COLLECTIVE OF AUGMENTED BODIES

HOW HUMAN BODY AUGMENTATION WILL REFLECT CHANGE IN THE HOSPITAL TYPOLOGY OF THE FUTURE.

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ABSTRACT

The following document is a representation of the design brief of 'The Collective of Augmented Bodies'. A hospital oriented project that is based around the following research question: "How will human body augmentation reflect change in the hospital typology of the future?". Hospitals are the most critical buildings within society, but are only a part of it during times of necessity. The highly complex program and dominant circulation of the 'healing machine' have created a labyrinth within the built environment. A labyrinth that society would rather avoid than partake in, discover, and be associated with. Innovation in the field of human body augmentation has started the transition of 'buildings', to 'bodies' as a healing machine. Not only changing the human body, but also the hospital typology as we know it today. The new hospital typology will be specialised solely in the custom procedures involved with augmenting human bodies. While also researching, and educating the next generation of professionals and society. The constant development of technology will require a flexible program and thus a modular structure. Which in turn offers the opportunity to open up the hospital and redefine the organisation of public spaces. The public spaces are not only an escape, but also offer opportunities for the general public to gather. Not only for a chat with friends over coffee, but also a market, a späti, and much more. The new modular hospital typology of the future will be interwoven with everyday life. Changing its image from an institute to a subtle collective of buildings that are part of the urban fabric. Introducing the Collective of Augmenting Bodies. A new hospital typology that is not only part of society when in need, but part of society every day.

INTRODUCTION

01

Hospital etymology

01 Introduction

1.0 INTRODUCTION

The studio Complex Projects is organised around nine different typologies, which can be categorised in three different groups; flows, area, and space. Airports, Stations, and Hospitals are part of the flows group. Parliament, Courthouse, and School are part of the Area group. Museum, Library, and Opera are part of the space group. Each group highlighting the most important spatial aspect within each building.

Students get the opportunity to choose which building typology they want to focus on; which in this case is the hospital typology. In addition to these nine different typologies, a collective group is also formed; which represents one topic that creates a narrative and overarching concept for a whole group. Which in this case is the 'material' group. + WIP

The following thesis will challenge the current role of hospitals within society; with an emphasis on the circulation space as a key-element of a functioning hospital, as well as the main 'public' space of the hospital.

1.1 THESIS TOPIC

Current definition and role of the hospital
The hospital is currently defined as "an institution providing medical and surgical treatment and nursing care for sick or injured people." (the Oxford Advanced Learner's Dictionary, 2023). This definition of the noun 'hospital' has nonetheless not always been defined in the same manor. As the noun 'hospital' has a rich etymology; see cover page of the chapter - dating back to the noun 'hospes', meaning 'host' or 'guest' in Latin.

History and etymology of the 'hospital
This changing definition of the noun 'hospital', has also been reflected in the architecture of hospitals through time and their role within society. Whereas we currently know the hospital as an institution that provides specialised medical and surgical treatment; while also offering nursing and care for sick or injured people - but this has not always been the case. Hospitals in the middle ages functioned as social institutions who only took care for the poor who fell ill; providing them with food, shelter and succor, but no treatment. These institutions were also known as Almshouses (Wagenaar, 2016).

Paradigm shift towards the hospital as a healing machine
The discovery of X-rays in 1985, by W.C. Röntgen, initiated a paradigm shift within the hospital typology. Whereas the hospital previously only possessed the power to take care for the poor who fell ill. It now possessed an unique method for investigating the human body with the introduction of the X-ray machine in 1897. This shifted the notion of hospitals functioning as social institutions for the part of society who could not afford treatment and care at home, towards the hospital functioning as an institution who could offer an unique treatment towards the upper class of society.

Focus on efficiency & industrialisation
This paradigm shift initiated the notion of hospitals being called 'healing machines' (machine à guérir); "buildings designed according to rational principles" - which offered the best possible chance of recovery, due to them being run as machines by medical professionals and technicians (Wagenaar, 2016).

This focus on creating the most efficient building with recovery in mind, also changed the treatment of humans; as if they were broken objects that needed to be fixed by the building functioning as a healing machine. This modernised way of thinking was also reflected in the illustration "Man as Industrial Palace," the 1926 lithograph by Fritz Kahn. Depicting the Human Body as a modern factory; which consisted out of mechanical lungs, a rock-sorting stomach, gears for a throat, and a switchboard for a brain. This illustrated the industrialisation of the human body as a machine within Western society, while also showcasing a different way of thinking about the human body that also showed it's vulnerability and potential to be broken.

Status quo of hospital - architecture
To fix this broken machine, also known as the human body, the hospital as a building of treatment and recovery had to be built using the most efficient of flows. This focus on organising the different flows of patients, staff, and guests, resulted in hospitals consisting out of a dominant amount of circulation spaces. Thus introducing vast distances of corridors, an array of doors, combined with walls. Creating connections for patients, staff, objects, and guests to visit different departments within the hospital. But simultaneously also hiding the activities, research, treatment, care, and thus also the role of the hospital within society, from the public (Wagenaar, 2016).

The "Institute" of Augmented Bodies
Following the development of the hospital typology from a social institute that took care of the poor, to the highly-specialised and optimised healing machines of the twentieth century. We can question what the next step is for the hospital future. Following the quote of Winston Churchill, in 1943: "We shape our buildings, thereafter they shape us.", it can be assumed that the next step would be the body functioning as a healing machine; a developed concept based on the hospital functioning as a healing machine. This is where the concept and program for the hospital of the future is introduced; 'The Institute of Augmented Bodies' - which focuses on the fusion of organic and artificial material within the human body. Resulting in augmented bodies that function as independent healing machines, that overachieve what was naturally possible. Representing the next phase and development within the field of medical procedures and the future. But also raising ethical questions about the development of the human body.

1.2 PROBLEM STATEMENT

The role of the hospital within society
This vast array of circulation facilitated the ideology behind creating a healing machine: "buildings designed according to rational principles", but in turn also followed to notion of de-humanizing the human body by treating it as a object. A concept not only applicable to the patients, but also the staff, and the guests of the hospital. Questioning if people that are in recovery should be surrounded by architecture that does not focus on creating a healing environment for the human in mind, but rather an efficient healing machine.

Stigma and singularity in use
Which in turn resulted in the hospital we know today the day: one of the most critical buildings within a functioning society, but also a building that is only used as a reactionary typology. A building that one only uses after an event of feeling unwell; a building characterised by a series of waiting points, that determine our journey through a series of diagnostics, testing, consultations, and a cure. where they get diagnosed, treated, and cared for. A public building for the public, but only if needed in the case of emergency.

Relevance
This stigma and singularity in use has affected the role of the hospital negatively, as it hides the important role of the hospital within our society. As well as the activities that happen behind the walls, corridors, and doors, that are synonymous to the hospital experience we all are exposed to, whenever we are visiting a hospital. This will also affect the awareness surrounding the development of new medical treatments, and the public discourse surrounding this development. One of the prime examples of this problem can be traced back to the recent pandemic; where a significant rise in protests against the Covid-19 vaccine, in combination with misinformation on social media, triggered an unexpected large part of society.

This is why the following research will question the role of public spaces within hospitals, and what opportunities these spaces have to open up the hospital program for society, while also initiating public discourse about what happens within the walls of the hospital.

1.3 RESEARCH QUESTION

Based on the introduction, the preliminary research surrounding the hospital typology, and the problem statement, the main research question is formulated as following:

"How will human body augmentation reflect change in the hospital typology of the future?"

The following two design questions need to be addressed to substantiate the answer on the main research question;

1. "How will augmentation change the hospital process for the human body, and thus the building program?"

2. "How can we create a living hospital structure, that can grow, upgrade, and get augmented through time?"

RESEARCH FRAMEWORK

02

02 Research Framework

The following chapter will focus on putting the main research-question within the context of the existing academic literature and research, in order to create a theoretical framework. While also emphasising the relevance of the research within the realm of existing scope of academic research and established ideas and discourse.

2.1 THEORETICAL FRAMEWORK

The role of the hospital within society

The research will focus on the historic role of the hospital within society, and respond to that development with an ambition to create a new role within society; where the hospital will play a vital role in exposing the development of medical treatments; such as human body augmentation. The following literature will be used as a base for the historical role of the hospital within society:

Wagenaar, C. (2006). The Architecture of Hospitals. In C. Wagenaar, A. de Swaan, S. Verderber, C. Jencks, A. Betsky, & R. Ulrich (Eds.), The Architecture of Hospitals (pp. 10-20). NAi Publishers.

The definition and characteristics of public space

There are multiple sources of existing literature on the topic of public space. As it has been an interesting and always developing definition of space, depending on its context in time, space, and culture.

The book 'public spaces', by Stephen Carr (1993), offers a good insight into the definition and characterisation of public spaces. Carr defines 'public space' as "the common ground where people carry out the functional and ritual activities that bind a community, whether in the normal routines of daily life or in periodic festivities.". In addition to the definition, Carr also highlights its constant development, as it evolves with the culture of the context; "new types of spaces may be needed and old ones discarded or revived.". Stephen Carr (1993) characterises public spaces, in his book 'Public Spaces', by the presence of

In addition to Stephen Carr, Vikas Mehta (2013) also developed a framework that quantifies the quality of public spaces, using the 'Public Space Index'. Which focuses on inclusivness, meaningfull activities, pleasurability, safety, and comfort.

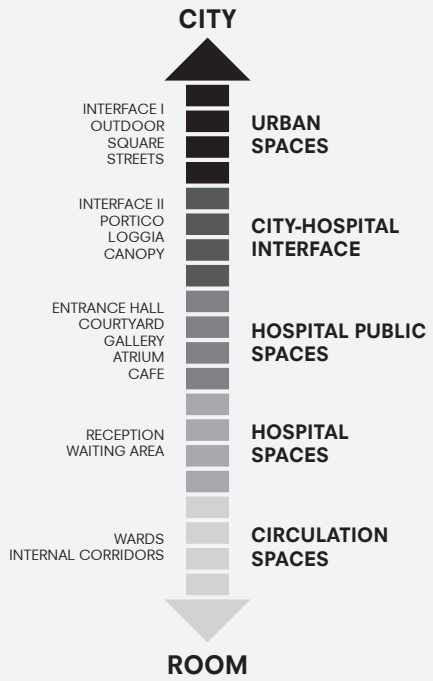


Figure 2.0 - Public spaces as transition spaces between the city and the room. (Setola and Borgianni, 2016)

By combining the Public Space Index and the definition and characteristics by Carr, a good foundation can be set to start building public spaces, which are not only part of the building program, but also part of the larger context: the city.

The public space as transition space

Public spaces function as transition spaces between different spaces and environs. Not only within the scale of the building, but also as a transition phase between the larger scale of the city and the interior of the building. Offering different levels of 'publicness' as well as privacy, which plays an important role for the patient as well as the public that visits a hospital.

Setola and Borgianni (2016) describe this concept of transition spaces, as a framework to create transitions from the urban spaces within the city, all the way towards to the interior room

of a hospital, by going through an array of different levels of 'publicness'. See figure 2.0. Which are represented through different public space typologies. These public space typologies range from outdoor square and streets, that are based on the urban scale, but also the scale of the interior spaces of the hospital. The research gives a good base for the existing public spaces within the hospital, using case studies as well as theory, based on the status quo of current hospitals. Using this as a starting point, this research will develop further on the current notion, and will try to enhance these spaces and typologies using architectural design strategies. Which lay their foundation in 'Healing architecture' evidence-based design, and the 'phenomenology' of material, colour, and texture. Both of which influence the personal experience of the patient, but also the visiting public, and the staff that works in the hospital. All-in-all, with the goal of enhancing the vast amount of existing public space that already exists within hospitals, in the form of functional circulation space. With the hope to change the singularity in use of the hospital, and the stigma that is tied to the hospital, dating back to the hospital as a 'healing machine'. This will also offer a new image of the hospital; by opening up the hospital to the public - to also discuss the developments that happen behind the doors, corridors, and walls of the hospital; which hopefully will enable public discourse.

Public versus private space

The 'companion to public space.', by Mehta and Palazzo (2023), expands on the notion of public versus private space. While moving through a city, a building, a space, we experience different dimensions of public space. Kevin Lynch (1981)

The phenomenology of material, colour, and texture & Healing architecture evidence-based design - WIP

2.2 RELEVANCE

This stigma and singularity in use has affected the role of the hospital negatively, as it hides the important role of the hospital within our society. As well as the activities that happen behind the walls, corridors, and doors, that are synonymous to the hospital experience we all are exposed to, whenever we are visiting a hospital. This will also affect the awareness surrounding the development of new medical treatments, and the public discourse surrounding this development. One of the prime examples of this problem can be traced back to the recent pandemic; where a significant rise in protests against the Covid-19 vaccine, in combination with misinformation on social media, triggered an unexpected large part of society. The current development of human body augmentation offers an opportunity to look at the potential image of the hospital of the future. This is why the following research will question the role of public spaces within hospitals, and what opportunities these spaces have to open up the hospital program for society, while also initiating public discourse about what happens within the walls of the hospital.

"How will human body augmentation reflect change in the hospital typology of the future?"

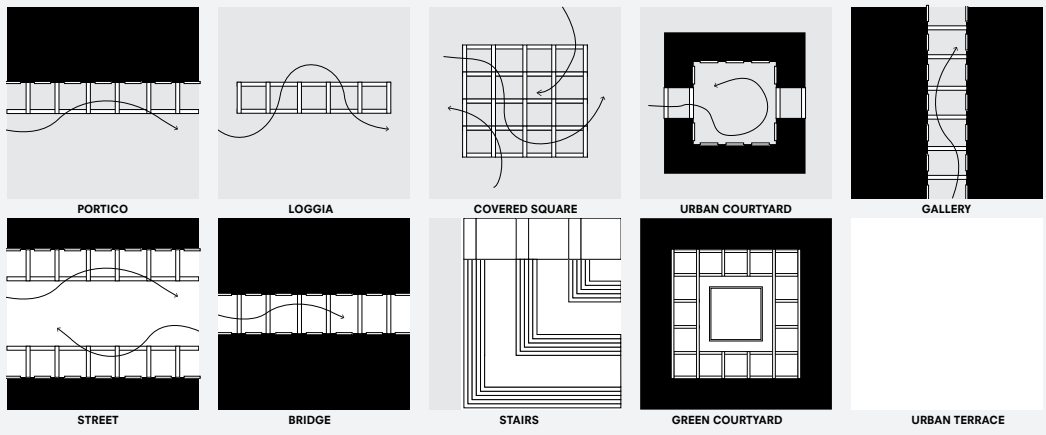


Figure 2.0 - Overview of Public space typologies. (Labics et al., 2023)

RESEARCH METHODS

03

03 Research Methods

In order to answer the research question and its related sub-question, the research will be structured into three different aspects. Namely the program, client, and site. Each aspect will be treated as separate elements of the project, but will simultaneously also inform the other aspects through narrowing down the scope of the research development. As a result this will provide a 'design brief', chapter 4, which will be constantly updated based on the findings within the realm of each aspect. In the end, the design brief will be an over compassing framework, which will describe the parameters of the project, through the aspects of the program, client, and site.

In the following chapter we will focus on what research methods will be used within the realm of each of the three aspects. This will in turn provide a framework for the methodology of the research and create an outline of the research structure.

3.1 PROGRAM

In order to determine the hospital program, the research starts-off with a pre-determined reference procedure as a starting point. This gives a first impression of what happens within the hospital itself, and what departments and specialisations are relevant. This is followed by a case study benchmark, in order to figure out the approximate size and proportions of the program, relative to existing hospitals. Finally the program will be researched in detail using pre-described rules and dimensions, which are sourced from existing literature, in combination with available plans and details from existing hospitals.

3.1.1 Hospital specialisation

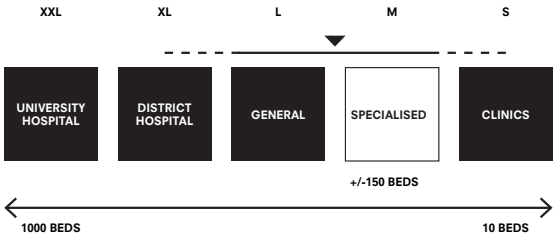
The program scope of the hospital has been framed based on the procedure that will be specifically carried out at the Institute of Augmented Bodies; the augmentation of the human body through the fusion of organic and mechanic material.

To get a better understanding of what this medical procedure entails, a literature study has been carried out based on an example of an augmentation procedure that has been carried out and described in the following article, sourced from the Lancet Neurology Medical Journal: "An exoskeleton controlled by an epidural wireless brain–machine interface in a tetraplegic patient: a proof-of-concept demonstration" (Benabid et al., 2019).

The article does not only describe the medical procedure, but also makes it tangible by visually summarising the procedure in a video that captures the recovery and training of the patient; who uses two wireless chronically implanted brain-computer interfaces (BCI) to control virtual signals, which can in turn control physical machines; like the exoskeleton which has been developed for him. The procedure and specialisations that are involved in making this medical procedure work, have been documented in figure 3.1.

3.1.2 Hospital case study and benchmark

In order to determine the approximate size of the hospital program, a comparative case study research has been done using a selection of several existing hospitals, varying from small to large scale, based on the amount of beds located within each hospital.



The following hospitals have been selected for the case study research:

1. AZ Groeninge - Baumschlager Eberle Arch.
   GFA 125,000 m² - 1100 beds (XL)

2. Rey Juan Carlos Hospital - Rafael de La Hoz
   GFA 72,000 m² - 260 beds (L)

3. Zaans Medisch Centrum - Mecanoo
   GFA 31,000 m² - 299 beds (L)

4. REHAB - Herzog & de Meuron
   GFA 15.000 m² - 92 beds (M)

5. UMC Imaging Center - Wiegerinck
   GFA 15.000 m² - 0 beds (S)

Each hospital was analysed based on the available floor plans and sections that were available either online or through literature. Each of which were re-drawn to scale, and analysed based on seven different types of program, that

were previously mentioned in the book 'The architecture of hospitals', by Wagenaar (2006):

- Hot Floor (Operation, Emergency & ICU)
- Hotel (Inpatient department)
- Office (Outpatient department & Polyclinics)
- Public (Public amenities & Public space)
- Factory (Logistics, Laboratories & Production)
- Circulation (Transition spaces)
- Storage (Spaces of storage)

All the case study projects have been analysed using the program structure that was previously mentioned, in combination with the available data of the total GFA, total of beds, and foot print. This resulted in an average proportion of hospital program, in correspondence to an average area per bed. Making it possible to create a substantiated estimate of the size of the desired hospital, based on the amount of beds needed, the average area per bed, and the proportion between different program that was present on average over the different hospitals.

The different case study projects also offer insight into the spatial arrangement of the different program, in addition to the raw data gathered from this case study benchmark analysis, which was mentioned in the previous paragraph. This offers insight into the different possible spatial arrangements of program, while also showcasing the potential to create space for public spaces in between the complex program of the hospital.

3.1.3 Flow, area, and space analysis

In order to determine the specific relevant program of the hospital; including the flows, areas, and space-relation schemes - multiple floor plans and dimensions have been consulted and sourced from literature; mainly from 'Architect's data', by Neufert (2023) - and from available floor plans that are published online.

3.1.4 Field work

Field work has also been carried out, in addition to the literature and case study approach of the program. This has been done in order to experience the hospital from the experience of the 'public', while also offering a way to capture architectural elements and public spaces in the hospitals we know today the day. Offering insight into the 'public' spaces of the hospital, through creating 'noli' maps of the interior lay-out of the hospital and its accessibility as a guest.

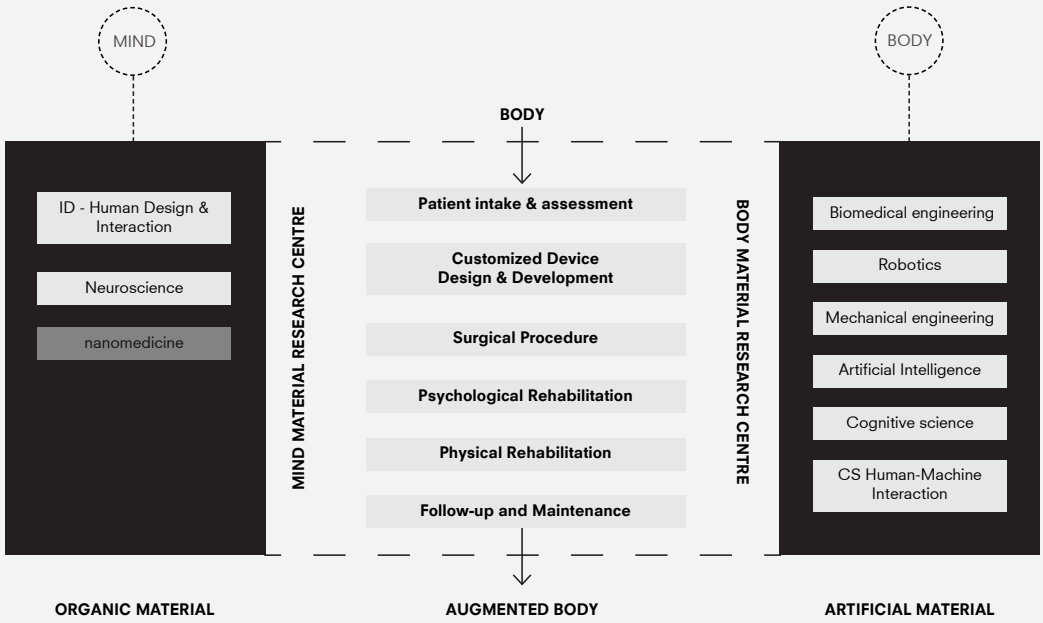


Figure 3.1 - A simplified scheme depicting the medical procedure of an augmentation procedure, based on the demonstration of Benabid et al., 2019. - author's work.

3.2 CLIENT

To get a better grasp of potential clients for the project, two bilateral perspectives will be used to distinguish different stakeholders within the development of medical procedures of body augmentation.

Market & Industry

The first perspective will use the market perspective to narrow the scope for potential industry backers for the project. Using market analyses about the Human Augmentation Market will give a more objective approach to the potential clients, purely based on their net. worth and investment portfolio. The following forecast can be used as an example and reference for this approach:

"Human Augmentation Market by Wearable (Wristwear, Bodywear, Footwear, Eyewear), AR (Head-mounted display), VR (Head-up display), Biometric (Fingerprint, Face, Iris), Exoskeleton (Powered, Passive), IVA (Chatbot), Functionality - Global Forecast to 2028"

Ethical and non-profit

The second perspective will use the perspective from a more ethical and academic approach to the subject of human body augmentation and the institutes that are already focused on the research and development, based on a solely non-profit, and ethical approach.

An interview with the MARCH Dreamteam from TU Delft; which focuses on developing an exoskeleton, using a interdisciplinary group of students - will also offer insight into the industry of the Human Augmentation Market.

3.3 SITE

Group - site requirements

The site of the project is determined through a inter-disciplinary approach, that consists out of two different parts: the site requirements following the group ambition of the 'material' group (group-work), as well as the typology-specific requirements which are connected to the hospital as building typology.

Typology - site requirements

In addition to the overarching site requirements of the group, the site-requirements tied to the typology specifically, also need to be taken into account. As the hospital also has a necessity for certain site-specific requirements, such as accessibility, density, and contextual requirements.

Matrix & Fieldwork

After selecting potential site-locations using the predetermined super-imposed maps, that contain the site-requirements of the group and the typology. A matrix will follow, which that takes into account the group and typology site-requirements on specific aspect requirements, in addition to emphasis, and priority; by adding a multiplier, which will give more weight to certain aspects that play an important role in the site-specific aspects of the project, and aspects that might inform the program of the hospital as well.

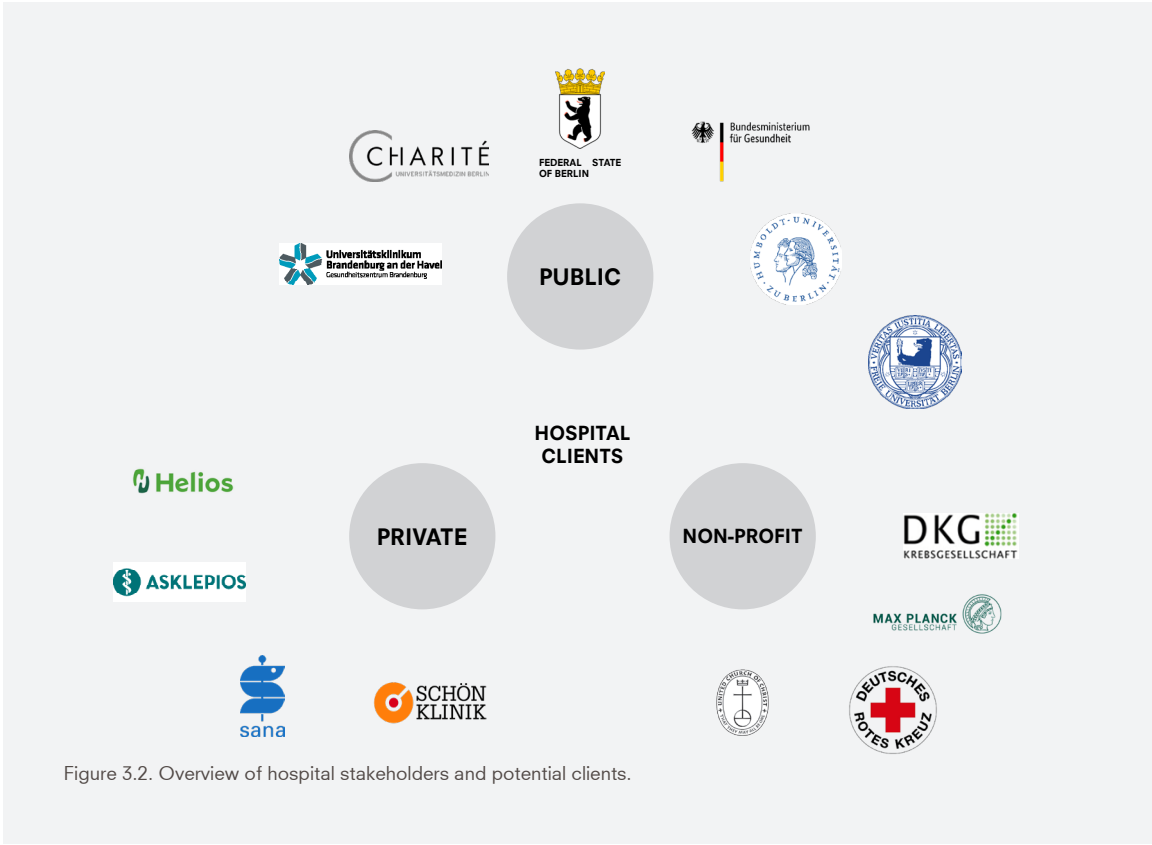
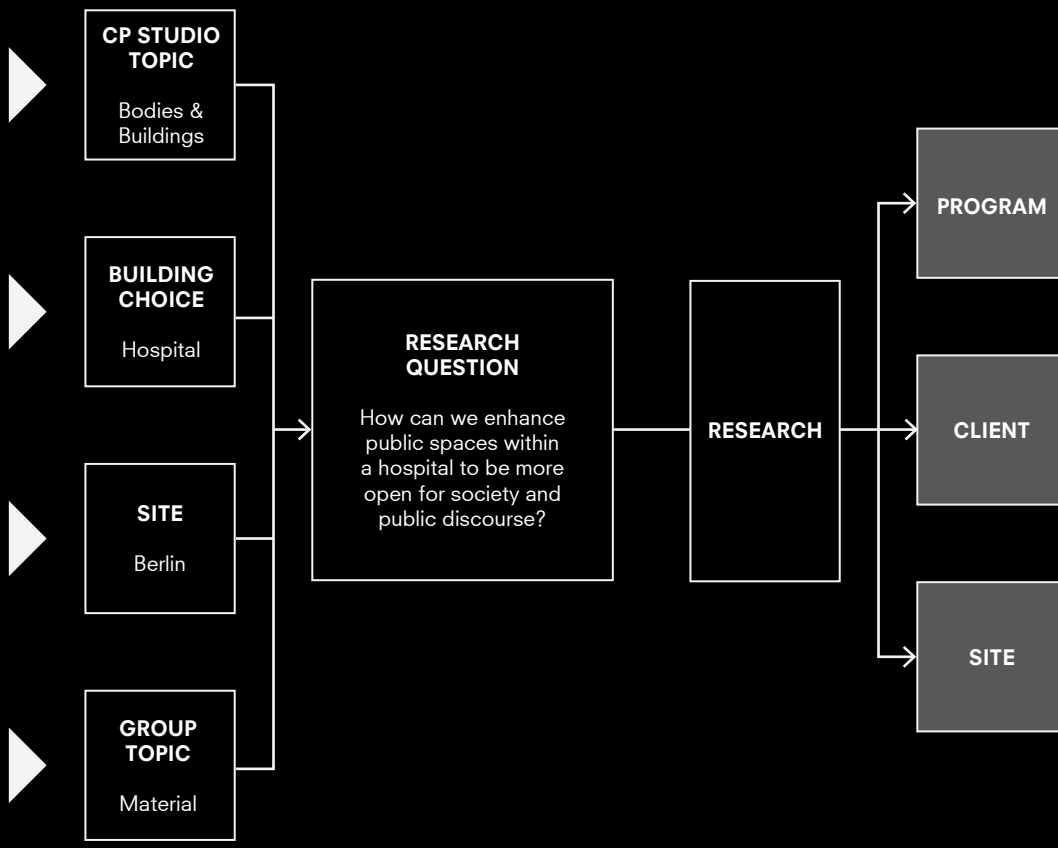
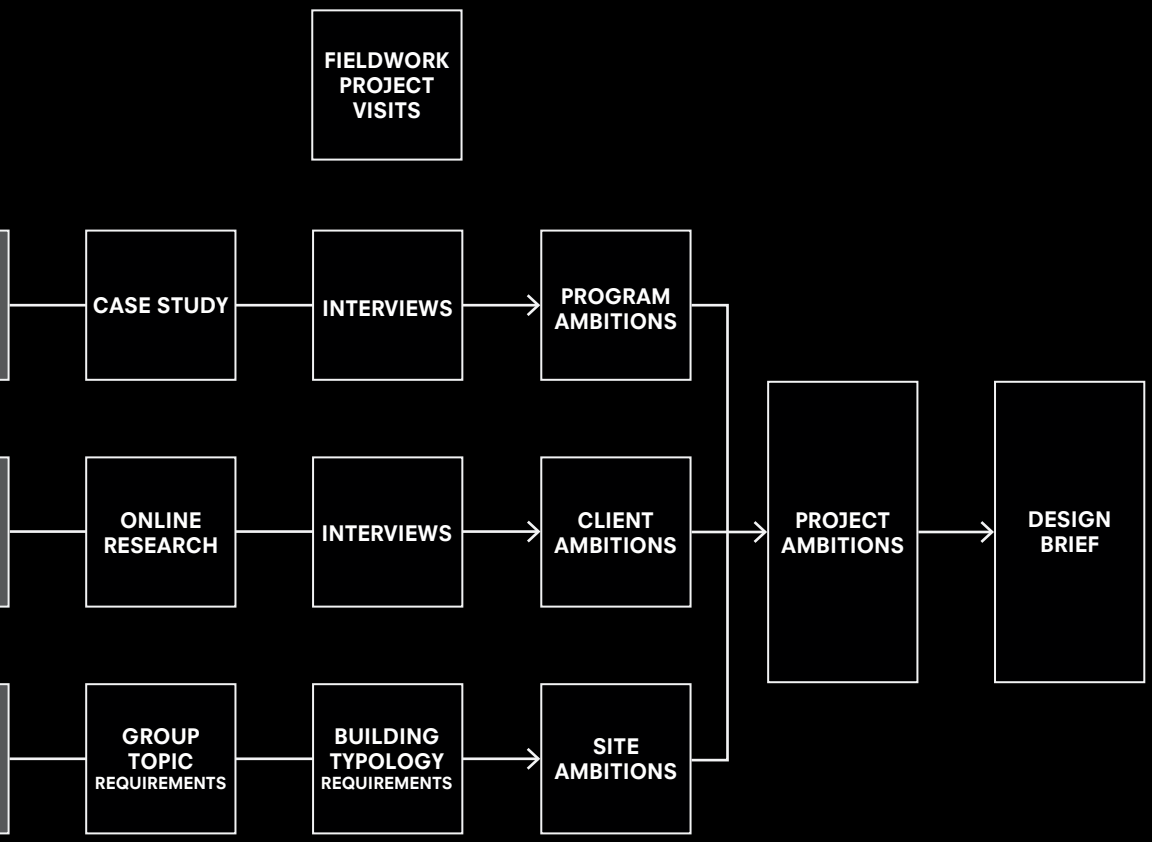


Figure 3.2. Overview of hospital stakeholders and potential clients.

Figure 3.3. Overview of hospital stakeholders and potential clients.

RESEARCH STRUCTURE




FIELDWORK
PROJECT
VISITS
CASE STUDY
INTERVIEWS
PROGRAM
AMBITIONS
ONLINE
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DESIGN
BRIEF
GROUP
TOPIC
REQUIREMENTS
BUILDING
TYPOLOGY
REQUIREMENTS
SITE
AMBITIONS

DESIGN BRIEF

04

04 Design Brief

The results that come forward from the research will be compiled into a 'design brief', which has been compiled in the following chapter. The goal of the design brief is to encapsulate all the project parameters and project information within the structure of program (4.1), client (4.2), and site (4.3).

4.1 Program

4.1.1 What does the hospital program entail?
A benchmark case study analysis has been done based on five different hospitals to get a better understanding about what the hospital program entails. This resulted in the following conclusions:

Average size
The average size of a hospital equals to 196, almost 200 m² per bed. The average size of the hospital program per bed has been growing through time. Due to increased specialisation and amenities.

Not a general hospital, but a generic program.
All the studied hospitals had a vast amount of different spaces and program within their compounds. Thus making the 'general' hospital not applicable anymore. Nonetheless, the program can be spatially subdivided into generic spatial program. Which we can distinct by the following terms: Hot Floor, Hotel, Office, Factory, Logistics, Public, Circulation, and Technical spaces.

Flows & Organisation : Circulation
All these different spaces are scattered around the hospital, but all interconnected using circulation spaces to facilitate the flows between the spaces and their connected departments. Hospitals consist out of 25% circulation space on average, and this thus means that the main circulation space of the hospital represents the key-element of the hospital typology. The corridor thus facilitates the various flows within the hospital program.

Flow over program
The large focus on facilitating the flows within the hospitals, using architectural elements; like walls, doors, corridors, and other circulation spaces - has resulted in the hospital as a 'healing machine'. Facilitating maximum efficiency, but in turn also hiding its activities, its program, its development, and most importantly; its critical role within society, from the general public.

Singular in-use
The highly complex program and dominant circulation of the 'healing machine' has created a labyrinth within the built environment; a labyrinth that society rather avoids, than partake, discover, and be associated with. This has resulted in hospitals being one of the most critical buildings within society, but only part of it in times of necessity.

4.1.2 Development
Following the conclusions from the benchmark case study analysis we can now focus on the following question:

"How will augmentation change the hospital process for the human body, and thus the building program?"

The question will be addressed in the following paragraphs, addressing change in the hospital program.

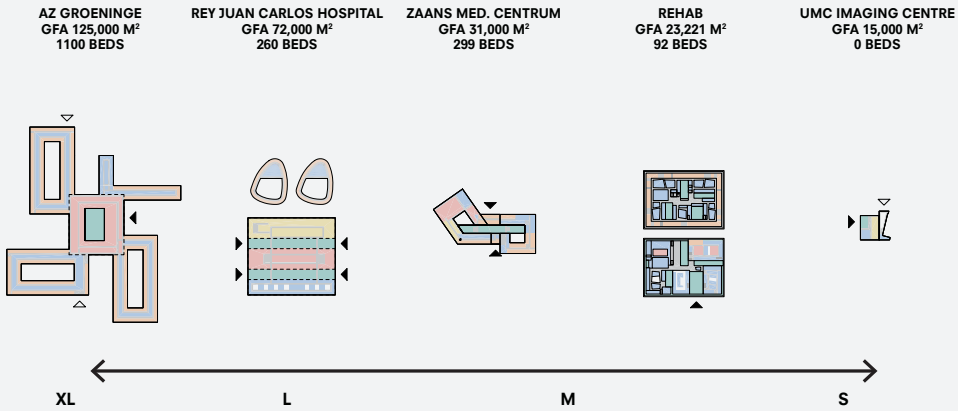


Figure 4.0 - A simplified analysis of the five different case study projects that were analysed.

From a general hospital to a specialised hospital

The program of the hospital will be specialised, using the same generic program that has been gathered in the benchmark case study analysis. But there will be different amounts of the generic program, in proportion to the focus on certain elements within the activities of the hospital. By using the described medical procedure of body augmentation; which was mentioned previously in chapter 3, and has been simplified in figure 3.1. The following program ambition has been constructed, based on the case study analysis and benchmark:

1. Redefining/Enhancing public spaces:
Redefining the dominant circulation spaces within hospitals, to open up to the city fabric and its society. (Toolbox)

2. Organisation;
Opening up program to the public, while maintaining an efficient organisation of flows and privacy. (Relation diagram + flows)

3. Program;
Adding public program through means of education and other public amenities - making the hospital a point of destination outside of moments of emergency, while also taking part in the urban fabric and thus its community, neighbourhood, and city.

Detailed program
This ambition, in combination with the data collected from the case study benchmark, and the literature analysis, resulted in the decision to redefine the circulation space into public space, while also adding a research department; in order to follow the narrative of the Institute of Augmented Bodies. This combination of decisions resulted in the following program:

Hot floor:
- Operation centre
- Diagnostic & Imaging centre - radiology
- Emergency department

Hotel:
- Inpatient department
- Intensive care unit

Office:
- Outpatient department
- Physical rehabilitation
- Neuro-psychological rehabilitation
- Administration office

Public:
- Public amenities
- Education
- Public transition spaces

Factory:
- Logistics

Circulation:
- Functional circulation

Storage:
- Functional storage & service area

Research:
- Body (& Mind) research centre
- Material research centre

This program has been elaborated further in figure 4.1, 4.2, and 4.3; from simplified into detail.

Figure 4.3. Detailed program break-down.

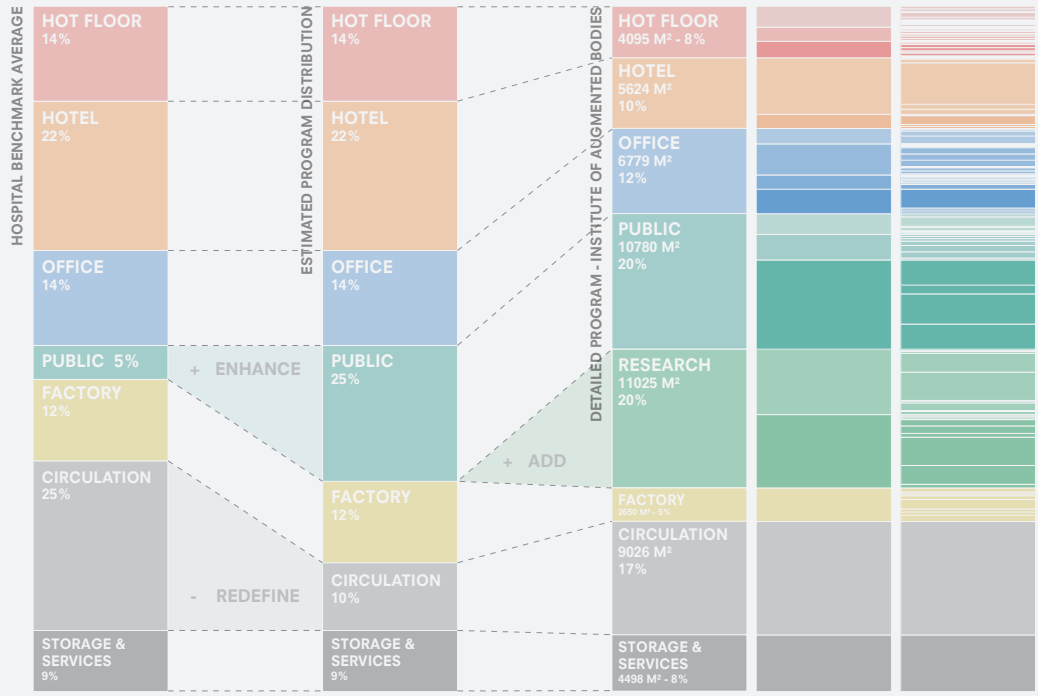
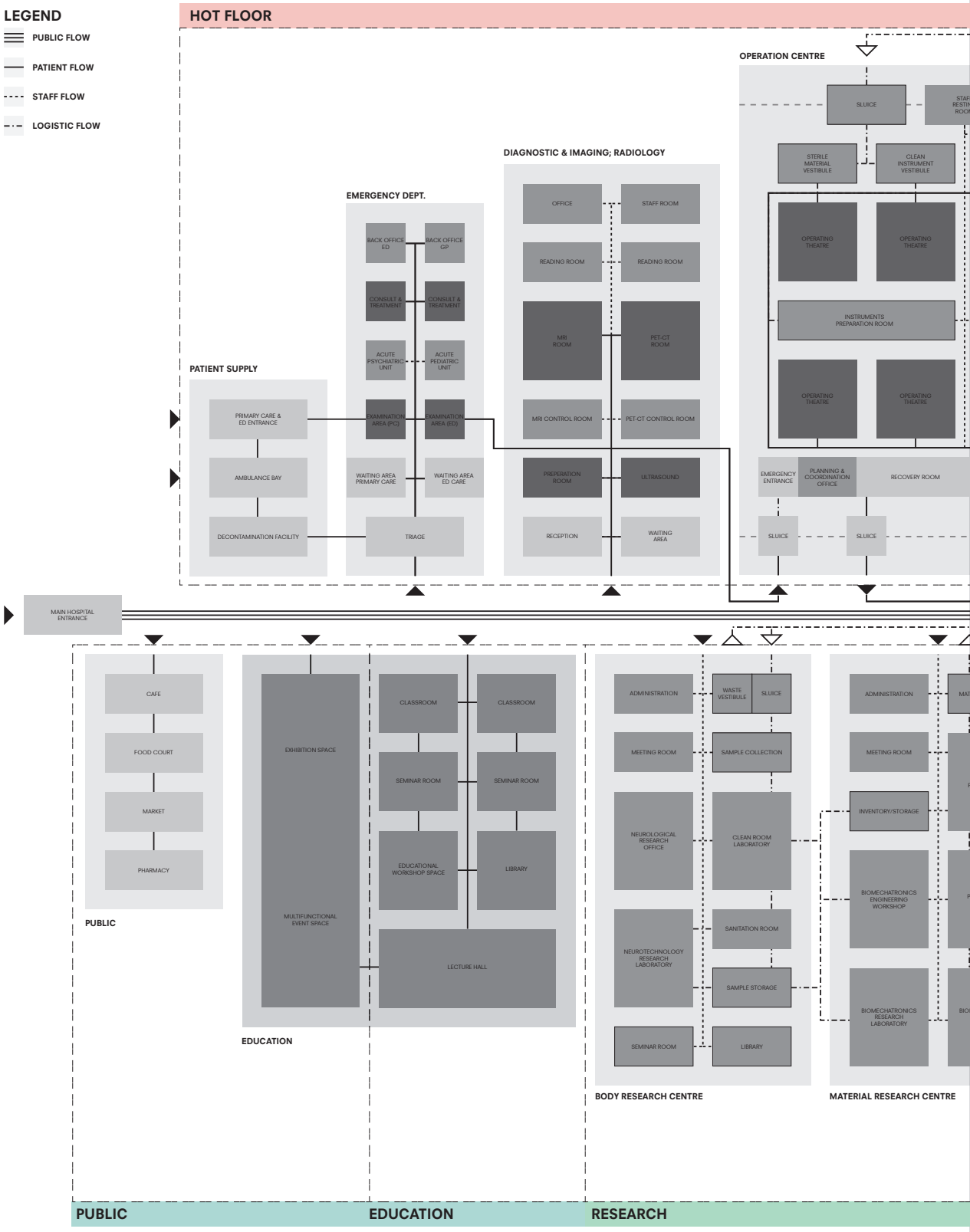
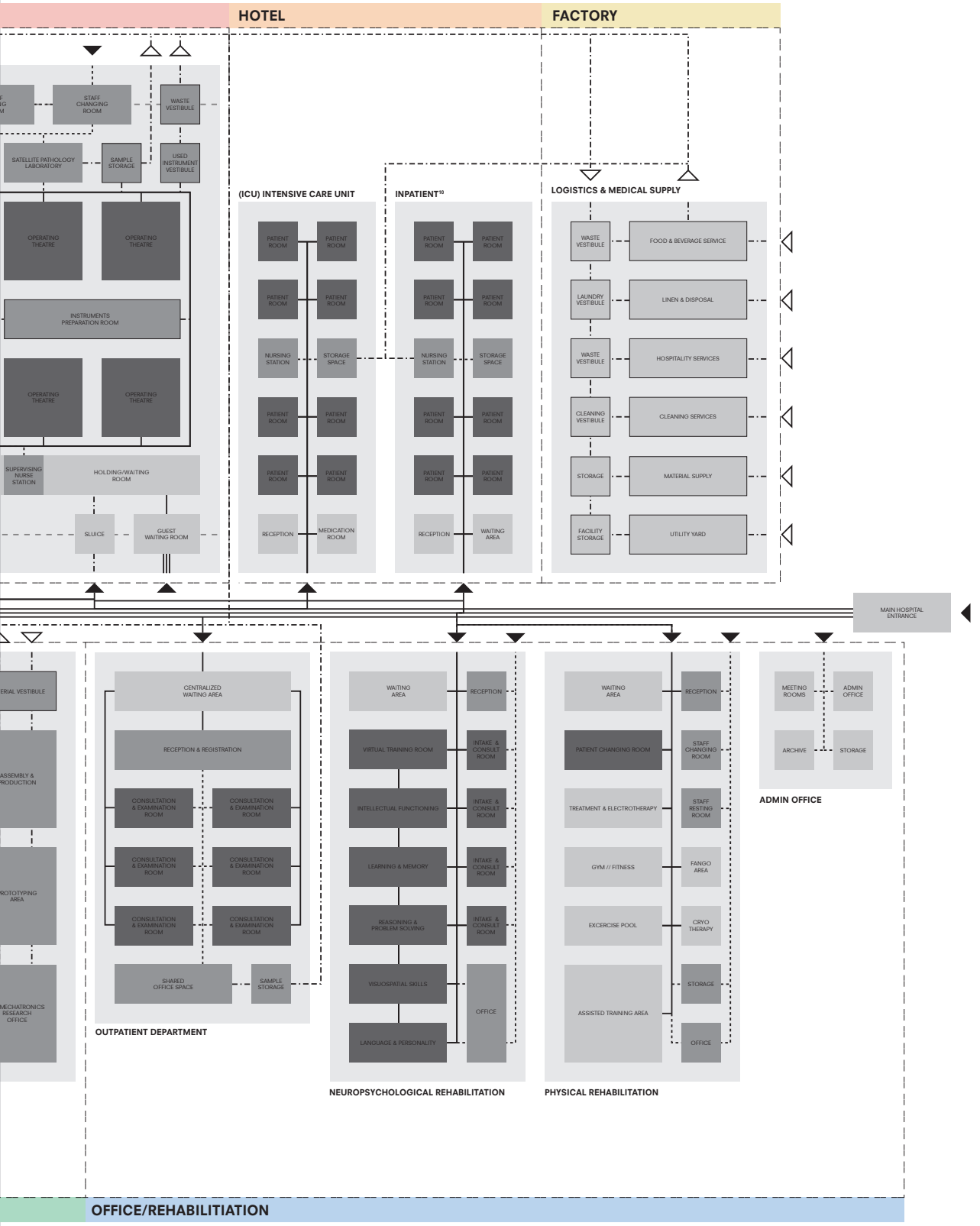


Figure 4.1. Simplified Program bar break-down

PROGRAM-RELATION SCHEME

Figure 4.2. Program-relation scheme, showcasing the different departments and flows.



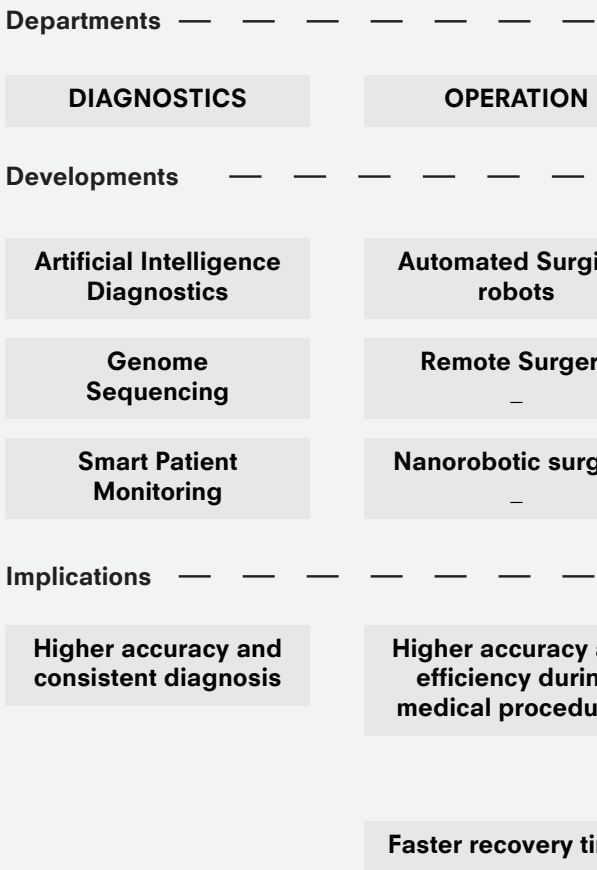

HOTEL
FACTORY
STAFF CHANGING ROOM
WASTE VESTIBULE
SATELLITE PATHOLOGY LABORATORY
SAMPLE STORAGE
USED INSTRUMENT VESTIBULE
OPERATING THEATRE
OPERATING THEATRE
INSTRUMENTS PREPARATION ROOM
OPERATING THEATRE
OPERATING THEATRE
SUPERVISING NURSE STATION
HOLDING/WAITING ROOM
SLUICE
GUEST WAITING ROOM
(ICU) INTENSIVE CARE UNIT
PATIENT ROOM
NURSING STATION
STORAGE SPACE
RECEPTION
MEDICATION ROOM
INPATIENT[10]
WAITING AREA
LOGISTICS & MEDICAL SUPPLY
WASTE VESTIBULE
FOOD & BEVERAGE SERVICE
LAUNDRY VESTIBULE
LINEN & DISPOSAL
HOSPITALITY SERVICES
CLEANING VESTIBULE
CLEANING SERVICES
STORAGE
MATERIAL SUPPLY
FACILITY STORAGE
UTILITY YARD
MAIN HOSPITAL ENTRANCE
ERIAL VESTIBULE
ASSEMBLY & PRODUCTION
PROTOTYPING AREA
MECHATRONICS RESEARCH OFFICE
CENTRALIZED WAITING AREA
RECEPTION & REGISTRATION
CONSULTATION & EXAMINATION ROOM
SHARED OFFICE SPACE
SAMPLE STORAGE
OUTPATIENT DEPARTMENT
VIRTUAL TRAINING ROOM
INTELLECTUAL FUNCTIONING
LEARNING & MEMORY
REASONING & PROBLEM SOLVING
VISUOSPATIAL SKILLS
LANGUAGE & PERSONALITY
INTAKE & CONSULT ROOM
OFFICE
NEUROPSYCHOLOGICAL REHABILITATION
PATIENT CHANGING ROOM
TREATMENT & ELECTROTHERAPY
GYM // FITNESS
EXCERCISE POOL
ASSISTED TRAINING AREA
STAFF CHANGING ROOM
STAFF RESTING ROOM
FANGO AREA
CRYO THERAPY
STORAGE
PHYSICAL REHABILITATION
MEETING ROOMS
ADMIN OFFICE
ARCHIVE
STORAGE
ADMIN OFFICE
OFFICE/REHABILITIATION

HOT FLOOR	**OPERATION CENTRE**							
4095	Holding/waiting room		200	1	200			
8%	Recovery Room		200	1	200			
	Supervising Nurse Station		25	1	25			
	Planning & Coordination office		25	1	25			
	Emergency Entrance		25	1	25			
	Operating Theatre		50	8	400			
	Instruments Preparation room		100	2	200			
	Satellite Pathology Laboratory		75	1	75			
	Sample Storage		50	1	50			
	Sterile Material Vestibule		50	1	50			
	Clean Instrument Vestibule		50	1	50			
	Used Instrument Vestibule		50	1	50			
	Waste Vestibule		50	1	50			
	Staff Changing room		50	1	50			
	Staff Resting Room		150	1	150			
	Sluice		15	4	60			40,54%
		Sub-total			1660	*830*	2490 m²	5%
	DIAGNOSTIC & IMAGING CENTRE: RADIOLOGY							
	Reception		25	1	25			
	Waiting Area		50	1	50			
	Preparation room		25	1	25			
	Ultrasound room		50	2	100			
	X-Ray room		50	2	100			
	MRI Control room		25	2	50			
	MRI Room		75	2	150			
	PET-CT Control room		25	2	50			
	PET-CT room		75	2	150			
	Reading room		25	8	200			
	Office		15	10	150			
	Staff room		15	5	75			27,47%
		Sub-total			1125	*562,5*	1687,5 m²	3%
	EMERGENCY DEPARTMENT							
	Triage		50	1	50			
	Waiting area - emergency doctor		100	1	100			
	Waiting area - primary care		100	1	100			
	Examination area/primary care		250	1	250			
	Examination area/emergency doctor		250	1	250			
	Acute Pediatric care		25	4	100			
	Acute Psychiatric unit		25	4	100			
	Consultation & Treatment		25	8	200			
	Back office General Practicioner (GP)		20	4	80			
	Back office Emergency Doctor (ED)		20	4	80			31,99%
		Sub-total			1310	*262*	1572 m²	3%
HOTEL	**INPATIENT DEPARTMENT**							
5624	Reception		25	4	100			
10%	Waiting Area		25	12	300			
	Patient Room		22	150	3300			
	Nursing Station		20	20	400			
	Storage and Medication Space		20	20	400			80,01%
		Sub-total			4500	*900*	5400 m²	10%
	INTENSIVE CARE UNIT							
	Reception		50	1	50			
	Waiting Area		50	1	50			
	Patient Room		22	32	704			
	Nursing Station		20	8	160			
	Storage and Medication Space		20	8	160			19,99%
		Sub-total			1124	*225*	1349 m²	2%
OFFICE	**OUTPATIENT DEPARTMENT**							
6779	Reception & Registration		50	1	50			
12%	Waiting area		150	1	150			
	Consultation & Examination room		25	16	400			
	Shared office space		15	40	600			
	Sample storage		25	1	25			18,07%
		Sub-total			1225	*245*	1470 m²	3%
	PHYSICAL REHABILITATION							
	Reception		25	1	25			
	Waiting area		50	1	50			
	Staff Changing room		50	1	50			
	Staff Resting room		50	1	50			
	Patient Changing room		6	4	24			
	Treatment & Electrotherapy		100	1	100			
	Gym // Fitness area		500	1	500			
	Excercise pool		500	1	500			
	Assisted Training Area		500	1	500			
	Fango Area		50	1	50			
	Cryotherapy		50	1	50			
	Storage		250	1	250			
	Office		15	15	225			
	Consultation rooms		25	4	100			36,50%
		Sub-total			2474	*495*	2969 m²	5%
	NEUROPSYCHOLOGICAL REHABILITATION							
	Reception		25	1	25			
	Waiting Area		50	1	50			
	Intake & Consultation room		20	4	80			
	Virtual Training room		50	2	100			
	Intellectual Functioning		50	2	100			

		Learning & Memory		50	2	100			
		Reasoning & Problem solving		50	2	100			
		Visuospatial Skills		50	2	100			
		Language & Personality		50	2	100			
		Neuropsychological Office		15	25	375			16,67%
			Sub-total			1130	*226*	1356 m²	2%
		ADMINISTRATION OFFICE							
		Administration		15	100	1500			
		Meeting rooms		25	6	150			
		Storage facilities		25	6	150			
		Archive		150	1	150			28,77%
			Sub-total			1950	*390*	2340 m²	4%
PUBLIC		**PUBLIC**							
	10780	Café		250	1	250			
	20%	Food court		250	3	750			
		Gift shop		100	1	100			
		Pharmacy		250	1	250			
		Meditation room		50	1	50			
		Prayer room		50	1	50			
		Family room		100	1	100			
		Children's playground		100	1	100			15,31%
			Sub-total			1650	*330*	1980 m²	4%
		EDUCATION							
		Classrooms		75	2	150			
		Lecture hall		180	1	180			
		Seminar rooms		100	2	200			
		Library		350	1	350			
		Exhibition space		500	1	500			
		Multifunctional event space		500	1	500			
		Workshop space		150	1	150			18,83%
			Sub-total			2030	*406*	2436 m²	4%
		PUBLIC TRANSITION SPACES							
		Courtyards		500	4	2000			
		Squares		350	2	700			
		Streets		300	8	2400			
		Galleries		250	8	2000			65,86%
			Sub-total			7100	*1420*	8520 m²	16%
FACTORY		**LOGISTICS**							
	2650	Facility Management & Logistics department		15	20	300			
	5%	Disposal department		1	150	150			
		Linen department		1	150	150			
		Utility Yard		1	300	300			
		Food & Beverage department		1	750	750			
		Pharmacy		1	250	250			
		Material supply		1	250	250			
		Storage		1	500	500			
			Sub-total			2650	*530*	3180 m²	6%
CIRCULATION		**FUNCTIONAL CIRCULATION**							
	9026		*Sub-total*			*9026*		*9026 m²*	*17%*
	17%								
STORAGE		**STORAGE**							
	4.498		*Sub-total*			4.498		m²	8%
	8%								
RESEARCH		**BODY RESEARCH CENTRE**							
	11025	Administration		25	1	25			
	20%	Meeting Room		25	4	100			
		Sample Collection		25	1	25			
		Clean Room Laboratory		75	2	150			
		NeuroPartner incubator; co-working space start-ups		15	100	1500			
		Neurological Research Office		15	150	2250			
		Sanitation Room		50	1	50			
		Sample Storage		150	1	150			
		Neurotechnology Research Laboratory		75	8	600			
		Seminar Room		75	1	75			
		Library		250	1	250			47%
			Sub-total			5175	*1035*	6210 m²	11%
		MATERIAL RESEARCH CENTRE							
		Administration		25	4	100			
		Meeting room		25	4	100			
		Inventory/storage		150	1	150			
		Material Vestibule		50	1	50			
		Assembly & Production		500	1	500			
		Biomechatronics Engineering Workshop		150	4	600			
		Biomechatronics Research Laboratory		75	4	300			
		Biomechatronics Research Office		15	150	2250			
		Incubator; co-working space start-ups		15	100	1500			
		Prototyping Area		150	2	300			53%
			Sub-total			5850	*1170*	7020 m²	13%
				12000					
				4,54					
				2,13		54477			
								25793 m²	
								49.979 m²	
								54.477 m²	

From a passive hospital to an active hospital

The transition from buildings as a healing machine to bodies as a healing machine, will not only affect the optimisation and digitisation of the human body, but also the building program. Figure 4.4 represents a simplified overview of innovation and optimisation per department, developments, and spatial implications. It is not important to speculate about how much this will affect the detailed program. What is important is to conclude that the hospital program is not passive anymore, and needs to be resilient and flexible for future changes and development. Not only in the realm of the building, but also in the realm of the human body.



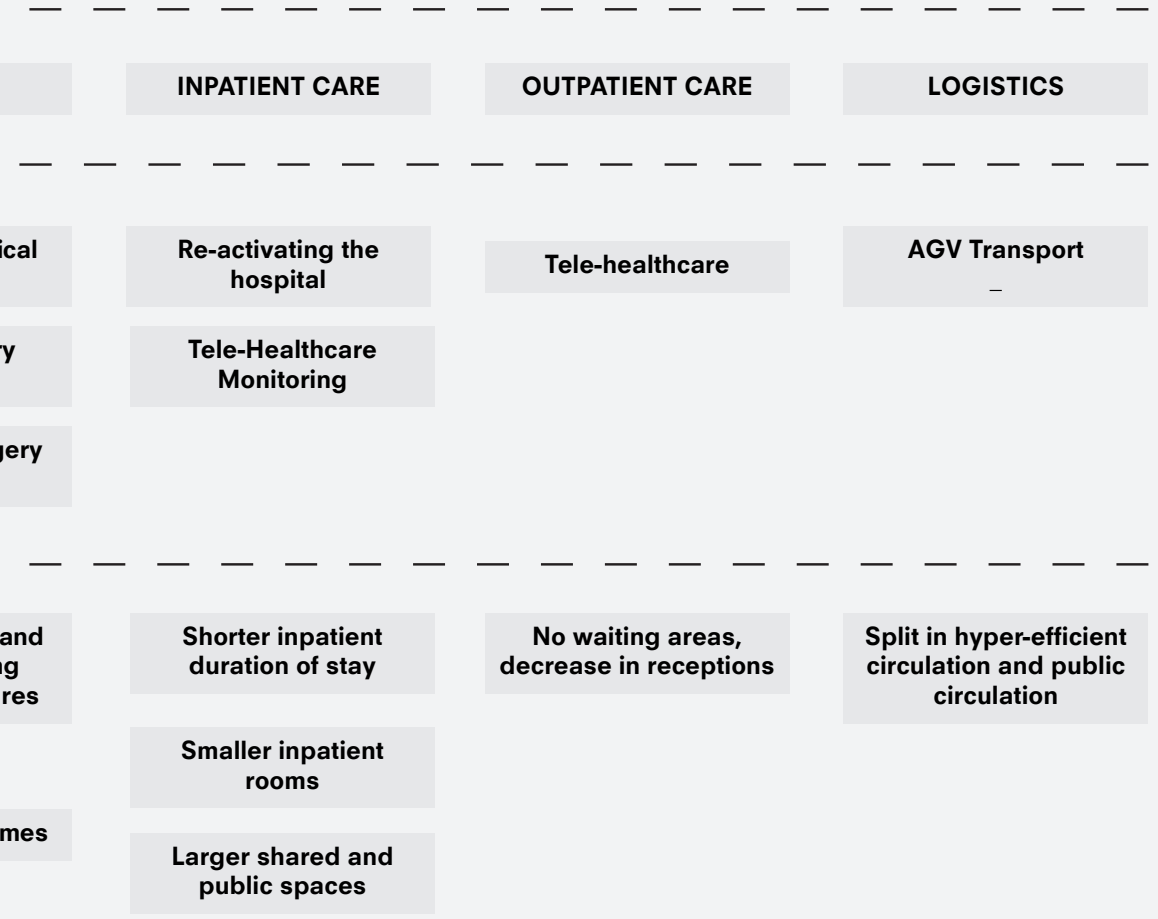


Figure 4.4 - A simplified overview of innovation and optimisation per department, developments, spatial implications.

From a passive hospital to an active hospital

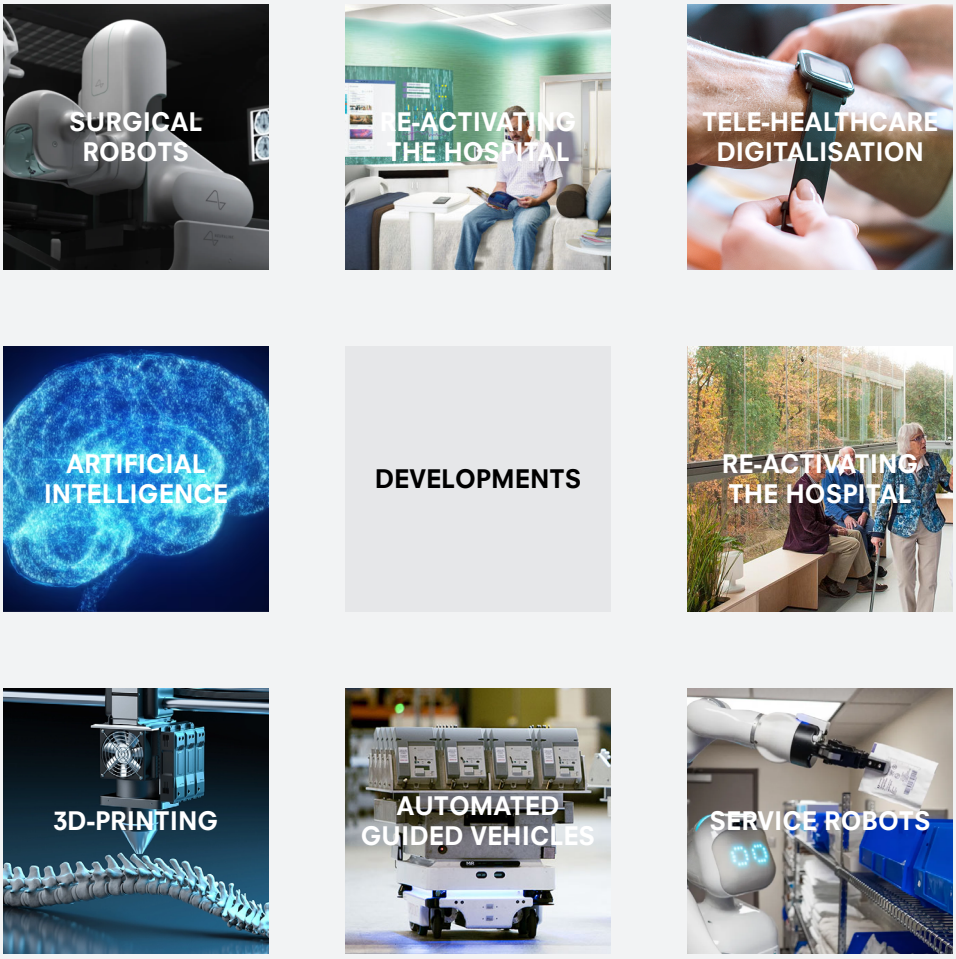


Figure 4.5 - A simplified overview of structural changes in the hospital program.

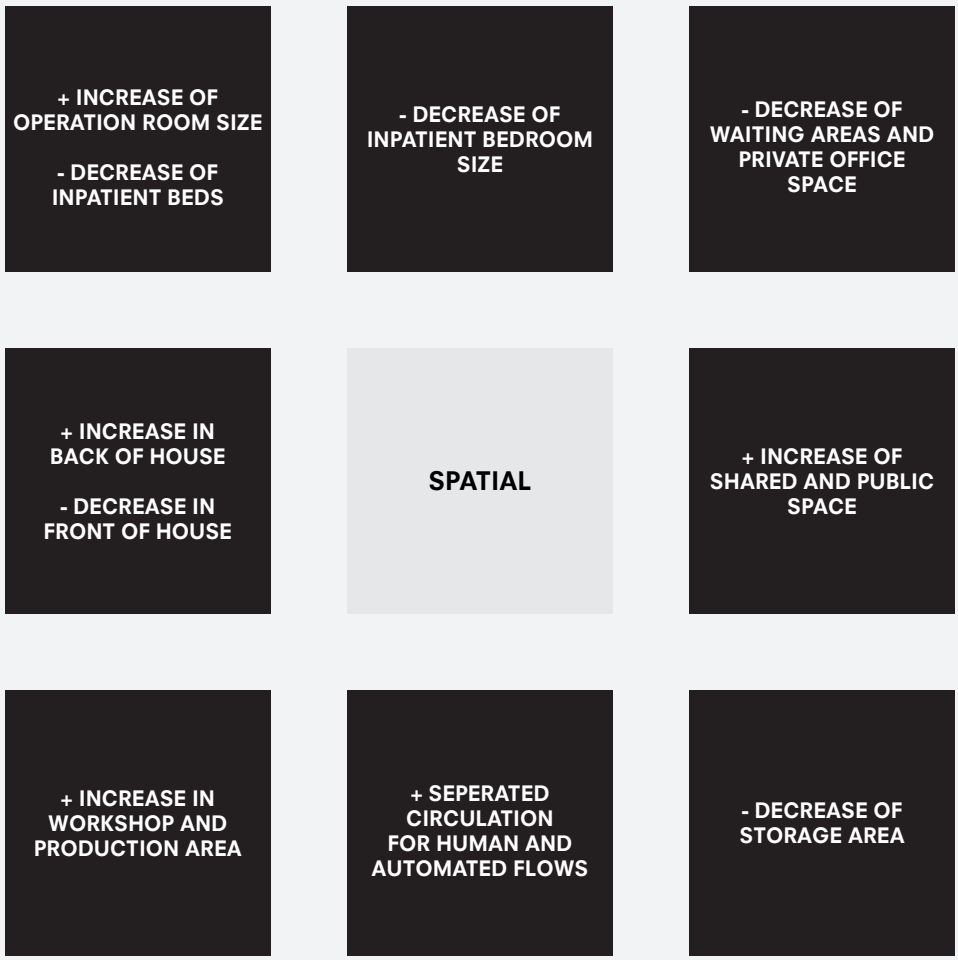


Figure 4.6 - A simplified overview of the spatial implications of innovation, and optimisation in the hospital program.

From a passive hospital to a flexible hospital structure

Following the insight gained from the previous question, the following question arises: “How can we create a living hospital structure, that can grow, upgrade, and get augmented through time?”. Using literature from Nickl-Weller, C., & Nicki, H. (2021) we constructed design principles for a flexible hospital structure. Which starts off with the size of the patient bed, as a starting point for the modulus, used in a larger modular grid. Which can be expanded to various modular sizes that are usable for different program within the hospital. The range of this modulus can be flexible between 7.2 and 8.4 meters, depending on the region and budget. As 7.5 works sufficiently in the case of modularity, we have illustrated the flexibility of the hospital structure in the following illustrations, starting off with figure 4.7.

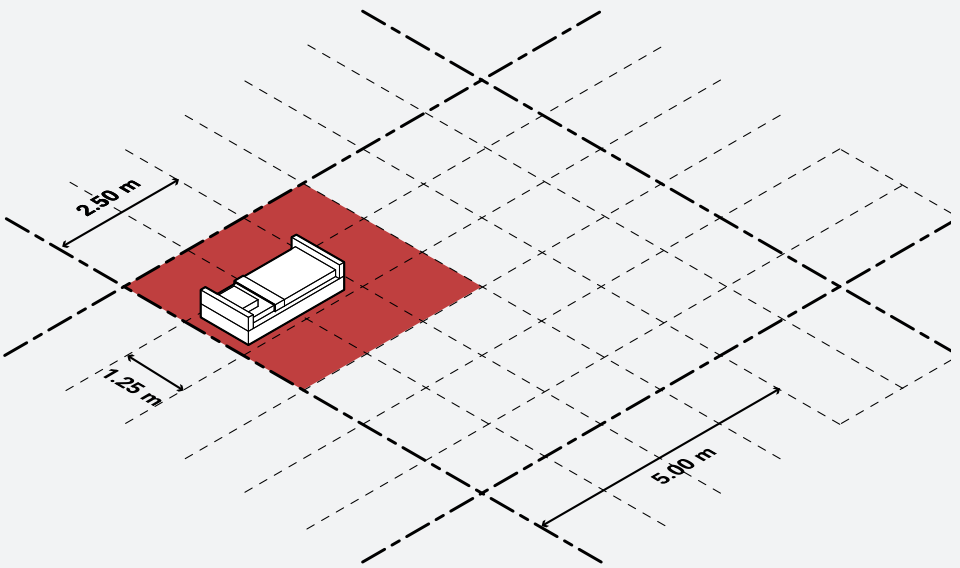


Figure 4.7 - Modular hospital structure principle. Nickl-Weller, C., & Nicki, H. (2021). Architecture for health.

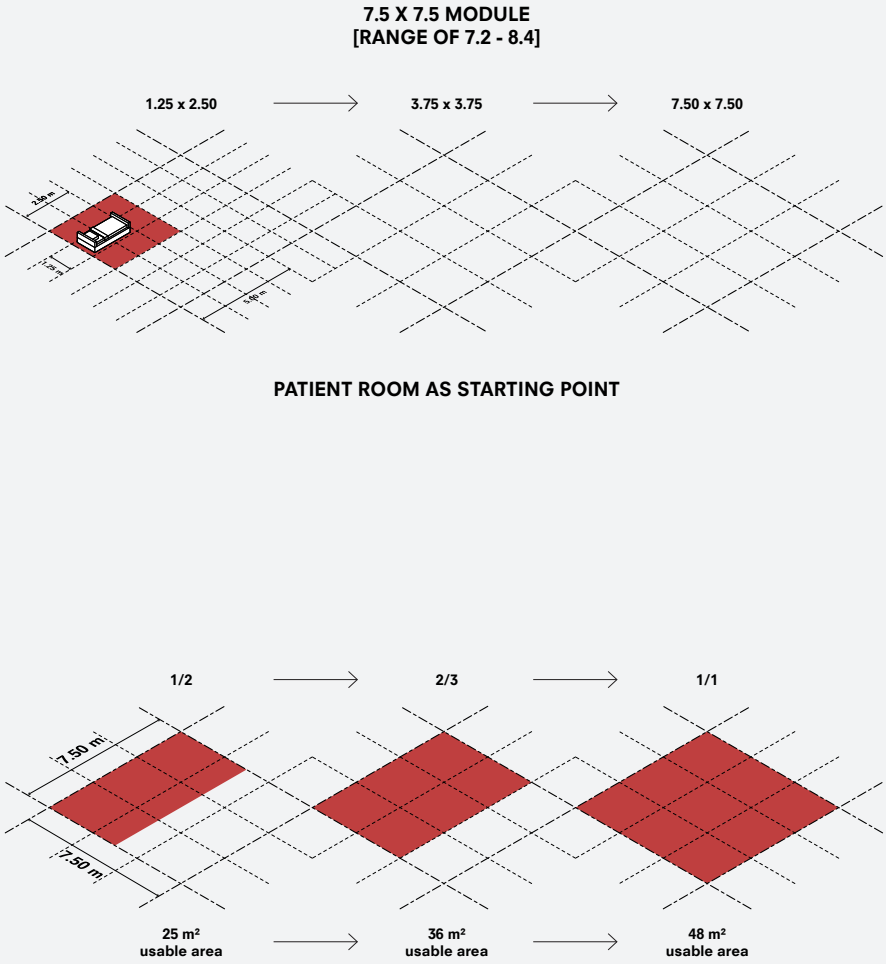
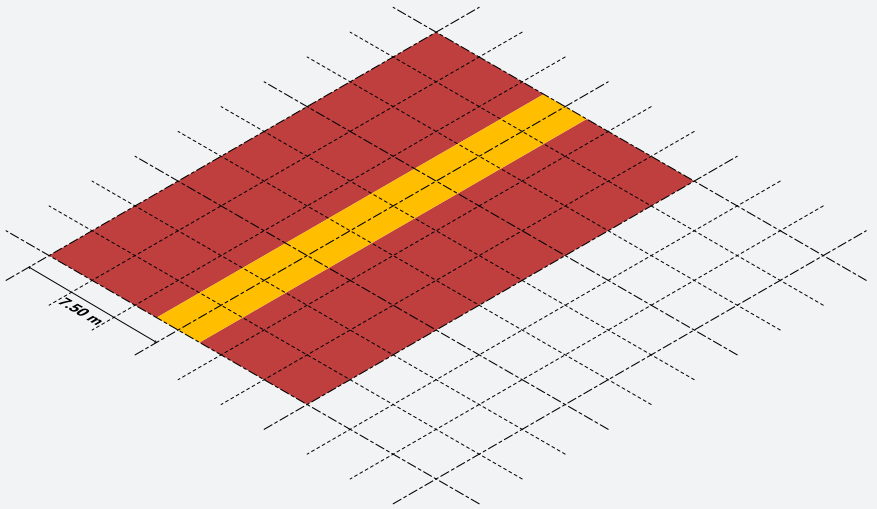


Figure 4.8 - Modular hospital structure principle. Nickl-Weller, C., & Nicki, H. (2021). Architecture for health.

INPATIENT DEPARTMENT - 15M WIDE



HOT FLOOR - 22,5M WIDE

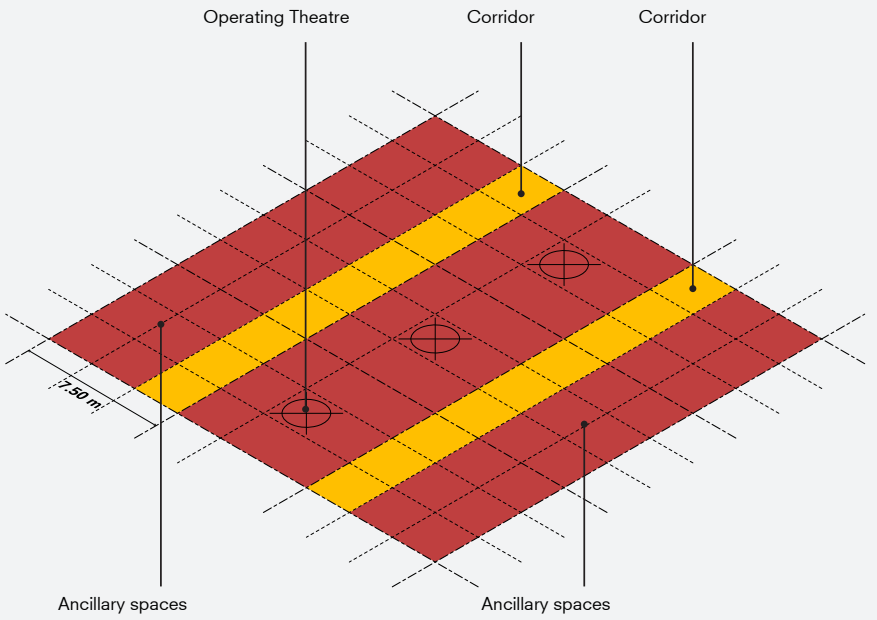
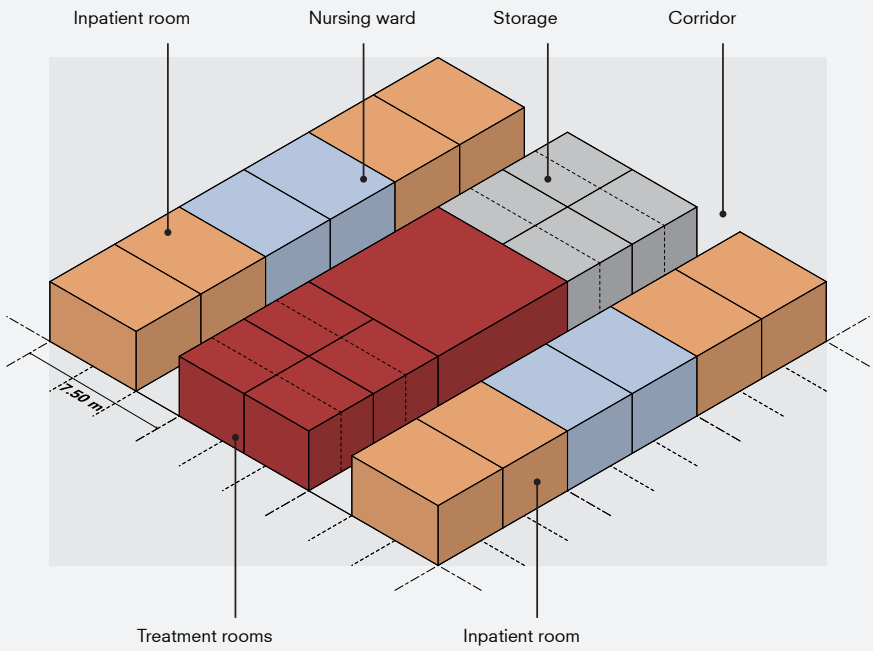
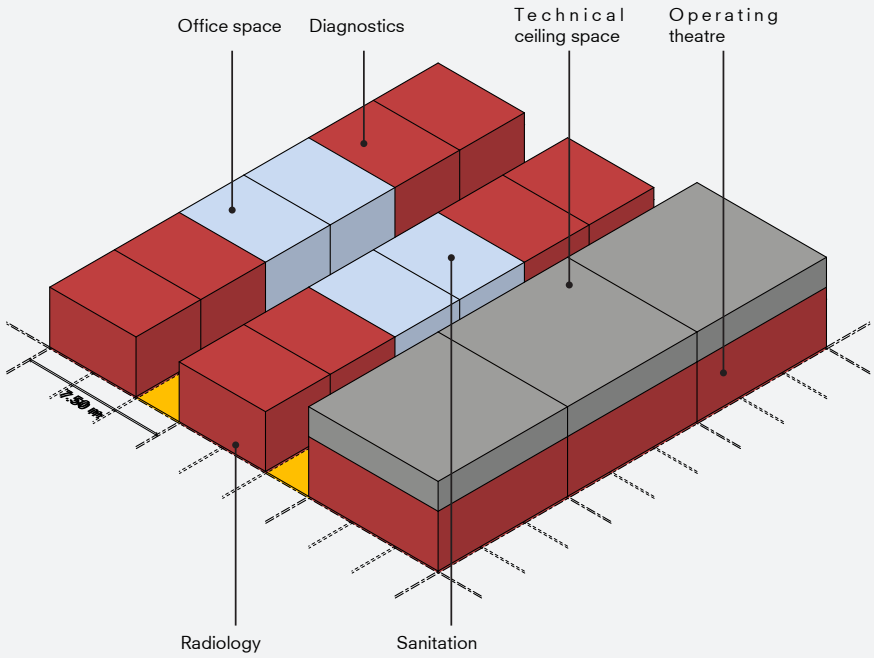


Figure 4.7 - Modular hospital structure principle. Nickl-Weller, C., & Nicki, H. (2021). Architecture for health.



HOTEL - INTENSIVE CARE DEPARTMENT



HOT FLOOR - DIAGNOSTICS & OPERATION

Figure 4.8 - Modular hospital structure principle. Nickl-Weller, C., & Nicki, H. (2021). Architecture for health.

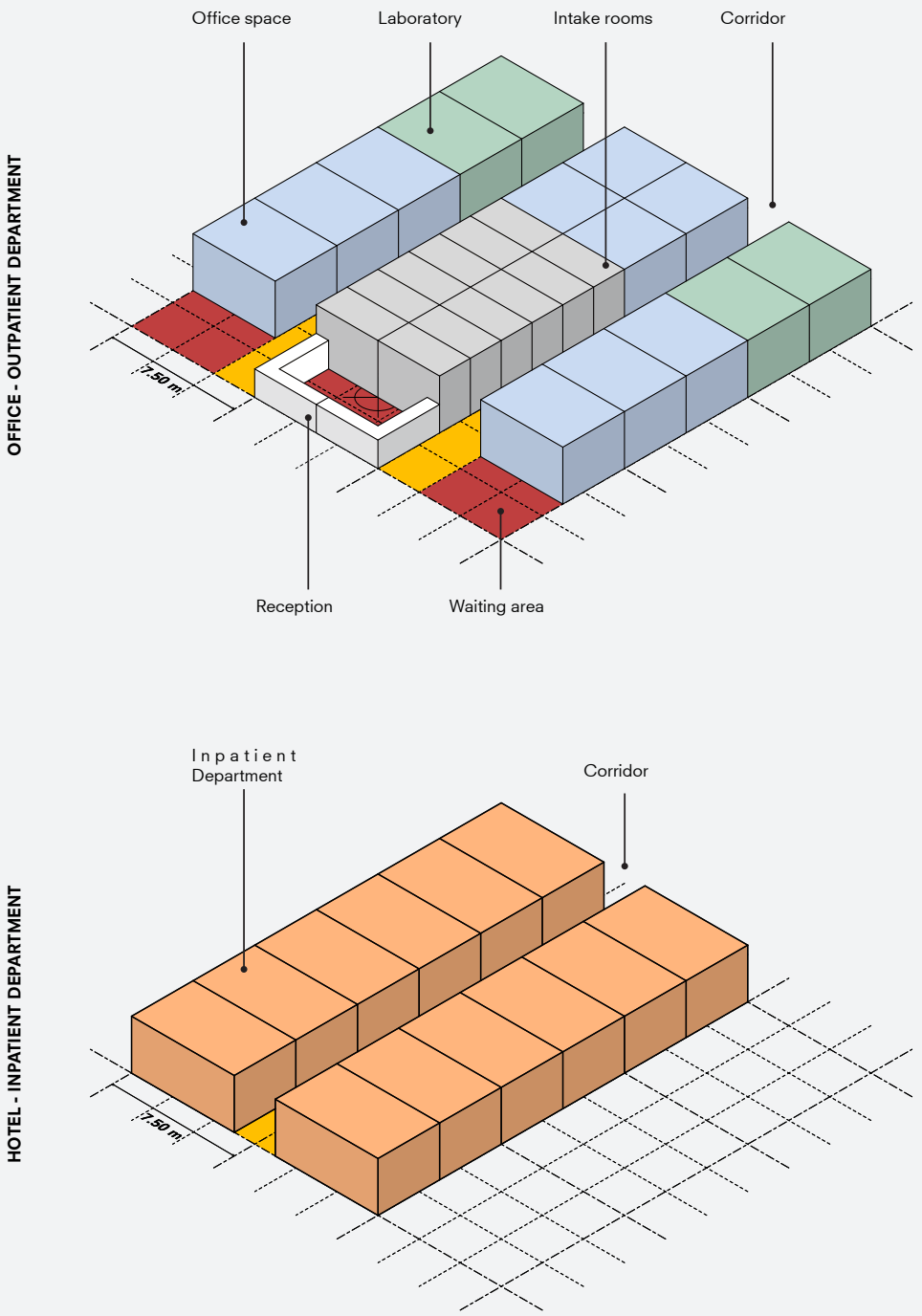
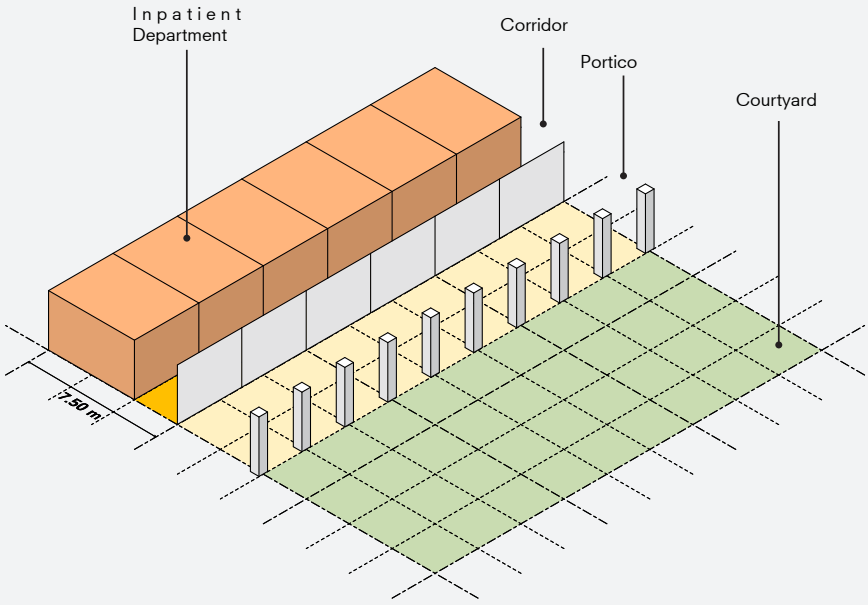
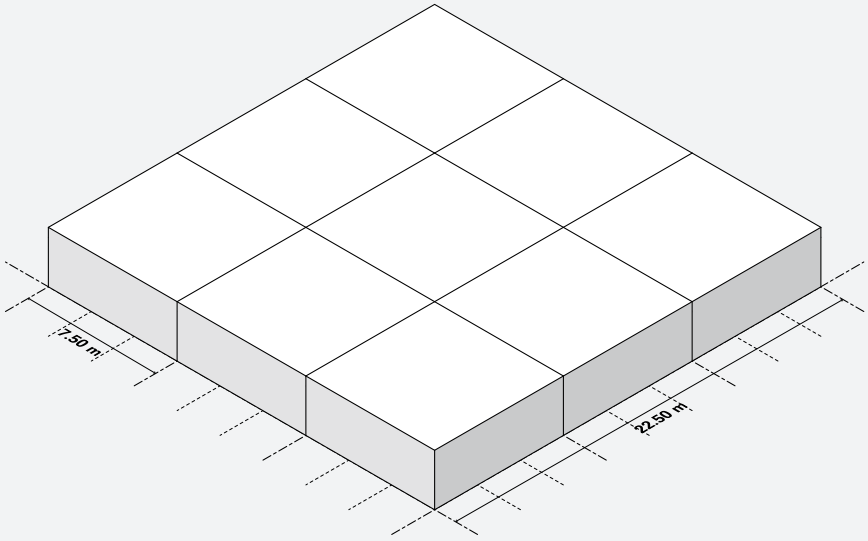


Figure 4.7 - Modular hospital structure principle. Nickl-Weller, C., & Nicki, H. (2021). Architecture for health.



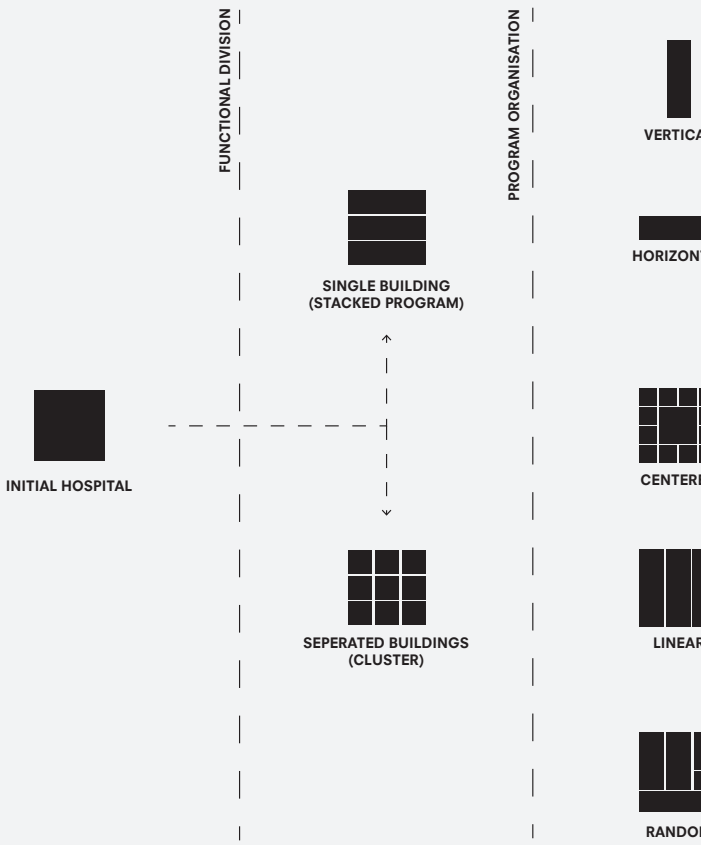


STANDARDISED MODULE 7.50 X 7.50 / 22.50 X 22.50

Figure 4.8 - Modular hospital structure principle. Nickl-Weller, C., & Nicki, H. (2021). Architecture for health.

From a closed hospital to an open hospital

The transition towards a flexible and modular structure, as stated in the last paragraph, also offer the opportunity in changing spatial organisations. Using the benchmark casestudy as starting point, we can see that there are multiple variations of organising hospitals and their respective departments. This can all be summarised into six clear spatial configurations; the cross, courtyard, the line, the campus, the comb, and the hybrid. These six strategies are illustrated in an overview on the next spread, and can be used to organise the hospital departments, flows, and their openness towards their surroundings.



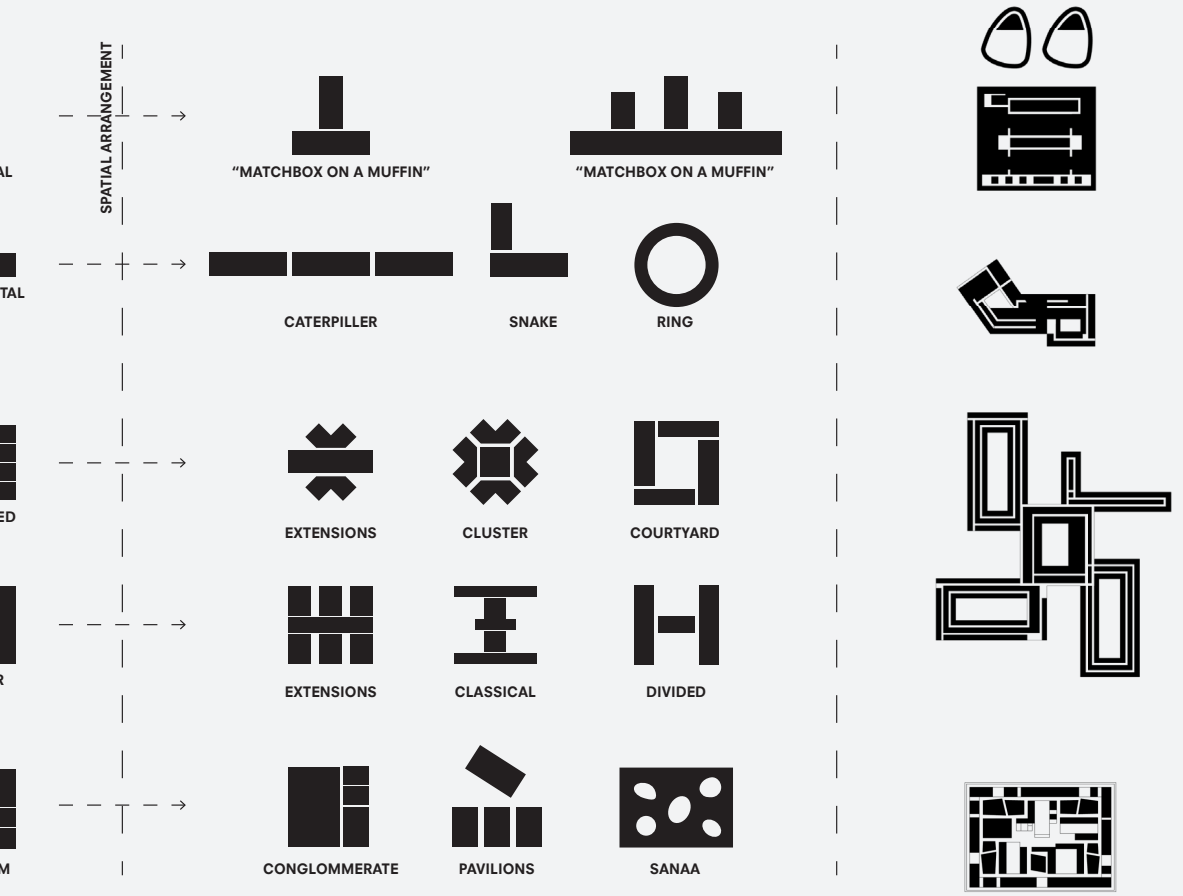
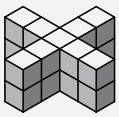
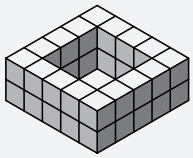
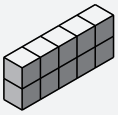
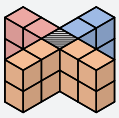
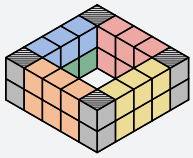
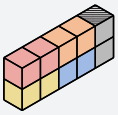
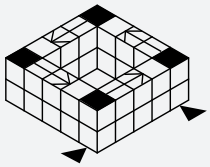
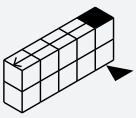
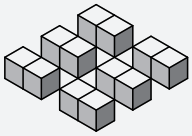
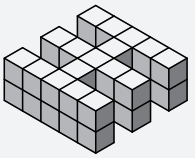
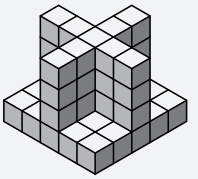
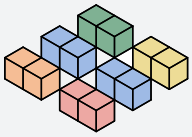
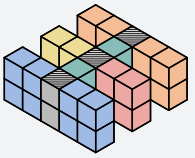
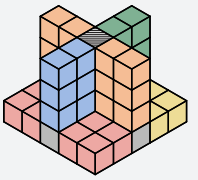
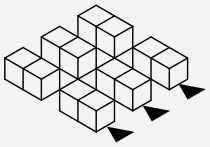
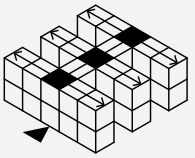
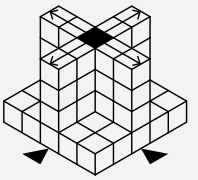


Figure 4.4 - A simplified overview of innovation and optimisation per department, developments, spatial implications.

	CROSS	COURTYARD	LINE
STRUCTURE			
ORGANISATION			
FLOWS			

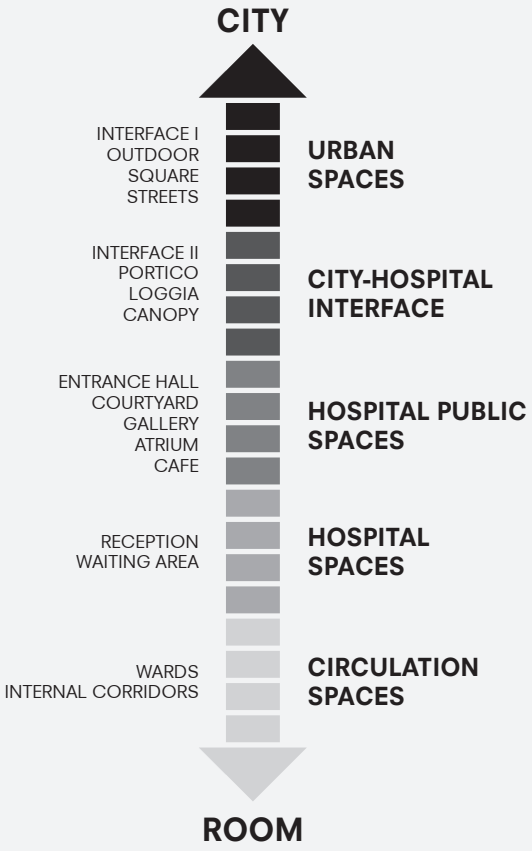
NICKL-WELLER, C., & NICKI, H. (2021). ARCHIT

CAMPUS	COMB	HYBRID
		
		
		

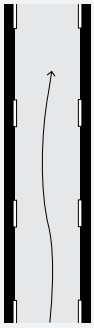
TECTURE FOR HEALTH. BRAUN PUBLISHING.

From a hospital for only patients to a hospital for society.

The various different spatial organisation strategies also offer an opportunity to reshape the image of the hospital. By redefining the key space of the hospital; the corridor - into an array of multiple public space typologies. This will open up the hospital towards the public, while also creating spaces that are inviting, and offer the opportunity to discover, stay, and explore the activities within the hospital.

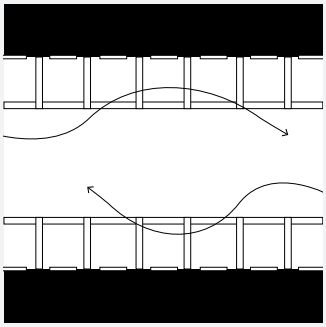


"THE STANDARD"

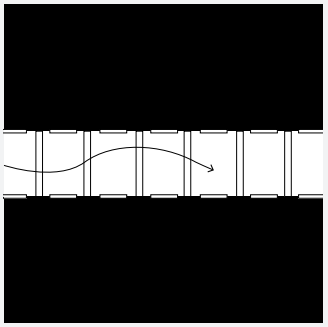


CORRIDOR

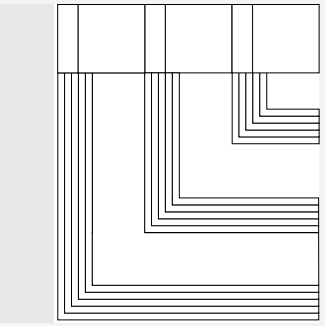
[2.25 - 3.00 M WIDE]



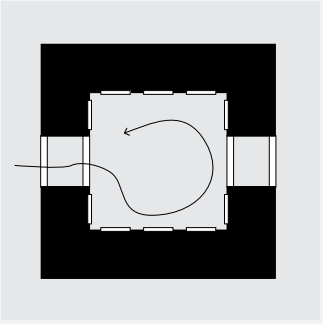
STREET



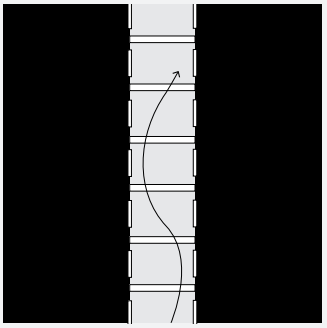
BRIDGE



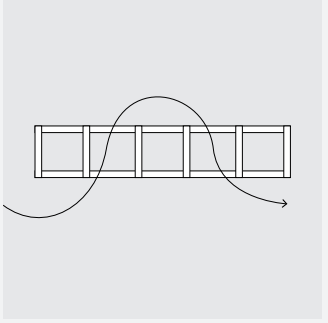
STAIRS



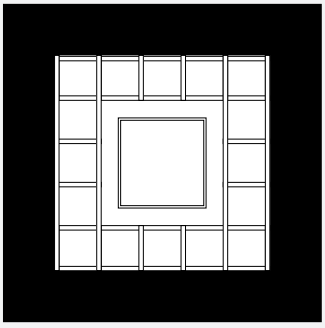
URBAN COURTYARD



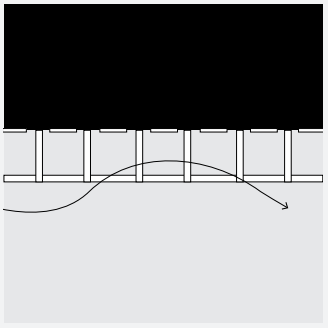
GALLERY



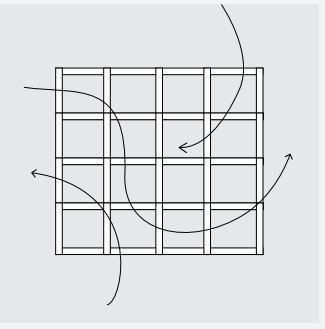
LOGGIA



GREEN COURTYARD



PORTICO



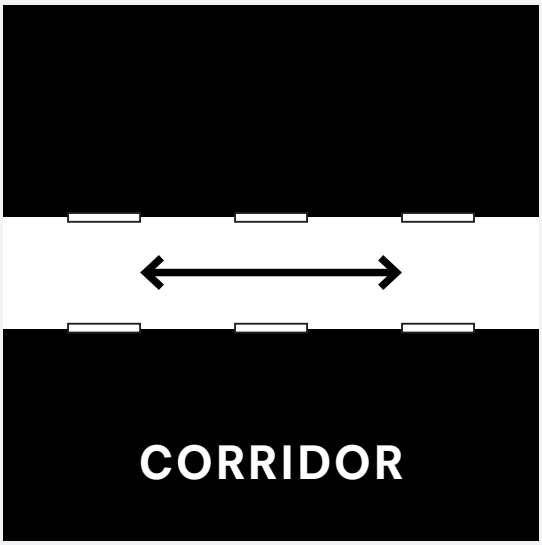
COVERED SQUARE

THE ARCHITECTURE OF PUBLIC SPACE (2023)
MARIA CLAUDIA CLEMENTE, FRANCESCO ISIDORI

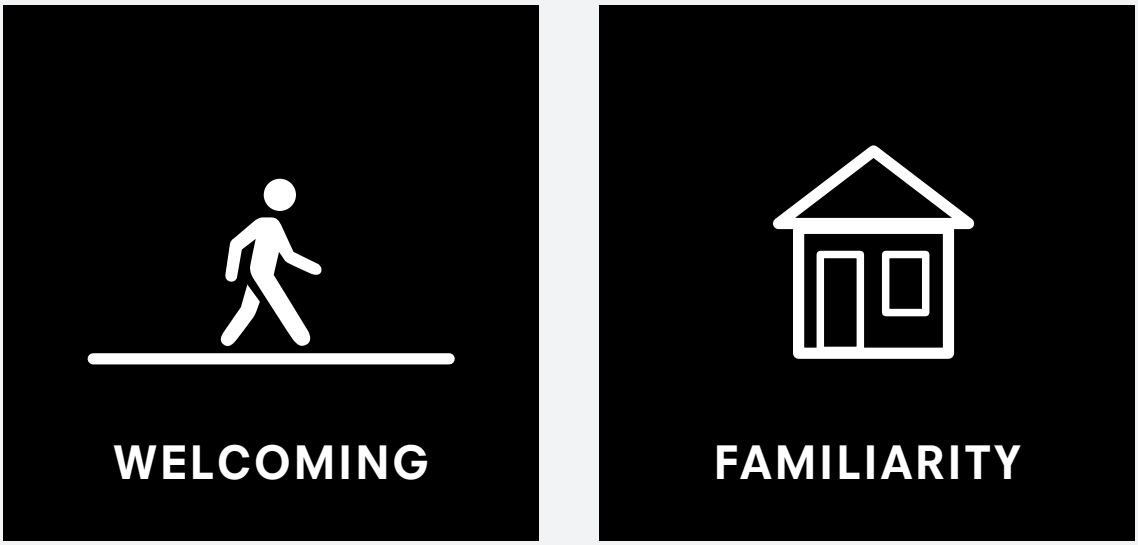
Re-materialise

Materials can be used to identify the different spatial conditions between public and private, between the patient room, and the city surrounding it. Based on the material framework of the Material group, a selection of materials has been made to help guide the public into the public realm of the hospital. While taking into account welcoming material characteristics, by the familiar settings they represent.

TYPOLOGY

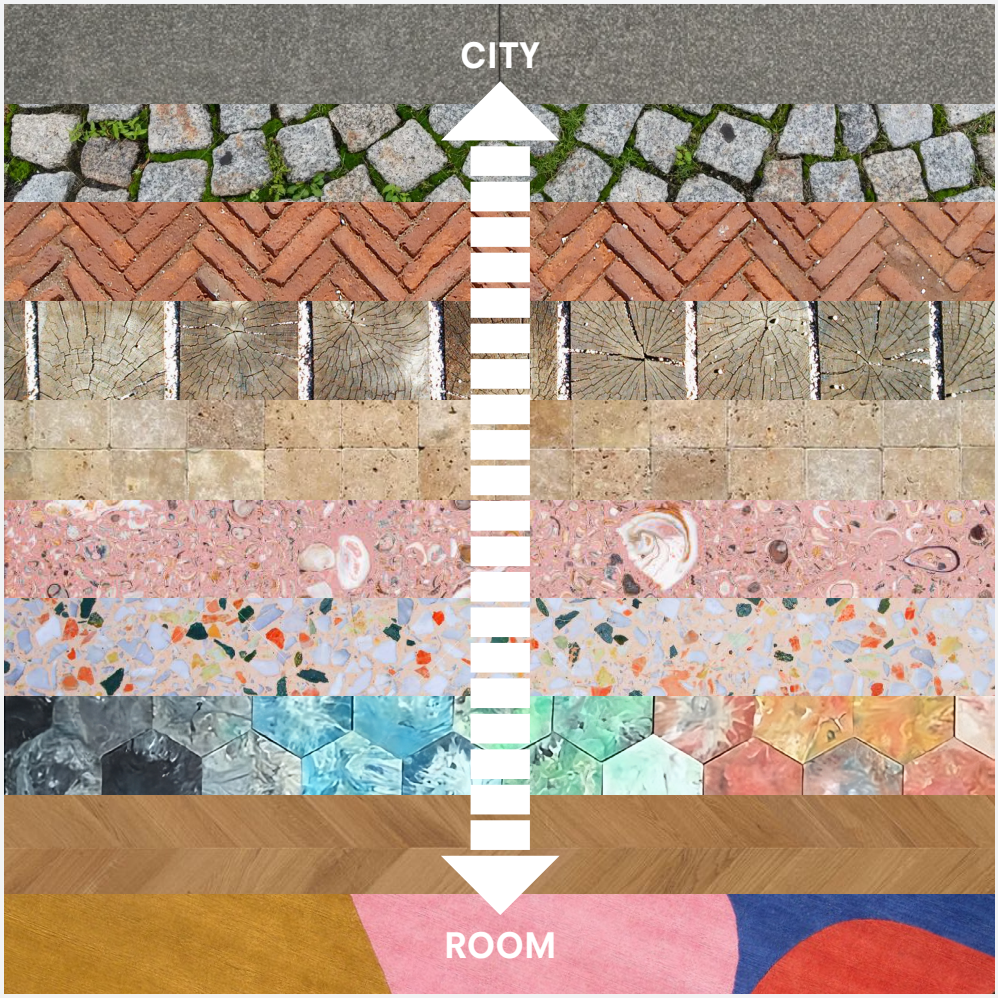


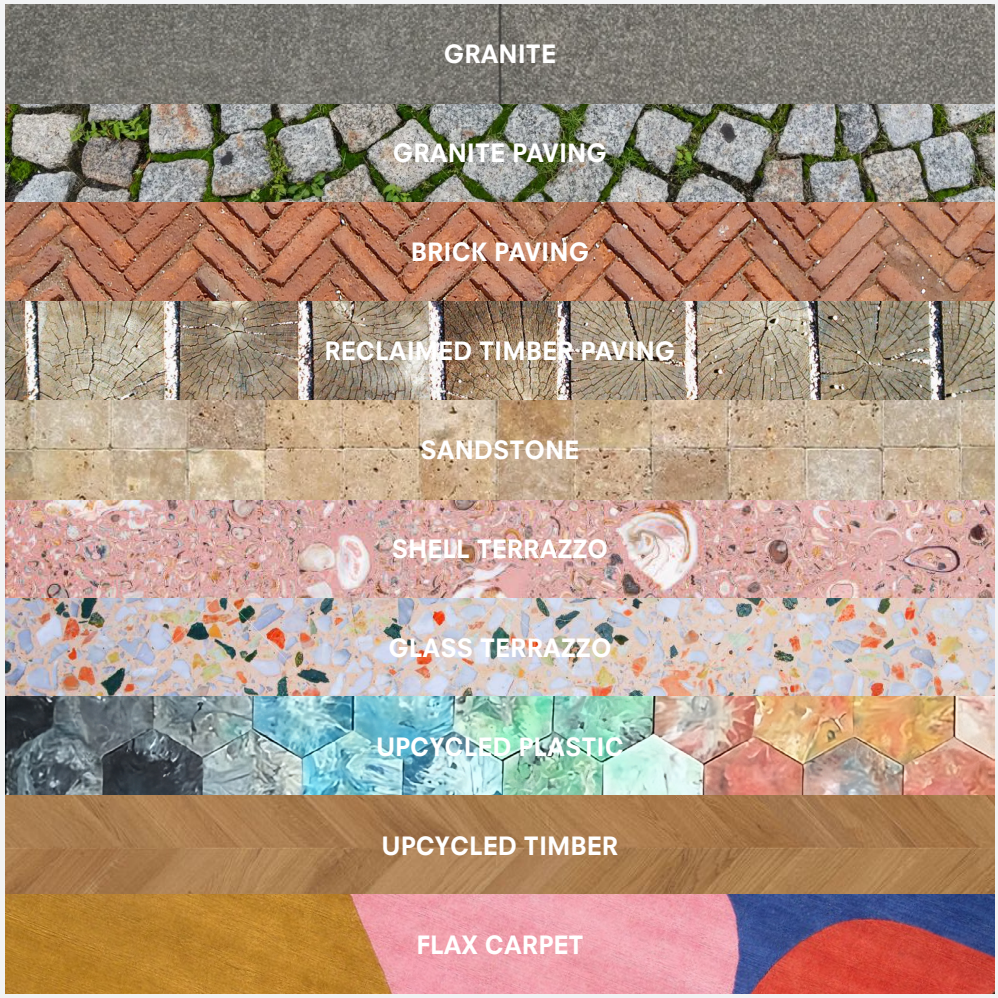
KEY SPACE



CHARACTERISTIC

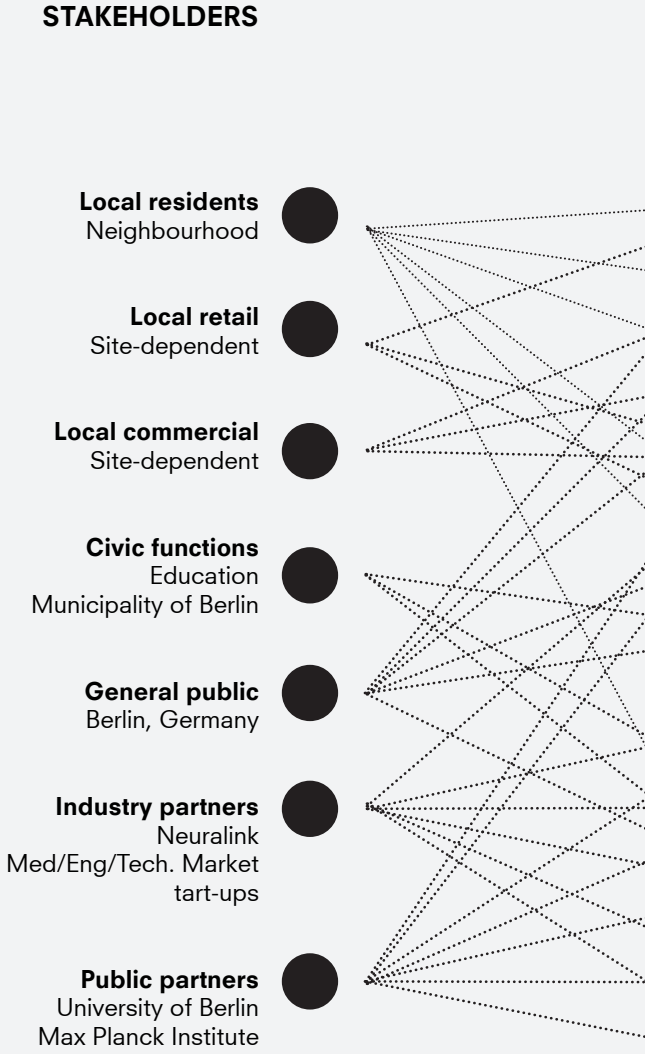
MATERIAL EMPHASIS

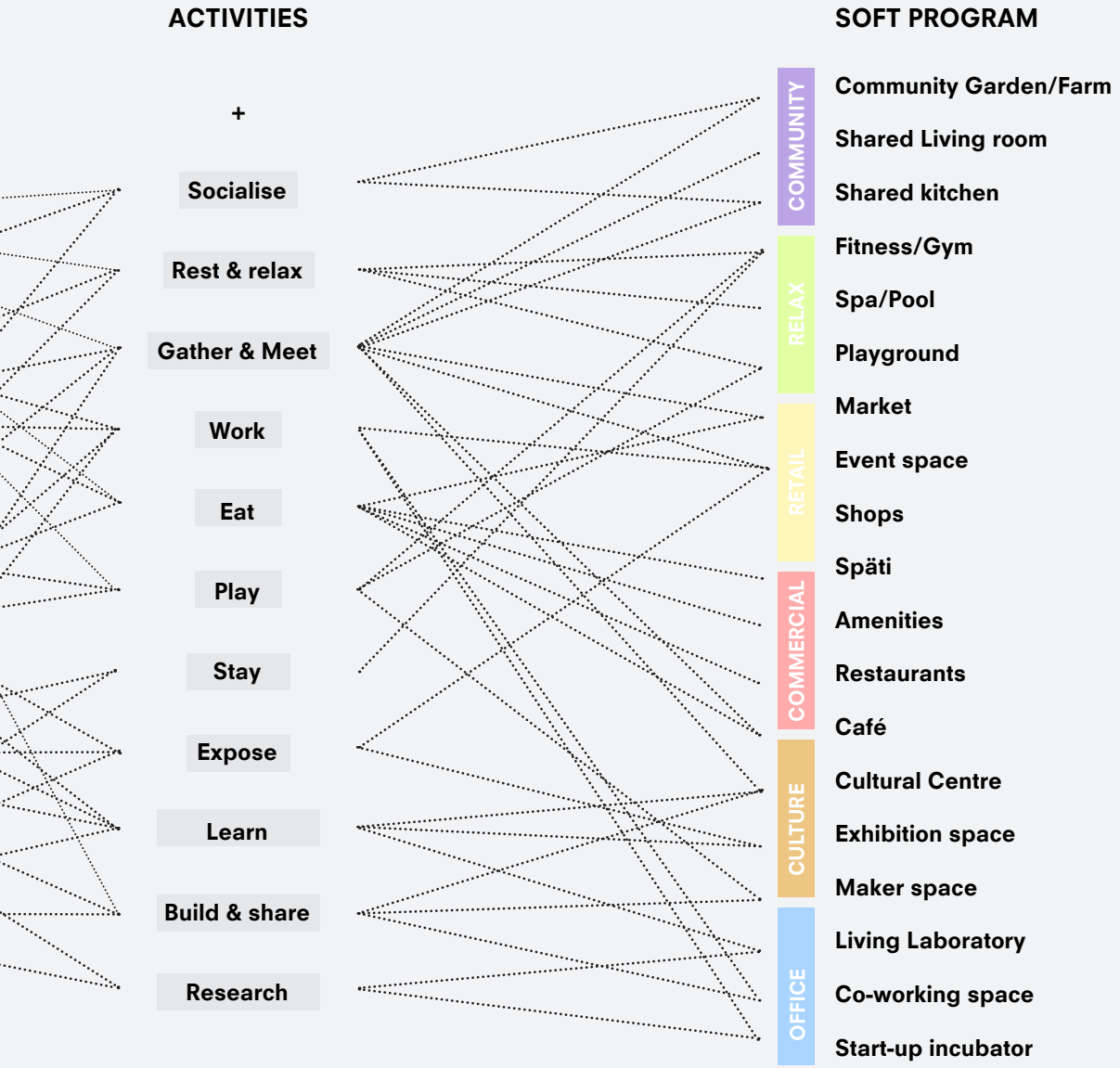

CITY
ROOM


GRANITE
GRANITE PAVING
BRICK PAVING
RECLAIMED TIMBER PAVING
SANDSTONE
SHELL TERRAZZO
GLASS TERRAZZO
UPCYCLED PLASTIC
UPCYCLED TIMBER
FLAX CARPET

Re-program

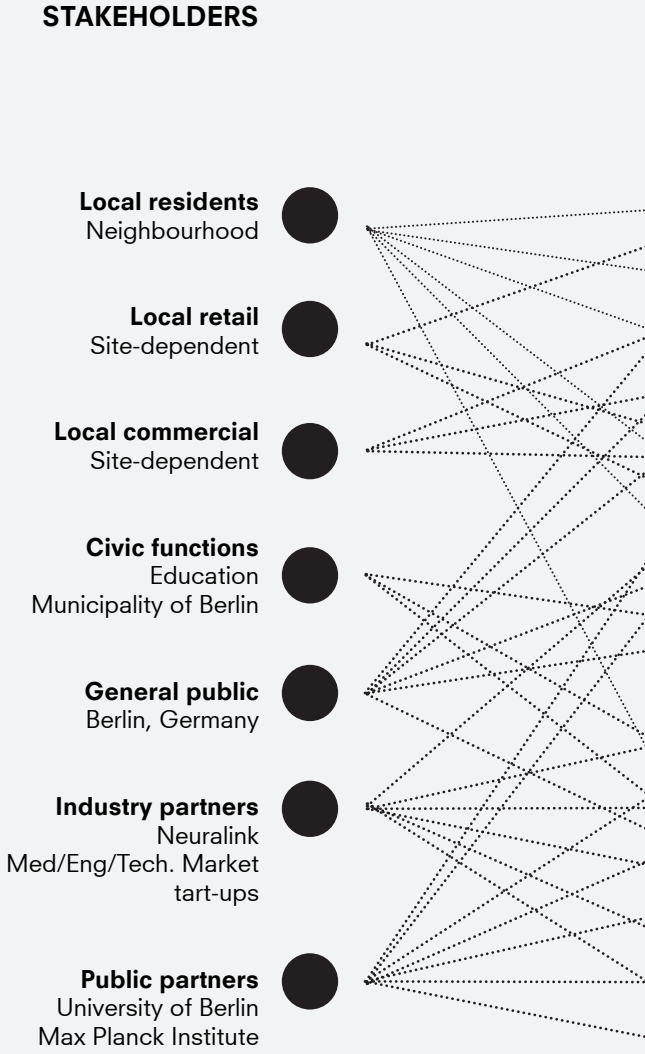
In order to create a hospital for society, there is a need to address the current program that is only catered towards patients. In order to address this singularity in-use, we need to re-program the existing hospital. By changing the spatial organisation, public spaces, and materiality of the hospital as an entity. We now have the opportunity to add program that caters towards the general public and society. To get a better grasp of what society needs, a combination of stakeholders, activities, and program related to it have been illustrated in the following figure. The indicated program functions as 'soft' program, in addition to the existing 'hard' program of the hospital itself. The 'soft' program will be distributed in ratio 1:2, in proportion to the 'hard' program of the hospital. This will result in a combination of program within the framework of the future typology of the hospital. Which is illustrated on the next spread.

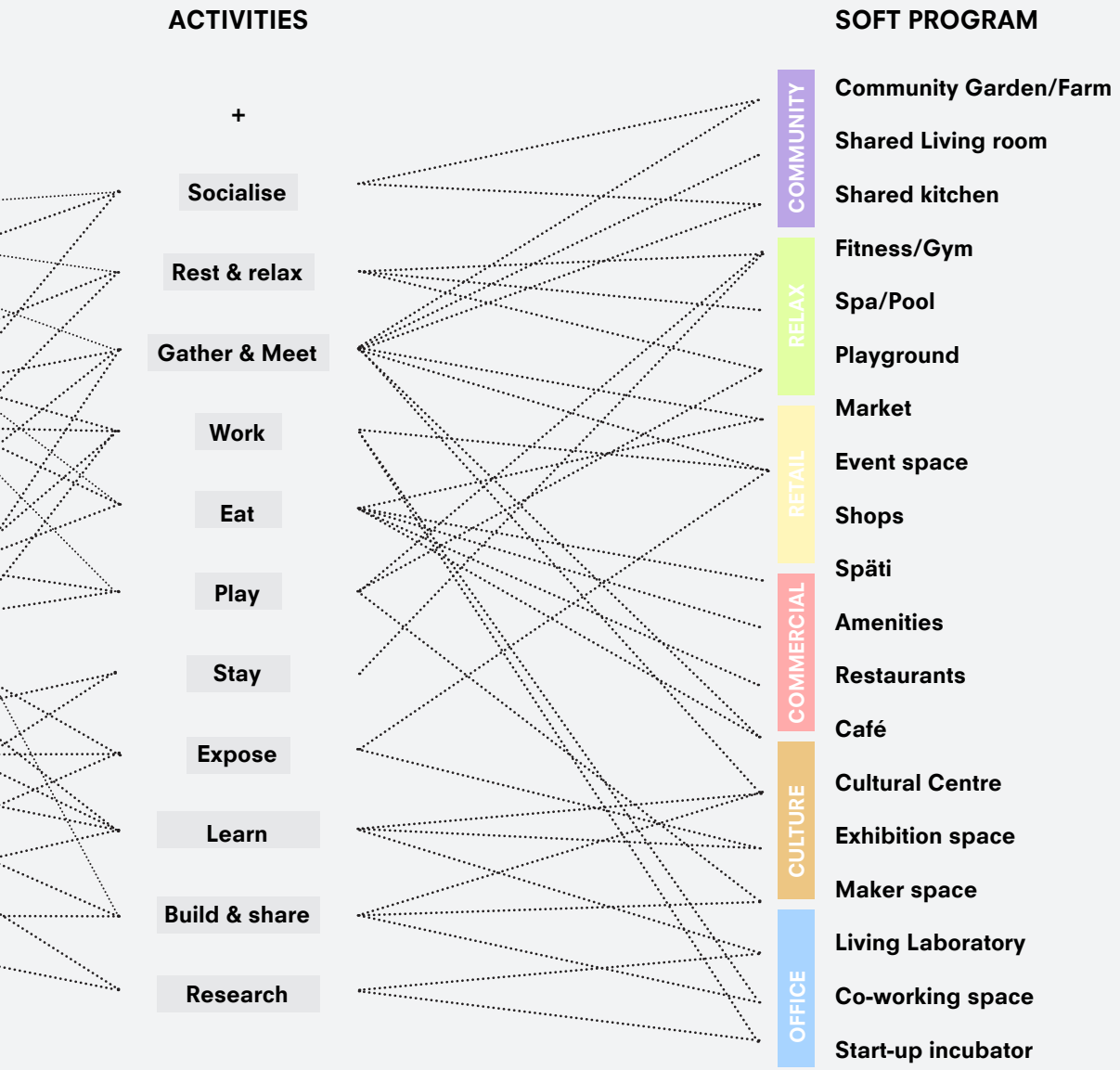



ACTIVITIES
+
Socialise
Rest & relax
Gather & Meet
Work
Eat
Play
Stay
Expose
Learn
Build & share
Research
SOFT PROGRAM
COMMUNITY
RELAX
RETAIL
COMMERCIAL
CULTURE
OFFICE
Community Garden/Farm
Shared Living room
Shared kitchen
Fitness/Gym
Spa/Pool
Playground
Market
Event space
Shops
Späti
Amenities
Restaurants
Café
Cultural Centre
Exhibition space
Maker space
Living Laboratory
Co-working space
Start-up incubator

Re-program

In order to create a hospital for society, there is a need to address the current program that is only catered towards patients. In order to address this singularity in-use, we need to re-program the existing hospital. By changing the spatial organisation, public spaces, and materiality of the hospital as an entity. We now have the opportunity to add program that caters towards the general public and society. To get a better grasp of what society needs, a combination of stakeholders, activities, and program related to it have been illustrated in the following figure. The indicated program functions as 'soft' program, in addition to the existing 'hard' program of the hospital itself. The 'soft' program will be distributed in ratio 1:2, in proportion to the 'hard' program of the hospital. This will result in a combination of program within the framework of the future typology of the hospital. Which is illustrated on the next spread.




ACTIVITIES
+
Socialise
Rest & relax
Gather & Meet
Work
Eat
Play
Stay
Expose
Learn
Build & share
Research
SOFT PROGRAM
COMMUNITY
RELAX
RETAIL
COMMERCIAL
CULTURE
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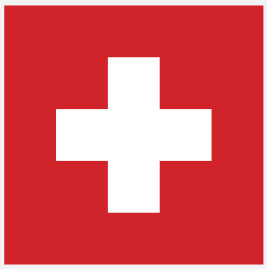
Market
Event space
Shops
Späti
Amenities
Restaurants
Café
Cultural Centre
Exhibition space
Maker space
Living Laboratory
Co-working space
Start-up incubator

From Institute to Collective

All-in-all, combining the ‘hard’ program with the ‘soft’ program catered towards society, will change the image of the hospital typology fundamentally. From singular-in-use institute, towards a mixed-use collective.



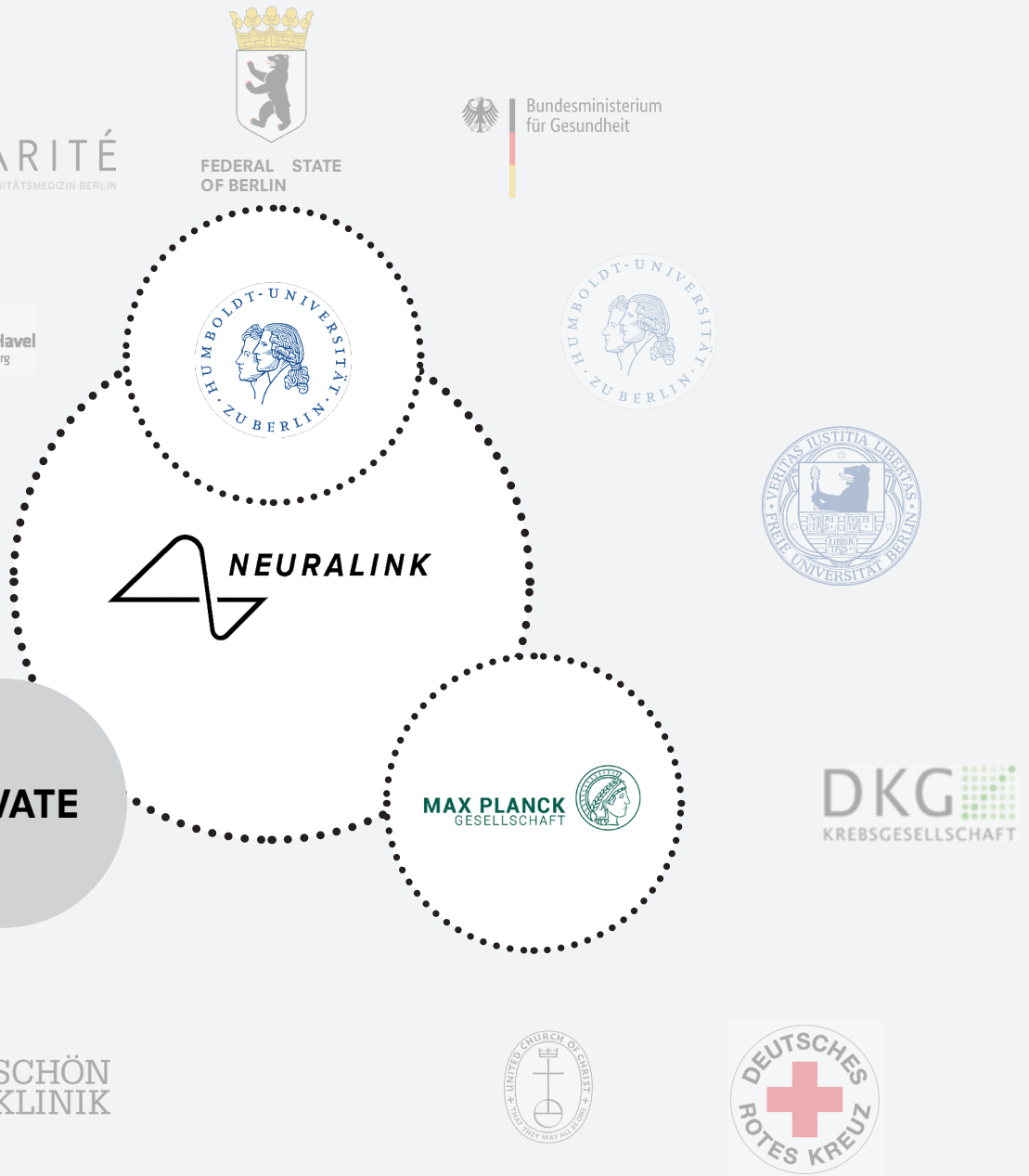
FROM SINGULAR IN-USE

TO MIXED-USE FOR SOCIETY

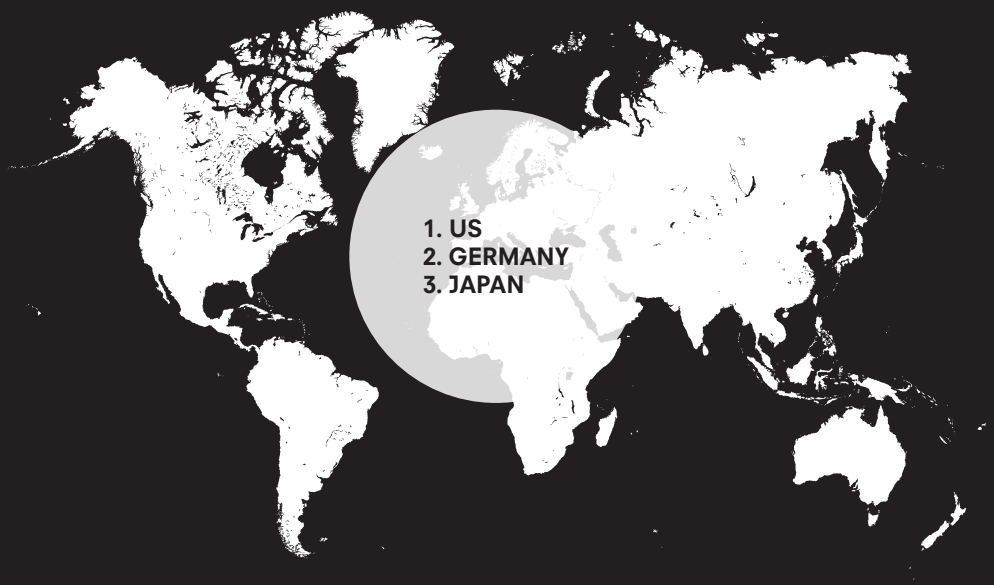
4.2 Client

Based on the specialised focus of the hospital; which focuses on augmentation of human bodies - online research has been carried out towards finding suitable clients who are already involved in developing this procedure and treatment. Not only from the perspective of the industry, but also from the non-profit and ethical perspective.

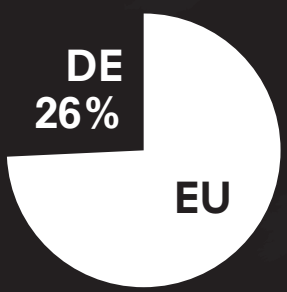
One of the leading companies which already has a main focus on the different applications of augmenting the body is Neuralink. Also known because of the funding by Elon Musk, the company has already received approval for the first human-trials, which will focus on implementing its brain implant for paralysis patients. Neuralink has been chosen as the main client and industry-backer of the project. In addition to the market and industry behind Human Augmentation, we also chose two other parties: namely the Max Planck Gesellschaft and the Humboldt University of Berlin - as two local and involved parties, that are interested in the academic development surrounding this topic, and mainly the ethical questions that will be raised within this industry. By sellecting the Max Planck Gesellschaft and the Humboldt University of Berlin, two local parties will also be involved the Institute of Augmented Bodies, thus connecting the interest of society, Berlin, Germany, with that of Neuralink, which has a global interest.


FEDERAL STATE
OF BERLIN
Bundesministerium
für Gesundheit
HUMBOLDT-UNIVERSITÄT ZU BERLIN
NEURALINK
MAX PLANCK
GESELLSCHAFT
DKG
KREBSGESELLSCHAFT
DEUTSCHES
ROTES KREUZ

GLOBAL MARKET LEADERS



EUROPEAN MARKET



MEDICAL DEVICE MARKET

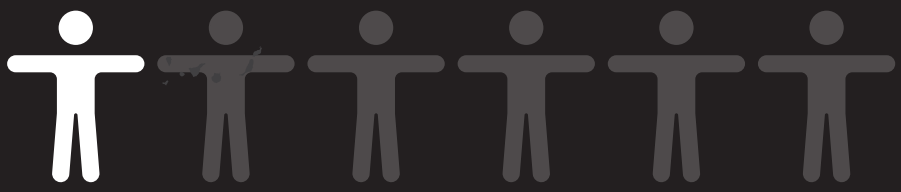
GERMANY
$42 BILLION

EUROPEAN UNION
$160 BILLION

The German medical device market is one of the most lucrative healthcare markets worldwide, accounting for roughly USD 42 billion annually, or 26.4% of the European market total.

LEADER OF THE EU

GERMANY AS HEADHUNTER OF THE HEALTHCARE QUALITY & INDUSTRY



1/6 JOBS LINKED TO THE HEALTHCARE SECTOR
678.2 BILLION EURO, 12% OF GERMANY'S GDP

German Medical
Healthcare market.

MENS

CGM CompuGroup Medical

YER

SARTORIUS

ger

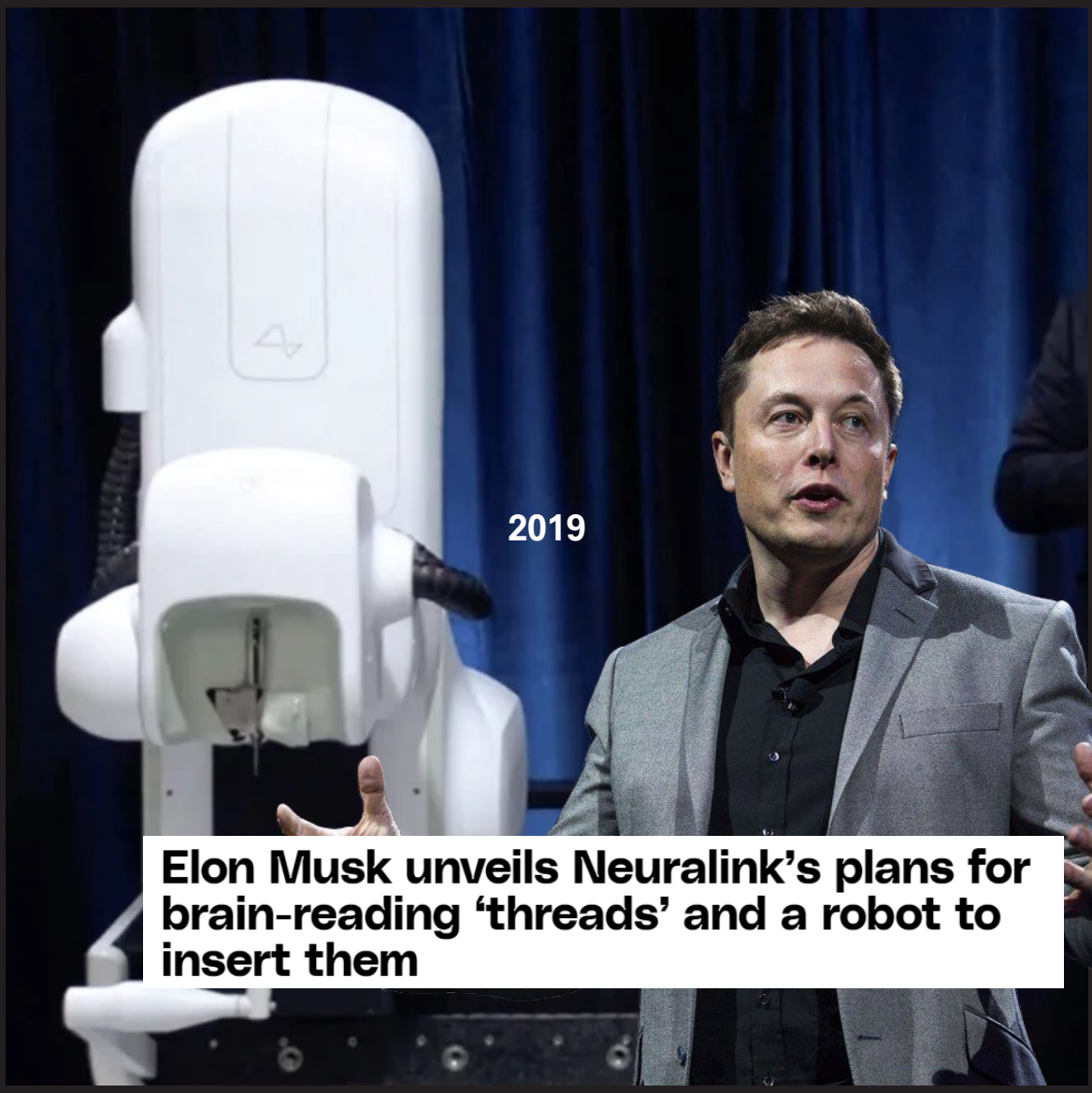
BIONTECH

ec●●

BIOTRONIK

A new competitor;
Neuralink - A brief history...


Elon Musk Launches Neuralink to Connect Brains With Computers
2016


2019
Elon Musk unveils Neuralink's plans for brain-reading 'threads' and a robot to insert them

2021

Neuralink Monkey Types With Brain Implant, Elon Musk Says Human Testing Coming

Elon Musk's startup Neuralink said it should be ready to test its brain-implant technology on humans in six months. WSJ's Daniela Hernandez reports on the event that showcased 'telepathic typing' in a monkey and the implantation of a neural device. Photo: Neuralink

By Wall Street Journal

Future of Health

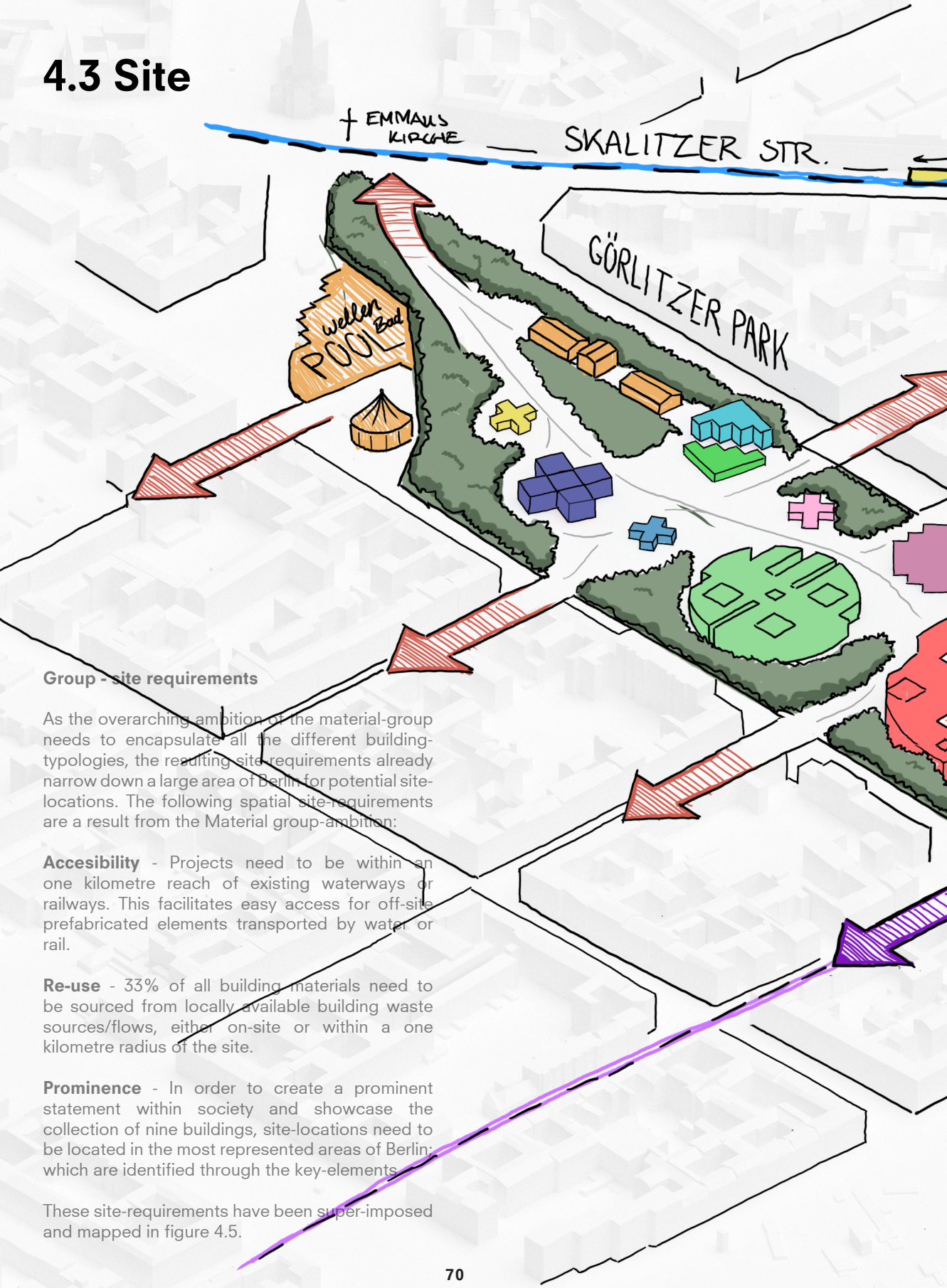
Musk's Neuralink to start human trial of brain implant for paralysis patients

Reuters


BREAKING NEWS Elon Musk reveals first human has received BRAIN implant from Neuralink 'and is recovering well'
NEURALINK

2024

4.3 Site



Group - site requirements

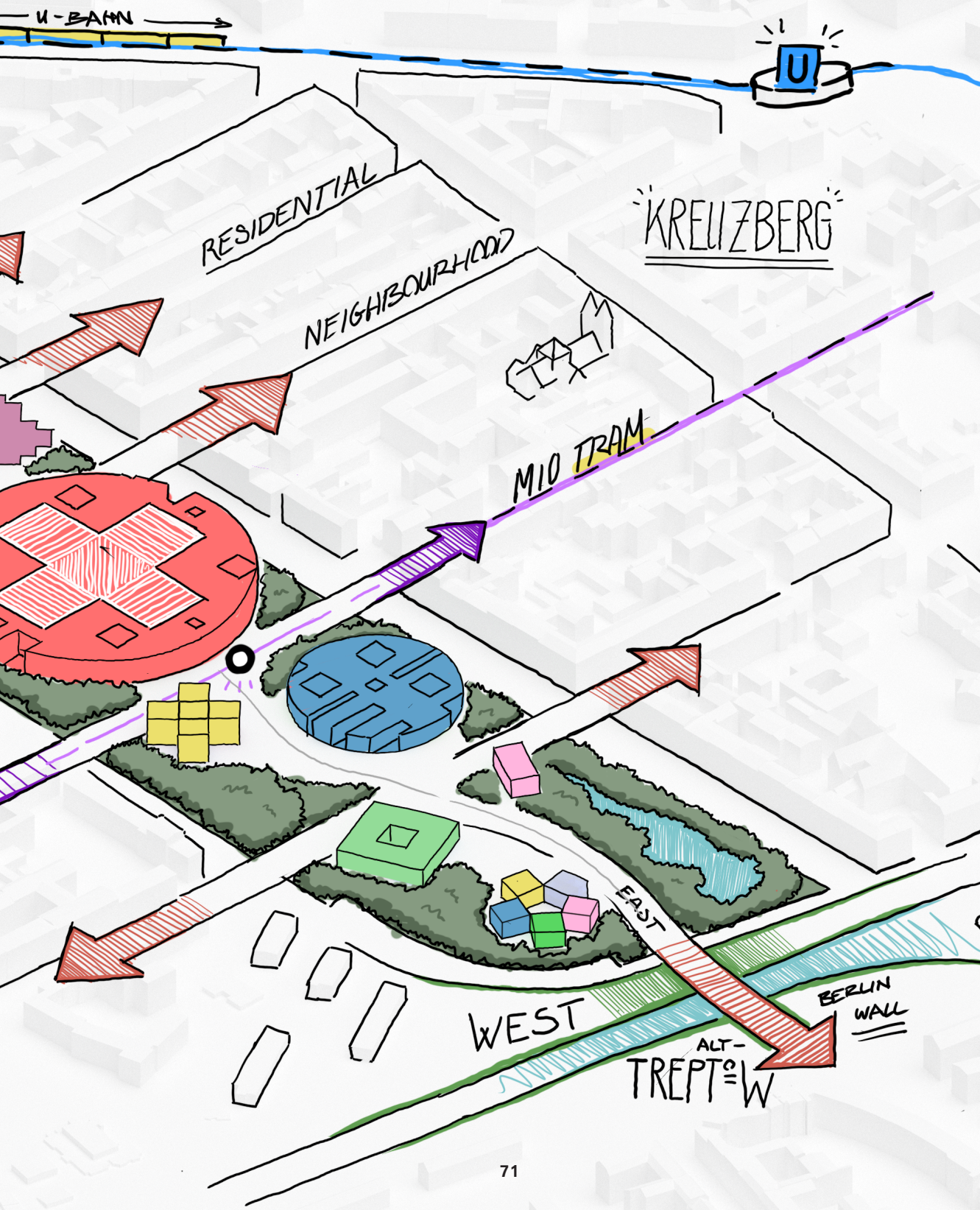
As the overarching ambition of the material-group needs to encapsulate all the different building-typologies, the resulting site-requirements already narrow down a large area of Berlin for potential site-locations. The following spatial site-requirements are a result from the Material group-ambition:

Accesibility - Projects need to be within an one kilometre reach of existing waterways or railways. This facilitates easy access for off-site prefabricated elements transported by water or rail.

Re-use - 33% of all building materials need to be sourced from locally available building waste sources/flows, either on-site or within a one kilometre radius of the site.

Prominence - In order to create a prominent statement within society and showcase the collection of nine buildings, site-locations need to be located in the most represented areas of Berlin; which are identified through the key-elements.

These site-requirements have been super-imposed and mapped in figure 4.5.


U-BAHN
U
RESIDENTIAL
NEIGHBOURHOOD
KREUZBERG
MIO TRAM
EAST
WEST
BERLIN
WALL
ALT-
TREPTOW

WORK
IN PROGRESS...

05

APPENDIX

06

06 Appendix

Bibliographical Literature

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Figure list

TU Delft
BK Bouwkunde

2023/2024

COMPLEX PROJECTS
BODIES & BUILDINGS
Berlin studio
AR3CP100

students
Job Vogel
Johannes de Groot
I-Tan Chen
Kalina Matova
Kjestyn Yee
Louisa Hollander
Martin Sitorus
Ruben Verboom
Shen Boyang

chair
Kees Kaan

CP coordinator
Manuela Triggianese

lab coordinator
Hrvoje Smidihen

group tutors
Edyta Milczarek & Jelmer van Zallingen