Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Sumeet Joshi
Student number	5823498

Studio		
Name / Theme	AR3CP100: Complex Project Graduation Studio | Bodies and Buildings	
Main mentor	Olindo Caso	Design Mentor
Second mentor	Jan Van de Vort	Building Technology Mentor
Third mentor	Martin Grech	Design Mentor
Argumentation of choice of the studio	Experiences within a city emerge from a dialogue between its inhabitants and the buildings situated in the urban landscape. As daily users, we often navigate through different buildings, each providing space, light, and shelter for specific activities. The design of these buildings is rendered by specific needs of the bodies (users in this case) correlated to movement, measures, safety, and security, thus influencing the overall experiences of the activities. In our current information-centric society, where data holds a pivotal role, bodies are perceived as data producers regulating the demand for the buildings to be more efficient and functional at the same time. Consequently, these dynamics are contributing to the increased complexity in designing buildings. The primary focus of the Complex project graduation studio is the relationship between the building and the bodies that inhabit them. The studio provides an opportunity to explore a highly specialized and function-specific complex building with a methodical and structural approach to the design process. The alignment of my graduation interest with the studio's objective made it a natural and preferred choice.	

Graduation project	
Title of the graduation project	Twin Anatomy: Hospital of a Human Data Twin
Goal	

Location:	Viktoria Speicher, Berlin, Germany
The posed problem,	As per the Oxford Dictionary, a 'Hospital' is defined as an institution that provides medical and surgical treatment along with nursing care for sick or injured individuals. In this traditional hospital model of 'cure and care', individuals seek medical attention only when afflicted by illness, injury, or diseases. Hospitals play a crucial role in cities, serving as spaces for recovery, rehabilitation, and even the rejuvenation of human life, but all within its institutional boundaries. The health datasets of individuals collected by hospitals are primarily used to understand the patient's medical history and address any immediate medical conditions. However, the health datasets hold the potential for much broader applications in information society, offering possibilities for holistic care preventing diseases, disorders, and undiagnosed deaths. Despite Germany's worldwide reputation for advanced medical care, a recent study highlights that a substantial portion of deaths in the country is primarily attributed to changes in body metabolism. These changes result in diseases of the circulatory system, accounting for 33.3% of cases and often leading to sudden heart failures. The onset of the COVID-19 pandemic also underscored the limitations of this 'cure and care' model, leading to significant loss of lives—both due to the acute illness of the virus and delays in diagnosis. Hospitals that once used to be social institutions known for care are now merely perceived as healing machines. Today, data is produced, processed, and consumed at every step. Individuals are placing a greater emphasis on their health and are willing to equip themselves with Internet of Things (IoT) devices, such as health watches or other body sensors, to keep track of their well-being. A study from 2021 shows that German health apps recorded a new high of 2.4 million downloads per quarter. The demand for personalized healthcare and big data generation presents an opportunity for hospitals to establish a smart healthcare system, transitioning from a 'cure and care' to a 'care first' model, extending assistance beyond institutional boundaries. Leveraging modern data management using Artificial intelligence can facilitate a comprehensive diagnostic procedure, covering an assessment of descriptive analytics (to review previous medical records), diagnostic analytics (to analyse the current root causes of medical conditions),

	predictive analytics (to forecast patient risk factors), prescriptive analytics (to suggest treatment plans), and discovery analytics (to research and explore medical trends previously unknown). Technological advancements now facilitate the digitization of the human body, creating a Human Data Twin (HDT) in cyberspace that corresponds to the physical entity in the real world—humans, in this case. These two components communicate between cyberspace and physical space through a syncing device (IoT) implanted in the human body. The HDT can perform simulations, validations, optimizations, evaluations, and offer personalized suggestions and predictions to the physical entity, all while diagnosing in real time. This empowers individuals to make informed decisions, enhance health performance, and extend life expectancy. This transformation in healthcare technology not only reshapes our understanding of personal well-being but also prompts a reevaluation of the hospital's architectural form and functions. It signals the emergence of a hospital designed for the information age, recognizing the dynamic interplay between data-driven healthcare advancements and the evolving needs of individuals in society.
research questions and	*How does the digitization of the human body in the information society impact the architectural and spatial design of hospitals?* Hospitals, as public buildings, establish connections with people in ways unparalleled by other structures. The architecture of a hospital directly influences its functionality, exerting a profound impact on the delicate balance between life and death. In the contemporary information society, where the body is conceptualized more as a collection of data for tracking individuals' health, the pendulum shifts decisively toward life. The transformative approach to healthcare through digitization has extensive implications, potentially necessitating the creation of new spaces within the hospital. Research indicates that the Artificial Intelligence revolution in medicine introduces new dynamics to spatial relations in the diagnostic process, where AI is likely to play a key role. The architectural design of hospitals also calls for reappraisal, presenting an opportunity to promote health, physical activities, and mental well-being of the society.

design assignment in which these result.	The research culminates in a project aimed at critically examining and designing a district-level medical center. This center not only offers traditional medical services but also provides individuals with the opportunity to elevate themselves into a Human Data Twin through Brain-Device Implant surgery. Furthermore, it serves as a state-of-the-art diagnostic center capable of monitoring individual health by analyzing extensive health datasets in real time, facilitated by Data Scientists and Artificial Intelligence. Beyond its primary functions, the center aspires to serve as a social connector, actively promoting the health and well-being of the community through thoughtful architectural design. As part of our group research focused on the Digitalization of Berlin, we delved into the current role of data centers in the urban environment. Our exploration centered on methods to integrate the data centers into public buildings, thereby transforming their perception from being black boxes devoid of human presence to becoming architectural elements that promote data awareness. Aligned with our group strategy and individual building typology research, the project brief places a significant demand on data storage within the hospital infrastructure. This demand is essential for the swift and secure processing of health datasets used for the diagnosis of individuals implanted with IoT device. Based on the criteria for building typology and site selection, our identified site is situated between two major neighborhoods, Friedrichschain and Kreuzberg, along the coast of the Spree River. The site, currently abandoned and used for grain storage, includes a heritage building that was formerly utilized for the same purpose. This location is part of the Media Spree development along the riverbank, and future development is anticipated. A key aspect of the site strategy involves responding to and repurposing the heritage building.

Process

Method description

The graduation project follows a systematic approach to design a complex hospital typology. The methodology involves creating a well-defined design brief encompassing a compelling narrative, a discerning client, a curated building program, and a suitable site.

The initial phase of our research is dedicated to constructing a narrative by identifying gaps in Berlin's current healthcare system and elucidating the evolving role of hospitals in today's information society. This involves a comprehensive analysis of the historical evolution of hospital typology, encompassing architectural developments, functions, and societal roles over time. The research extends to exploring the digitalization of healthcare, probing into the potential changes it introduces to healthcare processes. This collective exploration serves as the cornerstone for crafting a narrative for the project, laying the groundwork for the formulation of a pertinent research question.

Architects, responsibility extends to designing buildings that meet the needs and aspirations of our clients. The process of narrative development is not merely a creative exercise but a strategic approach to identify potential clients who share a vested interest in investing in this project. By delving into narrative development, we aim to unearth the ambitions of our prospective clients, aligning them seamlessly with the overarching project ambitions. This synergy between client aspirations and project goals not only strengthens the narrative but also forms the bedrock for a successful and purposeful architectural project.

Furthermore, due to the highly specialized nature of hospitals, meticulous attention to the spatial relationships among different spaces becomes paramount for cohesive functioning. Given that hospitals accommodate diverse users with varying functions, flows, and needs, a comprehensive study is essential. Conducting benchmarking case studies will prove invaluable, offering insights to deepen our understanding of this complex typology. Simultaneously, the research endeavors to address broader questions about how the architectural design of hospitals can contribute to the overall well-being of society. This involves examining specific references to projects that have successfully responded to social and cultural exchanges. The group research, in particular, will concentrate on developing a toolbox for seamlessly integrating a data center within public buildings, with a focus on hospitals.

The subsequent phase involves identifying potential sites within Berlin that align best with the project's ambitions. In conjunction with these ambitions, we will establish three group criteria to guide the location of the data center, as well as three criteria for regulating the location of the proposed hospital. The site selection process will be a well-informed decision based on these criteria. Subsequently, the chosen site will undergo thorough analysis at both the urban and neighborhood levels to comprehend the context and any historical significance. Specific site ambitions, tailored to respond to the context, will be carefully curated based on this comprehensive analysis.

The next step will be to bring together the project ambitions, client ambitions, and stie ambitions, to undertake an architectural form study on the identified site. A possible form will be proposed by the end of P2.

After the conclusion of P2, the primary focus will shift towards the detailed architectural design of the building. Simultaneously, the research will deepen its

exploration into the potential impact of Artificial Intelligence within key spaces of the hospital.

Concurrently, I will engage in digital explorations and drawings at each stage, utilizing these tools to effectively communicate the project. In parallel, the development of a physical model will complement the study and aid in presentations.

This comprehensive approach aims to not only facilitate a detailed architectural design process but also to address the research question that was formulated during the initial research stage.

Literature and general practical references

1. Lee, P., Goldberg, C., & Kohane, I. (2023). *The AI revolution in medicine: GPT-4 and beyond*. Pearson.

2. Mohamed, K. (2018). Health Analytics Types, Functions and Levels: A Review of Literature. Data, Informatics and Technology: An Inspiration for Improved Healthcare, 137- 140.

3. Nickl-Weller, C., & Nickl, H. (2020). Architecture for Health. Braun.

4. Li, A., & Shi, P. (2022). Research progress on wearable devices for daily human health management. Wearable Technology, 2 (1), 82 .https://doi.org/10.54517/wt.v2i1.1654

5. Riva , M. A., & Cesana, G. (2013). The charity and the care: the origin and the evolution of hospitals. European Journal of Internal Medicine, 24, 1-4. doi:https://doi.org/10.1016/j.ejim.2012.11.002

6. Shengli, W. (2021). Is human digital twin possible? Computer Methods and Programs in Biomedicine Update, 1, 100014.

7. Wagenaar, C. e. (2018). Hospitals : A Design Manual. Walter de Gruyter GmbH. Retrieved from http://ebookcentral.proquest.com/lib/delft/detail.action?docID=5155807.

8. Ramdurai, Balagopal. (2021). Use of Artificial Intelligence in Patient Experience in OPD. 1-8. 10.5923/j.computer.20211101.01.

9. Meskó, B., & Görög, M. (2020). A short guide for medical professionals in the era of artificial intelligence. *NPJ digital medicine*, *3*, 126. https://doi.org/10.1038/s41746-020-00333-z

10. Puaschunder, Julia & Feierabend, Dieter. (2019). Artificial Intelligence in the Healthcare Sector. SSRN Electronic Journal. 10.2139/ssrn.3469423.

11. Rao, D. J., & Mane, S. (2019). Digital twin approach to clinical dss with explainable ai. *arXiv preprint arXiv:1910.13520*.

12. Capolongo, S., Gola, M., Brambilla, A., Morganti, A., Mosca, E. I., & Barach, P. (2020). COVID-19 and healthcare facilities: a decalogue of design strategies for resilient hospitals. *Acta Bio Medica: Atenei Parmensis*, *91*(9-S), 50.

13. Heijink, A., van den Heuvel, J., & Schoonhoven, M. (2022). Increasing efficiency in healthcare: a showcase in an orthopedic outpatient clinic. *International Journal of Lean Six Sigma*, *13*(1), 33-45.

14. Babbu, A. H. (2016). Flexibility: a key concept in hospital design. *Int J Appl Innov Eng Manag*, *5*, 24-28.

15. Setola, N., Borgianni, S., Martinez, M., & Tobari, E. (2013, October). The role of spatial layout of hospital public spaces in informal patient-medical staff interface. In *the Ninth International Space Syntax Symposium, Seoul: Sejong University*.

16. Freihoefer, K., Nyberg, G., & Vickery, C. (2013). Clinic exam room design: present and future. *HERD: Health Environments Research & Design Journal*, *6*(3), 138-156.

17. Lin, S. (2022). A clinician's guide to artificial intelligence (AI): why and how primary care should lead the health care AI revolution. *The Journal of the American Board of Family Medicine*, *35*(1), 175-184.

18. Lacanna, G., & Wagenaar, C. (2018). Public Spaces in and Around the Hospital: Streets, Squares, Patios, Waiting Areas, Healing Gardens. In *Hospitals: A design manual* (pp. 61-64). Springer.

Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

Throughout my MSc Architecture track, my focus has centered on the exploration and understanding of public buildings, pivotal components in our urban landscape. In the initial stages, I participated in the MSc1 studio, collaborating with the Public Building group, where we designed a Media Innovation Center. This experience served as a foundation, guiding me in form exploration and challenging my perceptions of public buildings, all while adhering to the principles of circularity.

The complex project graduation studio, organized by Kaan architects, introduces a variety of public building typologies. Leveraging their diverse portfolio experience, the studio delves into researching and designing these structures. For my graduation project, I have chosen to design a hospital building—one of the nine specific public building types offered. Designing a hospital demands a unique set of knowledge, understanding, and training, and this studio provides an invaluable opportunity to expand my architectural capabilities.

The studio's structure is designed to offer not only a deep dive into individual projects but also a comprehensive understanding of other building types explored by fellow group members. Moreover, the studio emphasizes the practical aspects of professional practice, nurturing not just design and making skills but also presentation skills, a crucial aspect in the professional realm.
In essence, this graduation studio aligns seamlessly with my academic journey and prior studio experiences, offering a platform to further my understanding of public buildings and hone my skills for professional practice.

2. What is the relevance of your graduation work in the larger social, professional, and scientific framework?

The graduation project holds significant relevance in the current context, drawing inspiration from near-future predictions of technological advancements that will revolutionize healthcare. The envisioned transformation from generalized to personalized medication, facilitated by data science and technology, forms the crux of the project.

The primary focus is on enhancing efficiency and transparency within hospitals. By doing so, the project is poised to spark discussions around the imperative nature of leveraging and collaborating with technologies like Artificial Intelligence in hospital design. This discourse will shed light on ethical challenges and considerations inherent in such advancements.

In a broader sense, the project aspires to establish guidelines for designing hospitals of the digital future. By addressing the intersection of technology, healthcare, and design, it aims to contribute not only to the architectural profession but also to the larger scientific and social frameworks shaping the future of healthcare environments.