invloed op het efficiënt zijn van de werkprocessen?

4.5.2 Zouden de werkprocessen binnen de polikliniek efficiënter kunnen?
4.5.3 Hoe zou u dat voorstellen?

5. Smart tools / slimme technologieën

Het volgende onderdeel gaat over de digitale werkomgeving en de beschikbaarheid van informatie over de polikliniek.

5.1 Worden er bij u op de polikliniek al metingen uitgevoerd? (als ja ga door met de sub-vragen)
- 5.1.1 Ja:
  - 5.1.1.1 Wat voor soort metingen zijn dit?
  - 5.1.1.2 Welke tools worden gebruikt voor deze metingen?
  - 5.1.1.3 Hoe vaak worden de metingen uitgevoerd? Interval?
  - 5.1.1.4 Wanneer worden deze metingen uitgevoerd?
  - 5.1.1.5 Hoe wordt de data gelezen? Kunnen er conclusies uit getrokken worden?
- 5.1.2 Nee: wat is hier de reden voor?

5.2 Van wat voor soort digitale systemen wordt al gebruik gemaakt?
- 5.2.1 HotFlo, Hix, EPD

5.3 Wat voor informatie zou u ter beschikking willen hebben om de werkzaamheden op de polikliniek zo efficiënt mogelijk te kunnen uitvoeren?
- 5.3.1 Welke informatie daarvan heeft u al ter beschikking?
- 5.3.2 Hoe komt u aan deze informatie?
- 5.3.3 Hoe komt het dat de informatie die u nog niet ter beschikking heeft maar wel graag zou willen hebben, nog niet heeft?
- 5.3.4 Hoe denkt u aan deze informatie te kunnen komen?

5.4 In hoe verre denkt u dat real-time data een oplossing kan zijn voor het opvangen van de onvoorspelbare onzekerheden die zich afspelen binnen de poliklinieken?

5.5 Wordt er binnen uw ziekenhuis gebruik gemaakt van integraal capaciteit management, en ook op de polikliniek?
- 5.5.1 Ja:
  - 5.5.1.1 Op wat voor manier is dit ingericht? Wordt er een capaciteitsplan opgesteld, hoe vaak wordt dit herzien?
  - 5.5.1.2 Wordt ICM voornamelijk gebruikt voor het inplannen van personeel, of ook voor verdeling van de ruimtes?
  - 5.5.1.3 Hoe wordt het personeel ingepland en waarop is deze planning gebaseerd?
  - 5.5.1.4 Hoe worden spreekuren over de week verdeeld en op basis van wat voor gegevens wordt deze planning gemaakt?
  - 5.5.1.5 Wat zijn de doelen die op operationeel niveau zijn opgesteld?
  - 5.5.1.6 Om de doelen te kunnen meten, worden er KPI's (Key Performance Indicators) opgesteld, zijn deze bij jullie ook opgesteld. Zo ja wat zijn de bijbehorende KPI's?
  - 5.5.1.7 Hoe worden deze KPI's gemeten op dit moment gemeten? Wat voor tools worden daarvoor gebruikt?
- 5.5.2 Nee: Waarom wordt dit niet toegepast?

6. Beëindiging

6.1 Is er nog iets dat u zou willen toevoegen aan dit interview?

7. Na het interview

7.1 Heel erg bedankt voor uw deelname aan het interview.

7.2 Ik zal nu de opname stop zetten.

7.3 Ik zal het interview nu gaan transcriberen en mijn bevindingen zal ik opnemen in het onderzoek.

Appendix C.3 – Interview guide

Interview guide afdelingsmanager (teamleider) [naam ziekenhuis]

Door:	Lisa Cornelissen	
Interview:	Datum: 24 september 2021	Tijd: 11:00
Geïnterviewde:	Naam: [naam geïnterviewde]	Functie: [functie geïnterviewde]

De interview guide is een overzicht van het interview dat gaat plaatsvinden. De interview guide bestaat uit verschillende onderdelen. Als eerste wordt gestart met *1. Vooraf aan het interview*, hierin zal de interviewer zichzelf en het onderwerp voorstellen en wordt toestemming gevraagd voor de opname van het interview. Vervolgens zal begonnen worden aan het werkelijke interview, deze is opgedeeld in de categorieën 2 t/m 6, waar de laatste categorie bestaat uit de afronding van het interview. Om de ontmoeting af te ronden, *7. Na het interview*, zal nogmaals duidelijk gemaakt worden wat er met het interview gaat gebeuren en zal de geïnterviewde bedankt worden voor zijn/haar contributie aan het onderzoek.

1. Vooraf aan het interview

1.1 Introductie van mijzelf.

Goedendag, bedankt dat u deel wilt nemen aan dit onderzoek. Ik zal eerst mijzelf voorstellen en het onderwerp toelichten. Ik ben student aan de Technische Universiteit van Delft en volg de master track Management in the Built Environment. Binnen deze master ligt de focus op vastgoed en dan voornamelijk het ontwikkelen en beheren van de gebouwde omgeving en gebouwen. Op het moment ben ik met mijn afstudeerscriptie bezig, en doe daarom ook dit onderzoek om de laatste fase van mijn master te kunnen afronden.

1.2 Introductie van het onderwerp.

Dan zal ik nu een korte introductie geven van het onderwerp. Het onderzoek focust zich op het ruimte gebruik van de poliklinieken in Nederlandse ziekenhuizen. De laatste jaren, al voor corona maar corona heeft zeker het proces versneld, is er een verandering binnen de zorg aan het ontwikkelen. De vraag naar zorg wordt steeds groter en de middelen om die zorg te leveren worden steeds schaarser. Om deze reden moeten de beschikbare middelen zo efficiënt mogelijk in gezet kunnen worden. De reden dat specifiek voor de polikliniek is gekozen, is omdat er op de polikliniek veel onzekerheid is wat betreft de hoeveelheid zorg die nodig gaat zijn per dag en dus de capaciteit. Bij het doen van dit onderzoek wordt gekeken of smart tools kunnen bijdragen aan het efficiënter inzetten van de beschikbare middelen. Integraal Capaciteit Management (ICM) is een opkomend werkgebied. Binnen dit onderzoek zal gekeken worden of ICM een werkgebied is waar dergelijke slimme hulpmiddelen/tools kunnen worden ingezet. Het doel van dit interview is om de behoefte te inventariseren van de belanghebbende van de polikliniek. De ervaringen, behoeftes, en bepaalde zaken die zich afspelen binnen de polikliniek zijn belangrijk voor dit onderzoek, zodat daar op gestuurd kan worden.

1.3 Video opname.

Dat was de introductie, dan wil ik u nu vragen of u het goed vindt als dit interview opgenomen wordt? Ik zal dit nog een keer vragen als de opname aan staat.

2. Introductie geïnterviewde

2.1 Zou u een korte introductie kunnen geven van uzelf, wat betreft studieachtergrond, werkervaring.

2.2 Wat is uw huidige functie binnen [naam ziekenhuis]?

2.3 Sinds wanneer beoefent u uw huidige functie?

Wat zijn de werkzaamheden en verantwoordelijkheden die bij uw huidige functie horen?

3. De polikliniek

Deze sectie gaat over de fysieke ruimte van de polikliniek, het gebouwgebruik en de werklocatie.

3.1 Hoe zou u vanuit uw oogpunt de fysieke omgeving van de polikliniek omschrijven in [naam ziekenhuis]? (denk aan aanwezige ruimtes/indeling van de ruimtes; geschakeld, gecombineerd of gekoppelde spreekkamermodellen)

Figuur C 3 Spreekkamermodellen (Gmelig Meijling, 2011 en https://www.welldesign.com/portfolios/umc-polikliniek-van-de-toekomst/)

3.1.1 Heeft ieder specialisme of vakgroep zijn eigen deel van het ziekenhuisgebouw toebedeeld gekregen of zijn ze ingedeeld op een gemeenschappelijke polikliniek?

3.1.2 Wat zijn positieve punten aan het huidig ruimtegebruik van uw polikliniek en waarom?

3.1.3 Wat zijn nadelen aan het huidige ruimtegebruik van uw polikliniek en waarom?

3.1.3.1 Hoe is bijvoorbeeld de bezetting van de spreekkamers? Staan ze vaak leeg, verschilt dit per dag, is er onderbouwing vanuit real-time metingen? Zijn de spreekonderzoekkamers persoonsgebonden of zijn ze flexibel? Zijn de ruimtes volledig multifunctioneel of dedicated/specifieke ruimten?

3.2 Wat zou vanuit uw oogpunt de meest optimale indeling zijn voor de polikliniek? (Bijvoorbeeld een vaste indeling of een meer flexibele indeling? Denk aan de volgende ruimtes, hoe staan ze in verhouding tot elkaar):

3.2.1 Aanmeldplein

3.2.2 Wachtruimte

3.2.3 Balie, hoe wordt deze gebruikt? Heeft elke poli een eigen balie? Of is die gedeeld? En heeft die nog toegevoegde waarde?

3.3

3.3.1 Front office & Back office (bespreek wat de person hier onder verstaat).

3.3.2 Spreekkamer / behandelkamer

3.4 Hoe zijn de huidige werkplekken ontworpen?

3.4.1 Welk soort kantoorontwerp is toegepast? Vast/flexibel

3.4.2 Hoe worden de werkplekken toegewezen?

3.5 Zijn er andere type werkplekken gewenst?

3.5.1 Zo ja, wat voor soort werkplekken?

3.5.2 Zo nee, waarom werken de huidige goed?

3.6 Wat zou vanuit uw oogpunt de meest optimale werkplek zijn?

4. De organisatie

Het volgende onderdeel gaat over de organisatie binnen uw polikliniek.

4.1 Hoe is de samenstelling van de medewerkers binnen de organisatie in de polikliniek opgebouwd?

4.1.1 Wat werkt goed aan de huidige organisatie van de polikliniek en waardoor komt dat?

4.1.2 Wat zou beter kunnen binnen de organisatie van de polikliniek en hoe kan dit worden georganiseerd?

4.2 Welke activiteiten vinden plaats op de polikliniek?

4.2.1 Hoe worden deze activiteiten ingedeeld?

4.2.2 Krijgen bepaalde activiteiten voorrang op andere activiteiten?

4.2.3 Ziet u de type activiteiten in de toekomst veranderen? Zo ja, hoe? En gaat dit dan van invloed zijn op de indeling van de polikliniek?

4.3 Wordt er samengewerkt tussen afdelingen binnen de polikliniek?

4.3.1 Zo ja, hoe vind deze samenwerking plaats?

4.3.2 Hoe zou deze samenwerking geoptimaliseerd kunnen worden?

4.4 Wat is de missie binnen jullie organisatie?

4.5 Wat is de visie binnen jullie organisatie?

4.5.1 Wat voor cultuur heerst er binnen jullie organisatie?

4.5.2 Er is sprake van grote werkdruk binnen de ziekenhuizen, hebben de werkdruk en de cultuur binnen de organisatie invloed op het efficiënt zijn van de werkprocessen?

4.5.3 Zouden de werkprocessen binnen de polikliniek efficiënter kunnen?

4.5.4 Hoe zou u dat voorstellen?

5. Smart tools / slimme technologieën

Het volgende onderdeel gaat over de digitale werkomgeving en de beschikbaarheid van informatie over de polikliniek.

5.1 Worden er bij u op de polikliniek al metingen uitgevoerd? (als ja ga door met de sub-vragen)

5.1.1 Ja:

5.1.1.1 Wat voor soort metingen zijn dit?

5.1.1.2 Welke tools worden gebruikt voor deze metingen?

5.1.1.3 Hoe vaak worden de metingen uitgevoerd? Interval?

5.1.1.4 Wanneer worden deze metingen uitgevoerd?

5.1.1.5 Hoe wordt de data gelezen? Kunnen er conclusies uit getrokken worden?

5.1.2 Nee: wat is hier de reden voor?

5.2 Van wat voor soort digitale systemen wordt al gebruik gemaakt?

5.2.1 HotFlo, Hix, EPD

5.2.2 Hoe is het om met deze systemen te werken?

5.3 Wat voor informatie zou u ter beschikking willen hebben om de werkzaamheden op de polikliniek zo efficiënt mogelijk te kunnen uitvoeren?

5.3.1 Welke informatie daarvan heeft u al ter beschikking?

5.3.2 Hoe komt u aan deze informatie?

5.3.3 Hoe komt het dat de informatie die u nog niet ter beschikking heeft maar wel graag zou willen hebben, nog niet heeft?

5.3.4 Hoe denkt u aan deze informatie te kunnen komen?

5.4 In hoe verre denkt u dat real-time data een oplossing kan zijn voor het opvangen van de onvoorspelbare onzekerheden die zich afspelen binnen de poliklinieken?

5.4.1 Wat voor metingen kunnen er dan het best uitgevoerd worden? / Welke data is gewenst?

6. Beëindiging

6.1 Is er nog iets dat u zou willen toevoegen aan dit interview?

7. Na het interview

7.1 Heel erg bedankt voor uw deelname aan het interview.

7.2 Ik zal nu de opname stop zetten.

7.3 Ik zal het interview nu gaan transcriberen en mijn bevindingen zal ik opnemen in het onderzoek.

Appendix C.4 – Interview guide

Interview guide medisch specialist [naam ziekenhuis]

Door:	Lisa Cornelissen	
Interview:	Datum: 24 september 2021	Tijd: 11:00
Geïnterviewde:	Naam: [naam geïnterviewde]	Functie: [functie geïnterviewde]

De interview guide is een overzicht van het interview dat gaat plaatsvinden. De interview guide bestaat uit verschillende onderdelen. Als eerste wordt gestart met *1. Vooraf aan het interview*, hierin zal de interviewer zichzelf en het onderwerp voorstellen en wordt toestemming gevraagd voor de opname van het interview. Vervolgens zal begonnen worden aan het werkelijke interview, deze is opgedeeld in de categorieën 2 t/m 6, waar de laatste categorie bestaat uit de afronding van het interview. Om de ontmoeting af te ronden, *7. Na het interview*, zal nogmaals duidelijk gemaakt worden wat er met het interview gaat gebeuren en zal de geïnterviewde bedankt worden voor zijn/haar contributie aan het onderzoek.

1. Vooraf aan het interview

1.1 Introductie van mijzelf.

Goedendag, bedankt dat u deel wilt nemen aan dit onderzoek. Ik zal eerst mijzelf voorstellen en het onderwerp toelichten. Ik ben student aan de Technische Universiteit van Delft en volg de master track Management in the Built Environment. Binnen deze master ligt de focus op vastgoed en dan voornamelijk het ontwikkelen en beheren van de gebouwde omgeving en gebouwen. Op het moment ben ik met mijn afstudeerscriptie bezig, en doe daarom ook dit onderzoek om de laatste fase van mijn master te kunnen afronden.

1.2 Introductie van het onderwerp.

Dan zal ik nu een korte introductie geven van het onderwerp. Het onderzoek focust zich op het ruimte gebruik van de poliklinieken in Nederlandse ziekenhuizen. De laatste jaren, al voor corona maar corona heeft zeker het proces versneld, is er een verandering binnen de zorg aan het ontwikkelen. De vraag naar zorg wordt steeds groter en de middelen om die zorg te leveren worden steeds schaarser. Om deze reden moeten de beschikbare middelen zo efficiënt mogelijk in gezet kunnen worden. De reden dat specifiek voor de polikliniek is gekozen, is omdat er op de polikliniek veel onzekerheid is wat betreft de hoeveelheid zorg die nodig gaat zijn per dag en dus de capaciteit. Bij het doen van dit onderzoek wordt gekeken of smart tools kunnen bijdragen aan het efficiënter inzetten van de beschikbare middelen. Integraal Capaciteit Management (ICM) is een opkomend werkgebied. Binnen dit onderzoek zal gekeken worden of ICM een werkgebied is waar dergelijke slimme hulpmiddelen/tools kunnen worden ingezet. Het doel van dit interview is om de behoefte te inventariseren van de belanghebbende van de polikliniek. De ervaringen, behoeftes, en bepaalde zaken die zich afspelen binnen de polikliniek zijn belangrijk voor dit onderzoek, zodat daar op gestuurd kan worden.

1.3 Video opname.

Dat was de introductie, dan wil ik u nu vragen of u het goed vindt als dit interview opgenomen wordt? Ik zal dit nog een keer vragen als de opname aan staat.

2. Introductie geïnterviewde

2.1 Zou u een korte introductie kunnen geven van uzelf, wat betreft studieachtergrond, werkervaring.

2.2 Wat is uw huidige functie binnen [naam ziekenhuis]?

2.3 Sinds wanneer beoefent u uw huidige functie?

Wat zijn de werkzaamheden en verantwoordelijkheden die bij uw huidige functie horen?

3. De polikliniek

Deze sectie gaat over de fysieke ruimte van de polikliniek, het gebouwgebruik en de werklocatie.

3.1 Hoe zou u vanuit uw oogpunt de fysieke omgeving van de polikliniek omschrijven in [naam ziekenhuis]? (denk aan aanwezige ruimtes/indeling van de ruimtes; geschakeld, gecombineerd of gekoppelde spreekkamermodellen)

Figuur C 4 Spreekkamermodellen (Gmelig Meijling, 2011 en https://www.welldesign.com/portfolios/umc-polikliniek-van-de-toekomst/)

3.1.1 Heeft ieder specialisme of vakgroep zijn eigen deel van het ziekenhuisgebouw toebedeeld gekregen of zijn ze ingedeeld op een gemeenschappelijke polikliniek?
3.1.2 Wat zijn positieve punten aan het huidig ruimtegebruik van uw polikliniek en waarom?
3.1.3 Wat zijn nadelen aan het huidige ruimtegebruik van uw polikliniek en waarom?
3.1.3.1 Hoe is bijvoorbeeld de bezetting van de spreekkamers? Staan ze vaak leeg, verschilt dit per dag, is er onderbouwing vanuit real-time metingen? Zijn de spreekonderzoekkamers persoonsgebonden of zijn ze flexibel? Zijn de ruimtes volledig multifunctioneel of dedicated/specifieke ruimten?

3.2 Wat zou vanuit uw oogpunt de meest optimale indeling zijn voor de polikliniek? (Bijvoorbeeld een vaste indeling of een meer flexibele indeling? Denk aan de volgende ruimtes, hoe staan ze in verhouding tot elkaar):
3.2.1 Aanmeldplein
3.2.2 Wachtruimte
3.2.3 Balie, hoe wordt deze gebruikt? Heeft elke poli een eigen balie? Of is die gedeeld? En heeft die nog toegevoegde waarde?

3.3
3.3.1 Front office & Back office (bespreek wat de person hier onder verstaat).
3.3.2 Spreekkamer / behandelkamer

3.4 Hoe zijn de huidige werkplekken ontworpen?
3.4.1 Welk soort kantoorontwerp is toegepast? Vast/flexibel
3.4.2 Hoe worden de werkplekken toegewezen?

3.5 Zijn er andere type werkplekken gewenst?
3.5.1 Zo ja, wat voor soort werkplekken?
3.5.2 Zo nee, waarom werken de huidige goed?

3.6 Wat zou vanuit uw oogpunt de meest optimale werkplek zijn?

4. De organisatie

Het volgende onderdeel gaat over de organisatie binnen uw polikliniek.

4.1 Hoe is de samenstelling van de medewerkers binnen de organisatie in de polikliniek opgebouwd?
4.1.1 Wat werkt goed aan de huidige organisatie van de polikliniek en waardoor komt dat?
4.1.2 Wat zou beter kunnen binnen de organisatie van de polikliniek en hoe kan dit worden georganiseerd?

4.2 Welke activiteiten vinden plaats op de polikliniek?
4.2.1 Hoe worden deze activiteiten ingedeeld?
4.2.2 Krijgen bepaalde activiteiten voorrang op andere activiteiten?
4.2.3 Ziet u de type activiteiten in de toekomst veranderen? Zo ja, hoe? En gaat dit dan van invloed zijn op de indeling van de polikliniek?

4.3 Wordt er samengewerkt tussen afdelingen binnen de polikliniek?
4.3.1 Zo ja, hoe vind deze samenwerking plaats?
4.3.2 Hoe zou deze samenwerking geoptimaliseerd kunnen worden?

4.4 Wat is de missie binnen jullie organisatie?
4.5 Wat is de visie binnen jullie organisatie?
    4.5.1 Wat voor cultuur heerst er binnen jullie organisatie?
    4.5.2 Er is sprake van grote werkdruk binnen de ziekenhuizen, hebben de werkdruk en de cultuur binnen de organisatie invloed op het efficiënt zijn van de werkprocessen?
    4.5.3 Zouden de werkprocessen binnen de polikliniek efficiënter kunnen?
    4.5.4 Hoe zou u dat voorstellen?

5. Smart tools / slimme technologieën

Het volgende onderdeel gaat over de digitale werkomgeving en de beschikbaarheid van informatie over de polikliniek.

5.1 Worden er bij u op de polikliniek al metingen uitgevoerd? (als ja ga door met de sub-vragen)
    5.1.1 Ja:
        5.1.1.1 Wat voor soort metingen zijn dit?
        5.1.1.2 Welke tools worden gebruikt voor deze metingen?
        5.1.1.3 Hoe vaak worden de metingen uitgevoerd? Interval?
        5.1.1.4 Wanneer worden deze metingen uitgevoerd?
        5.1.1.5 Hoe wordt de data gelezen? Kunnen er conclusies uit getrokken worden?
    5.1.2 Nee: wat is hier de reden voor?
5.2 Van wat voor soort digitale systemen wordt al gebruik gemaakt?
    5.2.1 HotFlo, Hix, EPD
    5.2.2 Hoe is het om met deze systemen te werken?
5.3 Wat voor informatie zou u ter beschikking willen hebben om de werkzaamheden op de polikliniek zo efficiënt mogelijk te kunnen uitvoeren?
    5.3.1 Welke informatie daarvan heeft u al ter beschikking?
    5.3.2 Hoe komt u aan deze informatie?
    5.3.3 Hoe komt het dat de informatie die u nog niet ter beschikking heeft maar wel graag zou willen hebben, nog niet heeft?
    5.3.4 Hoe denkt u aan deze informatie te kunnen komen?
5.4 In hoe verre denkt u dat real-time data een oplossing kan zijn voor het opvangen van de onvoorspelbare onzekerheden die zich afspelen binnen de poliklinieken?
    5.4.1 Wat voor metingen kunnen er dan het best uitgevoerd worden? / Welke data is gewenst?

6. Beëindiging

6.1 Is er nog iets dat u zou willen toevoegen aan dit interview?

7. Na het interview

7.1 Heel erg bedankt voor uw deelname aan het interview.
7.2 Ik zal nu de opname stop zetten.
7.3 Ik zal het interview nu gaan transcriberen en mijn bevindingen zal ik opnemen in het onderzoek.

Appendix D.1 – Expert panel information

Afstudeeronderzoek Smart Tools in the Outpatient Department
Msc Management in the Built Environment, Technische Universiteit Delft

Onderzoek	MSc scriptie over slimme hulpmiddelen die bijdragen tot een efficiënt gebruik van de ruimte op de polikliniek van een Nederlands ziekenhuis.
Instelling	Technische Universiteit Delft
Interviewer	Lisa Cornelissen
Contact informatie	lisa.cornelissen@atosborne.nl
Datum	16/12/2021 [DD/MM/JJJJ]

Agenda

Opmerking: deze tijden zijn een indicatie

10:00	Welkom & introductie
10:15	Voorleggen stellingen gevolgd door discussie
11:00	Feedback & afsluiting

Stellingen

I	Het primaire proces moet meer geüniformeerd worden tussen de verschillende specialismen. Zodat de polikliniek meer één geheel wordt en minder bestaat uit 'losse eilandjes'.
II	Een flexibel concept (scheiding van front office en backoffice & generieke spreek / onderzoekskamers) zou beter benut moeten worden tussen verschillende specialismen zoals nu wel al gebeurt binnen het specialisme.
III	De implementatie van slimme technologieën, hebben een groter succes naarmate de lay-out van de polikliniek meer flexibel wordt.
IV	De Covid19 pandemie versnelt de implementatie / acceptatie van slimme technologieën.

Samenvatting van het onderzoek

Probleemstelling

De sector van de gezondheidszorg ondergaat transformaties, om de paar jaar veranderen de visies op de verstrekking van gezondheidszorg. De zorgvraag stijgt door de vergrijzing van de bevolking en meer en meer is mogelijk in de diagnostische behandeling door medisch-technische en ICT-ontwikkelingen. Verder vind de digitalisering steeds meer een weg in de zorgsector. De ondersteuning van informatiesystemen, met name op het gebied van procesharmonisatie en procesdigitalisering, belooft een kwaliteitsverbetering en een kostenverlaging. De Covid19-pandemie heeft als katalysator gewerkt op het gebied van de digitalisering en heeft aangetoond dat flexibiliteit wenselijk is in zowel de organisatorische processen als de fysieke ruimten en er dus geanticipeerd moet worden op enige overcapaciteit.

Volgens het Hoofdlijnenakkoord Medisch Specialistische Zorg 2019-2022 mogen ziekenhuizen niet meer groeien om de zorg betaalbaar te houden en kunnen ze dus niet meegroeien met de zorgvraag. Het ziekenhuis moet de toenemende vraag opvangen met minder financiële middelen en een hoge

druk op medewerkers en tegelijkertijd de technologische ontwikkelingen bijbenen. Hierdoor ontstaat een mismatch tussen vraag en aanbod.

Onderzoeksvraag & aanpak

De onderzoeksvraag die geformuleerd is aan de hand van bovenstaande probleemstelling luidt als volgt; “In hoeverre kunnen slimme hulpmiddelen en lay-out bijdragen aan een efficiënter en effectiever gebruik van schaarse middelen op de polikliniek van een Nederlands ziekenhuis?” Om deze vraag te beantwoorden zijn een literatuurstudie en empirisch onderzoek uitgevoerd. Zowel de literatuurstudie en het empirisch onderzoek zijn opgedeeld in 3 subhoofdstukken; real estate management, de polikliniek en smart tools.

Drie casussen hebben deelgenomen aan het onderzoek: casus 1, het WKZ; casus 2, het Deventer Ziekenhuis; en casus 3, het Zuyderland locatie Sittard-Geleen. De casussen zijn gekozen op verschil in ruimtelijk concept. Casus 1 heeft vanuit de historie nog een vrij vast ruimtelijk concept en casus 2 & 3 hebben een flexibel ruimtelijk concept.

Output van het onderzoek

Een informatiedashboard dat zowel de patiënten, de medisch specialisten als de managers van gepersonaliseerde informatie kan voorzien. Een dashboard dat voor meer uniformiteit binnen de organisatie moet zorgen, door transparantie in informatie te creëren kunnen onderbouwde discussies ontstaan tussen de afdelingen.

Vanuit de theorie is geconcludeerd dat het gebruik van slimme technologieën en layout bijdragen aan een efficiënter en effectiever ruimtegebruik. De scheiding van front office en back office zorgt voor meer flexibiliteit, waardoor ruimtes efficiënter gebruikt kunnen worden. En door middel van gebruik van slimme technologieën kan de bezetting inzichtelijk gemaakt worden en kan daarnaast bijvoorbeeld geanticipeerd worden op piekmomenten wat betreft drukte.

Echter, in de praktijk blijkt dat deze voordelen van flexibiliteit niet zodanig toegepast worden. In real estate management kan onderscheid gemaakt worden tussen 4 verschillende perspectieven; organisatorisch, functioneel, financieel en fysiek. Net zoals het doel van ICM om integraliteit te creëren, zal er een compromisoplossing moeten ontstaan tussen de 4 perspectieven. Wanneer er in het fysieke aspect iets verandert, door bijvoorbeeld verandering van layout concept of implementatie van slimme technologieën, betekent dit dat er in de andere drie perspectieven ook een verandering zal moeten plaatsvinden om het project te laten slagen. Aangezien het financiële aspect afhankelijk is van politieke besluitvorming en de zorgverzekeraar, zal de verandering neerkomen op de organisatorische en functionele perspectieven.

Appendix D.2 – Expert panel email

Beste deelnemer,

Hartelijk dank voor uw deelname aan dit onderzoek naar de mate waarin smart tools (slimme technologieën) kunnen bijdragen aan een efficiënt en effectief ruimtegebruik op de polikliniek van een Nederlands ziekenhuis. Dit onderzoek is onderdeel van mijn afstudeerscriptie voor de MSc track Management in the Built Environment aan de Technische Universiteit van Delft.

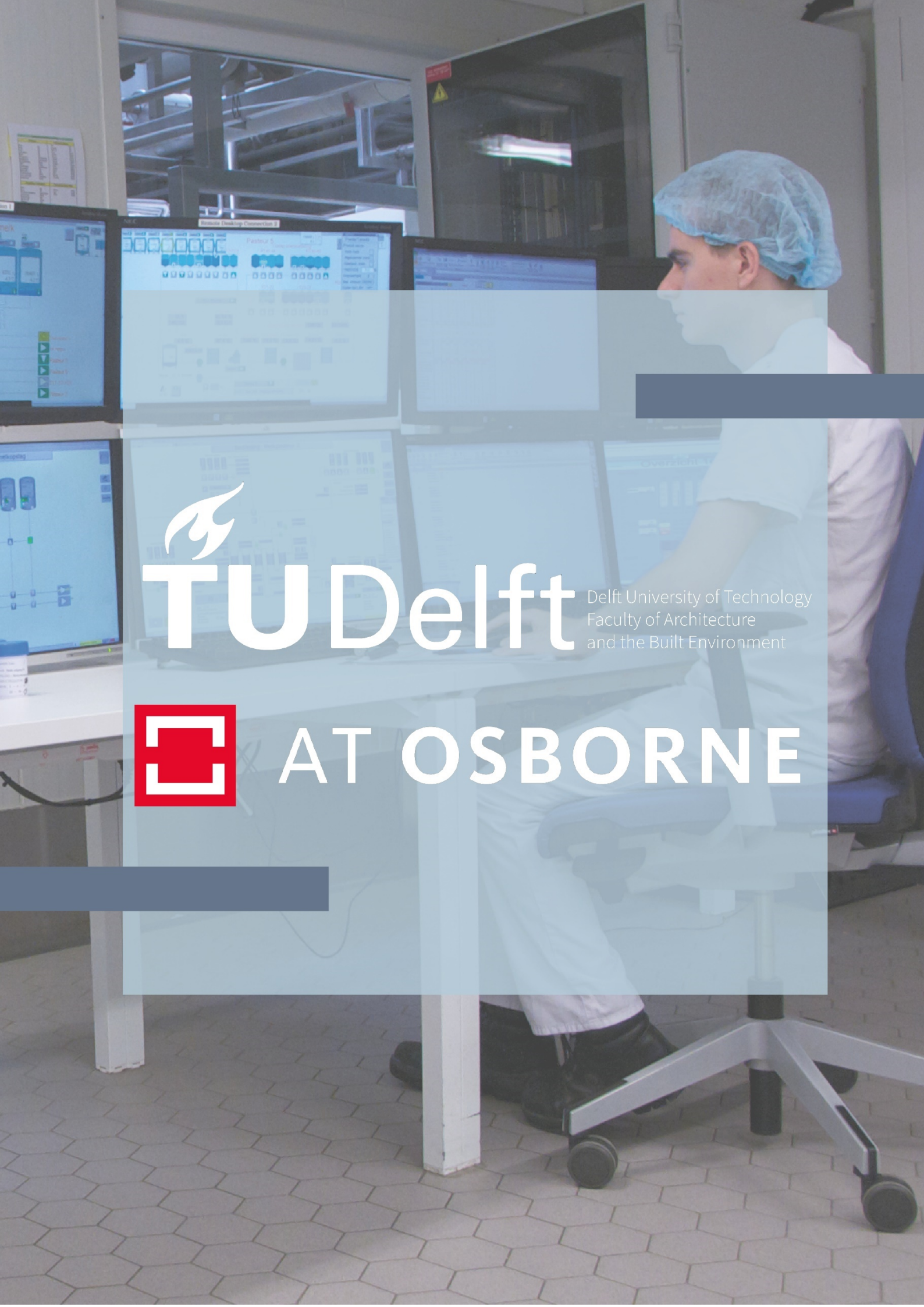
Het doel van dit onderzoek is om de afdelingsmanager en capaciteitsmanagers inzicht te geven in de mogelijkheden van lay-out concepten en implementatie van smart tools op de efficiëntie en effectiviteit van het ruimte gebruik. En hen te voorzien van adviezen op het zo efficiënt en effectief mogelijk benutten van de capaciteiten op de polikliniek. U bent een professional in de huisvesting van de zorgsector en beschikt over deskundige kennis over het werken (adviseren) met capaciteiten en ruimtegebruik op een polikliniek.

Tijdens deze vergadering zal ik de bevindingen van mijn onderzoek met u delen en deze in de vorm van stellingen aan u voorleggen. Ik zal de stellingen toelichten en vervolgens zullen we er openlijk over discussiëren. De discussie dient om mij praktische inzichten te verschaffen over mijn bevindingen en om mijn aanbevelingen voor mensen uit de praktijk te structureren. Er zijn geen goede of foute antwoorden, uw mening en inzichten zijn belangrijk.

Als u vragen heeft vóór het panel, gelieve contact op te nemen. In de bijlage zijn de agenda, stellingen en beknopte samenvatting van het onderzoek opgenomen.

L.G. (Lisa) Cornelissen

Lisa.cornelissen@atosborne.nl



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