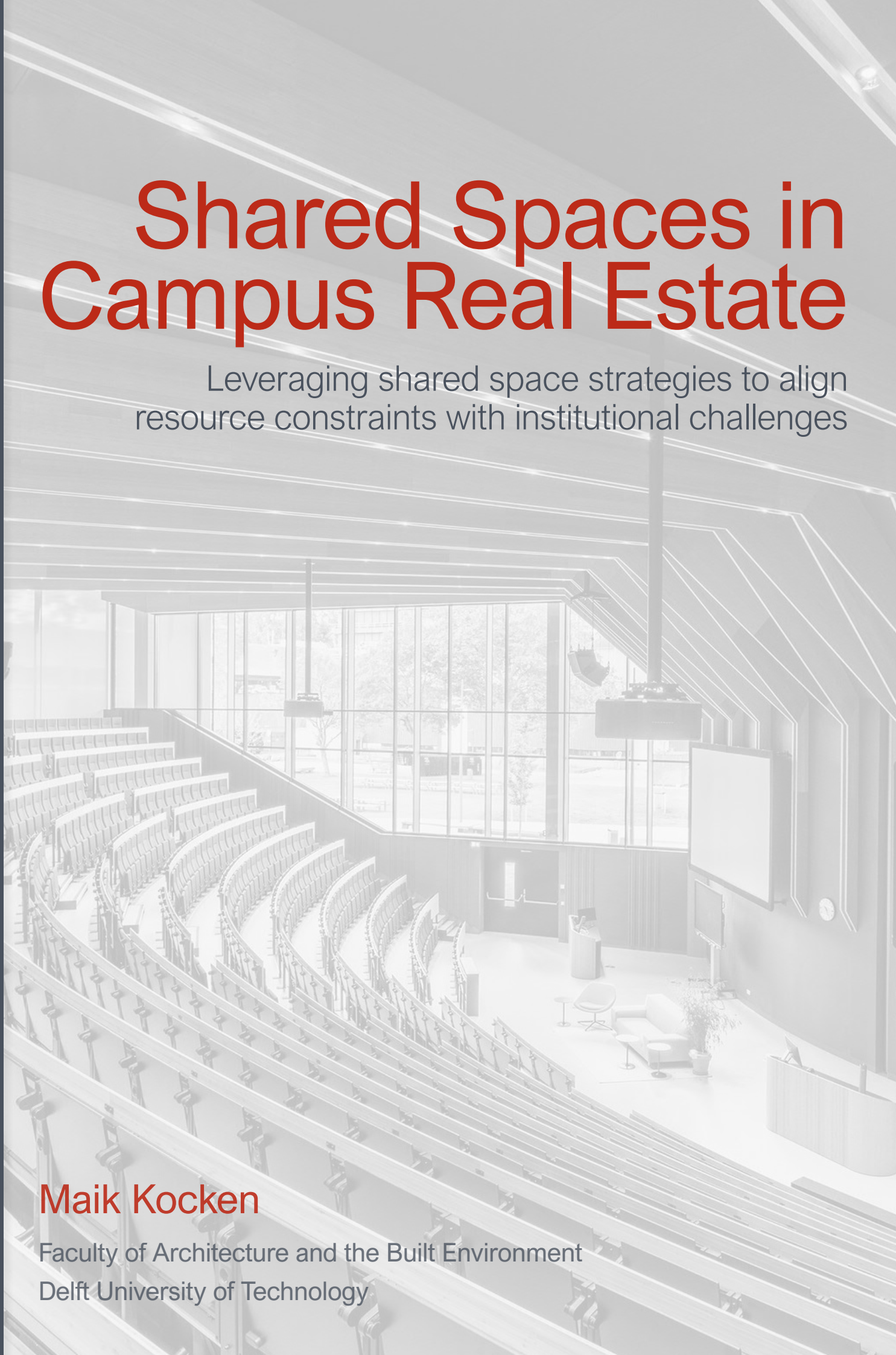

Shared Spaces in Campus Real Estate

Leveraging shared space strategies to align resource constraints with institutional challenges

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Faculty of Architecture and the Built Environment
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Preface

This research examines the development of shared spaces on university campuses in the Netherlands. This master's thesis is the culmination of a one-year graduation process from the Master Management in the Built Environment (MBE) at the Faculty of Architecture and the Built Environment, Delft University of Technology. Having pursued both my bachelor's and master's degrees at this faculty, this report represents the final step of my academic journey here.

The thesis underscores my commitment to the field of Management in the Built Environment, mainly focusing on Real Estate Management (REM). It also reflects my enthusiasm for the dynamic subject of campus management. Through this work, I aim to contribute to the ongoing innovation in addressing campus challenges, fostering best practices, and advancing knowledge in campus management.

I want to express my heartfelt gratitude to my mentors, Alexandra den Heijer and Michaël Peeters, for their support, thorough feedback, and especially for our interesting discussions. Additionally, I thank my graduation company, Aestate, and particularly Pity Jongens, for her expert guidance over the past year.

I am also grateful to all the participants who shared their engaging stories and compelling insights and to everyone who contributed to this thesis in various capacities.

I hope you enjoy reading this work!

With appreciation,
Maik Kocken

Delft, the 11th of June 2024

Colophon

Shared Spaces in Campus Real Estate - Leveraging shared space strategies to align resource constraints with institutional challenges. MSc Graduation Project – P5 Report

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TU Delft BK Bouwkunde — Department of Management in the Built Environment

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Contents

Abstract

Purpose. Dutch universities must cope with evolving demand when aligning their real estate, facing uncertainty due to dynamic trends and a relatively static portfolio. The result is a strategy moving towards a resilient, shared and centralised campus, emphasising multi-purpose spaces. This shift involves shared building use, a strategy of creating generic spaces accessible to a diverse range of internal (and external) users. A building is shared when a majority of its useful space is generic, not assigned to a specific individual or group of individuals and often adaptable to fit multiple users in the short and long term. Despite identifying general trends, the reasons and functionality behind the increased use of shared spaces remain unclear in current literature. Moreover, there is a noticeable absence in literature of an uniformly acknowledged definition and term that adequately encapsulates the characteristics of facilities described as 'shared'. This research aims to analyse the motivations driving this integration, establish a precise understanding of this particular approach to facility use and identify essential stakeholder requirements for practical use. Grasping the forces behind, the proces for and the effects of this trend is crucial for evaluating both positive and negative aspects of shared spaces on campus, contributing to achieving university real estate goals.

Research approach. The primary objective of this research is to study how shared spaces can be used to support and advance university real estate objectives. Therefore, the main question is: H*ow do shared spaces on the university campus align with organisational, functional, financial and physical real estate objectives?* This study will apply a case-study research approach to find an answer to the main question. First, desk research will be focussed on exploring the field of shared building use. Then, with the outcomes of desk research as a starting point, case-study research will be used to better understand a select number of cases within the field. The case studies aim to get comprehensive insights by analysing various perspectives and establishing KPIs. The methods used to study cases include literature study, interviews, existing data analysis and usage data analysis. The goal is to deliver a thorough theoretical background, a case overview for reference projects, detailed information on specific cases and a cross-case analysis.

Results. The cross-case analysis shows that financial constraints and the need for physical efficiency encourage universities to shift towards shared spaces. This shift is supported by functional and organisational demands, creating generic, versatile spaces that facilitate various activities. This approach can meet the diverse needs of users for flexibility and comfort while aligning with institutional goals of resource optimisation, organisational resilience and financial risk mitigation. The study emphasises the importance of continuous stakeholder engagement and integrated governance in ensuring shared spaces effectively meet university and user needs in a dynamic campus context.

Discussion. The research shows the complex interconnectedness of public values, trends and motivations concerning integrating shared spaces on campus. However, limitations are acknowledged, such as a focus on a select number of universities and reliance on qualitative data. Therefore, further studies examining shared spaces across educational and societal settings are suggested. Moreover, this thesis expands the theoretical understanding of campus management and offers practical insights for better campus planning, including shared spaces. For practitioners, the results stress the importance of adopting shared spaces for the future viability of Dutch university campuses, emphasising a shift towards sharing and collaboration. Laslty, campus managers are provided with practical insights and best practices from various contexts to support diverse stakeholder needs and institutional objectives.

Keywords: Public real estate, Campus real estate management, University campus, Shared spaces, Case-study research, alignment.

Executive Summary

Introduction

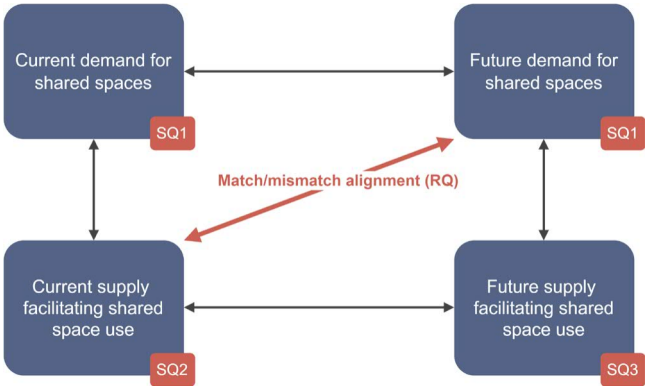
This thesis, "Shared Spaces in Campus Real Estate", investigates the ongoing integration of shared spaces on university campuses in the Netherlands. The study explores how shared spaces can align with the organisational, functional, financial, and physical objectives of campus real estate management. The context of this research results from the growing need for universities to adapt to institutional challenges amidst resource constraints, financial pressures, and sustainability goals. These resource constraints have changed how space is supplied on the university campus; Increased sharing has become a prerequisite for feasibility.

Campus managers are increasingly required to manage dynamic and uncertain demands for space due to fluctuating student numbers, changing educational models, and interdisciplinary research needs. Traditional campus real estate strategies, often characterised by fixed and dedicated spaces, have become unfeasible. Shared spaces offer a viable solution by creating flexible, multi-purpose environments that diverse internal and external stakeholders can use. This study aims to analyse the motivations behind the integration of shared spaces, understand their functionality, and identify essential stakeholder requirements for practical use.

Research Methods

The main research question of the research is as follows: How do shared spaces on the university campus align with organisational, functional, financial and physical real estate objectives? Three sub-questions have been defined using the DAS Framework to structure the research:

- SQ1: What trends can be discerned influencing university real estate objectives, and the demand for and supply of shared spaces on campus?
- SQ2: How are universities implementing shared spaces and buildings in their real estate portfolio and what characterises these facilities?
- SQ3: How can shared spaces be aligned with the needs of the university and campus users?



The research employs a mixed-method approach to gather insights into the use and impact of shared spaces on university campuses. The methods used include:

- *Desk Research*: A thorough review of existing literature on campus real estate management, shared spaces, and relevant trends.
- *Case Studies*: Detailed case studies of shared spaces at VU Amsterdam (O|2 and NU), Wageningen University (Forum and Aurora), and Delft University of Technology (Echo). These case studies involve document analysis, interviews with campus managers, policy employees, facility managers, program managers and users, and analysis of key performance indicators.
- *Cross-Case Analysis*: A comparative analysis of the findings from the case studies to identify common themes, challenges, and best practices.

Data collection methods include literature review, document analysis, interviews, and usage data analysis.

Case Overview | Case study | Cross case analysis

Theoretical Framework

The theoretical framework for this research is grounded in the Designing an Accommodation Strategy (DAS) framework (De Jonge et al., 2009) and the four perspectives of Campus Real Estate Management developed by Den Heijer (2011). The DAS framework outlines a structured approach to aligning campus real estate with universities' evolving needs, focusing on four key steps: assessing the current situation, exploring changing demand, generating future models, and defining projects to transform the current situation. CREM involves balancing four perspectives to achieve comprehensive and effective campus management:

- *Organisational perspective*: This perspective focuses on strategic choices affecting the continuity and reputation of the university, including internationalization, diversity, and educational policies.
- *Functional perspective*: This perspective emphasises the needs and well-being of campus users, such as students, faculty, and staff, highlighting the importance of flexible and adaptable spaces.
- *Financial perspective*: This perspective concerns the economic feasibility of real estate strategies, including cost efficiency, revenue generation, and risk mitigation.
- *Physical perspective*: This perspective addresses the sustainability, quality, and technical conditions of the campus infrastructure, aiming to minimize the physical footprint and promote resource efficiency.

This framework helps to analyse shared spaces by ensuring that all relevant factors and stakeholder perspectives are considered.

Emperical research

The analysis revealed several key findings related to the purpose of the research:

- *Financial constraints:* The shift towards shared spaces is primarily driven by the need to optimise the use of limited financial resources and to dedicate more financial resources to the primary academic process. Shared spaces are often a prerequisite for feasibility through decreased total cost of ownership and can potentially reduce operational expenses on a campus level.
- *Physical efficiency:* Shared spaces contribute to physical goals by promoting efficient use of physical resources. This improvement in occupancy reduces demand, lowering the need for new construction and minimising the university's physical footprint. Through an effective physical alignment, a growing organisation can be accommodated with relatively fewer physical assets if more spaces are shared.

- *Functional demands:* Shared spaces are designed to meet users' diverse needs, which can help align with the functional requirements of different user groups. However, this depends on user behaviour and adaptability. If a transition to shared spaces is not managed effectively, it can result in user dissatisfaction and resistance.
- *Organisational resilience:* Shared spaces enhance organizational resilience by creating versatile environments that can adapt to changing academic demands. This flexibility is crucial for universities facing fluctuating student numbers, evolving educational models, and dynamic research needs. However, this requires more than physical arrangements; it requires a comprehensive institutional strategy, including organisational flexibility.

The cross-case analysis highlighted the importance of integrated governance and continuous stakeholder engagement, among other key lessons learned, in ensuring that shared spaces effectively meet the needs of both universities and their users.

Conclusion

The research concludes that shared spaces are a viable strategy for universities to address financial, functional, organisational, and physical challenges. Shared spaces provide a flexible and resource-efficient solution that aligns with the strategic goals of campus management. Key benefits include reduced accommodation costs and a spatial demand mitigation, which means more resources can be allocated to the primary academic process. However, successful implementation requires an integrated and multi-disciplinary approach, active stakeholder involvement, and continuous adaptation to evolving needs and trends.

Discussion

The discussion elaborates on the implications of the research findings and offers recommendations for campus managers, policymakers and researchers:

1. *Long-term strategy development:* Universities should develop long-term real estate strategies incorporating shared spaces as one of it's instruments. This approach will provide flexibility and mitigate risks associated with resource constraints and changing demands.
2. *Design for Versatility:* Shared spaces should be designed with versatility in mind to accommodate a variety of users and activities. This includes creating zones for different activities, ensuring adaptability for future needs, and extending usage beyond standard academic hours.

3. *Promote a sharing culture:* Universities should stimulate a culture of sharing within their academic and administrative environments. Regular assessments of real estate portfolios can help identify underutilised spaces and promote their efficient use.
4. *Integrated governance:* Effective governance structures should be established to ensure continuous stakeholder engagement and alignment with institutional goals.

The research acknowledges several limitations, which are essential to understanding the implications of the study:

- *Limited scope:* The study focuses on a select number of universities in the Netherlands, which may limit the generalisability of the findings to other contexts or regions.
- *Quantitative data collection:* While each case was thoroughly described and analysed, data collection setbacks affected reliability. Problems such as limited availability and inconsistency led to increased reliance on qualitative data.
- *Qualitative Data Dependence:* The research relies on qualitative data from interviews and case studies, which may introduce subjective biases and affect the replicability of the results.

These limitations suggest areas for future research, including broader studies across different types of educational institutions and regions, as well as incorporating quantitative data to complement qualitative insights.

Part I
Introduction

(Entreehal Echo, Bloem, n.d.-b)

1. Context

The main focus of this thesis is shared spaces in campus real estate. Before delving into the specifics of this topic, the problem statement or the research question, this section will explain the context in which the research will occur. This will entail an introduction to CRE (Campus real estate) management, an overview of recent trends influencing demand for flexible spaces on campus, and a short exploration of current shared space practices. The context presented in this section also establishes the boundaries of this research.

CRE-management

The well-functioning of the education system is of crucial importance to society. This is also reflected in the budget allocated to universities and the size of their real estate portfolios. In 2022, the Dutch Government spent over 11 billion Euros on higher education (Rijksoverheid, 2023, p. 9), and in terms of real estate, few other organisations own either more significant buildings in terms of gross floor area or have a more extensive overall real estate portfolio (Den Heijer, 2021). Dutch universities have had ownership of their real estate and land since 1995. Before this, all university real estate was government-owned, assessed and approved (Den Heijer, 2021). This transference of ownership came with responsibility and financial burdens but also with opportunities, as universities no longer needed government approval for changes in their real estate (Den Heijer, 2011). Many non-academic functions, research institutes, and universities of applied sciences made the campus multifunctional. Thus, the profession of campus manager was born. CRE management supports universities in achieving a more meaningful, functional, resource-efficient, and sustainable built environment (Den Heijer, 2011).

Dynamic demand for space

Campus mutations result from the alignment between the (current) supply of space and (future) demand for space. Many changes have affected the quantitative and qualitative demand for and supply of space on campus, leading to increased uncertainty and risk. This section will provide a brief overview of these developments.

On the demand side, developments include unpredictable student numbers due to internationalisation (Valks et al., 2021), flexible and digital learning environments, decreases in long-term research planning, rising workforce dynamics, digitalisation and increased hybrid working (Beckers et al., 2015; Den Heijer, 2021; Den Heijer et al., 2016; Last et al., 2023). Moreover, education is transforming from being primarily focused on knowledge transmission to facilitating project-based collaboration among students and staff (Last et al., 2023; Van Sprang et al., 2019).

On the supply side, the most significant changes are goals for resource efficiency as a result of physical and financial restrictions (Den Heijer, 2021). All Dutch universities have adopted a strategy of creating a physically sustainable campus that minimises energy usage and optimises space utilisation, leading to decreased space use and, therefore, a reduced physical footprint. From a financial perspective, academic capitalism has grown as a result of internationalisation and a drop in government funding for education, putting more strain on financial resources (Curvelo Magdaniel et al., 2019). Besides this, working interdisciplinary with an increased focus on synergies and collaboration between various departments, both internal and external, has led to an increase in supply for shared spaces and facilities (Last et al., 2023).

Campus developments

Developments in both student numbers and total floor space for Dutch universities show a remarkable intensification of resource use over the past decades, according to Den Heijer (2021). Student numbers at, for example, TU Delft have more than doubled (+113%), while the size of the real estate portfolio (+2.5% GFA) or staff numbers (+14%) have barely changed in comparison. This means the allocation of resources and use of space on campus have substantially changed.

A shift in campus real estate strategy, characterised by an increased emphasis on flexibility, multi-purpose use and centralisation of resources, is reported in several articles. In fact, 77% of Dutch universities have expressed an intent to enhance the number of 'flexible' facilities (Rymarzak et al., 2020). The flexibility of campus facilities is crucial in aligning with the increasingly dynamic demands for university real estate to mitigate risks while working with a relatively static portfolio.

The call for flexible and optimised use of buildings is further strengthened by the most recent Intergovernmental Panel on Climate Change 2023 (IPCC) report, which states that urban systems play a pivotal role in reducing emissions and promoting climate-resilient development. One of the interventions highlighted to achieve a 66% potential demand-side mitigation of the built environment by 2050 is the highly efficient and optimised utilisation of buildings (IPCC, 2023).

Shared spaces on campus

Under the influence of context developments and the call for increasingly efficient building utilisation described above, the amount of shared space on campus has increased in the past decades. Earlier developments in sharing space such as centralised libraries, flex offices, or, more recently, hybrid working have begun a shift from a traditional campus to a network campus. Den Heijer (2021) Uses the phase change from 'solid' to 'liquid' and 'gas' as a metaphor to describe the changing university campus. Solid represents the traditional campus with fixed structures, hierarchy and territory. Liquid signifies the network campus, which is flexible, multidisciplinary and shared. Gas describes the virtual campus as one characterised by individual autonomy and high mobility. The shift from solid to liquid and gas is visible in the curriculum, employee population, research programmes and partnerships, but most notably for the campus, in the increasingly multi-purpose and flexible facilities. (Den Heijer, 2021).

Within this metaphor, shared building use would be classified as liquid, as these buildings or spaces are flexible in function, non-territorial and used by multiple user groups, both internal and external to the organisation. Shared spaces can house several campus functions, ranging from study places to research amenities and large-scale lecture halls or non-academic functions. Activities

from multiple faculties or external organisations can be scheduled in these spaces, and they can offer places for interdisciplinary education that isn't bound to one faculty. This new type of facility is part of a broader shift in education, and perhaps society as a whole as well, which has been moving towards an increasingly dynamic community that is more international, interdisciplinary, flexible, mobile and temporary (Den Heijer, 2021). Shared space use seems to combine these developments under one roof.

The campus real estate manager

Shared spaces are introduced by the campus real estate manager. The role of this stakeholder is a multifaceted one, demanding a careful balance of the four perspectives of CRE management: organisational, functional, financial, and physical (Den Heijer, 2011). Positive and negative associations can be identified with a shift towards more shared spaces. The question may be asked about the reasons campus managers have for introducing this on campus, what characterises these facilities, and how shared spaces align with and impact university real estate objectives.

(Zaal B Echo, Bloem, n.d.-c)

2. Problem Statement

Dutch universities face a complex task in aligning their real estate portfolio with current and future changes in demand (Den Heijer et al., 2016). Dynamic trends affecting the demand for and supply of space, stemming from the four perspectives on CRE management, combined with a relatively static real estate portfolio, have lead to uncertainty and risk. The campus real estate manager is responsible for interconnecting these variables within this challenging framework.

These developments seem to have led to an increasingly 'liquid' campus, with real estate strategies focussing on adaptable, flexible, multi-purpose and centralised resources. The societal trends affecting campus real estate and the response to increased flexibility, multi-purpose use and centralisation can also be seen in other public and private sectors. The exact reasons, timeframe and institutional level might differ. Still, shared space use could be considered part of these broader societal trends leading to a sharing economy for the built environment. A liquid campus strategy can be translated to implementing shared spaces. There is, however, a noticeable absence in the literature of a uniformly acknowledged definition and term that adequately encapsulates the characteristics of facilities described as 'shared'.

While a movement towards flexibilisation and consolidation of real estate facilities can be distinguished, and while general trends affecting the university context can be identified, the reasons behind implementing a real estate strategy resulting in increasing shared building use and how these facilities function on the campus remain elusive. Besides, the financial and physical investments made into these types of facilities should be justifiable in relation to the results. Studying the drivers behind shared building trends and assessing how the organisation uses these buildings, as well as the advantages, disadvantages and challenges perceived by stakeholders, could shed some light on how these facilities align with and contribute to university real estate objectives.

Therefore, this study seeks to investigate the rationale behind integrating shared spaces into university real estate strategies and establish a precise understanding of this particular approach to facility use. The definitive definition of 'shared' may consequently evolve during this research. The research will also assess the integration of shared spaces from the four perspectives on campus management (organisational, functional, financial and physical), identifying the factors contributing to success and those leading to inadequacy for stakeholders in effectively utilising these facilities. Understanding the driving forces behind this trend from diverse campus management perspectives is crucial for elucidating both favourable and unfavourable aspects of the functionality associated with shared spaces. This research, therefore, aims to examine the role of shared spaces on campus in promoting and achieving university real estate goals.

(O|2 woonkamer, EGM Architecten, n.d.)

3. Relevance

As explained in the previous section, this research examines the role of shared spaces in promoting and achieving university real estate goals. The added value of this research goal has both academic and societal relevance, which will be elaborated upon in this section.

3.1 Academic relevance

Academically, there has been a growing interest in CRE management in the past decades. Researchers have started investigating the trends that affect the university campus context and how managers align their real estate with these trends. More specifically, concepts like adaptability and resource sharing have also gained attention in the literature.

The problem, however, is that the articles addressing this are rarely specific to the university campus context, which often encompasses a more diverse group of stakeholders and users. Additionally, the concepts of shared spaces or the network campus are relatively new, which means the literature coverage is still largely lacking, and a universally acknowledged definition is still missing. Besides, the existing literature does not offer practical guidance on executing a strategy for utilising shared spaces, understanding its connection to broader societal trends, and evaluating its enduring effects on university (real estate) objectives.

This means the academic relevance of this thesis lies in addressing these gaps by offering in-depth insights, accounting for institutional differences, providing clear definitions, and evaluating the implications of shared spaces on both campus users and broader university goals.

3.2 Societal relevance

Real estate management should deliver value to the public organisation and the individuals using the real estate. The impact of campus management should be considered through four perspectives, as defined by Den Heijer (2011). These perspectives are organisational, functional, financial and physical.

From an organisational perspective, strategic choices must be made about the direction campus management should take. Why should there be more or fewer multi-purpose facilities, are faculties willing to share, and how can shared spaces contribute to collaboration and innovation? Furthermore, these organisational questions are also relevant on a cultural level. This research could contribute knowledge on how can centralised facilities help deal with fluctuations in (international) student numbers, on the extent to which they influence talent attraction, and how they support academic excellence?

The user, and therefore, the individual needs, are included in the functional perspective. In the context of this research, this is a very relevant point of view, as the collective willingness of users determines how a shared building is used (Den Heijer, 2021). Therefore, this research could contribute to exploring this perspective by understanding what users demand from a shared building and how these facility types can support their activities, productivity, health and well-being.

Since the financial context often determines strategic choices, the financial/economic perspective provides a reality check. This research could contribute to this assessment by analysing the financial impact of shared buildings and whether these spaces offer reduced operational costs and other investment schemes compared to faculty buildings. The perspective also relates to the justifiability of investing in these buildings, especially when considering responsible public spending. A portion of educational funding comes from public sources, making society a stakeholder in efficiently managing these institutions' real estate.

The physical perspective is dominated by issues such as sustainability, heritage and technical conditions. This research can contribute to understanding shared building use from this perspective by analysing technical performance, the quality of place, the physical footprint and contribution to circularity or climate adaptability. The relevance of examining the physical footprint lies in uncovering whether the investment in physical resources for constructing shared facilities realises a significant demand-side mitigation, as mentioned in the IPCC 2023 report.

The societal relevance of this research can thus be found in combining the four perspectives on campus real estate management and the influence shared spaces can have on these perspectives.

4. Reading Guide

This thesis will be divided into five parts, each with several chapters. These chapters can then again consist of several sub-sections. In Part II, the research methodology and approach are described. The research questions, comprising a central research question and a series of sub-questions, are introduced to offer a framework for the research. Following this, the research methodology is defined, and the research's typology, methods and techniques, data collection protocols, and data analysis procedures are examined. Subsequently, an overview of the research output is presented, encompassing the defined objectives, deliverables, datasets, and target audiences. Part III contains the theoretical underpinnings that form the foundation of this research. Literature on the key theoretical concepts that drive the study will be expanded upon. Subsequently, the overarching theoretical framework that informs the research is presented, illustrating the interconnections and dependencies among these theoretical concepts and relevant gaps in the literature.Part IV will encompass the empirical research findings. It will present the empirical data and observations from the research, offering a view of this study's practical implications and applications. Lastly, part V will present a discussion of the results and the conclusions derived from this research in the form of an answer to the research questions.

Definitions & Abbreviations

Shared spaces on campus: A strategy of generic spaces accessible to a diverse range of internal (and external) users. These spaces are designed to be non-territorial, meaning they are not permanently allocated to any specific individual or group. To facilitate this, the spaces must be adaptable to fit multiple users in the short and long term.

Campus real estate (CRE): Campus real estate encompasses building portfolios and land properties that serve a purpose for the university, are funded by the university, accommodate university functions and are accessible to university staff and students (Den Heijer, 2021).

Campus real estate management (CREM / campus management): CREM is defined as aligning the campus with the evolving context of the university, meeting the demands of diverse stakeholder groups, and contributing to the university's performance (Den Heijer et al., 2016)

Sharing economies: Individuals or organisations allowing (temporary) access to their underutilised or idle physical assets, potentially in exchange for compensation (Franken & Schor, 2017).

Resource efficiency: The optimal use of financial, physical and human resources to align campus real estate with policy, legal, budget, physical and organisational restrictions and goals.

Utilisation: The number of people present in a space relative to the number of available seats.

Occupancy: The presence of activities in a space relative to the reservations.

CRE: Campus real estate
CREM: Campus real estate management
ESA: Education and student affairs
FCO: Facilitaire Campus Organisatie
FM: Facility management
LLO: Leven-lang-ontwikkelen (Life-long learning)
TCO: Total cost of ownership
TU Delft: Delft University of Technology
VU: Vrije Universiteit Amsterdam
WUR: Wageningen University and Research

Part II

Research Approach

(Echo TU Delft collegezaal, Van Oosten, n.d.)

1. Research Questions

1.1 Main Question

The primary objective of this research is to study how shared spaces can be used to support and advance university real estate objectives. This investigation also seeks to uncover the underlying motivations for incorporating shared buildings on university campuses and to shed light on what stakeholders might need to effectively use this type of facility on campus, now and in the future. The drivers behind this trend from the various perspectives of campus management must be understood in order to disseminate positive and negative aspects of the functionality of shared building use. This focus is especially relevant given the evolving and dynamic context in which campus real estate managers operate. Therefore, the main question is as follows:

> How do shared spaces on the university campus align with organisational, functional, financial and physical real estate objectives?

Figure II-1: Main question (Author)

1.2 Sub-questions

To find an answer to the research question, several sub-questions (SQ) have been defined (Figure II-2). These sub-questions will help to structure the research and will assist in systematically analysing how shared building use can support and advance university real estate objectives. The DAS framework can be applied to understand the alignment of shared spaces with real estate objectives, specifying current supply, current demand, future supply, future demand and the match/mismatch between current supply and future demand.

In addressing the main question, it is essential to understand the context in which university real estate managers operate and what objectives universities have for their real estate portfolio. This will provide an overview of current and future demand. To do this, the four perspectives on campus management will be used to discern the drivers resulting in the demand for centralised, flexible and multi-purpose space on campus (SQ1). In this context, 'flexible' refers to the adaptability and versatility in accommodating various needs and activities within the same space. 'Centralised' indicates the building is intended to be used by users from multiple organisations (internal and external). 'Multi-purpose' describes the capability of the building or space to serve multiple functions or house various activities under one roof. Additionally, this sub-question will uncover what current university real estate objectives are.

The next step is to analyse how shared buildings are being implemented on campus, what characterises these facilities and how these buildings relate to the campus real estate portfolio they belong to (SQ2). This will provide an overview of the current supply facilitating shared spaces.

Lastly, to understand how shared buildings can be used, this research must shed light on the alignment with the needs of the university and campus users (SQ3). This will provide an overview of the match/mismatch between current supply and future demand and can show what is necessary to create a potential match. This requires an understanding of how these buildings are used and finding out what positive or negative associations stakeholders can identify related to these buildings.

> SQ1: What trends can be discerned influencing university real estate objectives, and the demand for and supply of shared spaces on campus?

> SQ2: How are universities implementing shared spaces and buildings in their real estate portfolio and what characterises these facilities?

> SQ3: How can shared spaces be aligned with the needs of the university and campus users?

Figure II-2: Sub-questions (Author)

1.3 Conceptual Model

Figure II-3 shows the conceptual model for the central question of this research, based on the DAS framework by De Jonge et al. (2009). As explained, the main research question tries to uncover the alignment of shared spaces with real estate objectives, which is shown in the model as the match/mismatch between future demand for shared spaces and current supply facilitating shared utilisation.

Additionally, the relationship between the main question and sub-questions can be identified in the figure. SQ1 lays the groundwork by identifying the trends shaping the current and future demand for shared spaces, SQ2 examines how universities currently respond to these trends by supplying shared buildings, and SQ3 explores the aspect of aligning these buildings with the diverse needs of the university and its users, resulting in future supply facilitating shared utilisation. Together, they provide a comprehensive understanding of the factors, implementation strategies, and alignment considerations related to shared buildings on university campuses.

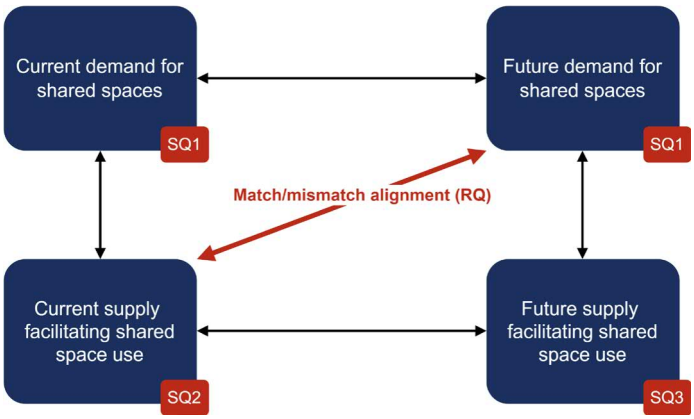


Figure II-3: Sub-questions (Author)

(O|2 Science Café, Fokkema en Partners Architecten, n.d-a)

2. Method

This chapter describes the research method chosen to answer the research questions. First, the type of study and the methods and techniques to be used will be explained, followed by a section on data collection and analysis. Lastly, ethical considerations will be reviewed.

2.1 Type of study and research framework

The research planning is shown in Figure II-4 and roughly depicts what research steps will be performed at what moment and before which presentation. The following sections explain the various elements of this overview.

This study will apply a case study research approach, which is explorative in nature. Mainly, qualitative research will be used to find an answer to the research question, which is supported by qualitative data, as is shown for each research question in Table II-1. With desk research as a starting point, case study research will be used to better understand a select number of cases within the field. The case studies aim to yield comprehensive insights by analysing documents, interviewee perspectives and KPIs.

2.2 Methods and techniques to be used

The initial phase of the research involves establishing a comprehensive theoretical framework covering diverse aspects relevant to this study. This framework is a foundational reference for shaping the methodology, enabling reflection on eventual results, facilitating conclusion drawing, and providing insights for recommending future research. The main question of this research, however, relates to the practical implications of using centralised facilities on campus, which necessitates empirical research.

First, a case overview will be made, providing an inventory of different shared education buildings or spaces added to the universities' real estate portfolios over the past few years. This overview will partially be based on the *Campus of the Future* Fair Data set by Den Heijer et al. (2023), and will provide information on how universities are implementing shared buildings and what essential characteristics these facilities have. Furthermore, the case overview will help in making an informed case selection for the case study research.

The case studies consist of three steps, focusing on specific buildings and related campuses in the Netherlands selected from

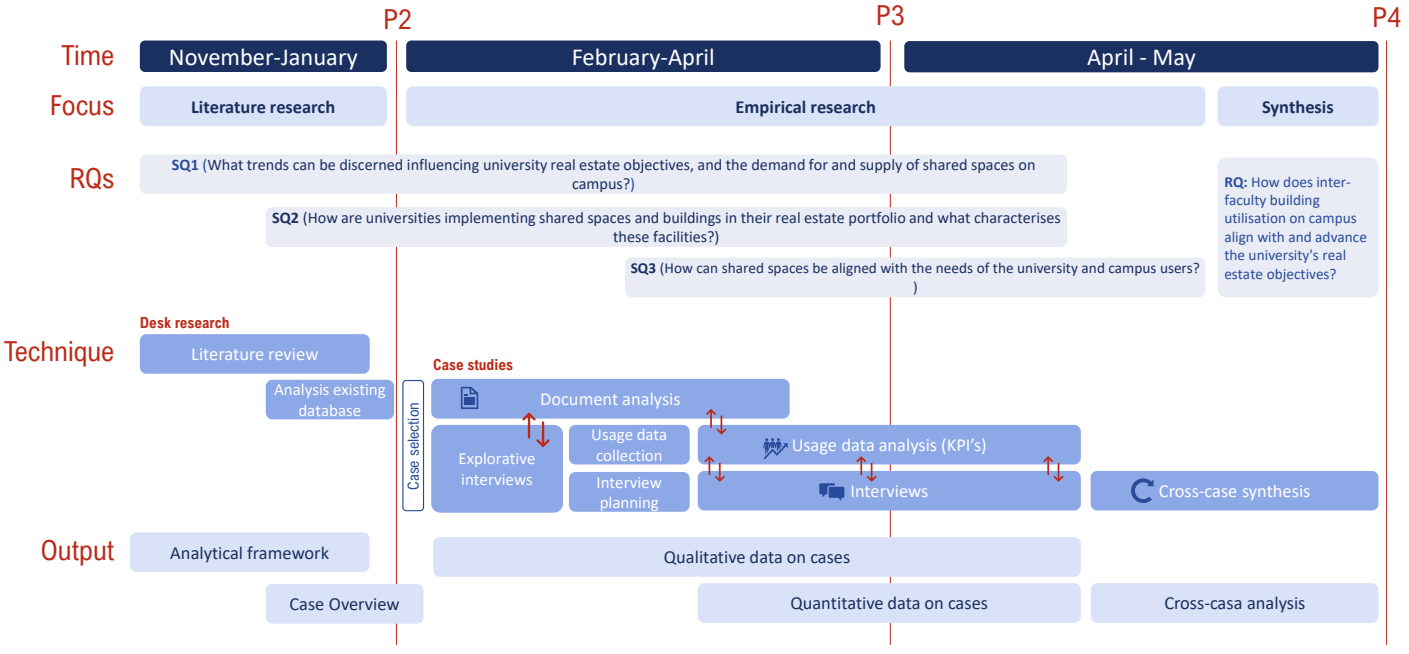


Figure II-4: Research Planning (Author)

Table II-1: Research methods and techniques per sub-research question (Author)

	research-question	Research method	technique
1	What trends can be discerned influencing university real estate objectives, and the demand for and supply of shared spaces on campus?	Desk research Case studies	Literature review Document analysis Interviews
2	How are universities implementing shared spaces and buildings in their real estate portfolio and what characterises these facilities?	Desk research Case studies	Literature review Analysis existing database Document analysis KPI analysis Interviews
3	How can shared spaces be aligned with the needs of the university and campus users?	Desk research Case studies	Literature review KPI analysis Interviews

the abovementioned overview. To get an in-depth understanding of the topic, a select number of 3 universities will be used, with two buildings on their campus as a case. This provides the advantage of having a multiple-case design while also providing embedded cases (Yin, 2018), increasing validation.

The first steps of the case studies are to analyse context-specific and case-specific documents and to conduct preliminary interviews with CRE managers. This will determine the goals and objectives related to shared spaces, formulating KPIs for the second step. Based on the KPIs uncovered in the previous step, the cases can be studied using existing data. This data will need to be gathered from the CRE or university scheduling department, and it will provide information on the practical use of these facilities and their impact on the campus overall. In-depth interviews with campus real estate managers, asset managers and end-users will serve as the primary third method, offering a deeper understanding of the experiences, perceptions, and attitudes regarding the shared use of spaces on campus.

The use of multiple types of data during the case studies will ensure a holistic exploration of the role and impact of shared building usage on the university's real estate portfolio and enable triangulation of the data (Blaikie & Priest, 2019). Figure II-5 summarises what the research intends to find out.

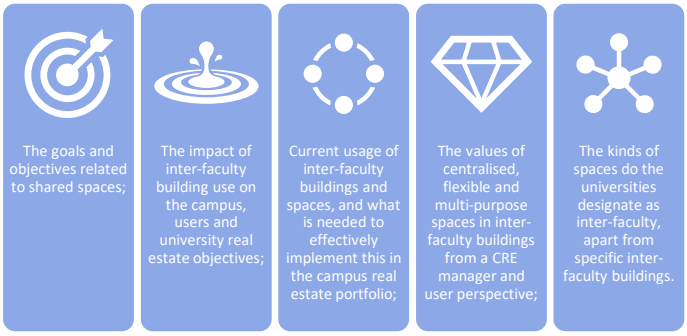


Figure II-5: Goals and objectives of the emperical research (Author)

2.3 Data collection

Data will be collected to execute the proposed research method. The data collection for each step of the research is described in this section, an overview of the data collection is provided in Table II-2, and the research method and relation between the various data types are summarised in Figure II-6.

2.3.1 Theoretical framework

A literature review will be conducted to provide the research with a theoretical background. This review intends to shed light on the research topic by collecting data through academic research databases, such as Scopus and the TU Delft Library. Academic sources are found by using search terms and keywords. Furthermore, key authors are identified, and AI searching tools such as Research Rabbit will be applied to ensure a thorough scope of the existing literature.

2.3.2 Case Overview

To compile an overview of recent examples of shared spaces and their fundamental features, educational buildings that offer space for lectures, instruction rooms, group work, or research will be identified. Additionally, the focus will be on spaces utilised by multiple faculties within the same universities or external organisations, ensuring a broad spectrum of collaborative and multi-functional educational environments is covered. Relevant information to be collected is the project name, location, year of delivery, function(s), user group(s) and size.

The *Campus of the Future* Fair Data set will be used to identify such buildings. This data set aims to *"formulate decision-making strategies grounded in evidence to align future campus supply and demand,"* (den Heijer et al., 2023, p. 2). This repository includes a dataset of architectural data sourced from Arch Daily regarding 780 university buildings worldwide.

Table II-2: Data collection and sampling throughout the research (Author)

Method	Goal	Sampling
Case Overview	Get an overview of the trend and recent examples of inter-faculty education buildings and their essential characteristics	Number of cases ≈ **25** Convenience sampling
Case-study	**Preliminary interviews:** find out the goals and objectives related to inter-faculty building utilisation	Number of embedded cases = 2-3 Amount = 1 per case **= 2-3**
	Documentation: Gather case-specific data on the campus and related policy and building specifications.	4-6 cases x 4-5 documents = **16-30** Stratified (/convenience) sampling Selection: Diverse case selection
	Usage data analysis: Gain a systematic understanding of the functioning of inter-faculty building utilisation.	Number of cases **= 4-6** (2-3 uni's) Usage data of 1 academic year (September-August)
	In-depth interviews: Gain a deeper understanding of experiences, perceptions, and attitudes.	Amount: 2-3 per case (**=12-18**) Sampling: Convenience sampling

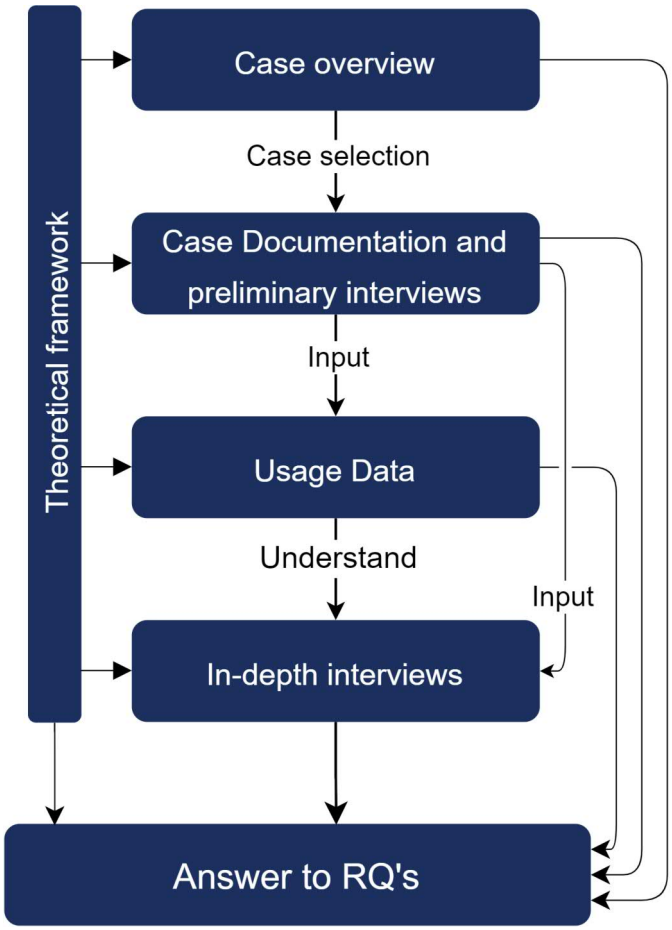


Figure II-6: Research methods and data collection (Author)

2.3.3 Case studies

From the case overview, several projects will be selected to delve deeper into as a case study. The goal is to be able to generalise these findings to a generic answer to the research question, so a diverse case selection is preferable. Additionally, having projects within the same context helps in preventing asymmetrical information, comparing and contrasting the approaches with outcomes, and simplifying data collection. This means at least two universities should be chosen for their context, and two cases per univeristy should then be selected. To explore the subject deeply, it is essential to ensure the chosen cases vary in size, function(s), and user groups.

The data for these cases will be collected in three different ways. First, case-specific information concerning the (university) campus to which the building belongs, policy documents such as the real estate strategy of this campus, and the building's brief will be documented. Along with this step, preliminary interviews will be conducted with the campus managers of each selected university.

The second step is to gather data related to KPIs from the CRE or scheduling departments of the various universities that will be studied. The KPIs that will be used are identified in Table II-3.

The third way in which data for the cases will be collected is through in-depth interviews, since not all information related to building utilisation is quantifiable, and they will provide further insight into the KPIs. Additionally, they offer the opportunity to delve into more subjective user experiences, such as those identified by Den Heijer (2021) in Table III-5 on page 45. In-depth interviews allow participants to express their opinions, share anecdotes, and articulate nuanced viewpoints, enriching the data and contributing to a comprehensive analysis (Blaikie & Priest, 2019). It would be insightful to speak to a policy employee, an asset manager and at least two users for each case. These users can be students or staff. It should be noted that interviewees will probably be able to discuss all cases selected for their particular university, enhancing the efficiency of data collection. The interviews will be semi-structured and in-depth to allow the participants to share detailed insights while maintaining flexibility in their responses.

2.4 Data analysis

This section describes the data analysis steps of the empirical research. The data gathered throughout the research will be analysed using thematic analysis to identify common themes, topics, ideas, and patterns of meaning that come up repeatedly. This will be used for both the case overview and the case studies.

2.4.1 Case overview

Data collected in the case overview will be analysed descriptively. Essential characteristics of the buildings matching the definition of shared buildings for this research will be collected, and an analysis of these characteristics of the buildings will be made, focussing on footprint, building year, location, and institution.

2.4.2 Case studies

The case-specific data gathered throughout the case studies will be analysed using thematic analysis. The themes to be reviewed will be based on the theoretical framework and open coding. The coding scheme is included in appendix D. Overall, this approach aims to facilitate a nuanced understanding of the qualitative data.

Case-specific data is analysed via internal or external documents by reading and scanning these documents, identifying relevant information and clustering these per theme in AtlasTI. Additionally, the preliminary interviews seek to identify goals and objectives related to shared spaces for each campus context. These interviews will be transcribed and analysed using AtlasTI as well.

The KPI analysis depends on the information CRE or scheduling departments can provide for this research. Most KPIs can be calculated based on general building characteristics such as a floorplan or brief. Additionally, the utilisation rates and overall development of seats have to be collected from the CRE departments, and financial indicators can be collected from annual reports. Universiteiten van Nederland can supply developments in student numbers.

For the interviews in this research, thematic analysis will be employed to systematically examine and identify patterns within the qualitative data obtained from decision-makers and end-users. Following the semi-structured format, interviews will be transcribed. Initial coding with AtlasTI will follow from the transcriptions, highlighting significant insights and opinions.

2.4.3 Cross-case analysis

A cross-case analysis is the final part of the research methodology, involving the comparison and synthesis of the thematic analyses of the studied cases. This method allows for identifying similarities, variations, and patterns by examining individual cases.

The research aims to be applicable to a broader context by scrutinising various cases. In this way, the cross-case analysis seeks to enhance the validity and generalizability of the research outcomes.

2.5 Data management

The data management plan has been devised utilising the DMP Online tool, a resource offered by Delft University of Technology, and is included in Appendix A. This research adheres to the FAIR data principles, ensuring the data is Findable, Accessible, Interoperable, and Reusable. To enhance the findability and accessibility of this research, it will be publicly available in the repository of Delft University of Technology. Interoperability is addressed by presenting the research in English, with clear and specific definitions of the concepts under investigation, complemented by a comprehensive theoretical background in Part III. Lastly, to promote reusability, this chapter provides a detailed explanation of the methodology and all references are cited and easily accessible.

2.6 Ethical considerations

To ensure the ethical conduct of this research, it is vital to outline various ethical considerations. Blaikie and Priest (2019) delineate five primary areas that require careful attention:

- Participation should be voluntary;
- Participants must be informed about the nature of the research, and consent should be obtained;
- Participants should know they can withdraw from the research anytime;
- Anonymity and confidentiality should be guaranteed;
- Participants should be protected from any harm, risks or deception.

These ethical principles are fundamental to maintaining the integrity and responsibility of the research process. Participation in the study is completely voluntary, and participants are not obliged to respond to questions, prioritising the principle of avoiding harm. Opting out of answering questions may impact data analysis, but this choice is respected. Participants have the freedom to withdraw from the research at any point. If individuals prefer to maintain anonymity, their wishes will be honoured. Before deciding to participate, individuals will be asked for informed consent (Appendix E) and provided with a comprehensive understanding of the study's purpose, benefits, risks, and data collection methods. Information about the publication of the research will also be communicated. Only relevant data essential

Table II-3: KPIs for emperical research (Author)

KPI		Calculation	Relevance
Building level KPIs	**Net useful space shared**	GFA / Net useful floor area (m^2)	Indicates the ratio of space reserved for education to the supporting or circulation space and therefore indicates the efficiency of the building layout.
	Useful space shared per seat	Capacity of seats / net useful floor area	Indicator of the functionality and efficiency of the design of the building.
	Occupancy rate	Method varies per university (%)	Indicator of efficiency of the physical use of the building, considered for study, education, office and research (if applicable).
Campus level KPIS	**Student numbers**	Annual student numbers	Indicates of the annual development of organisational growth.
	Accommodation costs	Annual total accommodation costs (€mln)	Indicator of the annual development of the sum of rents, legal fees, maintenance, operation, energy, and other accommodation costs.
	accommodation costs / total expenses	Annual accommodation costs / total expenses (%)	Indicator of the annual development of the accommodation expenses relative to the size of the university's total expenses.
	Accommodation costs / student	Annual accommodation costs / student numbers (€)	Indicator of the annual development of the accommodation expenses relative to an indicator of the organisational growth.
	Seats per student (annually)	Total seats in all education spaces / total students	Indicator of the annual development of the physical efficiency of space use (If seats are unavailable, m^2 GFA might be used.)

for the research will be retained and treated confidentially, and unnecessary information will be deleted. The research will maintain transparency to prevent deception or exaggeration. It adheres to ethical standards, ensuring no plagiarism or research misconduct, and the results will be accurately presented.

(O\2, New Joy Concepts, n.d.)

3. Research Output

3.1 Goals and objectives

Managing campus real estate poses a considerable challenge due to the complex interplay between dynamic and uncertain space demands and supplies. This inherent complexity is further heightened by the need to balance the four perspectives in campus management. Introducing centralised, flexible and multi-purpose space emerges as a potential strategy to address multiple challenges arising from this complexity. This study seeks to investigate shared buildings or spaces, identify success or failure factors for their integration on campus, and examine their effectiveness in resolving issues arising from the uncertain university campus context. This research will compile a comprehensive inventory of centralised, flexible and multi-purpose facilities, highlighting their strengths and weaknesses. The objectives are to concretely outline the impact of these facilities on the campus and articulate the value they may contribute to the overall campus environment.

3.2 Deliverables and data sets

The goals and objectives can be translated to specific products and data sets to be delivered at the end of the research (Figure II-7). Firstly, a thorough theoretical background will be provided for the main concepts of this research. Part III will describe CRE management, trends affecting the campus context, sharing economies and resource sharing on campus. Following this, the case overview is presented, which will provide a list of shared buildings based on the *Campus of the Future* FAIR Dataset (Den Heijer et al., 2023). This could provide campus real estate managers with a database to find reference projects for their shared facilities. The case studies will deliver detailed information on specific cases of shared spaces on campus in three ways. First, an analysis of documents related to the cases will be delivered that describes the project, along with a KPIs assessment. The data analysis will provide information on the performance of the selected buildings, and the case study chapters will further explore the patterns, behaviours, and challenges related to the alignment of shared facilities with campus user needs. Transcriptions from these observations and interviews will elaborate on the four projects and their implications for the campus. Lastly, through a cross-case analysis, an inventory of the knowledge and practical applications of implementing shared building use is developed.

3.3 Dissemination and audiences

This research focusses on education campuses and is most applicable to the real estate owned by universities in the Netherlands. Despite focusing on Dutch Universities, lessons learned from this research might still apply to other educational institutions (such as HBO or MBO) or other countries. The study aims to give (campus) real estate managers insights into the possibilities of implementing shared spaces and what consequences this might entail. This allows campus real estate managers or other decision-makers to learn from the presented cases and implement aspects of these cases on campus.

Figure II-7: Research output: Case overview (26 times), case studies (involving document analysis, KPI-analysis, in-depth interviews) and cross-case analysis (Author).

4. Personal study targets

Since the master thesis is the final step in my MSc education, it is relevant to outline specific personal study targets. It's crucial to articulate specific study objectives that align with both my academic growth and professional development so that I can later reflect on this development.

At a broader level, I aim to enhance my skills in utilizing data analysis tools, fostering effective time management, research planning and practising organizational skills. These competencies will not only help during my current research but also serve as valuable assets in future professional pursuits. Moreover, I recognize the importance of improving my communication and presentation skills. The ability to articulate complex research findings with clarity, both in written reports and oral presentations, is a vital skill set that I aspire to refine.

Digging deeper into the specifics of my study, an important goal is to cultivate a profound understanding of real estate management, with a distinct focus on the dynamics of public real estate and campus real estate. This necessitates a comprehensive exploration of literature, academic articles, and insightful case studies. By immersing myself in this knowledge, I aim to get a strong theoretical foundation that not only informs my current research but also lays the groundwork for a nuanced understanding of the complexities inherent in managing real estate within a complex organisation.

Furthermore, study goals related to the research methods can be identified. A significant study target is practising conducting in-depth interviews. This skill is crucial for collecting qualitative data from key stakeholders, including decision-makers and end-users. Additionally, I aim to methodically process the interview data using qualitative analysis programs. This includes acquiring proficiency in software tools designed for qualitative data analysis, ensuring in-depth examination of interview transcripts and deriving meaningful insights from participants' perspectives. Another study target involves learning to conduct a data analysis. This skill is essential for gaining firsthand insights into reservation data, usage patterns and resource allocation. Subsequently, I will develop skills in methodically processing this data, ensuring accurate documentation and interpretation. In addition to these core study targets, I aim to enhance my understanding of broader research methodologies, including case study methodologies. This involves selecting diverse cases from different universities and cities to provide a comprehensive analysis of inter-faculty building.

In essence, these study goals come together to help develop a well-rounded and effective approach to conducting meaningful research. Furthermore, these personal study goals will serve as a guide throughout the research process and will be reflected upon after the research to determine the level of growth.

Part III

Theoretical Framework

(Aurora, WUR n.d.)

1. Campus real estate management

The primary discipline involved in this thesis is CRE-management (CREM), which falls under the broader study area of (public) real estate management and has been evolving as a separate discipline over the past decades. To understand how shared building use can supply centralised, flexible and multi-purpose space on campus and to define what is still unknown about this type of facility use, it is essential to gain an understanding of the current body of knowledge on CREM based on the campus research of the past decade. To do this, it is necessary first to define CREM as a discipline and then take a broader perspective and discuss alignment, which is a critical aspect of CREM. This section will then continue with the four perspectives on campus management based on the broader alignment theory, which will serve as a theoretical framework for this thesis. Lastly, this section will provide an overview of knowledge on the changing campus models.

1.1 Definition

The term CRE-management consists of several more minor subjects whose definitions can help gain an informed understanding of the broader concept. First, campus real estate encompasses building portfolios and land properties that serve a purpose for the university, are funded by the university, accommodate university functions and are accessible to university staff and students (Den Heijer, 2021). Vande Putte (2020) defines management as *"a set of activities, resulting in the deployment of means, directed at an area of attention to achieve a desired objective within a given context,"* (Vande Putte, 2020, p. 3). The definition of CREM mentioned by Den Heijer et al. (2016) combines these definitions: CRE management is the alignment of campus real estate with the evolving context of the university, meeting the demands of diverse stakeholder groups and contributing to the university's performance.

1.2 Alignment – DAS framework

An essential aspect of the definition of CRE management is alignment. The Designing an Accommodation Strategy (DAS) framework by De Jonge et al. (2009) illustrates the process of alignment and is depicted in Figure III-1. Four steps are shown: (1) assessing the current situation, (2) exploring changing demand, (3) generating future models, and (4) defining projects to transform the current situation. These steps describe an iterative process that first analyses the problem and then designs a solution (Den Heijer et al., 2016). The four management steps can be executed through several tools, such as Den Heijer (2011) discussed: Table III-1 shows an overview of these steps.

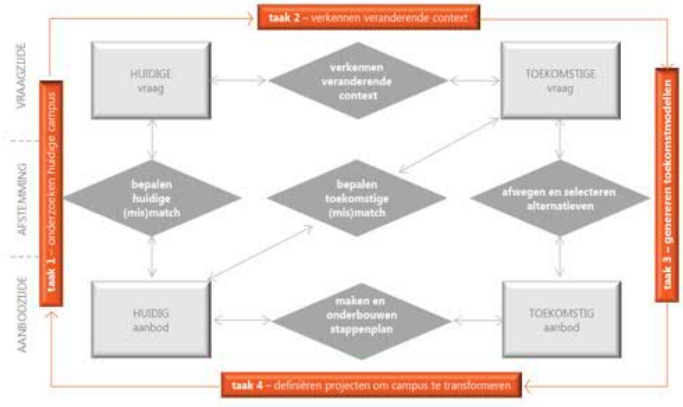


Figure III-1: DAS Framework (De Jonge, Arkesteijn, Den Heijer, Vande Putte, & De vries, 2009)

Table III-1: Elements of the PREM strategy process framework (Den Heijer, 2011)

Step	Evaluation task	Planning task	Methods and tools
1. Assessing the current situation	Compare current with past situation	Benchmark current with peers in PRE	Portfolio database
2. exploring changing demand	Analyse past demand	Forecast future demand	Scenario analysis
3. generating future models	Evaluate current models	Compose future models	Serious gaming dashboard design
4. Defining projects to transform	Evaluate past projects	Benchmark with PRE projects	Project Database

1.3 Four perspectives

The stakeholders involved in alignment within CREM have been defined by Den Heijer (2011). These stakeholders can be divided into four groups or perspectives on campus management. These perspectives, which need to be considered when making decisions about campus real estate, are organisational, functional, financial and physical on an institutional level or cultural, social, economic and environmental on a societal level. This section will describe each of the perspectives and their stakes in CREM.

The organisational perspective of Den Heijer (2011) contains most of the strategic choices affecting the continuity of the university. From this perspective, policy documents and visions are generated, relating to subjects such as reputation, internationalisation, diversity, educational policy, research policy or social engagement. This also has a significant influence on aspects such as collaboration, community, culture, identity and networking (Den Heijer, 2021).

Controllers are represented in the financial perspective. This can be seen as a reality check for strategic choices, as the financial context often determines the feasibility of new plans. This is also relevant when taking into consideration that investments in real estate should be balanced with investments in education or research (Den Heijer, 2021). Goals associated with the financial perspective are decreasing the total cost of ownership, increasing revenue and mitigating risk (Den Heijer et al., 2016).

From a functional standpoint, the focal point revolves around the individual needs of the user, marking a departure from the financial and strategic perspectives where the institution's goals take precedence (Den Heijer, 2011). Users play a crucial role as the ultimate consumers of campus facilities. This user demographic

Table III-2: Elements of the four-perspective PREM model (Den Heijer, 2021)

Perspective	Performance	Variable	Value	stakeholder
Organisational	Continuity, community, identity, diversity	Organisational goals	Societal, cultural	Policy-makers
Functional	Functionality, well-being, productivity	Users	User value	Users
Financial	Feasibility, accountability	Euros	Property, financial	Controllers
Physical	Sustainability, quality, circularity	Footprint	Environmental, Architectural	Engineers

ranges from students to teachers and supporting staff, presenting a challenge regarding diverse needs and expectations. The complexity arises from the diversity within the user group. The potential for dissatisfaction among users is a hurdle in the decision-making process.

Lastly, the physical perspective focuses on footprint, heritage preservation, quality of the indoor environment and environmental sustainability (Den Heijer, 2011)To make decisions from this perspective, environmental regulations and goals must be translated into the campus's qualitative and quantitative requirements. The balance between traditional buildings with designated spaces for specific users and shared spaces that could be considered unpersonal and unattractive is relevant to the campus real estate portfolio.

The campus manager is tasked with adding value to the performance of campus real estate by balancing these four perspectives (Den Heijer, 2021). This task is complex as the interests of different stakeholder groups often contradict. The most important message of this model is that strategies should never be based on just cost per m2 but also on organisational goals, added value to education and research and user satisfaction (Den Heijer et al., 2016).

1.4 The changing campus

Implementing shared spaces on campus can be seen as a part of the broader development of the changing campus. This section will, therefore, present the work of Den Heijer (2021) on this campus development and the CREM strategies related to this.

The university campus has been adapting under the influence of several trends, which will be discussed in Chapter 2 of the literature review. In the book *Campus of the Future*, Den Heijer (2021) uses a metaphor for the three physical states to describe the different models that can be applied to a university, a campus or a building. These are solid for the traditional campus, liquid for the network campus and gas for the digital campus. Fixed structures, hierarchy, territorial behaviour and exclusiveness characterise the conventional campus. Liquid, on the other hand, is all about flexibility, multidisciplinary collaboration, openness and sharing space on campus. The virtual campus represents mobility, freedom, autonomy and the work-from-anywhere online campus. Table III-3 shows a summary of these three

Solid	Liquid	Gas
Traditional	**Network**	**Virtual**
Hierarchy	Horizontal organisation	Bottom-up organisation
Small academic communities	Dynamic academic community	Anywhere-off campus community
Separate facilities per faculty	Shared and centralised facilities	Off-campus facilities
Cellular offices	Open office	Work-from-anywhere

Table III-3: Summary of the three campus models, adapted from Den Heijer (2021)

types. Most universities are nowadays a combination of these three models and, therefore, combine positive and negative elements from all three states (Den Heijer, 2021).

The development of the network/liquid campus is particularly relevant to this study. According to Den Heijer (2021), many campuses have gradually shifted from traditional/solid to liquid structures. Two relevant real estate shifts illustrate this. The first is the centralisation and shared use of lecture halls due to scarcity and smarter scheduling of facilities. Even the temporary changing of the function of the space became a possibility. Second, multidisciplinary education and research resulted in the central library that often replaced the faculty library (Den Heijer, 2021).

This transformation has resulted in a growing student population, aligning with a tendency towards heightened resource sharing, necessitated by the challenge of construction not keeping pace with the rapid growth. Table III-4 illustrates the associations linked with this campus model, derived by Den Heijer (2021) from interviews with Dutch university controllers, workshops involving other academic institutions, and insights from campus literature. The table illustrates the two sides of the model. On the one hand, the model highlights collaboration, inspiration from others, flexibility, and visibility. Contrarily, the model is also associated with anonymity, crowded spaces, decreased privacy and productivity, more time spent on mobility and a lack of social control.

Table III-4: Associations with the Liquid/Network model and potential positive and negative added values (Den Heijer, 2021)

	+ Positive associations	Neutral associations	- Negative associations
Organisational	○ Multinational organisation with multidisciplinary potential ○ World player, also considering size and network connections ○ A university that can respond to societal challenges and changing demand ○ Adaptable, flexible workforce ○ More shared space encourages interaction, collaboration and innovation	Horizontal organisation	○ Large organisations can make individuals feel anonymous ○ A large institution can overshadow many different identities and cultures of faculties and schools ○ an open campus can be a risk to safety and security ○ less (social) control ○ Weaker (social) cohesion
Functional	○ More user group mix, which enriches campus life and adds to diversity goals ○ More public space and interaction can make people feel part of a vibrant community ○ Being part of different teams can encourage talent development rotation and provide career opportunities ○ Higher utilisation rates ○ Users can find their preferred place for each activity and move around the campus ○ Bast facilities are accessible to all users	Multiple workplaces	○ Less territory can make people feel less at home and less visible ○ More interaction on campus can be distracting and affect mental well-being ○ Less privacy and silence can affect productivity ○ Shared space often requires reservations or keeping other user's demands into account ○ More shared space means more time spent to move between locations, which affects productivity.
Physical	○ Reduced footprint and energy consumption per user ○ More resource-efficient ○ Flexible for change in demand ○ More Sustainable	Shared facilities	○ More shared space means more mobility on campus, which takes energy ○ More mobility demands a higher quality of public space and circulation space
Financial	○ Lower costs ○ More resilient for change, fewer costs need to be made when demand changes ○ Total costs of campus shared with more partners ○ Some facilities are only feasible when they are shared; other funding streams for the academic business case	Multiple funding sources	○ More intensively used facilities need more cleaning maintenance, which raises costs ○ Meeting more diverse space demands of user groups raises costs per m2 ○ Management spends more human, financial and energy resources on dynamics, required flexibility and increased mobility.

Key takeaways

CRE-management (CREM) is the primary discipline involved in this thesis. CREM involves aligning university real estate with the institution's evolving context, meeting diverse stakeholder demands, and contributing to overall university performance. According to the literature, alignment is an essential aspect of CREM, for which the Designing an Accommodation Strategy (DAS) framework is used.

CREM is approached from four perspectives: organisational, financial, functional, and physical. The literature highlights the emergence of the network/liquid campus model, characterised by centralisation, shared spaces, and a shift towards multidisciplinary education, as an essential aspect of campus development.

While the literature provides a comprehensive overview of CREM, an explanation for how shared buildings fit within the changing campus context seems lacking. The literature does mention the challenges of the liquid campus model but does not delve deeply into potential solutions or strategies to mitigate its negative aspects. Further exploration of practical approaches would enhance the understanding of campus management strategies.

2. Trends affecting the campus context

Universities are confronting a rising level of uncertainty, with demand for space becoming more unpredictable in terms of quality and quantity. As the shared building is part of a recent shift in campus strategy, it is crucial to understand the campus manager's context and what issues they might be trying to solve with a plan for shared spaces on campus.

Therefore, this chapter of the literature review will present and analyse the current knowledge on the developments that have caused a shift in both the demand and supply side for campus real estate. This will be done using the four perspectives of CRE management to get a holistic view from each stakeholder's perspective.

2.1 Definition

Before discussing the literature on trends affecting the campus context, it's necessary to define precisely what this means. In this thesis, trends affecting the campus context are defined as fluctuations in demand and supply for space on the university campus regarding quality or quantity, stemming from the four perspectives on CRE management.

2.2 Organisational

The policymakers, such as the university board or faculty management, represent the organisational perspective. As mentioned in section 1.3, the policymakers are primarily associated with choices regarding reputation, internationalisation, diversity, educational policy, research policy or social engagement.

A significant trend from this perspective is related to the internationalisation of the academic field and the resulting unpredictability of the number of students (Valks et al., 2021). This is also confirmed by OECD (2023) which states that overall international student numbers for OECD countries have increased since 2013: International students formed 5% of bachelor programmes, 14% of all master programmes and 24% of doctoral programmes in 2023 (OECD, 2023). The COVID-19 pandemic saw an enormous decline in international student numbers, albeit temporarily. Besides this, a political debate has been growing in the Netherlands about the inflow of international students, with the recent elections of 2023 potentially influencing the future number of international students in the Netherlands. (ScienceGuide, 2023), and therefore, the demand for space on campus.

Two emerging trends regarding research have been identified, which are essential functions of a university campus. The first trend relates to the increasing unpredictability in research planning due to a decrease in long-term studies, as determined by Den Heijer et al. (2016). Universities report that the changing dynamics in research funding systems, marked by swiftly evolving themes, shorter project timelines and heightened involvement in international networks, lead to a less predictable demand for research space. This also relates to the growing presence of temporary staff engaged in research projects with shorter timelines and the rise in part-time employees. This necessitates a workplace that can readily adapt to changes, given the substantial number of guest researchers, visiting professors, and internal staff members who have become more mobile due to appointments at multiple universities (Den Heijer et al., 2016).

The second change related to research is that universities are expressing a greater commitment to working interdisciplinary with an emphasis on synergy and collaboration between diverse fields, both internal and external, which is the second development connected to research (Last et al., 2023).

2.3 Functional

From a functional perspective, the user is the most relevant stakeholder. The user is, in a campus context, quite a broad concept. There are, for example, different user groups such as students, teachers, researchers or other staff, but within these user groups, each user, to some extent, also has their individual needs (Den Heijer, 2011). Still, several trends can be identified that are related to user behaviour and preferences and affect their demand for space on campus.

First, recent years have shown a shift towards a flexible learning environment. Van Sprang et al. (2019) and Beckers et al. (2015) explain how institutions are changing from being primarily concerned with disseminating knowledge to being involved in helping students work together on projects (Van Sprang et al., 2019). Beckers et al. (2015) mention a transition from the conventional supply-driven method of teaching and learning to more contemporary, personalised, and demand-driven approaches to education, which also impacts real estate through fluctuations in the number of hours spent on campus and an increase in the demand for study space per student.

The *Campus NL 2016* research also mentions a notable transformation in education, marked by a rise in entrepreneurship education and the introduction of broader interdisciplinary bachelor's programs. Changes are observed in the dynamics of student-teacher interactions, alongside a shift toward smaller, more intensive educational models. The student demographic is evolving with an increased focus on accelerated study paces and a growing influx of young students (Den Heijer et al., 2016).

In addition to the learning environment, changes in the working environment of the campus can be identified, too. Due to advancements in ICT, but mainly due to the Covid-19 pandemic, widespread adoption of various forms of flexible working has emerged. According to Den Heijer et al. (2016), scientific researchers emphasise the importance of functional and comfortable workspaces, prioritising the ability to work with concentration and adequate communication facilities.

The demand for and use of office space is changing, and research facilities have also seen some developments in recent years. Den Heijer (2021) writes about the costliness of laboratories combined with the short lifespan of installations due to shorter time horizons for research projects, which has led to increased shared use for laboratories. The cancellation of research projects on the grounds of costs has changed the attitude of researchers towards the shared use of laboratories; a shared laboratory is, after all, better than no laboratory. Another stimulant for this trend has been the increased

focus on collaboration between universities, resulting in shared investments and inter-university use of laboratories.

2.4 Financial

The financial context in which universities and other educational institutions operate is increasingly dynamic, resulting from changing funding structures, increased academic competition, and declining utilisation rates.

Beckers et al. (2015) explain how the Dutch government slashed funding for education and supporting programmes, infrastructure, and buildings due to the 2008 financial crisis. This phenomenon is also mentioned by Den Heijer (2021), Den Heijer et al. (2016) and Rymarzak et al. (2020). This meant procuring and maintaining the financial resources necessary for the functioning of universities has become increasingly challenging.

To remain competitive, universities must draw in the top students and work in tandem with the public, commercial, and outside sectors (OECD, 2023), which puts pressure on financial resources. They are increasingly drawn into an intense rivalry to draw and retain talented academics in their regions, cities, countries, and continents (Rytkönen et al., 2017). Curvelo Magdaniel et al. (2018) explain that this financial competitiveness within higher education stems from a global increase in students and faculty.

Academic capitalism has been fueled by increased competition and reduced government financing, resulting in a combination of public and private expenditures (Curvelo Magdaniel et al., 2018). Academic capitalism, as defined by Kauppinen (2012), involves diverse market activities employed by faculty and institutions, such as patenting, establishing spin-off companies, obtaining grants, fostering university-industry partnerships, and implementing tuition fees. This alteration of funding structures is a pivotal factor challenging the processes involved in campus management (Rytkönen et al., 2017).

The increased pressure on financial resources has also led to an increased focus on utilisation rates and efficient resource allocation. Den Heijer et al. (2016) observe the underutilisation of academic workspaces. Valks et al. (2021) have determined that for TU Delft, the average occupancy of educational spaces, such as lecture halls, group workspaces or exam halls, is well below 60%, despite a steady decrease in the average seats per student due to growing student numbers, as can be seen in Figure III-2 (Valks et al., 2021).

The underutilisation of the academic workspace and education areas combined with declining financial resources results in changes in how campus space is supplied.

2.5 Physical

Since the physical perspective focuses on footprint, heritage preservation, quality of the indoor environment and environmental sustainability, it poses one of the most significant changes in the supply of campus space, mainly fuelled by goals to be resource-efficient as a result of environmental restrictions and sustainability goals (Den Heijer, 2021). Sustainability stands out as a central theme and a significant criterion in the majority of campus plans, playing a pivotal role in most campus projects (Den Heijer et al., 2016). As a result, many recent construction initiatives align with high sustainability standards, evident through the attainment of energy-saving interventions, energy labels, circular material use and BREEAM certifications (Last et al., 2023).

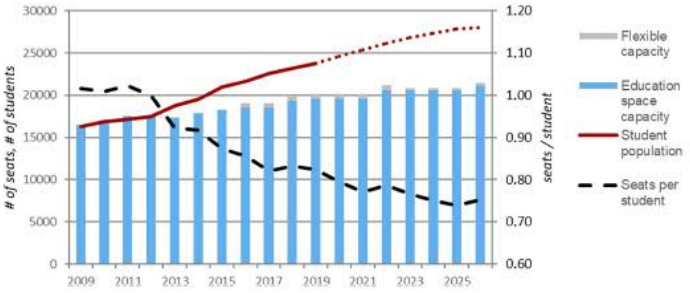


Figure III-2: Student population and forecast vs. the education space capacity and forecast at TU Delft (Valks et al., 2021)

A key emphasis lies in fostering flexibility in usage to reduce footprint and extend buildings' technical and functional lifespan. The recent Intergovernmental Panel on Climate Change 2023 report (IPCC, 2023) explains urban systems play a pivotal role in reducing emissions and fostering climate-resilient development. The IPCC report particularly emphasises the importance of interventions that can potentially lead to a 66% demand-side mitigation of the built environment by the year 2050. The highly efficient and optimised utilisation of buildings is a crucial way to achieve this goal. This underscores the significance of adopting strategies that not only contribute to mitigating climate change but also align with the broader goal of sustainable and resilient urban development (IPCC, 2023).

2.6 Effects on the campus real estate portfolio

As the literature presented highlights, Universities now have to deal with a greater degree of uncertainty regarding their facilities, which are erratic in both number and quality. Figure III-3 shows an overview of the trends described per campus management theme.

Society is undergoing significant changes marked by a dynamic and rapidly evolving environment. The increasing speed of development necessitates a multidisciplinary approach to address emerging societal challenges, surpassing the traditional confines of faculties and departments (Den Heijer et al., 2016). These transformations are not isolated but unfold within a broader societal context, swiftly evolving professional landscape, and flexible job market. The transition towards a knowledge-oriented network economy requires the campus to be responsive (Last et al., 2023).

Den Heijer (2021) argues that these developments have influenced the scope of the campus manager, who is now primarily influenced by demand and driven by supply and external factors. The campus manager asks for flexibility from both users and organisations in order to adjust demands in light of the restricted supply. Furthermore, it is argued that increased focus on interdisciplinary work, fluctuations in student numbers, financial restrictions, and sustainability goals have led to increased demand for centralised, shared, and flexible

space. Den Heijer et al. (2016) mention the need for flexible solutions and explain it is essential to refrain from programming based on peak loads and, instead, embrace the compact campus, where all faculties are accommodated, further facilitating the ability to adapt to swift developments.

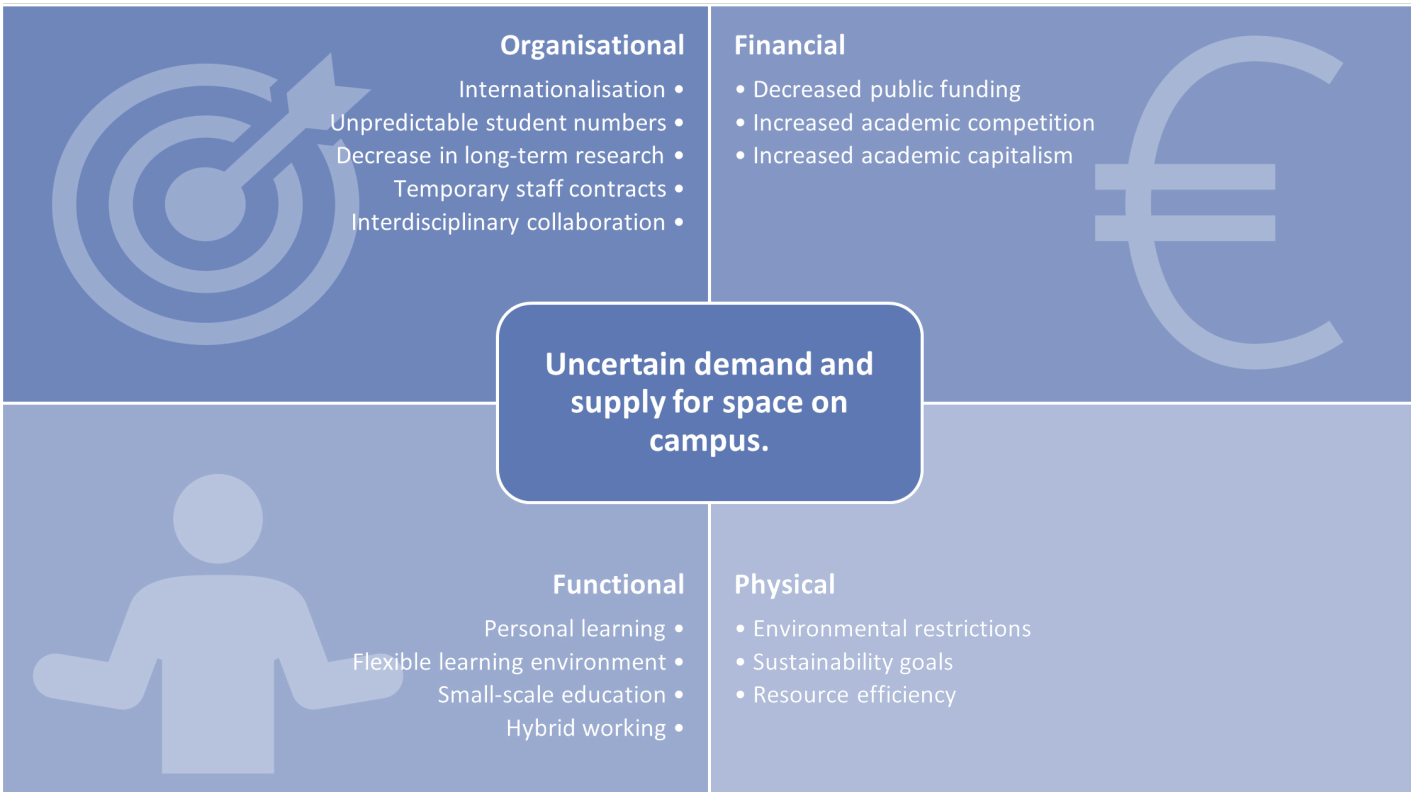


Figure III-3: Trends creating uncertain demand and supply for space on campus (Author, 4 perspectives of campus management by Den Heijer (2011))

Key takeaways

The literature presented above underscores that educational institutions are dealing with escalating uncertainties in their facilities, which are marked by fluctuating quality and quantity demand and supply. The organisational perspective highlights internationalisation's impact on student numbers and unpredictable research dynamics. The functional perspective emphasises shifts in user behaviour, from flexible learning environments to transformed working spaces. From a financial perspective, academic capitalism, heightened competition, and financial pressures shape universities' spatial dynamics. The physical perspective underlines sustainability as a core theme, reflected in construction initiatives and environmental considerations. In this evolving landscape, societal changes direct universities towards adaptability, requiring campus managers to navigate the dynamics of supply and external factors, making flexibility a strategic choice.

The literature review highlights overarching trends in university management. However, it lacks specific insights into implementation strategies and does not show how these developments relate to broader societal trends or developments in other sectors. Moreover, the focus on Dutch universities limits the generalizability of findings, and these trends' long-term impact on overall university functioning and competitiveness is not extensively explored. Future research could provide more detailed insights into implementation strategies, consider regional variations, and assess long-term impacts to address these knowledge gaps.

3. Sharing economies

Increased institutional sharing and centralisation of facilities extends beyond universities and education, encompassing various public and semi-public entities such as government agencies, municipalities, and the police. Private organisations have also adapted their real estate to optimise space utilisation, often embracing shared usage. This shift indicates broader societal and economic developments, leading to a sharing economy. These trends manifest differently across organisations, showing distinct causes and timelines. This section explores the societal trends underpinning the sharing economy and its impact on real estate management. Additionally, it explores how these trends have led to centralisation and the increasingly optimised use of space. This section thus seeks to identify lessons learned from other sectors for CRE management and implementing centralised, flexible, multi-purpose campus spaces. To do this, the sharing economy is first defined as a starting point for this literature review. Then, the development of the sharing economy in general is discussed, followed by developments in the private and public sectors. These developments will then derive lessons learned for CREM and implementing shared spaces on campus.

3.1 Definition

Providing a clear definition of the sharing economy is challenging, as the term is used in various ways in the literature, making it difficult to capture its full scope. Besides, the sharing economy applies to the built environment, and different economic and societal activities are discussed broadly in the literature on this concept. Piracha et al. (2019) identify a diverse range of activities, covering everything from running errands to providing accommodation, participating in online labour markets, utilising transportation services, engaging in collaborative workspaces, and participating in online marketplaces.

The subject's relevance for this thesis lies in the implications of the sharing economy for the built environment, specifically for the shared use of buildings or spaces. When considering the built environment, providing accommodation and engaging in collaborative workspaces are most relevant, and the definition of the sharing economy should include these activities. That is why in this thesis, the definition by Frenken and Schor (2017) is used: Individuals or organisations allowing (temporary) access to their underutilised physical assets, potentially in exchange for compensation, constitute the sharing economy. The core concept defining the sharing economy for the built environment is thus the sharing of idle capacity made possible by the underutilisation of assets (Frenken & Schor, 2017).

3.2 Sharing economies

Entrepreneurs, innovators, established businesses, policy-makers, and academic researchers are all showing a rapidly increasing interest in understanding the characteristics and effects of sharing economies (Martin, 2016). Understanding the reasons for deriving lessons from implementing the sharing economy is necessary.

According to Martin (2016), people have always shared things as a fundamental way of exchanging goods. This behaviour is rooted in our biology. Sharing encompasses the distribution of possessions or assets for others' use and the receiving or taking of items from others for our use, and while sharing is a phenomenon as old as humankind, the sharing economy is a phenomenon born of the Internet age (Belk, 2014). Sharing often occurs within close relationships, family, and friends, and less often between distant colleagues or strangers (Frenken & Schor, 2017).

The literature defines multiple reasons for individuals or organisations to participate in the sharing economy. Most notably present in the literature are sustainability and economic incentives. Firstly, engagement in sharing is commonly associated with ecological and environmental sustainability (Hamari et al., 2016). The sharing economy is often seen as a potential route to sustainability as it challenges the unsustainable patterns of over-consumption and under-utilisation (Martin, 2016). Frenken and Schor (2017) do, however, emphasise that the claim that sharing is environmentally friendly lacks empirical evidence. To truly understand environmental impacts, it's essential to consider all systemic changes resulting from sharing practices (Frenken & Schor, 2017). On the other hand, involvement in sharing can be a rational and utility-maximizing choice, as individuals or organisations choose more cost-effective alternatives rather than exclusive ownership of assets (Hamari et al., 2016).

3.3 Private sector developments

Starting in the previous century, the private sector, especially office usage, has undergone a notable transformation in its approach to real estate strategies, with a pronounced shift towards centralisation, multi-purpose and flexible space use. In the following paragraphs, three examples from the literature will be presented, showcasing companies that have implemented this strategy. Subsequently, key insights and lessons learned from these cases can be derived.

First of all, Weatherhead (1997) describes the IBM case, which stands out for its centralisation efforts. In response to economic challenges, shared desks became a pivotal element in the real estate strategy, replacing the previous practice of providing excessive individual spaces. Simultaneously, meeting space policies were overhauled, emphasising efficiency by reducing room numbers and encouraging flexible usage with extended opening hours. Flexibility and adaptability were further highlighted through IBM's introduction of touchdown facilities. This showcased a strategic move away from generously allocated spaces to ones tailored for non-permanent use (Weatherhead, 1997).

A similar development within the investment bank Goldman Sachs is described by Benezet and Welch (2006). Recognising the need for enhanced competitiveness, sustainability, resilience and adaptation, Goldman Sachs adopted a consolidated corporate campus strategy, moving from several facilities in lower Manhattan to a more streamlined operation in a central location. Protocols for space allocation based on a pyramid concept were implemented, promoting optimal space utilisation (Benezet & Welch, 2006).

Thirdly, Edwards and Ellison (2004) describe the case of Clifford Chance's London-based practice. The company used to

occupy six sites. The firm opted for a larger centralised building to address fragmentation, technological needs, and space inadequacy. The strategy aimed for 95% space usage, emphasising cost efficiency and client satisfaction. This target was set because a space audit by the property team revealed lawyers spent 50% of their time away from desks, intensifying space utilisation goals. The adjustments resulting from this include creating two team rooms from four offices, doubled capacity, and improved collaboration and information sharing. Furthermore, Concerns about noise and privacy were addressed effectively with curved-top screens (Edwards & Ellison, 2004).

There has been a precise pressure to "*rethink corporate real estate to increase workplace agility, flexibility and resilience*" (Yang et al., 2023, p. 140), and these cases illustrate the argument made by Corenet Global (2015) Organisations have been adapting their real estate practices due to the impact of globalisation and the ever-changing landscape of macroeconomic influences, which has led to the transformation of workplaces into flexible workspaces and the need for fluid real estate.

3.4 Public sector developments

Like the private sector, public real estate management (PREM) strategies have been shifting towards increased sharing and centralisation under the influence of the increasing dominance of market economies starting from the 1980s, resulting in an increased emphasis on cost rationalisation, professionalisation of PREM, and heightened efficiency in asset management (Trojanek, 2015). Public real estate in the Netherlands held a valuation of 85.5 billion euros in 2018, constituting taxpayer funds that warrant proficient management, considering both financial and societal dimensions (Veuger, 2018). Several trends in public real estate management have been identified in the literature:

Compact public service: This involves the centralisation and consolidation of ministries and municipalities, the merging of regional police units into the National Police Force, and the downsizing of the armed forces (Veuger, 2018);

Cost-saving efforts since the 2008 financial crisis: The Central Government Real Estate Agency (RVB) was required to achieve significant cost reductions (€142 million on office accommodation). Likewise, the National Police faces the imperative of saving €76.5 million annually on its real estate costs starting from 2025 (Veuger, 2013, 2018);

Outsourcing: Dutch government agencies more often decide to use outsourcing compared to other European countries (Marona & van den Beemt-Tjeerdsma, 2018);

Urban living: The global trend towards urban living is placing immense strain on the capacities of cities worldwide, leading to challenges such as scarcity and high costs of space in larger urban areas (Brinkoe & Nielsen, 2017);

New ways of working: reduced space per workplace and flexible office concepts (Veuger, 2018);

Sustainability goals (van den Beemt & Veuger, 2014).

These public real estate management developments are most widely described in the literature from a municipal perspective. This can be explained by the wide range of property types managed by municipalities, such as schools, sports facilities, healthcare facilities, day-care institutions, cultural facilities and workspaces for civil servants (Brinkoe & Nielsen, 2017). Municipalities consider real estate ownership as a means to fulfil policy objectives rather than a primary purpose and emphasise the importance of aligning with community demands and exercising cost-conscious management of their real estate assets (van den Beemt & Veuger, 2014).

Especially the growth of urban populations resulting in demand for extra space in combination with the urgency to realise real estate spending cuts (Marona & van den Beemt-Tjeerdsma, 2018) has been forcing municipalities to consider the sharing of space. Brinkoe and Nielsen (2017) give examples of different schools sharing sports facilities, civil servants from various departments sharing the same office or a child-care institution using the same outdoor space as an elderly home. Furthermore, the authors emphasise that a number of barriers and unknowns have been identified in creating shared spaces.

In summary, PREM has mirrored private sector trends in some

Table III-5: Lessons learned for shared space use from other sectors of the economy (Author)

Sharing economy	Private Sector	Public Sector
- Apply sharing economies by providing shared accommodation and collaborative workspaces.	- Embrace shared desk spaces for efficiency and collaboration.	- Focus on cost efficiency to stimulate sharing.
- Tackle underutilisation through shared use of assets.	- Smoothly phase out surplus facilities to minimize disruption.	- Centralise to create a more compact organisation.
- Sharing is in the biological roots of humans but happens less naturally between colleagues.	- Avoid excessive provisions of space	- Sharing assets can be used to save space.
- Stimulate sharing through economic and environmental incentives.	- Extend opening hours to encourage flexible usage.	- Introduce new ways of working to reduce space per worker.
	- Tailor facilities to average, not peak, demand.	- Assets can be shared between different organisations that have similar space demands.
	- Centralise facilities to tackle the problem of fragmentation	- Shared space use still poses barriers and unknowns.

ways, emphasising sharing and centralisation, efficiency, and policy-driven management. Key trends include compacting public services, cost-saving, outsourcing, urban challenges, new working methods, and sustainability. As a result, municipalities owning diverse properties have started exploring shared spaces.

3.5 Lessons learned

The previous sections have presented an overview of the current literature on the sharing economy, emphasising its relevance to the built environment, and more specifically lessons that can be applied to shared space use on campus. This section will discuss those lessons, along with Table III-5 which shows a more detailed overview of the lessons learned per section.

The approach to real estate as an asset has been changing in the private sector (earlier) and the public sector (Trojanek, 2015). Lessons from private sector cases like IBM, Goldman Sachs, and Clifford Chance emphasise embracing 'fluid real estate' for efficiency, which entails using shared spaces, tailoring facilities to average demand, and stimulating flexible usage. The shift in public sector real estate management towards sharing and centralisation, driven by market economies, emphasises cost rationalisation, professionalisation, and efficiency. These insights suggest the importance of aligning real estate strategies with evolving business needs, embracing shared and flexible spaces, and considering the societal and environmental implications of such practices on university campuses.

Key takeaways

The evolution of real estate strategies in both the private and public sectors reflects a broader societal shift towards a sharing economy. Companies adapt 'fluid real estate,' emphasising centralisation, shared spaces and flexibility. PREM has responded to market trends, focusing on cost rationalisation and heightened efficiency. Lessons for university campuses include encouraging shared and flexible space use and tailoring facilities to average, not peak demand. Overall, the lessons learned emphasise the interconnectedness of various economic and societal activities, urging organisations, including universities, to adapt real estate practices for a more flexible and sustainable future.

4. Sharing space on campus

Shared spaces on the university campus result from diverse shared space practices influenced by contextual changes, including the growing demand for resource efficiency and adaptability, as discussed in Chapter 2 of the literature review. Other types of shared space use include activity-based working, co-working spaces, and hybrid working. Notably, shared spaces on campus are not a new concept, with examples like shared lecture rooms and libraries predating it. This chapter presents current literature and knowledge on facilitating and promoting shared space use within the campus context. Beginning with a definition of 'sharing space on campus' to establish the framework, this chapter explores the motivations behind shared space practices. Subsequently, it delves into the types of spaces that should be shared, how campus users utilise these shared spaces, and strategies for stimulating such usage.

4.1 Definition

The notion of sharing space on campus encompasses a broad spectrum, spanning policies like shared desks in academic offices to collaborative laboratories and communal storage spaces. Given the focus of this research on shared spaces on campus, it's necessary to define it within this context.

Shared space use and synonym concepts like adaptability or flexibility have been viewed as favourable attributes in buildings for a long time (Pinder et al., 2017), resulting in many definitions for these and other related concepts. Interestingly, Pinder et al. (2017) mention the strong contextuality of the concept due to its wide application. A general definition of shared space is provided by Brinkoe and Nielsen (2017, p. 2): "*Shared space is a unifying term for organising the use of many different types of spaces, with the one thing in common that the space or facility in question is shared between at least two different individuals, groups or organisations.*" Building on this general definition, shared space use on campus allocates university real estate resources to multiple users, groups of users from different internal and external faculties to the university organisation.

4.2 Motivations for shared space practices

As demonstrated in Chapter 3, there is apparent pressure for organisations, including universities in the Netherlands, to rethink their corporate real estate to increase adaptability, flexibility and overall resilience. Brinkoe and Nielsen (2017) Shared spaces in public building portfolios can help achieve optimised utilisation, cost reductions, synergies, increased sustainability, and portfolio flexibility. However, a university's motivations might differ despite similar strategic goals or comparable types of facilities. Drawing on chapters one and two of the literature review, this section will discuss the main motivations behind shared space practices on the university campus.

4.2.1 Dealing with uncertainty

As Chapter 2 of the literature review demonstrates, universities operate in an increasingly dynamic context, leading to uncertainty. The CRE manager is tasked with dealing with this uncertainty.

The literature reveals several interventions to deal with uncertainty through the real estate portfolio. Den Heijer (2021) discusses transforming the academic workplace by sharing resources, establishing a hybrid learning environment, expanding business hours, utilising smart tools, and reconsidering storage. Nonetheless, the general strategy appears to provide flexibility, which has been extensively studied in the literature. Since higher education has made increasing portfolio flexibility a priority, campus managers need to make sure there is enough space available to support campus users' activities. This is important because it will allow for the smooth and dynamic growth of both staff and students (Curvelo Magdaniel et al., 2019).

4.2.2 Increasing resource efficiency

Generally speaking, universities aim to optimise the allocation of their resources, including real estate, facilities, staff, curriculum, and students, to achieve the highest possible educational outcomes (Sankari et al., 2018). A study by Valks et al. (2021) shows that actual occupancy rates at TU Delft for educational spaces are well below the target rate of 60%, while goals for scheduled frequency (75%) and scheduled occupancy (60%) are generally met. The results of this study are also shown in Figure III-4 and Figure II-5.

Reducing the physical impact and maximising space utilisation are necessary for sustainable and resource-efficient development, and these goals can be reached by cooperatively sharing facilities (Rymarzak et al., 2020). This results in a higher average user-to-space ratio, diminishes the overall space requirements, and contributes to decreased operational and maintenance expenses for facilities, encompassing costs like rent, heating, cooling, lighting, and cleaning (Sankari et al., 2018). An additional rationale behind institutional sharing is that greater financial flexibility can be allocated to high-quality investments or other university goals when a larger number of users share space, resulting in more efficient usage (Den Heijer et al., 2016).

4.2.3 Informal and flexible learning spaces

Developments in education, as discussed in Chapter 2 of the literature review, have led to a changing demand for space. According to Sankari et al. (2018)Students advocate for adaptable and informal learning environments catering to collaborative study. Consequently, these learning spaces should support student-centred and informal social learning methods. As a result, real estate managers in academic settings should explore innovative solutions to accommodate users' evolving collaborative work habits. (Sankari et al., 2018). Besides developments in teaching relations, universities are expressing a stronger commitment to multidisciplinary work. This is underscored by both the *Campus NL* research (Den Heijer et al., 2016) which shows a rise in partnerships with businesses, research institutions, universities of applied science, and non-governmental organisations in addition to increased interuniversity research and education, and by Kärnä and Julin (2015), highlighting a worldwide viewpoint on this trend and putting more of an emphasis on interdisciplinary cooperation and synergy. Increased collaboration and interdisciplinary

work have thus increased the demand for shared space on campus.

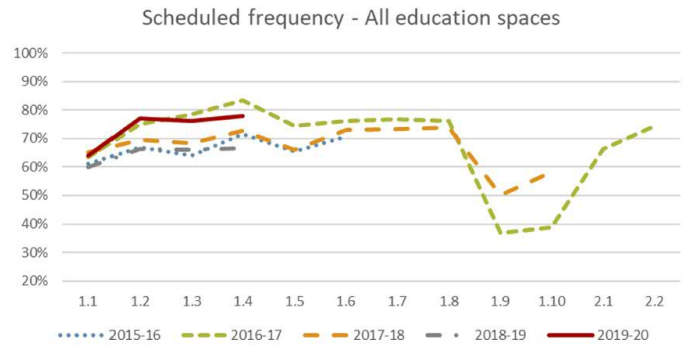


Figure III-4: Average scheduled frequency (TU Delft) (Valks et al., 2021, p. 455)

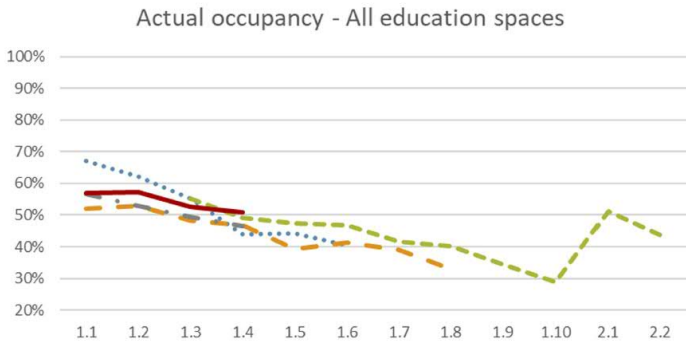


Figure III-5: Average actual occupancy (TU Delft) (Valks et al., 2021, p. 456)

4.3 Types of shared spaces on campus

The notion of sharing space on campus is not a recent development, as various instances of intra-faculty and shared space sparing have been established for an extended period. This section, therefore, aims to explore the literature on what types of shared spaces already exist on campus and what characterises these facilities.

Shared space concepts have gradually been implemented within faculties, including co-working spaces and activity-based working. Shared space sharing has also been facilitated through centralised scheduling, central libraries, and laboratories. This increase in shared facilities is mentioned by Curvelo Magdaniel et al. (2018), Den Heijer et al. (2016) and (Rytkönen et al., 2017). In a study by Curvelo Magdaniel et al. (2019), the information, displayed in Figure III-6, reveals notable variations in the quantity of shared amenities amongst universities. While certain universities list hundreds of shared amenities, others just make a few mentions. A range of settings, including libraries, lecture halls, study rooms, and seminar spaces, were included in this study. The information demonstrates the universities' desire to encourage internal cooperation and institutional sharing. (Curvelo Magdaniel et al., 2019).

In a study on shared office utilisation by PhD students at universities, Adikesavan and Ramasubramanian (2023) explain that a thriving shared campus work environment should provide settings for absorbing and expressing knowledge and recharging to ensure productivity, health, and overall well-being. It should also be considered that shared academic spaces are part of a more extensive network, like homes, local libraries, and coffee shops, for various educational activities such as learning, teaching, and research. Sankari et al. (2018) express that the shared spaces:

- Should encourage a situation in which people from different backgrounds come together;
- Should be multi-purpose;
- Should be offered as a service through which users get access for a certain period;
- Should be highly accessible in terms of location and opening hours;
- And should be attractive to deliver positive user experiences

4.4 How to facilitate and stimulate shared space utilisation on campus?

Shared space utilisation is not a given, especially in a professional setting such as the academic workplace. Personal preferences, cultural differences, competition for resources, security concerns and challenges in communication are some of the general hindrances mentioned in the literature (Brinkoe & Nielsen, 2017; Frankó et al., 2023; Lahti et al., 2022). This section will thus explore the current knowledge on facilitating and stimulating shared space use between different parts of the academic organisation.

4.4.1 Obstacles to shared space use on campus

The body of research indicates that universities may experience some disadvantages from institutional sharing. One notable concern, as pointed out by Den Heijer et al. (2016) iis the possibility that variations in work cultures among campus user groups could impede the utilisation of shared space, given that users have a strong demand for a home base and, to some extent, their territory. Place attachment is a profoundly ingrained phenomenon and is closely connected to territorial behaviour (Frankó et al., 2023). The problem of encouraging cooperation and resource sharing between other faculties and their users is further made more difficult by financial limitations, as indicated by Rytkönen et al. (2017). Adikesavan and Ramasubramanian (2023) emphasise the challenge of reducing

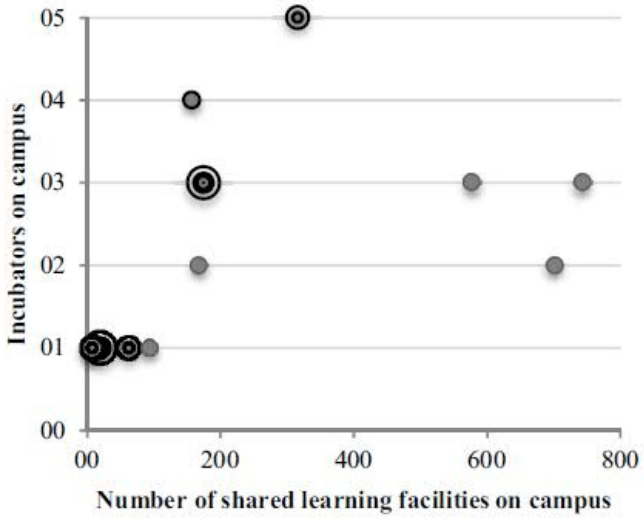


Figure III-6: Potential of UT's campuses to cluster knowledge workers and student to stimulate innovation and collaboration (n=13) by Curvelo Magdaniel, Den Heijer, and Arkesteijn (2019, p. 228)

uncertainty when trying to find a workplace and the difficulty of finding appropriate alternative locations, such as third places and public spaces.

Besides this, Søiland and Hansen (2019) have shown that flexible buildings alone do not necessarily lead to flexible users. Therefore, the willingness of the user to be flexible determines for a large part the success of a shared space, which highlights the significance of addressing user groups' collaborative and cultural dynamics in addition to the practical aspects of sharing space.

4.4.2 Facilitating shared space utilisation on campus

According to Brinkoe and Nielsen (2017)Three themes are essential when working with shared spaces: territoriality, involvement, and practicalities. Facilitating shared space falls mainly into the category of practicalities, and the literature mentions several ways to tackle the challenges of institutional sharing.

Kärnä and Julin (2015) illustrate how providing faculties with services to overcome financial constraints and enabling unrestricted access to information and infrastructure services can encourage institutional sharing on an organisational level. Implementing workspace information systems, like real-time availability displays and booking systems for up-to-date occupancy information, is also seen as crucial in facilitating shared space use (Adikesavan & Ramasubramanian, 2023; Den Heijer et al., 2016; Frankó et al., 2023; Kärnä & Julin, 2015). Other design enhancements according to (Adikesavan & Ramasubramanian, 2023) involve reducing auditory distractions through private conversation areas, ensuring optimal proximity between different activity zones to minimise transfer time and energy, and offering a diverse range of spaces that cater to the need for both internalisation and externalisation and extended opening hours.

4.4.3 Stimulating shared space utilisation on campus

Since "the collective willingness of users determines the ability of the oragnisation bottom-up, regardless of top-down policies" (Den Heijer, 2021, p. 113), facilitating shared space use won't be enough. It is also essential to stimulate space use. The other two essential themes when working with shared spaces are territoriality and involvement, which can be used to facilitate shared space use.

Den Heijer et al. (2016) explain that measures can stimulate flexible space use, such as transforming the academic environment by shifting individual territoriality to group territoriality, promoting interdisciplinary cooperation through projects and creating a hybrid learning environment. Moreover, Rachuba et al. (2023) suggest integrated and central planning to stimulate the efficient use of resources. To address obstacles in place attachment and cultural differences and to increase involvement, participatory planning might be used (Frankó et al., 2023). This involved end-users in more minor decisions to enhance their engagement in shared spaces (Frankó et al., 2023)

Key takeaways

The literature underscores that shared space practices on university campuses can be seen as a solution for contextual uncertainty and the need for heightened resource efficiency. Motivations include mitigating uncertainty, optimising resources, and adapting to evolving learning methods. Existing shared spaces like co-working areas and centralised scheduling have already become integral to many campuses.

Despite the prevalence of shared spaces, challenges persist, such as cultural differences and financial constraints. Key themes to be considered are territoriality, involvement, and practicalities. Means of facilitating and stimulating shared space use related to these themes involve transparency, diverse spaces, transforming academic workplaces, fostering interdisciplinary cooperation, and embracing hybrid learning and working.

Existing literature primarily focuses on shared spaces within the academic workplace, leaving a knowledge gap in their application to educational facilities and labs. Moreover, multiple authors emphasise that, despite abundant data on shared spaces, its accessibility remains low due to its distribution across the university organisation. Case studies on successful implementations in educational contexts are lacking, emphasising further research, especially since having the correct data is crucial for making well-informed real estate decisions.

5. Key takeaways and gaps in the literature

The literature reviewed for this thesis will serve as a foundational reference for shaping the methodology, enabling reflection on eventual results, facilitating conclusion drawing, and providing insights for recommending future research. This last section of the literature review will present a concise overview of the theoretical framework by highlighting the interconnected relationships among the primary concepts. The gaps identified in the literature review will be presented following this.

5.1 Key take-aways

The summarisation of critical takeaways in Figure II-7 provides an overview of how universities align their real estate with the four perspectives on campus management. In CRE-management (CREM), the DAS framework aligns university real estate with organisational developments. CREM is approached from organisational, financial, functional, and physical perspectives, each representing key stakeholders and their unique perspectives on CREM. The CRE manager is tasked with balancing these perspectives and aligning campus real estate.

The figure shows how the dynamic changes in the operational context of universities lead to a more 'liquid' nature of real estate. The landscape in which universities operate is marked by escalating uncertainties in the demand for and supply of facilities. The reviewed literature emphasises adaptability as a solution, making flexibility and shared spaces a strategic choice for campus managers. These developments have contributed to universities changing from 'solid' (traditional) to 'liquid' (network) or even 'gas' (virtual). The reviewed literature indicates that combining these models might be most suitable for a future campus strategy. The liquid model is especially relevant for this thesis, as it embraces centralisation and shared spaces.

Additionally, the key takeaways in Figure II-7 shed light on the uncovered theoretical aspects of shared spaces and outline the prerequisites necessary to overcome challenges associated with this paradigm. Literature on the broader societal trend towards the sharing economy reveals a shift with real estate strategies focussing on centralisation, shared spaces, and flexibility. The reviewed literature revealed that shared spaces can mainly reduce uncertainty-related risks and increase resource efficiency if challenges can be overcome. Key themes to overcome these challenges include territoriality, involvement, and practicality.

5.2 Gaps in the Literature

The literature and existing knowledge on CRE management are substantial. However, as the preceding sections of the literature review have shown, gaps have still been identified, offering opportunities for further exploration:

- The precise role of shared buildings within the campus context remains inadequately addressed in the literature. Challenges associated with these 'liquid' facilities are presented, but an exploration of potential positive or negative associations with shared spaces on campus is lacking.
- The literature emphasises the need for more accurate and easily obtainable data on the use of shared spaces.
- Case studies on successful implementations and using shared spaces on campus are lacking.
- The overall focus on Dutch universities limits the generalizability of findings.
- The literature addresses challenges associated with shared spaces. However, further research is needed to explore these challenges and potential solutions.
- While existing literature focuses on shared spaces in the academic workplace, there is a knowledge gap in their application to other facilities intended for education.

To summarise, the literature lacks practical insights into implementing a strategy for utilising shared space, its relationship to broader societal trends, and its long-term impacts on overall university goals. Research addressing these gaps should provide detailed insights, consider institutional variations, and assess the effects of shared spaces on the campus user and university goals.

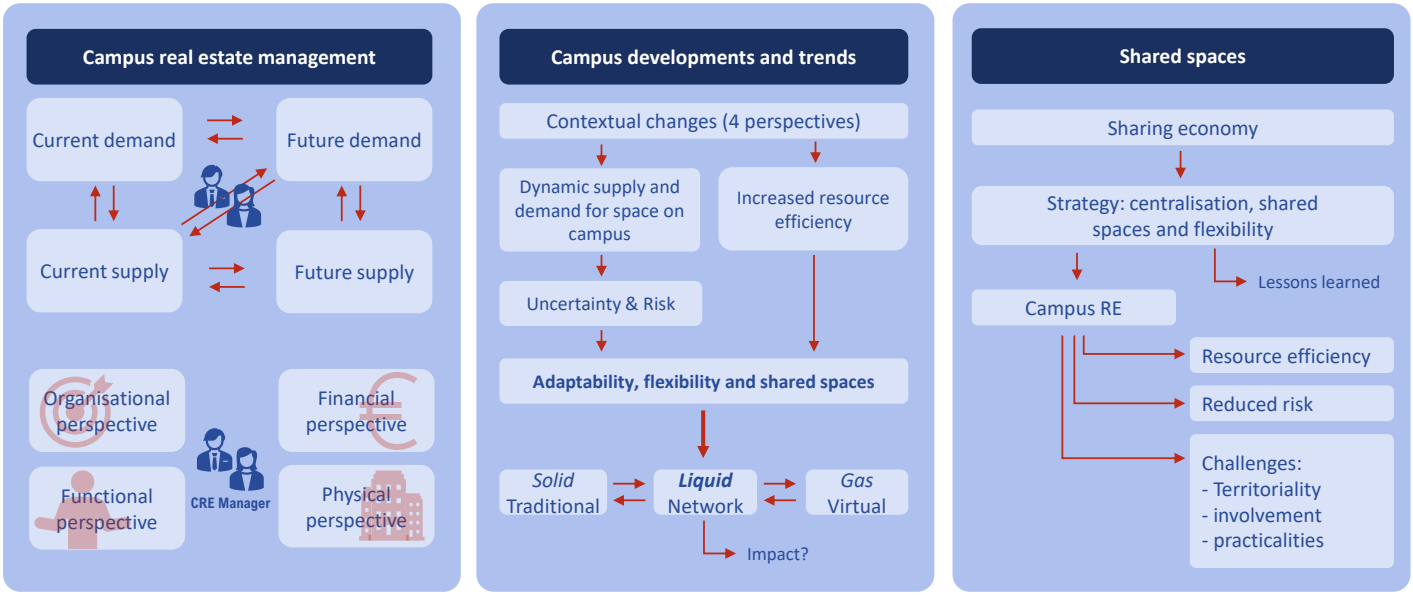


Figure III-7: key take-aways of the theoretical framework, author based on Benezet and Welch, 2006; Brinkoe & Nielsen, 2017; De Jonge et al., 2009; Den Heijer, 2011; Den Heijer et al., 2016; Frankó et al., 2023; Lahti et al., 2022; Rytkönen et al., 2017; Trojanek, 2015.

Part IV

Emperical reserach

(WUR Campus, Author)

Hasegawa, 2020

Case overview & Selection

1. Case overview & Selection

This section of the empirical research will delve into an in-depth exploration of shared education buildings or spaces, aiming to offer a select overview of diverse facilities added to various campuses in recent years. A total of 26 cases are under review, initially sourced from the *Campus of the Future* Fair Data set by den Heijer et al. (2023). Additionally, this study incorporates new data from Arch Daily and educational institution websites.

The section will start by describing the analysis and the steps taken to get to this case overview. Furthermore, it will expand upon the criteria used in selecting cases for in-depth case studies, leading to the final selection of cases.

1.1 Analysis

Table IV-1 on page 58 shows the complete analysis. This section highlights the most critical aspects of this analysis. The main goal is to get a sense of the characteristics of this data set of shared educational buildings. It should be emphasised that this analysis does not exhaustively cover all possible buildings that meet these criteria.

The division of buildings per country in the case overview is shown in Figure IV-1. Clearly, most buildings found to match the definition of a shared building originate from the Netherlands. Furthermore, Figure IV-3 shows the division of delivery years for the building set. Most buildings in the set have been constructed between 2015 and 2020, followed by 2020 and now. Only 5 cases have been identified in the data set that predate 2015. Additionally, two projects have yet to be delivered. When zooming in on the buildings in the Netherlands, it can be seen that six out of thirteen universities in the Netherlands have been included in the overview (Figure IV-2). The universities with the most shared buildings are Delft University of Technology and Wageningen University, followed by the VU Amsterdam, Tilburg University and Erasmus University Rotterdam. Furthermore, the building identified for the University Utrecht is still in development.

Figure IV-6 on page 56 depicts the distribution of buildings aligned with various campus themes within the dataset, as discerned in the *Campus of the Future* Fair Data Set. As the theme 'learning environment' was a part of the definition of shared buildings in the context of this research, all buildings had to match this criteria. Subsequently, as new buildings were integrated into the dataset, a consistent coding approach was employed to designate relevant themes.

Emerging as the next prominent campus theme is 'non-academic functions', encompassing a spectrum from sporting facilities to espresso bars and theatres. This theme holds significance

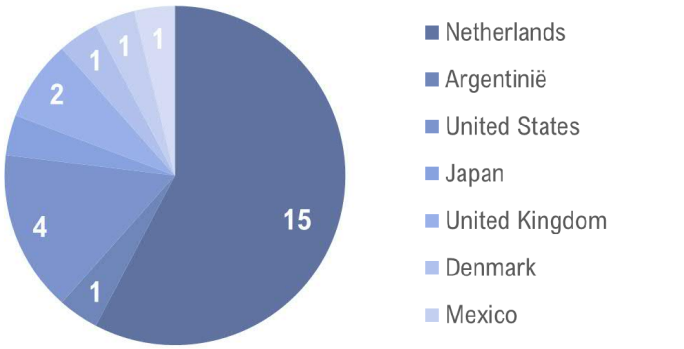


Figure IV-1: Number of buildings per country in the case overview (Author)

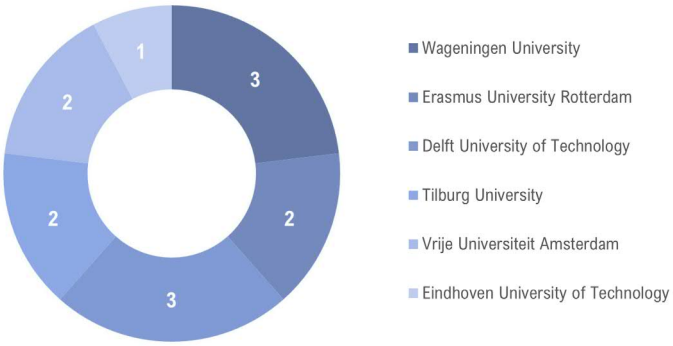


Figure IV-2: Number of buildings per University in the Netherlands (Author)

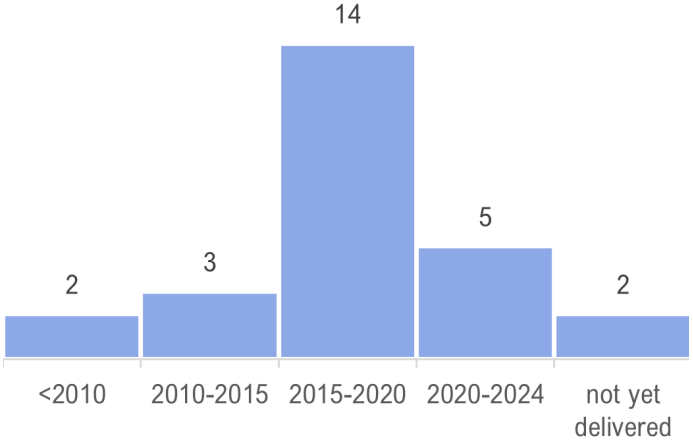


Figure IV-3: Delivery year of the buildings in the case overview (Author)

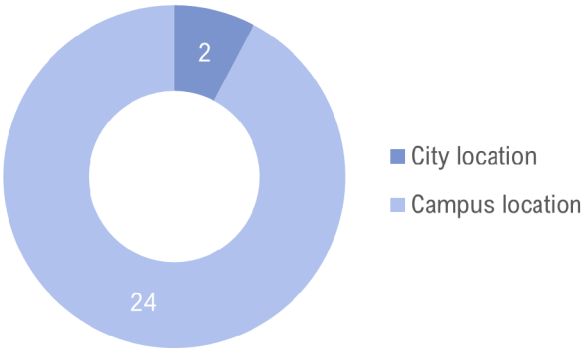


Figure IV-4: Buildings with a campus or city location in the case overview (Author)

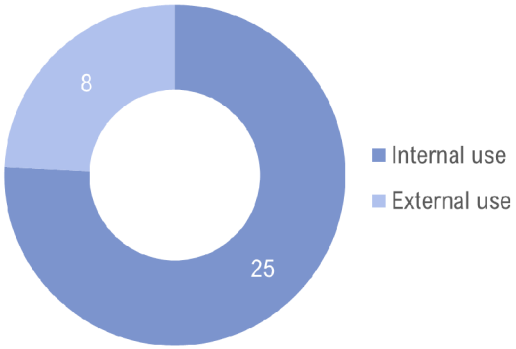


Figure IV-5: Buildings suitable for internal and external users in the case overview (Author)

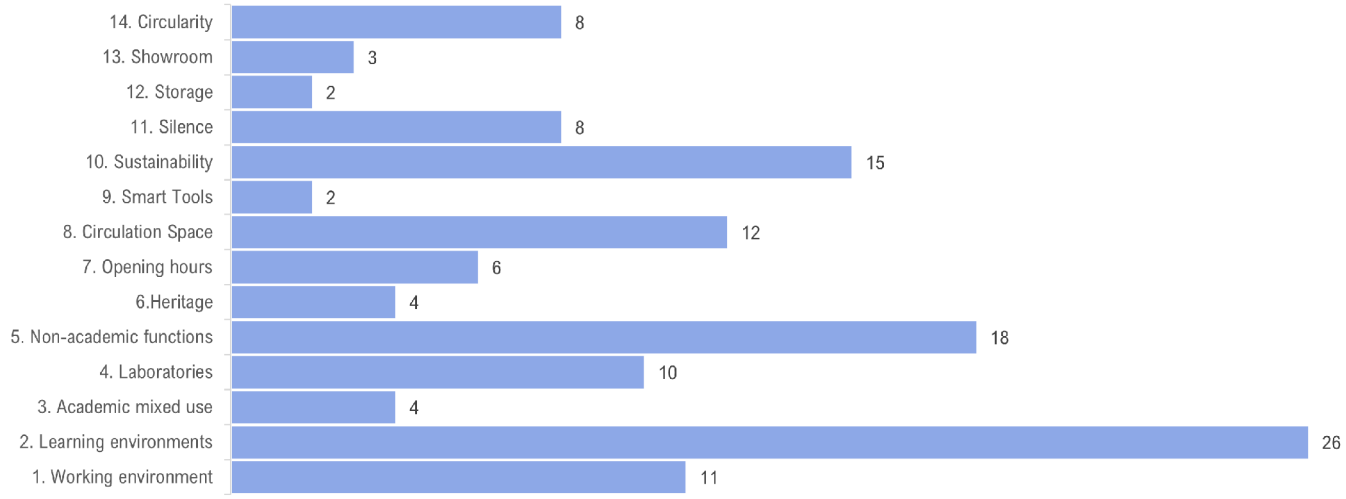


Figure IV-6: Number of buildings for each campus theme in the case overview (Author, based on den Heijer et al. (2023))

in identifying external non-academic users. Additionally, the theme of 'sustainability' spotlights buildings committed to maintaining high environmental standards. Given the predominance of newer buildings subject to stringent sustainability regulations, this theme garners notable attention. Conversely, themes such as 'smart tools', 'storage', 'showroom', and 'heritage' appear less frequently within the dataset, indicating relative scarcity or lesser prominence.

Lastly, Figure IV-4 and Figure IV-5 show additional information gathered for all buildings, including those already in the existing data set. The first is the context in which the building is situated and, by extension, the campus type. Therefore, the case overview also distinguishes between buildings on a campus or in a city. It turned out only two buildings are not located on the traditional campus but are part of a city-as-campus model, while all other buildings are part of a campus-as-city model (Den Heijer, 2021). Another factor relevant to this research is whether the buildings are suitable for internal and external users (these are not mutually exclusive). Except for one building (owned by three institutions), all buildings are suited to internal use, while external users also utilise eight.

Figure IV-7: College & University Centre Coeur D'Alene (Swimmer, 2019)

Figure IV-8: Teaching and learning centre university of Birmingham (University of Birmingham, 2020)

Figure IV-9: Musashino Art University Building (Hasegawa, 2020)

Table IV-1: Case Overview (Author, based on den Heijer et al. (2023))

General information										
Nr.	Project name	Educational institution	Country	City	year of delivery	Size (GFA m2)	Dominant campus theme	1. Working environment	2. Learning environments	3. Academic mixed use
1	Forum	Wageningen University	Netherlands	Wageningen	2007	36500	Learning environment	■	■	■
2	Muenster University Center	Muenster University	United States	Vermillion	2009	2880	Learning environment		■	
3	Campus Classroom Building	University of Chile	Chile	Nunoa	2012	-	Learning environment		■	
4	Orion	Wageningen University	Netherlands	Wageningen	2013	21030	Learning environment		■	
5	Polak	Erasmus University Rotterdam	Netherlands	Rotterdam	2015	8400	Learning environment		■	
6	Center for Science and Innovation	Johnson & Wales University	United States	Providence	2016	6596	Learning environment		■	
7	Pulse	Delft University of Technology	Netherlands	Delft	2018	4700	Learning environment		■	
8	CUBE	Tilburg University	Netherlands	Tilburg	2018	11000	Learning environment		■	
9	O2	Vrije Universiteit Amsterdam	Netherlands	Amsterdam	2018	33000	Laboratories	■	■	
10	UNC Virtual Campus	Universidad Nacional de Córdoba	Argentinië	Cordoba	2018	2520	Learning environment		■	
11	VUC	VUC Storstrøm	Denmark	Næstved	2018	5150	Learning environment		■	
12	College & University Center	Lewis-Clark State College, University of Idaho, and North Idaho College	United States	Coeur D'Alene	2019	2700	Learning environment	■	■	
13	Teaching and Learning Building	University of Birmingham	United Kingdom	Birmingham	2019	4800	Learning environment	■	■	
14	Innovation and Design Education Building	Southern New Hampshire University	United States	Hooksett	2019	6200	Learning environment	■	■	
15	Teaching and Learning Centre	Durham University	United Kingdom	Durham	2019	8250	Learning environment	■	■	
16	Atlas	Eindhoven University of Technology	Netherlands	Eindhoven	2019	42000	Academic mixed use	■	■	
17	Nieuwe Universiteits- gebouw (NU)	Vrije Universiteit Amsterdam	Netherlands	Amsterdam	2020	31100	Academic mixed use		■	■
18	Musashino Art University Building	Musashino Art University	Japan	Kodaira	2020	3444	Learning environment		■	■
19	Transparente The Rectoria	Monterrey Tec	Mexico	Monterrey	2020	6700	Learning environment	■	■	
20	Aurora	Wageningen University	Netherlands	Wageningen	2021	7500	Learning environment		■	■
21	Echo	Delft University of Technology	Netherlands	Delft	2022	8300	Learning environment	■	■	
22	Langeveld Building	Erasmus University Rotterdam	Netherlands	Rotterdam	2022	8748	Learning environment		■	
23	Jakoba Mulderhuis	Amsterdam university of applied sciences	Netherlands	Amsterdam	2022	27000	Learning environment	■	■	
24	Flux	Delft University of Technology	Netherlands	Delft	2023	2115	Learning environment		■	
25	Marga Klompé	Tilburg University	Netherlands	Tilburg	exp. 2024	4500	Learning environment		■	
26	Anna Maria van Schuurmangebouw	University Utrecht	Netherlands	Utrecht	exp. 2027		Learning environment	■	■	

Function											Users				Source	
4. Laboratories	5. Non-academic functions	6.Heritage	7. Opening hours	8. Circulation Space	9. Smart Tools	10. Sustainability	11. Silence	12. Storage	13. Showroom	14. Circularity	Internal use	External use	City location	Campus location	Original source	Link
■	■						■	■			■			■	Education institution website	www.wur.nl/nl/locatie/forum-gebouwnummer-102.htm
■	■			■			■	■			■	■		■	Arch Daily	www.archdaily.com/275575
	■			■		■					■			■	Arch Daily	www.archdaily.com/626548
■	■		■	■		■	■				■			■	Arch Daily	www.archdaily.com/425951
	■			■		■					■	■		■	Arch Daily	www.archdaily.com/802442
■	■			■					■		■	■	■		Arch Daily	www.archdaily.com/925815
	■		■	■		■					■			■	Education institution website	www.tudelftcampus.nl/nl/projects/pulse/
	■		■				■				■			■	Arch Daily	www.archdaily.com/902592
■	■			■		■					■	■		■	Education institution website	www.vu.nl/nl/over-de-vu/meer-over/o2-labgebouw
■			■		■		■				■			■	Arch Daily	www.archdaily.com/926222
	■			■							■		■		Arch Daily	www.archdaily.com/909649
	■											■		■	Arch Daily	www.archdaily.com/974431
		■									■			■	Arch Daily	www.archdaily.com/955792
						■					■			■	Arch Daily	www.archdaily.com/954414
	■					■	■				■			■	Arch Daily	www.archdaily.com/934656
	■	■			■				■	■	■			■	Arch Daily	www.archdaily.com/914644
■	■					■			■	■	■	■		■	Education institution website	www.vu.nl/nl/over-de-vu/meer-over/nieuwe-universiteitsgebouw
■										■	■	■		■	Arch Daily	www.archdaily.com/970714
		■								■	■			■	Arch Daily	www.archdaily.com/963343
■				■		■					■			■	Architectenweb	www.architectenweb.nl/nieuws/artikel.aspx?ID=50894
	■		■	■		■	■			■	■			■	Arch Daily	www.archdaily.com/985343
	■					■				■	■			■	Arch Daily	www.archdaily.com/1000541
■	■		■			■					■	■		■	Arch Daily	www.archdaily.com/989360
				■		■				■	■			■	Education institution website	www.tudelftcampus.nl/projects/flux/
						■	■			■	■			■	Education institution website	www.tilburguniversity.edu/nl/actueel/persberichten/start-bouw-marga-klompe-building
	■	■		■		■					■			■	Education institution website	www.uu.nl/organisatie/campus-development/anna-maria-van-schurmangebouw

1.2 Case study criteria

As mentioned in Section II, several projects from the case overview will be selected for case studies. The objective is to use these case studies to form a generic and comprehensive answer to the research questions. Therefore, the cases are selected using a diverse case study selection method based on the criteria in Table IV-2.

1.3 Case selection

All projects in the market review were evaluated against the selection criteria. While most projects didn't meet the primary criteria individually, a diverse case selection was chosen, allowing numerous options to remain. Hence, assessing the entire range of selected cases and determining their coherence as a combined set was crucial. Additionally, data accessibility was essential, mainly impacted by the connections the graduation company can provide. This meant convenience sampling was also a part of the selection process. Altogether, this has led to the following five buildings:

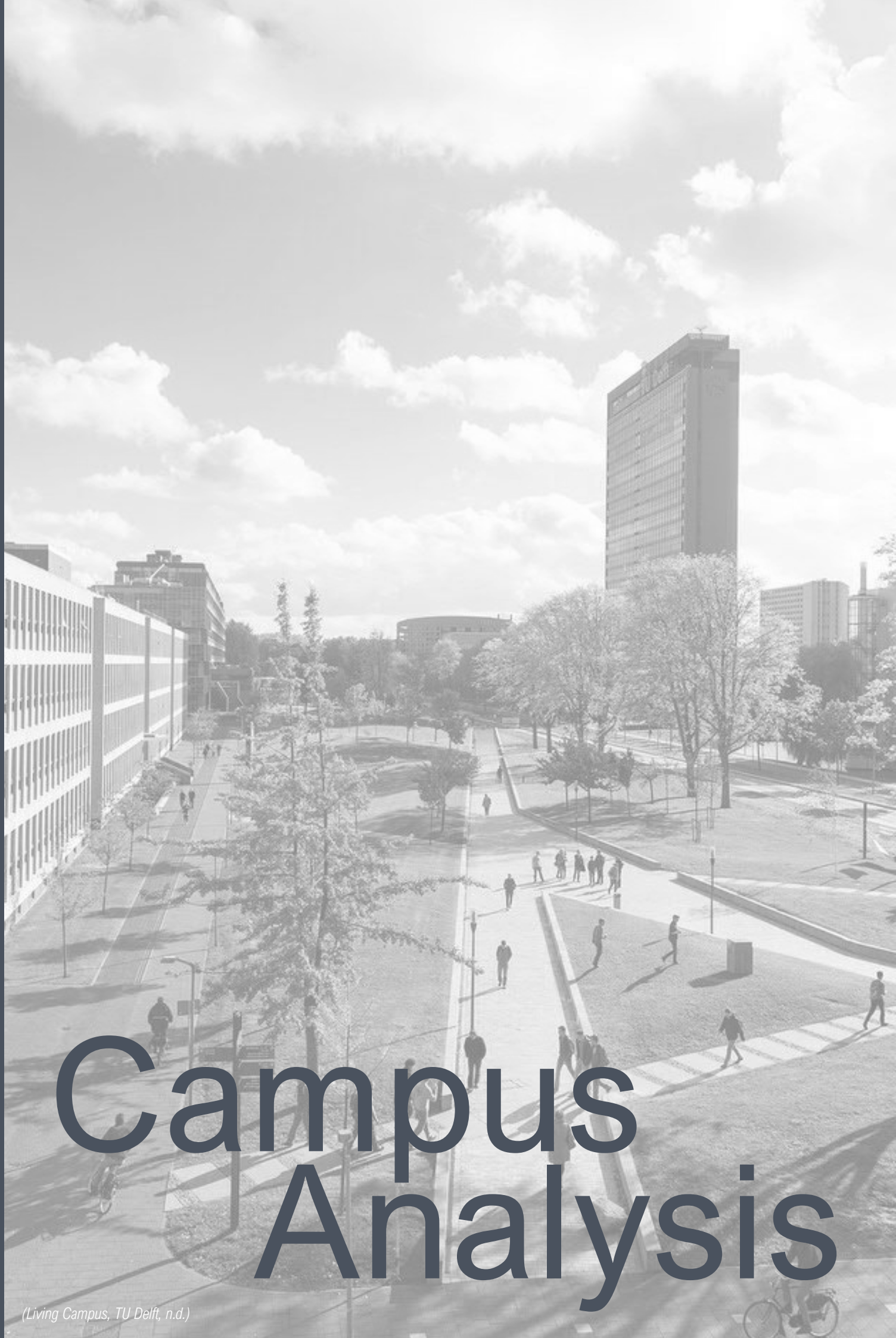
- NU – VU Amsterdam
- O|2 – VU Amsterdam
- Forum – Wageningen University
- Aurora – Wageningen University
- Echo – Delft University of Technology

Table IV-2 shows how all of these projects meet the selection criteria together. It also shows the main characteristics of these buildings. The following chapters will elaborate on these buildings and the campuses to which they belong.

Table IV-2: Case selection criteria and match (Author)

Related to	About	Criterium	Explanation
Campus	Location	At least two different cities in the Netherlands.	It provides more opportunities to find differences between locations and campus types.
	University	At least two different universities.	It provides more opportunities to find differences in approach.
	Number of shared buildings	Two or more buildings that can be studied per campus.	Provides embedded cases to study different approaches/outcomes in a comparable context.
Building	Users	At least two buildings with external and internal users for all cases.	Allows for studying the approaches and effects of including external users.
	Year of delivery	Include at least one older building to have a mature case.	A mature case allows for an extensive study of lessons learned.
	Function	Include campus themes 1, 3, 4, 5, 7, 8.	Including the most relevant functions for these buildings allows to get a comprehensive insight into various cases, which increases generalisability.
Information	Accessibility	Enough information about the project is available to the researcher	Without accessible and available data, the case study can't have enough depth.

NU	OI2	Forum	Aurora	Echo	Combined
Amsterdam	Amsterdam	Wageningen	Wageningen	Delft	✓
VU Amsterdam	VU Amsterdam	Wageningen University	Wageningen University	TU Delft	✓
Together with OI2	Together with NU	Together with Aurora	Together with Forum	Together with Pulse, Flux	✓
Internal + External	Internal + External	Internal	Internal	Internal	✓
2020	2018	2007	2021	2022	✓
2, 3, 4, 5, 8, 10, 13, 14	1, 2, 4, 5, 8, 10	1, 2, 3, 4, 5, 11, 12	2, 3, 4, 5, 8, 10	1, 2, 5, 7, 8, 10, 11, 14	✓
Yes	Yes	Yes	Yes	Yes	✓



Campus Analysis

(Living Campus, TU Delft, n.d.)

2. Campus Analysis

This section of the empirical research forms a part of the case studies, focusing on the contextual characteristics of the selected campuses. Through an analysis of documents such as campus strategies, educational strategies and year reports, alongside conducting preliminary interviews, this section seeks to provide a deeper understanding of the dynamics within each campus. These documents offer a broad overview of the current campus characteristics and shed light on the strategic approaches guiding the implementation of shared buildings or spaces on campus. Simultaneously, interviews with campus managers are discussed, offering insights into their perspectives on campus strategy developments. The protocol for these preliminary interviews is detailed in Appendix C. The following three sections will present the results of studying the campuses of the VU Amsterdam, TU Delft, and Wageningen University campuses (Figure IV-10).

Figure IV-10: Location of cases in the Netherlands: Echo at TU Delft, O|2 and NU at VU Amsterdam, Forum and Aurora at WUR (Author)

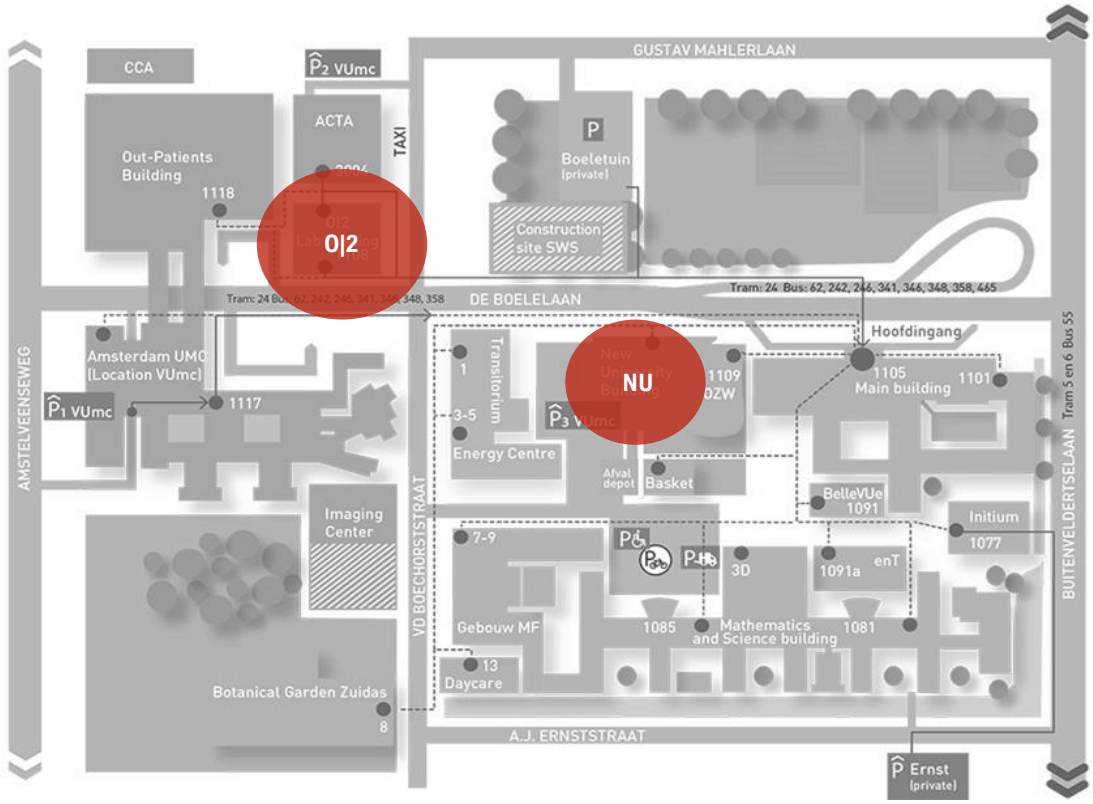


Figure IV-11: VU Campus map, VU Amsterdam (n.d.-a) (adapted)

2.1 VU Amsterdam

This section analyses the VU campus. It starts with an overview of key facts and figures, then uses the four perspectives on campus management to organise information gathered from various documents and two interviews with the campus real estate department. The goal is to provide a context in which the development of the buildings selected for a case study can be placed and to identify whether the perspectives might conflict. The analysed documents and interviews are presented in Table IV-3 and Table IV-5.

Table IV-3: Documents analysed related to VU Campus (Author)

Document	Ref.
Strategy 2020-2025	Vrije Universiteit Amsterdam (2020b)
Vision on student wellbeing	Vrije Universiteit Amsterdam (2021b)
Vision on education	Vrije Universiteit Amsterdam (2021a)
Annual Report	Vrije Universiteit Amsterdam (2023c)
Environmental Vision Amsterdam 2050	van den Beuken and Kuijt (2021)
Energy Masterplan 2035	Facilitaire Campus Organisatie Vrije Universiteit (2017)
VU Campus – Long-term housing plan	Vrije Universiteit Amsterdam (2023d)
Masterplan VU Campus	Vrije Universiteit Amsterdam and VUmc (2014)

Table IV-5: Interviewees VU campus analysis (Author)

	Interviewee	Stakeholder group	CRE Goals	
VU1	Director Real Estate VU	CRE Manager		Organisational, financial, physical
VU2	Policy employee VU	CRE Manager		Organisational, financial, physical

Table IV-4: Facts and Figures VU (VU Amsterdam, 2020b, 2021a, 2021b, 2023c, 2023d; VU Amsterdam & VUmc, 2014)

Vrij Universiteit Amsterdam		
Organisation	Location	Amsterdam, the Netherlands
	Number of faculties	9
	Disciplines	Health & life sciences, governance, humanities, law, sociology, business and economics
Users	Students bachelor	19.736
	Students Master	12.025
	International students	18,6%
	Academic Staff (FTE)	2.887
	Support staff (FTE)	1.874
Real estate Portfolio	Land property	36 hectares
	Portfolio size	252.412 m²
	Real estate costs (yr.)	€47,7M (2022)

2.1.1 Facts and figures

VU Amsterdam in the Netherlands is a research university that offers many disciplines. The university offers programs in fields such as humanities, social sciences, natural sciences, economics, law, psychology, and health sciences (VU Amsterdam, 2020b). Table IV-4 provides an overview of facts and figures. The VU campus is situated in the southern part of Amsterdam, easily accessible by public transportation. The campus encompasses modern and historic buildings, providing teaching, research, and student life facilities. VU Amsterdam's real estate strategy is focused on sustainability, innovation, and community engagement (VU Amsterdam, 2023d). The university also prioritises the development of modern, flexible learning spaces and research facilities to support its academic programs.

2.1.2 Organisational

From an organisational perspective, the VU is portrayed as a campus university in the 2022 annual report (VU Amsterdam, 2023c). The campus has to stimulate a community comprising students, staff, and partners of VU Amsterdam while leaving a positive and lasting impression within the Zuidas knowledge district. According to interviewee VU1 and VU Amsterdam (2023d), the VU doesn't create separate buildings for individual faculties but develops multidisciplinary facilities that group users based on research themes. Interviewee VU2 points out the traditional office setup, with everyone isolated behind closed doors in their cubicles, prompts the question of whether this environment is conducive to meeting and sharing knowledge. They suggest a university campus should instead offer a setting where interactions are more spontaneous, creating a space where individuals are visible and approachable. Additionally, the university's cultural ambitions aim to enhance campus vitality to boost the campus feeling and liveliness (Interviewee VU2).

The organisational perspective also relates to the university's growth trajectory regarding student enrolment and research. Projections indicate the continued growth as experienced in recent years (Figure IV-12) to persist until 2026, beyond which a decline in the enrolment of Dutch students is anticipated (VU Amsterdam, 2023c, 2023d). Policy documents and interviews also shed light on other identified trends, such as navigating an increasingly complex societal landscape, a rise in research activities, expansion in employee numbers, and overall organisational growth (VU Amsterdam, 2020b, 2021a, 2023d).

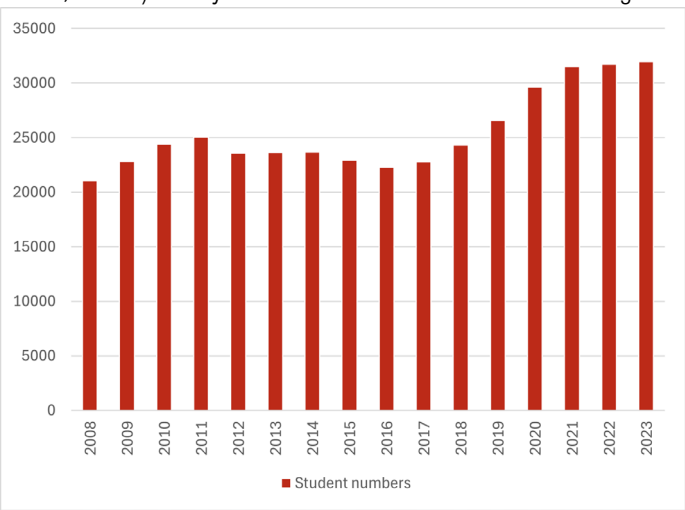


Figure IV-12: Student numbers VU (Pieck, 2024)

2.1.3 Functional

From a functional perspective, VU Amsterdam (2020b) and interviewee VU2 describe education as evolving slowly due to digitalisation, affecting both its content and delivery. Although traditional lectures still prevail, experimentation with smaller and hybrid group formats has been conducted. Recently, there's been a shift moving away from online or hybrid methods and back to on-campus classes. The interviewee expects large lectures to become less frequent, with a growing demand for more interactive and engaging teaching methods that foster dialogue through smaller group settings. This will also lead to on-campus education focussing on applying knowledge, developing skills and increasingly personalised, small-scale and flexible education (VU Amsterdam, 2020b). For research interviewee VU1 notes an increased pace at which functional demands evolve, influenced by technological advancements. Student and staff wellbeing is another crucial aspect to consider (VU Amsterdam, 2021b). The campus should encourage positive and healthy user engagement by fostering a sense of belonging and inspiration (VU Amsterdam, 2023d).

The interviewees have also discussed the effects of increased sharing on campus. From a functional perspective, they identify a major behavioural shift in the previous years: "*I think one of the biggest challenges is transitioning from having a space to yourself, where you can do everything just the way you want, to having to share that space with others and adapt your routines, no longer having your territory,*" Interviewee VU2.

2.1.4 Financial

Leading trends from a financial perspective are the decreased government funding per student (Interviewee VU1; VU Amsterdam (2020b)), the increasing awareness of accommodation costs (VU Amsterdam, 2023d) and rising uncertainty in terms of group sizes and research funding. Interviewee VU1 explains, "*We're not going to receive additional funding. So, we had to rethink our operations regarding the accommodation costss that we want and can afford compared to the overall structure of the university. There's simply a business-economic pressure on the structure.*" That is why these challenges are tackled with a real estate strategy focusing on providing generic and shared spaces, aiming for increased utilisation, multifunctional use of spaces for increased flexibility and a decreased workplace factor for employees and labs (VU Amsterdam, 2023d). The overall goal of these measures from a functional perspective is increasing cost-effectiveness.

Financial indicators resulting from this strategy are presented in Figure IV-13 and Figure IV-14. Figure IV-13 shows the total annual accommodation costs and the annual accommodation costs per student from 2008 to 2020, while Figure IV-14 displays these costs as a percentage of the total university expenses. Both indicators fell

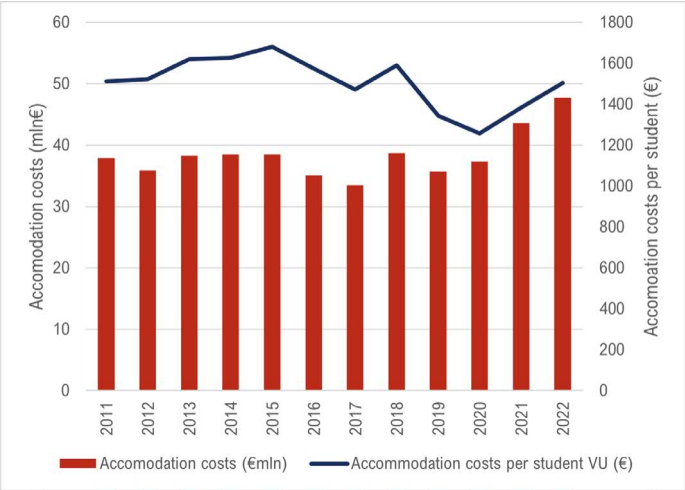


Figure IV-13: Accommodation costs and accommodation costs per student VU (Author, based on annual reports VU)

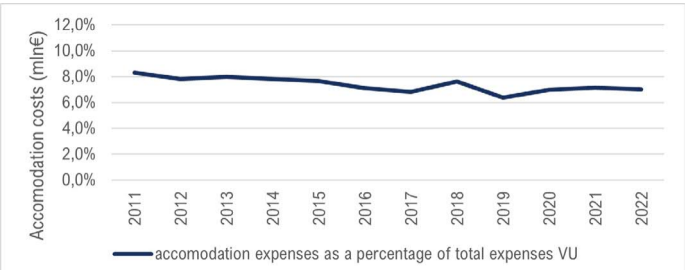


Figure IV-14: Accommodation costs as a percentage of total expenses (Author, based on annual reports VU)

from 2009 to 2018, then increased slightly. The rise in expenditures per student was significant due to higher accommodation expenses, though the simultaneous increase in student numbers helped offset this rise. However, the share of accommodation costs in total expenses remained relatively stable, indicating that total expenses also increased.

In addition, the decision was made to move towards smaller buildings to increase manageability and flexibility in terms of their layout, which allows for greater adaptability in their use, according to interviewee VU2: *"In a new transition phase towards a smaller building, we're focusing on identifying commonalities: what aspects apply to everyone? What elements require custom solutions? This approach allows for much greater flexibility in utilising the space."*

2.1.5 Physical

From the physical perspective, the prevailing trends that have led to the implementation of shared usage are the optimised utilisation of scarce resources, mainly stemming from sustainability goals and climate change. Interviewee VU2 describes an additional trend: "*Occupancy measurements from years ago already showed shallow usage. This raises the question: why maintain all these empty offices? Additionally, having empty floors is unattractive and uninspiring."* Hybrid working trends also change how education, offices, and labs are used, leading to tranquil and busy days (Interviewee VU2). This shift also means people structurally miss seeing each other. The VU is addressing these trends alongside managing a campus built in the '60s and '70s. According to interviewee VU1, although the campus was maintained, it was never updated, and there have been significant changes in demand stemming from lab usage and the scale of education.

The long-term accommodation plan advocates for three key strategies to address future spatial requirements: optimising existing spatial resources, curbing spatial demand, and augmenting spatial supply as necessary. (VU Amsterdam, 2023d). Many solutions devised to address the scarcity of physical resources offer dual benefits, conserving both financial and physical resources. Furthermore, there is a relation with organisational objectives, as the anticipated overall growth of the institution may increase spatial demands. On the other hand, measures striving for compact office usage, with dedicated use but also more distinct zones and more meeting areas could be beneficial as it presents opportunities to reclaim space for other facilities like sports, culture and student initiatives, according to interviewee VU1.

2.1.6 Conclusion and tensions

To recapitulate, insights gained from interviews with the CRE department and document analysis show several trends VU Amsterdam identifies, as shown in Figure IV-15. Among these trends are the projections of overall organisational growth, the decline in public funding, the gradual shift towards personalised and flexible education, and the increasing scarcity of physical resources.

Furthermore, the results of this section have shed some light on the motivations behind the introduction of shared spaces on the VU campus. The interviewees emphasise the financial and physical perspective. *"If you include growth projections, the replacement of our real estate portfolio, and price developments, and extrapolate them all linearly as we've done in the past, then we simply wouldn't survive. We'd introduce such significant costs that we couldn't afford them,"* Interviewee VU1. The tension between these factors leads to the conclusion that the university had to introduce sharing. This approach was adopted in both scheduling and real estate projects, where the real estate department emphasised sharing and building generic spaces as standard, except when specialised facilities were necessary. Even in those cases, the baseline involves shared usage among user groups. *"Ultimately, I believe it's economically savvy because if you manage to limit your accommodation costs, you can allocate more money to education and research, and that's really what it's all about,"* Interviewee VU1.

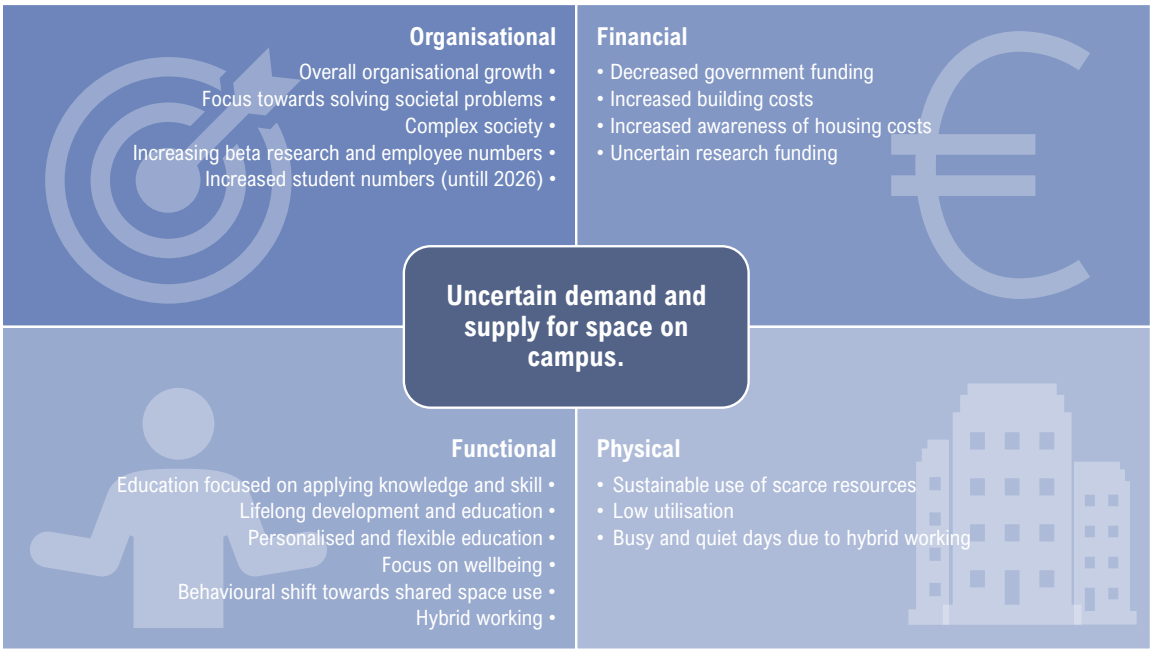


Figure IV-15: Trends identified for VU (Author, based on WUR, 2013, 2021b, 2022a, 2022b)

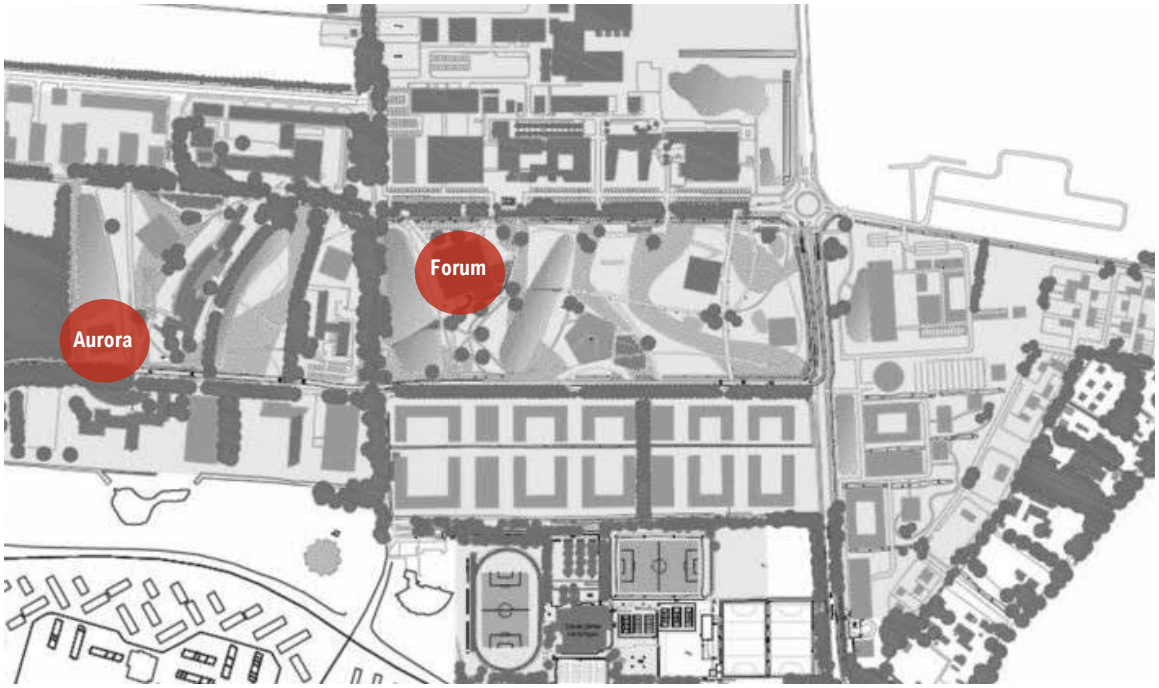


Figure IV-16: WUR campus map, Pizarro and Rahman (2013) (Adapted)

2.2 Wageningen University

This section examines the WUR campus, beginning with a summary of essential data. It then organises information from various documents and an interview with a real estate department policy employee, using the four perspectives on campus management. Table IV-6 and Table IV-8 present the documents and interviews that were analysed.

2.2.1 Facts and figures

WUR in the Netherlands is known for its focus on agriculture, life sciences, environmental sciences, and related fields. The university offers various disciplines, including agroecology, food technology, and environmental and social sciences (Table IV-7).

The university campus spans several hectares and is surrounded by greenery and agricultural landscapes. The campus features green spaces, gardens, and recreational areas where students and staff can relax and socialise. (WUR, 2022b).

2.2.2 Organisational

WUR has experienced a consistent increase in student enrolment (6.000 in 2015 to 13.000 in 2023, see Figure IV-19 on page 69) over recent years, resulting in an expansion of campus facilities and staff numbers (x1.5). Looking ahead, however, the real estate department "*does not anticipate further growth beyond the current bandwidth of 13,000-15.000 students*" (Interviewee

Table IV-8: Interviewees WUR campus analysis (Author)

	Interviewee	Stakeholder group	CRE Goals	
WU1	Policy employee WUR	CRE Manager		Organisational, financial, physical
WU 3	Asset manager WUR	CRE Manager		Organisational, functional, physical

Table IV-6: Documents analysed related to VU Campus (Author)

Document	Ref.
Strategic agenda WR 2022-2025	Wageningen University & Research (2022b)
Strategic Plan 2019-2024 (update)	Wageningen University & Research (2022a)
Campus strategy Wageningen	Wageningen University & Research (2013)
Strategic Housing Plan 2021-2026	wageningen University & Research (2021)
Annual report 2022	Wageningen University &

Table IV-7: Facts and Figures VU (VU Amsterdam, 2020b, 2021a, 2021b, 2023c, 2023d; VU Amsterdam & VUmc, 2014)

Wageningen University and Research (2022)		
Organisation	Location	Wageningen, the Netherlands
	Number of faculties	1 (5 groups)
	Disciplines	Food, agriculture and living environment
Users	Students bachelor	5.740
	Students Master	7.266
	International students	27,0%
	Academic Staff (FTE)	6.579
	Support staff (FTE)	-
Real estate Portfolio	Land property	120 hectares
	Portfolio size (m2)	250.000 m²
	Real estate costs (yr.)	€29,2M (2022)

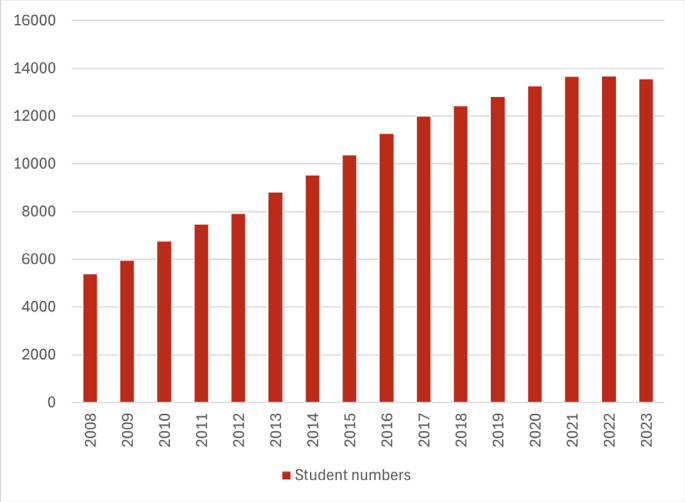


Figure IV-19: Student numbers WUR (Pieck, 2024).

WU1; WUR (2022b)). However, the university's research sector is expected to continue expanding, driven partly by the rise in international research collaborations with universities, businesses, and societal partners. Moreover, the university has a distinctive centralised structure, characterised by a single faculty overseeing all education programs. This centralised structure facilitates efficiency measures, such as the centralised scheduling of education spaces. Complementing this organisational setup is the real estate strategy outlined by WUR (2021b), which emphasises the utilisation of buildings by multiple research groups. As articulated in the accommodation plan (WUR, 2021b), this strategy involves a shift in the function of buildings from just workspaces to collaborative hubs.

2.2.3 Functional

From a functional standpoint, WUR has prioritised education, placing students at the organisation's core (Interviewee WU1). This emphasis is evident in the physical layout of the campus, where all generic educational buildings are central. Moreover, the organisational structure revolves around education, with teachers commuting from their office buildings to the educational facilities (Interviewee WU1).

In line with the campus strategy, there's recognition of heightened demand for diverse spaces, workstations, and amenities, partially caused by the hybrid working and learning trend. Despite this, all regular education is expected to continue on campus (Interviewee WU1) Additionally, attention is directed towards promoting social cohesion (WUR, 2021b).

2.2.4 Financial

Financially, WUR takes two major trends into account. The first is the continuous growth of the government grant and the growth of assignments coming from the Ministry of Agriculture, nature and Food Quality at Wageningen Research (WUR, 2023b). The second trend is that international competition for research and academic talent is increasing, resulting in lower cash inflow and personnel costs. To improve cost-effectiveness, the real estate strategy aims to increase the number of shared (research) facilities. Sharing and extending the group of facility users ultimately provides the majority of the financial means for investments (WUR, 2013). Additionally,

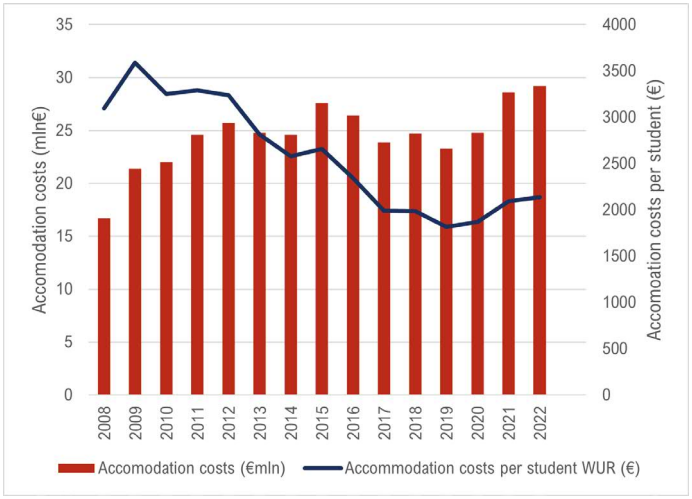


Figure IV-17: Accommodation costs and accommodation costs per student WUR (Author, based on annual reports WUR)

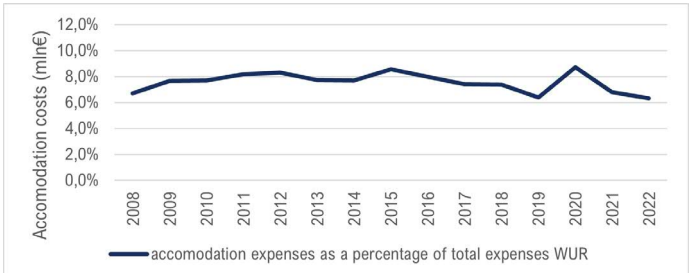


Figure IV-18: Accommodation costs as a percentage of total expenses (Author, based on annual reports WUR

the real estate department recognises that the stable development of student- and employee numbers makes financing real estate easier (Interviewee WU1).

Figure IV-17 and Figure IV-18 show financial indicators resulting from this strategy. Although total accommodation expenses increased, the costs per student dropped significantly. The proportion of accommodation costs in total expenses stayed fairly stable, ranging from 6.5% to 9%, suggesting that total expenses increased alongside accommodation costs.

2.2.5 Physical

Concerning the physical perspective, sustainability is the primary trend at Wageningen University. Universities have created a joined ambition for building sustainably. The primary efforts for Wageningen currently revolve around the energy transition and circular use of building materials (Interviewee WU1).

Among the public values identified, the efficient utilisation of space stands out, particularly emphasising reducing the organisation's overall physical footprint. One proposed strategy to accomplish this goal is through "*peak shaving,*" wherein educational and work schedules are distributed evenly throughout the week to optimise space utilisation (WUR, 2013).

2.2.6 Conclusion and tensions

WUR has placed central and shared educational spaces at the core of its campus strategy. This stems from the centralised education organisation, which operates as one faculty. The university currently uses three generic buildings for all regular educational purposes,

which the real estate department regards as highly efficient financially and in terms of occupancy. There is no expectation of additional student enrolment or spatial demand stemming from education. Research, however, is expected to continue expanding. Therefore, the real estate strategy emphasises flexible spaces to accommodate evolving educational and research needs. These and other trends have been identified in Figure IV-20.

The public values indicate that shared buildings on the WUR campus are primarily associated with resource efficiency, user experience, and organisational values such as culture and image. Some tensions between these values can also be identified. The organisational structure prioritises centralised governance and efficient space utilisation, while the functional perspective emphasises placing personal education at the organisation's core and fostering collaborative environments. Centralised control may hinder achieving decentralised collaborative spaces. Additionally, increasingly high-quality lab demands stemming from a functional perspective might conflict with financial goals despite the stable financial inflow.

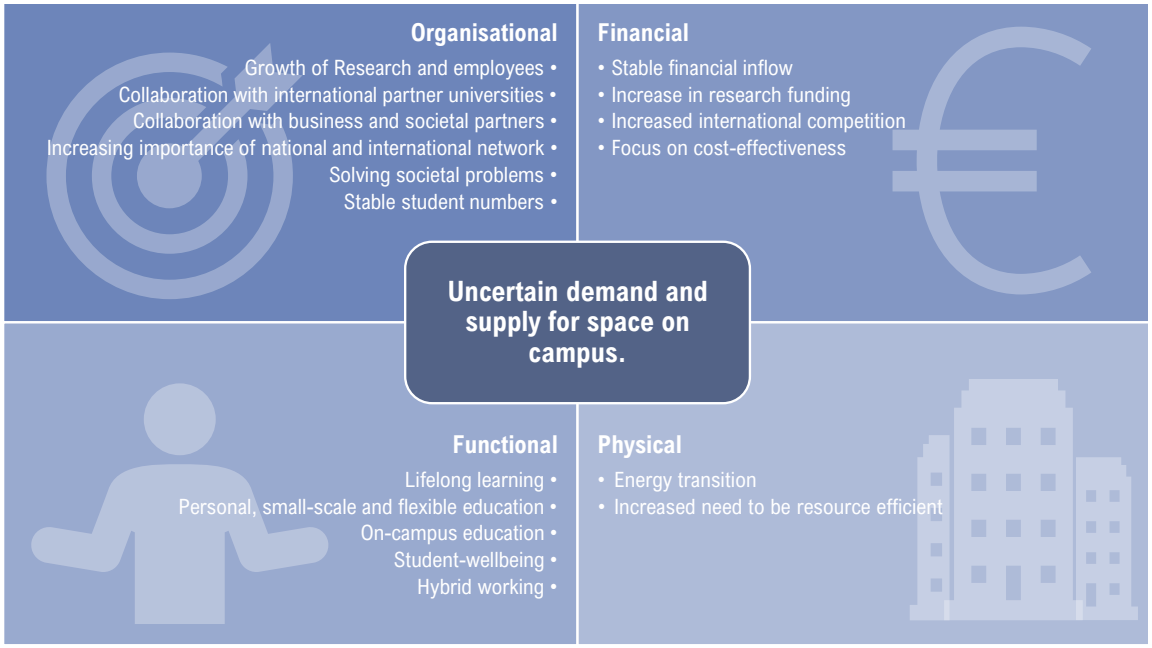


Figure IV-20: Trends identified for WUR (Author, based on WUR, 2013, 2021b, 2022a, 2022b)

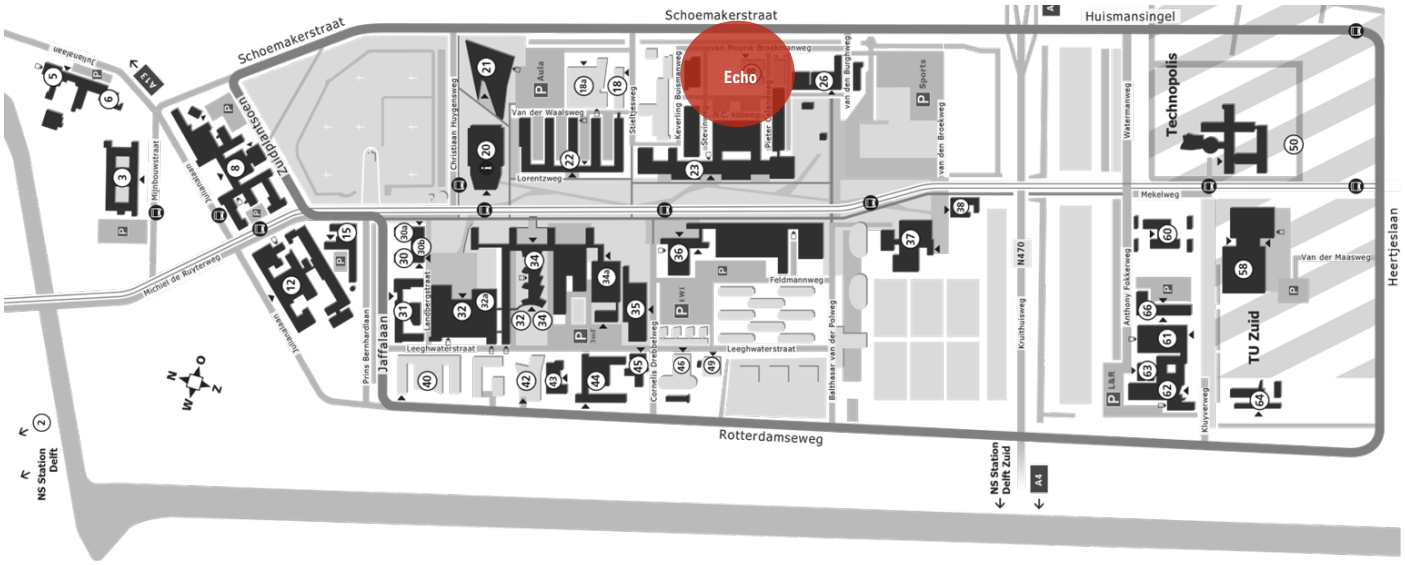


Figure IV-21: Delft University of Technology campus map, by Delft University of Technology (2024b) (adapted)

2.3 Delft University of Technology

The following sections will discuss the analysis of the TU Delft campus. The first section will highlight facts and figures, after which the four perspectives on campus management will be used to structure the information gathered in documents and an interviews. Table IV-9 and Table IV-11 present an overview of the documents and interviewees included in the results.

2.3.1 Facts and figures

TU Delft in the Netherlands is known for its focus on engineering, technology, and applied sciences. The university offers a wide range of disciplines, including civil engineering, mechanical engineering, architecture, and industrial design. Table IV-10 provides an overview of facts and figures. The campus spans several hectares and comprises various faculties, research centres and generic education buildings. In addition to academic buildings, the campus features green spaces, plazas, and recreational areas where students and staff can gather. The university aims to create a campus environment that promotes academic excellence, fosters interdisciplinary collaboration, and minimises its environmental impact (van Dorst et al., 2023).

2.3.2 Organisational

The most significant ambition mentioned from an organisational perspective is the goal to have 40.000 students in 2040. According to TU Delft (2018); van Dorst et al. (2023) this goal is set because of an increasing societal demand for engineers. This would have a significant impact on the demand for space. Interviewee TU1, however, pointed out that for this goal to be achieved, a lot of student growth still needs to happen, as this is currently at 25.000 (Also see Figure IV-22). Staff shortages further hinder this growth potential. Moreover, not all of this development is planned to occur on the

Table IV-11: Interviewees TU Delft campus analysis (Author)

	Interviewee	Stakeholder group	CRE Goals	
TU1	Policy employee TU Delft	CRE Manager		Organisational, financial, physical
TU2	Asset manager TU Delft	CRE Manager		Organisational, functional, financial, physical

Table IV-9: Documents analyzed related to TU Delft Campus (Author)

Document	Ref.
Campus vision 2040	van Dorst et al. (2023)
Environmental vision Delft 2040	Besselink et al. (2021)
TU Delft Strategic Framework 2018-2024	Delft University of Technology (2018)
TU Delft's vision for education	Delft University of Technology (2017)
Annual report 2022	Delft University of Technology (2023)

Table IV-10: Facts and figures TU Delft (Delft University of Technology, 2024a; TU Delft, 2022, 2023)

Delft University of Technology		
Organisation	Location	Delft, the Netherlands
	Number of faculties	8
	Disciplines	Engineering, sciences, design.
Users	Students bachelor	10.767
	Students Master	9971
	International students	25,3%
	Academic Staff (FTE)	4.461
	Support staff (FTE)	2.804
Real estate Portfolio	Land property	161 hectares
	Portfolio size	580.000 m²
	Real estate costs (yr.)	€83,5M (2022)

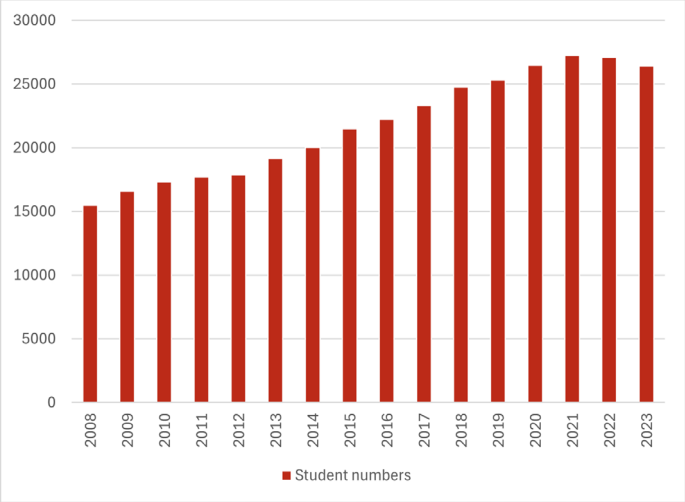


Figure IV-22: Student numbers TU Delft, Pieck (2024)

campus in Delft. TU Delft (2018) also mentions the uncertainty stemming from globalisation in the academic sector with increased international collaboration and competition. This is also reflected in the expected unpredictability of international student numbers coming to the Netherlands. Additionally, the effects of globalisation and an increasingly complex society are leading to more cross-disciplinary, cross-national and cross-cultural collaboration, and TU Delft is actively committed to stimulating this according to the vision on education 2018-2024 (TU Delft, 2017, p. 14).

From a public value perspective, these trends are expected to have several implications for the campus. The anticipated growth of student numbers and programmes is the most significant effect on spatial demand. Interviewee TU1 highlights this challenge, noting the difficulty in predicting student enrolment numbers at the outset of an academic year. *"This unpredictability, combined with a static real estate portfolio, complicates aligning classroom spaces with fluctuating class sizes. As faculties expand significantly, matching available rooms with group sizes within a single building becomes increasingly challenging. Adopting a university-wide approach to sharing all available lecture halls can substantially enhance the likelihood of finding suitable spaces that meet quality standards for both teaching and learning"* (Interviewee TU1).

In addition, TU Delft makes a point of creating a lively, inspiring, and shared campus to encourage an open academic community and cross-pollination between various user groups (van Dorst et al., 2023). When asked how shared buildings contribute to this, interviewee TU1 mentions, "*This idea is somewhat reflected in their design and intention, which reinforces the open nature of these structures. The aim is to create spaces where students can easily meet and interact, underscoring the importance of community and collaboration within the educational environment"* (Interviewee TU1).

2.3.3 Functional

TU Delft identifies several functional trends concerning changing working and learning patterns for education. These relate to developments such as lifelong learning and digitalisation of education, but also the changing group sizes and didactical methods, which will lead to different space requirements (TU Delft, 2017). Contrary to what is often said, group sizes for instruction halls have increased from 30-60 to 60-100, according to Interviewee TU1. Regarding whether there will be a shift in educational demands towards more project- or lecture-based teaching, interviewee TU1 observes that the situation has remained relatively stable: *"There isn't a clear, articulated policy direction in terms of educational delivery preferences."* Despite recurrent discussions suggesting that traditional lectures are becoming obsolete, *"there has been no significant change in this regard over the past decade".* Interviewee TU1 thinks that *"while there might be a desire for change, practical constraints such as staffing levels and the financial implications of hiring additional personnel play a limiting role".* Interviewee TU2, on the other hand, explains that *"research into the level of quality and type of functionality generic educational spaces need to offer resulted in the development of mixed didactic spaces that can combine frontal and project education."* This diversification of educational spaces has been an active part of the policy for all generic education spaces at TU Delft since 2014 (Interviewee TU2).

From a public value perspective, TU Delft has also introduced generic educational spaces because of user dissatisfaction. "*All our instructors were quite dissatisfied with the quality of educational spaces. When teaching in building X, an instructor could use the existing PC. However, if the same instructor had to teach at another location, different cables or computers were required"* (Interviewee TU2). Concerning the impact of shared buildings on the user, interviewee TU1 mentions that currently, students and staff spend most of their time within their respective faculties, maintaining an approximate ratio of 80-20 or perhaps 75-25: *"There is no significant feedback to suggest that this shift in the ratio is viewed negatively or poses any issues."* Additionally, The interviewee questions the significant impact of shared buildings on users, particularly students. *"Students appear to appreciate using shared buildings as a base for group study, provided the spaces are well-designed. It's unclear whether this preference is due to the building's generic nature or if a similar sentiment would exist in a faculty building conducive to comfortable studying."* One notable advantage of generic educational buildings, according to interviewee TU1, is their smaller size and focus on just education. *"This aspect makes locating spaces less challenging compared to some larger faculty buildings, where finding a suitable study spot can be more problematic."*

2.3.4 Financial

The strategic framework and campus strategy of TU Delft both emphasise the increasing uncertainty stemming from various trends influencing the organisation's financial position. These are internationalisation and increased academic competition, declining government funding per student and the effects of demographic changes influencing student enrolment patterns (TU Delft, 2018). This will lead to uncertainty in the university's funding model and a greater need for cost-effectiveness. Additionally, Interviewee TU2 mentions the general feeling that the educational spaces weren't

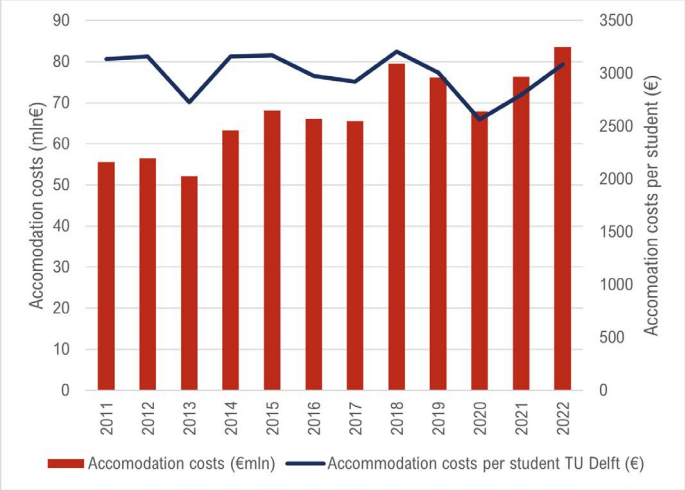


Figure IV-23: Accommodation costs and accommodation costs per student TU Delft (Author, based on annual reports TU Delft)

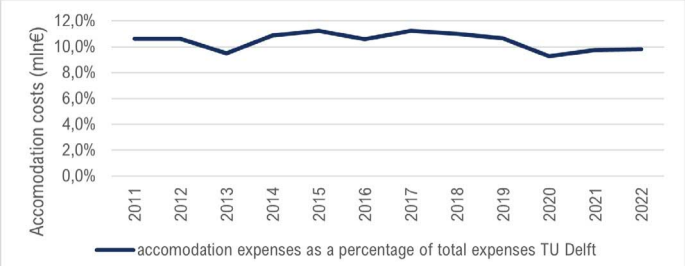


Figure IV-24: Accommodation costs and accommodation costs as a percentage of total expenses TU Delft (Author, based on annual reports TU Delft

being used efficiently and that, in the past, sudden extreme growths in student numbers needed to be facilitated in very short periods. According to interviewee TU1, the risks of student groups growing or shrinking are currently mitigated by increased sharing within the organisation: *"Sharing all available classrooms across faculties, thereby enhancing the likelihood of finding suitable spaces that meet quality standards for teaching and learning, could tackle some of these challenges."* Furthermore, the financial value of increased sharing is that clustering similar activities—such as educational, office, or laboratory functions—either within the same or different dedicated areas of a building significantly enhances operational efficiency. *"It simplifies maintenance, management, the design of systems, and facility processes while minimising interference between different functions"* (Interviewee TU1).

Financial indicators from this strategy are displayed in Figure IV-23 and Figure IV-24. While total accommodation expenses increased, the costs per student remained stable until 2018, then declined until 2020, followed by a slight increase back to earlier levels. The proportion of accommodation costs in total expenses decreased from 11% to 9% between 2017 and 2020, indicating that total expenses rose alongside accommodation costs.

2.3.5 Physical

Efficient resource allocation and increased flexibility are the most prevalent goals found for TU Delft. This means the campus in 2040 should be sustainable and designed to absorb changes. Educational and research buildings can change function over time and eventually become residential buildings. In addition, (climate) adaptability and circularity are also mentioned as critical public values to consider from a physical perspective (van Dorst et al., 2023). When asked what the role of shared buildings in this strategy will be, interviewee TU1 commented that for new development, "*there is an intentional effort to separate the generic functions of a building into a separate structure*". A significant portion of the educational spaces currently housed within a faculty building will thus be transferred to a separate generic structure during redevelopment. As an example, interviewee 3 confirms that they are presently "*involved in the engineering for a new generic educational building, which is located in the southern area.*" This location is part of an intentional strategy: "*The campus can be divided into three sections: north, central, and south. In each section, there should be a generic educational building available for use by the surrounding faculties*" (Interviewee TU2).

2.3.6 Conclusion and tensions

To sum up, TU Delft anticipates trends related to increasing demand for engineers, globalisation, academic competition, and the shift towards cross-disciplinary collaboration (see Figure IV-25 for all identified trends). Shared buildings are seen as a partial solution to these challenges and have, up until now, been used to tackle rapidly changing demand for educational spaces as well as functional demand for changed group sizes and didactical methods: "*Various central educational facilities are being developed on the TU Delft campus. The aim is to create educational facilities within the space pool that multiple faculties utilise and are centrally managed. These interfaculty educational buildings support generic education that does not require 'faculty-specific' setups or facilities.*" (Projectgroep NEC1; TU Delft, 2017, p. 10)

For TU Delft, buildings like Echo and Pulse act as an overflow capacity when there is a mismatch between functional demand and the physical characteristics of the space. This means the demand for educational space is first addressed within the faculty before looking at shared buildings. Other relevant values related to implementing shared buildings on the TU Campus are environmental sustainability, increased resource efficiency, risk mitigation, and organisational values such as culture and image through encouragement of collaboration and openness among various faculties.

Several tensions among the various perspectives related to the trends mentioned above and shared spaces can be identified. The interviews have shown a challenge might lie in balancing the identity and autonomy of individual faculties with the benefits of shared resources. Functionally, shifting group sizes and the potential transition to more lecture-based or project-based learning models raise the need for more flexible and adaptable educational spaces. Financially, the university's growth should be weighed against decreased funding by increasing operational efficiency. Physically, the drive for sustainability and adaptability in campus development must reconcile with maintaining a cohesive and functional educational environment.

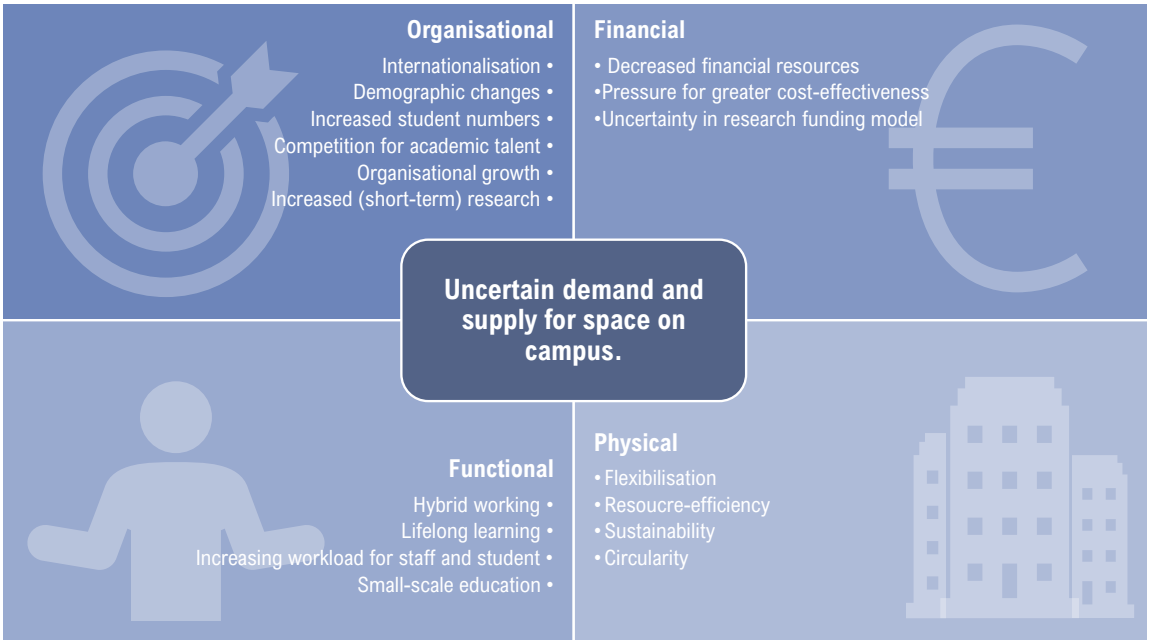


Figure IV-25: Trends identified for TU Delft (Author, based on Besselink et al., 2021; Delft University of Technology, 2024a; TU Delft, 2017, 2018, 2023; van Dorst et al., 2023)

(Echo, Bloem, 2022)

3. Echo - TU Delft

Echo is the second in a series of shared educational buildings at TU Delft. It serves students and staff, featuring various education and study spaces, offices for the WI faculty, and a restaurant. All lecture halls and project rooms are part of a shared educational space pool, accessible to all faculties (Projectgroep NEC1; TU Delft, 2017). Study places are available to all students. This section of the empirical research presents the first case study. It includes results from document analysis, interviews, and both qualitative and quantitative Key Performance Indicators (KPIs) collected.

3.1 Data collection

The data includes several documents and four interviews, detailed in Table 8. The most significant document is the brief, which provides insights into the building's original purposes and connection to the campus strategy. Interviews were conducted with a policy employee (TU1) who was knowledgeable about the campus's real estate policy and data collection. An interview with the Asset Manager (TU2) is also critical. Additionally, two students who frequently use the facility were interviewed to gather user perspectives from a functional perspective.

3.2 Context

Urban context

Echo sits centrally on the TU Delft campus, adjacent to the faculties of Civil Engineering and Mathematics & Computer Science, directly connected to the latter's building. Its layout is centred around a square positioned at the building's front. This arrangement allows for a clear view of the main halls and destinations from the square, enhancing the building's clarity and readability (Projectgroep NEC1; TU Delft, 2017).

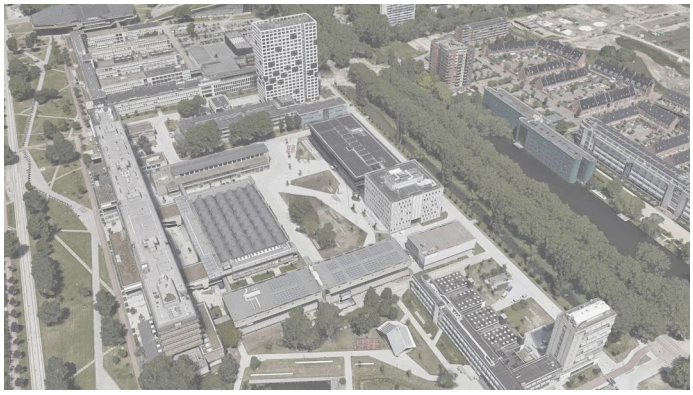


Figure IV-26: Urban context Echo (Google Earth Pro, n.d.-b)

Campus context

Echo is the second instalment in a series of new, versatile educational buildings at TU Delft, constructed in response to a significant surge in student enrolment, as noted by Interviewee TU2. Unlike facilities tailored to specific faculties or disciplines, Echo, similar to its predecessor Pulse, and to some extent, the library and Auditorium/Congress Centre, serves a broad range of uses. Preceding Echo is Flux (2023), established to meet the growing need for mixed-use educational spaces

Building layout

Echo is designed for students, student teams, teachers, staff, and guests, encompassing various spaces for education, study, office work, and informal meetings (Projectgroep NEC1; TU Delft, 2017). Located on the ground floor is a lecture hall that can accommodate up to 700 students and can be divided into three smaller halls (Figure 38). Adjacent to the central staircase is a debate room for discussions between students and teachers. The upper levels feature six mixed-use lecture halls that support different teaching methods, suitable for lectures, group work, and projects. The building also includes office spaces for the maths and computer science faculty. It offers 360 study spots in different zones, including a communal area with a restaurant for socialising, silent study areas, and group study spaces.

Table IV-12: Documents included in analysis Echo (Author)

Document	Ref.
ECHO PvE New Education Centre	Besselink et al. (2021); Projectgroep NEC1; TU Delft (2017)
Echo – Technical design	UNSTUDIO Architecten (2019)
Annual report 2022	Delft University of Technology (2023)
Echo – Archdaily	Harrouk (2020)
Echo – Stedenbouw.nl	Debaere (2022)
Measurement utilisation 2022	TU Delft CREFM (2023)

Table IV-13: Interviews conducted for Echo case (Author)

	Interviewee	Stakeholder group	CRE Goals	
TU1	Policy employee TU Delft	CRE Manager		Organisational, financial, physical
TU2	Asset manager TU Delft	CRE Manager		Organisational, functional, financial, physical
TU3	Student	User		Functional
TU4	Student	User		Functional

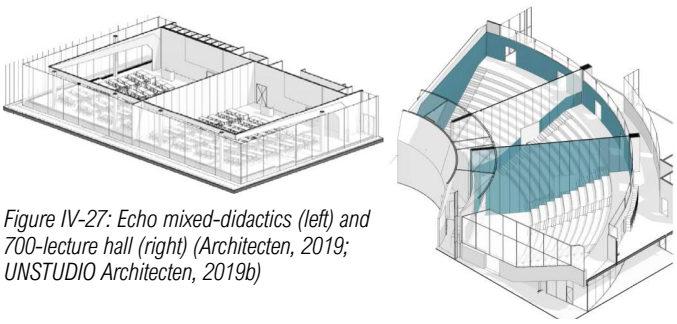


Figure IV-27: Echo mixed-didactics (left) and 700-lecture hall (right) (Architecten, 2019; UNSTUDIO Architecten, 2019b)

3.3 Values

3.3.1 Organisational

From an organisational perspective, Echo serves two primary purposes. Firstly, it was designed to accommodate the growing student population at TU Delft, providing 1300 lecture places, 360 study spots, and 1000m² of office space (TU Delft, 2023). Secondly, from a cultural/organisational perspective, Echo functions as an autonomous educational resource, enhancing interaction among students from various faculties, adding to the campus vibrancy, fostering ownership among groups like student teams, encouraging extended stays, and promoting cooperation with the university surroundings (Interviewee TU1; Interviewee TU2; (Projectgroep NEC1; TU Delft, 2017); TU Delft (2017); (TU Delft, 2018)).

Despite meeting its capacity goals, it became evident that another generic building was needed near Echo to support further expansion, as pointed out by Interviewee TU2. Regarding its cultural and organisational objectives, interviewee TU1 explains that "*the steps taken by the university to transform the campus into a more cohesive community are beginning to yield fruitful results. Extended opening hours serve as a significant draw in this effort.*" Interviewee TU2 notes, "*In addition to our students, students from universities of applied sciences and vocational education students frequently use Echo for studying.*"

Interviewee TU2 states there are currently no external users, but "*all necessary facilities are already in place, and the building is open; it simply requires organisation and management, which presents a significant challenge. […] Careful thought must be given to this, as it is crucial that if an event is held in an educational building during the evening, the premises must be ready for our students the following morning.*" Concerning internal users, the interviewee confirms that students often organise themselves into groups or clubs and use the Echo for their activities: "*An interesting aspect to consider is the potential for a single organisation to oversee and manage this entire operation effectively.*"

Whether the building succeeds in stimulating interaction amongst students and staff remains up for debate. Interviewee TU1 believes that "*the interaction among students is an integral part of becoming an engineer. This cannot be forced, but our approach has been to provide facilities that support and facilitate this gradual process. Over the past few years, we have seen significant results and improvements in this area.*" Interviewee TU3 describes their experience, "The presence of unfamiliar faces and the uncertainty about the building's activities can lead to a sense of lacking identity. This may be because the building's design does not reflect the specific field of study. […] Buildings like Echo are designed to be as neutral as possible to accommodate a variety of functions and purposes, which might not evoke the same sense of belonging or inspiration." Interviewee TU4, however, mentions "*the approach of shared spaces has positive aspects. My experience influences this perspective in […], where I completed my bachelor's degree. There, faculties didn't have separate areas; while there were designated spaces within buildings, there was a lot of mingling. This layout facilitated fewer divisions or 'islands' among different faculties.*" In their experience, "*each study program in Delft still retains its dedicated building. Thus, Echo is an additional resource rather than a fully integrated part of the university's infrastructure.*" As a result, the interviewee still experiences a significant degree of segmentation among different user groups.

3.3.2 Functional

TU Delft's real estate policy actively facilitates a mix of didactical forms. From a functional perspective, Echo was therefore supposed to provide flexible shared spaces (meaning non-specific for one faculty or programme according to interviewee TU1), suitable for different group sizes, hybrid teaching and multiple types of didactics, such as frontal, mixed, project/group, debate and exams (TU Delft, 2023). This mix of functions also had to be reflected in the self-study areas by creating places for both (silent) individual study and group work (Projectgroep NEC1; TU Delft, 2017). Additionally, the shared spaces must be suitable for social interaction, meet the functional expectations of students and teachers, and result in satisfied users (Interviewee TU2). According to interviewee TU2, this means "*when a teacher is conducting a class, they should be able to do so effortlessly. […] Any disruption, whether it be a projector screen that won't work or difficulties connecting a PC, can significantly disrupt their concentration.*"

An important factor in optimising user satisfaction for shared spaces is ensuring that the teaching method aligns with the room characteristics, as noted by Interviewee TU2. The scheduling department is responsible for this match, while the flexible layout and generically applicable equipment fall to facility management and the ICT department, respectively (Interviewee TU2). Both Interviewee TU3 and TU4 confirm that the shared spaces in Echo are well-designed for efficient work, aligning with the educational approach of their courses. However, Interviewee TU2 notes, "*an incidental mismatch between the nature of the course and the intended use of the space still occurs.*"

The support services system for Echo has also been rethought: "*The staff working in these buildings are specifically recruited with an educational perspective in mind. They are trained and encouraged to enter classrooms proactively, ready to offer assistance and support to teachers," (Interviewee TU2). It was decided that all generic educational classrooms should be available*

for students to study to increase flexibility. "Initially, this presented challenges, such as determining when classrooms were occupied for classes and when they were free and addressing situations where a teacher might need to ask students to vacate a classroom. This occasionally led to friction," (Interviewee TU2). To address this issue, room managers have been installed to indicate when a room is in use and open for students. However, Interviewee TU4 describes this as 'insider knowledge,' noting that few students know they can use this feature. Interviewee TU3 revealed that they were unaware of this feature and avoided studying at Echo due to the difficulty of finding available space. Interviewee TU4 adds perspective by noting, "*Despite often being busy, it's usually possible to find a spot to study if you arrive before ten.*"

Overall, users tend to appreciate the facilities at Echo. According to interviewee TU2, "*a recent evaluation […] on Echo has resulted in an average rating of 7.5 from teachers and students.*" Additionally, the interviewee explained that the high ratings "*can be attributed not only to its novelty but also to the high-quality and mix of facilities provided there, which are perceived as fantastic by the users.*" Interviewees TU3 and TU4 agree that Echo offers a calming atmosphere conducive to working, minimal classroom distractions, spaciousness, good acoustics, and various spaces. However, many of these positive aspects are attributed to the building's newness.

3.3.3 Financial

Financial goals mainly relate to cost-effectiveness and risk management. First, interviewee TU2 mentions, "*It's crucial to consider the potential for future repurposing right from the design phase to avoid constructing a building limited to a single function.*" According to the brief, the generic spaces in Echo were built to support short- and long-term transformations. Short-term transformations are primarily about enabling different layouts. Long-term transformations involve changing the building's function, where the shell is the starting point for a new purpose (Projectgroep NEC1; TU Delft, 2017). Secondly, the education spaces in Echo were designed to be flexible, allowing for adjustments to accommodate fluctuations in group sizes and student numbers from year to year (Interviewee TU2). TU Delft has also chosen a strategy for shared generic spaces because "*there was a perception that the campus was being used inefficiently. ESA indicated that they were scheduling the spaces to full capacity, while FM observed that when walking through the halls, there appeared to be low occupancy.*" (Interviewee TU2). For Echo, this has resulted in the goal of using the space more efficiently in terms of (scheduled) occupancy, which results in higher cost-effectiveness.

Concerning risk management, the room dividers "*allow for adaptation to varying group sizes and efficient use of space,*" (TU Delft, 2023, p. 27). Additionally, it's compartmentalised in such a way that manageability is maintained, even if only some parts of the building are in use (Debaere, 2022). Interviewee TU2 explains that Echo was designed so that the shared spaces can also be converted into offices: "*It was explicitly requested in the design to ensure that the floor slabs are installed so that a floor can be easily added to create office spaces. Even if you remove the 700-people lecture hall […], we can insert a floor in the open area and convert it into offices*". This was done because "*it's entirely conceivable that in 20 years, educational methods will have evolved to such an extent that the building could be efficiently converted into office spaces*" (Interviewee TU2).

As highlighted earlier, Echo's generic lecture halls are available for students to study when classes are not in session. This approach optimises the use of otherwise vacant halls and provides a cost-effective solution to the need for more study areas. It ensures optimal space usage significantly during exam periods when demand for study spots increases and there are fewer lectures (Interviewee TU1). Furthermore, to enhance cost-effectiveness, Interviewee TU2 mentions that while Echo is currently used exclusively for education, "*the venues can also be made available in the evenings to other schools or evening courses, or for meetings or any other event.*" This could also serve as a revenue model for the university (Interviewee TU2).

3.3.4 Physical

Resource efficiency is a crucial consideration for TU Delft. Interviewees TU1 and TU2 highlight that the university has chosen to meet the growing demand for educational spaces through new and shared facilities rather than expanding existing buildings, which would have increased the footprint and reduced resource efficiency. Additionally, there is an expectation that spaces in these shared buildings will be used more intensively. (Interviewee TU2; Projectgroep NEC1; TU Delft (2017)). In addition, the brief for Echo explains that the environmental objective is to realise sustainable accommodation in terms of energy use. It describes the design objectives: "*The Delft engineer prefers no-nonsense buildings that are primarily functional but can also be quickly adapted to personal preferences. The design of the educational building will be robust in appearance and open in layout to make education visible.*"

Regarding resource efficiency, interviewee TU2 says, "*Educational halls, especially Echo, seem to have higher occupancy rates than other buildings. […] However, generally speaking, and this may vary at other universities, the occupancy of lecture halls is quite high.*" The interviewee explained that the high occupancy they described pertains to whether a lecture is scheduled and if it is indeed taking place. "*When considering utilisation, which is the number of students present in a hall relative to the number of available seats, there is certainly room for improvement. However, this aspect can be challenging for a university to manage effectively*" (Interviewee TU2). Moreover, the interviewee expressed that study paces at Echo are very well utilised. Interviewees TU3 and TU4 confirm this in their interviews, and section 3.4 will expand upon this.

Concerning environmental sustainability, both Debaere (2022) and interviewee TU2 mentioned Echo has a high energy label and BREAAM certificates. Interviewee TU2, however, says, "*the factors contributing to this likely include the buildings'*

recent construction and the university's heightened sustainability ambitions," and doesn't attribute this to the shared nature of the building.

Lastly, Interviewees TU3 and TU4 describe Echo's environment as calming and suitable for work. They think this is because of how the room is set up, the materials used, and the building's design. The classrooms are spacious and naturally light. The acoustics and layout of tables are also mentioned as essential to prevent distraction in the busier areas.

3.3.5 Tensions

Table 8 summarises various goals identified from the results above and their relationship to the four perspectives on campus management. The colour of the icons indicates whether the values are conflicting, are not in conflict, or have shared interests. This section further explores the often complex relationships between public values.

A notable organisational goal to accommodate more users presents challenges from other perspectives. As more students use Echo, it becomes crowded, operational costs rise, and the university's overall footprint cannot decrease. Another significant reconstruction stems from the organisational aim to bring external organisations onto campus. While Echo suits this purpose, Interviewee TU2 highlights a conflict: lecture halls must be prioritised for education. Hosting other events in the evening could disrupt classes the following day, creating a dilemma; involving the community is beneficial, but it should not compromise the quality of education.

Furthermore, the functional goal of making Echo's educational spaces as flexible and generic as possible creates a shared interest with the financial and physical perspectives, as this might increase efficiency and reduce costs. However, it also conflicts with the organisational goal of reflecting the diversity of faculties on campus. Finally, the table shows that financial and physical efforts to reduce resource use can conflict with making the building functionally pleasing and appealing, often resulting in less space or quality.

3.4 KPIs

The KPIs calculated for Echo are displayed in Figures 43 and 44. According to TU Delft CREFM (2023), the occupancy rates of the building was 72% for education and utilisation was 36% for study places in 2022, which is based on an educational classroom measurement conducted from weeks 1 to 4 of the first semester and a study space measurement in weeks 8 and 9. This is interesting compared to the university overall, which is 62% for education and 30% for study places based on a measurement of 15.478 spots in educational classrooms and 9.217 study spaces. The comparison indicates Echo has a higher utilisation rate and occupancy than the university average.

In addition to building-level indicators, it's crucial to assess the impact of Echo on the campus. Figure 43 illustrates the trends in student numbers and the total available seats in all generic educational spaces at TU Delft. Using these figures, the ratio of seats per student has been calculated annually since 2008. From this data, two key observations emerge. Firstly, it's evident that the ratio of seats per student has been on a decline since 2008, particularly between 2012 and 2021. During this

Table IV-14: Goals, subgoals, value tensions and results for Echo (Author)

Goals and subgoals *Derived from theory and case specific*		**Values** blue = no conflict (light)/shared (dark), red = conflicting	**Results Echo** (✓ = match, ↻ = Semi-match, × = no match, empty = uncertain)	
	Multidisciplinary organisation.		Echo facilitates education from various disciplines, but the segregation between student groups is still experienced; they tend to focus on their expertise.	↻
	Increased interaction, collaboration and innovation.		Segmentation between faculties is still experienced. The building attracts some external users.	↻
	Safety and security.		The building can be compartmentalised during evening hours to increase the security and manageability of the facility.	✓
	Enriching campus life, diversity and a vibrant community.		Attracts (external) students to the campus outside of regular education hours—no current external user organisations.	↻
	Users can find preferred facility for each activity.		Suitable for the frontal, project, mixed didactics and various group sizes (movable walls), a mix of study place types and group workspaces.	✓
	Accessibility for all users.		Facilities are open to all campus users. Classroom accessibility is not widely known or used.	↻
	Increased cost-effectiveness.		CRE employees report higher cost-efficiency in operating the building. Building generic facilities is seen as more expensive.	↻
	Resilience for change, less costs when demand changes.		Some educational spaces can be divided into smaller spaces with flexible walls, and (most) are suitable for mixed didactics (except the 700-lecture hall).	✓
	Costs shared with partners.		No external partners use the building or have been involved in development.	×
	Reduced footprint and energy consumption: High resource efficiency.		Higher occupancy and multifunctionality reduce spatial demand and energy consumption, but the overall footprint rose due to organisational growth.	↻
	Higher utilisation rates.		Higher scheduled occupancy rates Echo increases cost-effectiveness. Actual occupancy vs. available seats can be improved.	↻
	Physically flexible for change in demand.		Spaces can be transformed short-term by moving walls and long-term by adding floors.	✓
Case-specific	Realise additional capacity for organisational growth		The intended capacity has been realised (despite falling short of ever-increasing demand).	✓

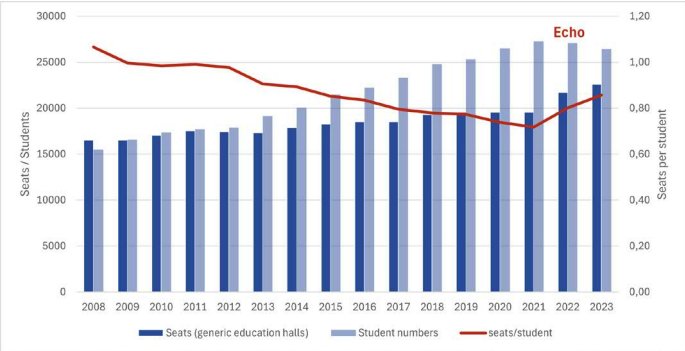


Figure IV-28: Number of seats, student numbers and seats per student for TU Delft and Echo, based on Pieck (2024); Valks (2024)

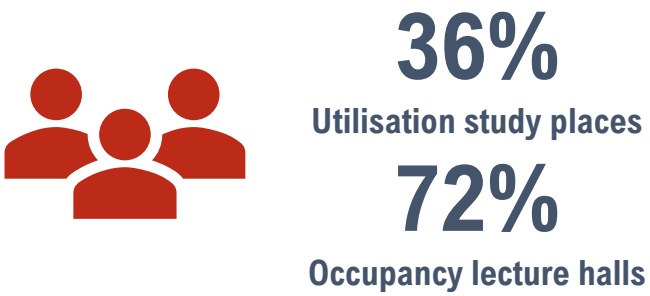


Figure IV-29: Occupancy and utilisation Echo (TU Delft CREFM (2023))

period, the surge in student numbers significantly outpaced the addition of new seats, causing the seats-per-student ratio to fall well below TU Delft's capacity norm of 0.84 seats per student (Valks, 2024). Secondly, the opening of Echo in 2021 brought an influx of seats while there was a slight decrease in student numbers, increasing the seats-per-student ratio and approaching the 0.84 norm once more. Only in 2023 (with the opening of Flux) was the norm exceeded again.

3.5 Conclusion

In summary, Echo plays a pivotal role in accommodating the growing student population at TU Delft, aims to unite faculties, and was constructed to enhance overall resource efficiency. Interviews and document analysis reveal that Echo is designed for versatility, supporting various educational activities and study environments. Occupancy data indicates that Echo is slightly more efficient compared to other spaces at TU Delft. The broader campus analysis shows improved spatial efficiency until 2021, with the opening of Echo marking a turning point by raising the seats-per-student ratio. However, it remains below the levels seen before 2012.

Despite successes in providing flexible and shared spaces, challenges persist. Echo's goal to integrate external organisations into campus life is complicated by the need to prioritise educational activities, highlighting a tension between community engagement and maintaining education as the top priority. Additionally, the drive for efficiency and resource conservation can conflict with creating spaces that are both functional and rich in identity for the university.

Several lessons learned have been identified from this case. A central theme in TU Delft's real estate department's approach was that education should be enhanced by switching to generic and shared buildings. "*We observed within the governance model that different areas of expertise, scheduling, facility management, real estate, and ICT, often did not listen well to each other. A fundamental principle in establishing the governance model was the unified objective of enhancing education. However, this requires that individuals from each area of expertise are willing to listen to and consider insights from other areas, aiming for an integrated approach,*" said Interviewee TU2. This interviewee emphasises that an integral approach must cover all aspects of the building, from student space usage to daylight access and facilities that meet teachers' pedagogical needs or the functioning of all equipment. Furthermore, the interviewees highlighted that the key factors that make or break shared spaces are their versatility and adaptability to individual needs, alongside offering a variety of facilities within one building to cater to different preferences per situation. A shared facility like Echo can significantly enhance campus liveliness when implemented effectively. "*It's a combination of all these elements that makes these shared spaces so successful,*" explained Interviewee TU2.

(O|2 labgebouw, Duivenbode, n.d.)

4. O|2 - VU

O|2, located at the VU campus, primarily serves as a shared research facility. It emerged as part of the campus's real estate update following the partial demolition of the W&N Building. The building accommodates life sciences research teams from Amsterdam UMC, VU, and their partners, offering shared offices and labs. These groups are co-located to share facilities and access to specialists. Although multi-tenant buildings are typical in the Netherlands, this setup, where groups truly 'cohabit' and use laboratory and office spaces together, was innovative at the time. This section examines O|2 as the primary case study focused on the academic workplace, with findings derived from documents, stakeholder interviews, and collected data.

4.1 Data collection

Like the previous case, the results include documents, interviews, and quantitative data. Table IV-15 lists the reviewed documents, and Table IV-16 details the interviewed stakeholders. Noteworthy in this case are the external program managers who were interviewed. Interviewee VU6 played a limited role in the building's development phase, and interviewee VU7 was involved in reorganising several spaces a few years after the building was opened.

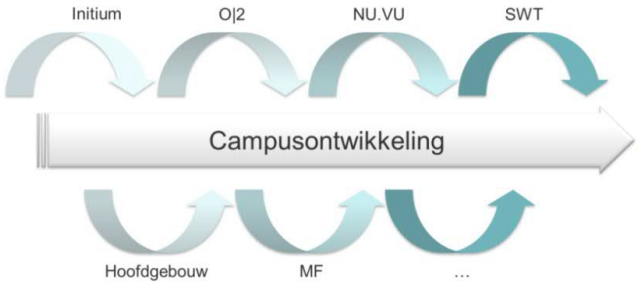


Figure IV-31: Campus development scheme VU, in FCO VU (2014, p. 5)

Table IV-15: Documents included in analysis O|2 (Author)

Document	Ref.
Besetting's- en activiteitenmeting O|2	Vrije Universiteit Amsterdam (2023a)
Building concept O|2	Vrije Universiteit Amsterdam (2023a)

Table IV-16: Interviews conducted for O|2 case (Author)

	Interviewee	Stakeholder group	CRE Goals	
VU1	Director Real Estate VU	CRE Manager		Organisational, financial, physical
VU2	Policy employee VU	CRE Manager		Organisational, financial, physical
VU6	Programm manager	User representative		Organisational, functional, financial, physical
VU7	Programm manager	Housing consultant (external)		Organisational, functional, financial, physical

Figure IV-30: Urban context O|2 (nr. 6), Amsterdam UMC (n.d.)

4.2 Context

Urban context

O|2 is next to the Amsterdam University Medical Centre, as shown in Figure IV-30. It's bordered by two main roads that split the VU campus, and its entrance is at the front for visibility from nearby buildings.

Campus context

The development of O|2 is not standalone but is part of the renewal of the VU Campus, as depicted in Figure IV-30. According to FCO VU (2014) it follows the new construction of the Initium building and the renovation of the Main Building as the next phase in the VU Campus's overall development, which has enabled the partial demolishment of the outdated W&N building. According to interviewee VU2, part of this strategy involved shifting towards smaller buildings to make management more feasible and to allow for more flexible configurations.

Building layout

O|2 is designed mainly for research groups, including desk and lab researchers, academic staff like professors and post-docs, support staff, and some students and instructors. The ground floor, the most public area, features a café, meeting spots, and classrooms for hands-on learning. The upper levels are divided into research teams, offering common areas, shared offices, meeting spaces, support facilities, and labs. While most labs are versatile for various life sciences studies, the building also includes specialised labs like a MLIII lab. The concept layout in the ambition document is illustrated in Figure IV-32.

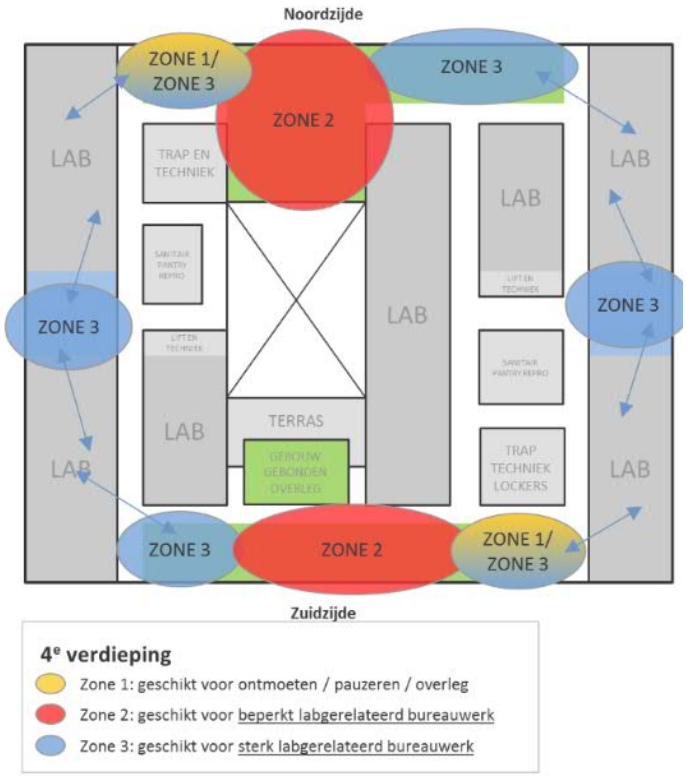


Figure IV-32: Zoning O|2, yellow = meeting/break, red = deskwork, blue = lab work, in FCO VU (2014, p. 14)

4.3 Values

4.3.1 Organisational

O|2's introduction of shared lab spaces is influenced by two main factors: campus real estate developments and advancements in the biomedical sector. Firstly, the need to replace the W&N building led to the construction of new facilities, including those for the expanding biomedical research demands housed in O|2 (FCO VU, 2014). Secondly, the aim was to colocate similar research areas to foster knowledge sharing and collaboration, as described by interviewees VU6 and corroborated by interviewees VU1 and VU2: "*Within the domains of science and biomedical science, certain areas have evolved over the years, with some becoming much closer. Whereas in the past, disciplines such as biology, chemistry, or physics were distinct, nowadays, they have converged into fields like biophysics, medical biology and nutritional science, becoming much more interwoven.*" According to interviewees VU2 and VU6, this is the reason why the university decided that this building should have a clear human life sciences profile with shared facilities: "*Not a building where an organisational structure is a binding factor, but a building where conducting fundamental beta-medical research unites the users,*" (FCO VU, 2014, p. 2)

The building is shared at both institutional and research group levels. At the institutional level, VU and UMC Amsterdam each brought their unique 'blood groups' to the project, as described by interviewee VU6, referring to their distinct real estate departments, researchers, governance, and objectives. For example, the interviewee describes the VU CRE department as "*very centralised, which was somewhat less the case for the VUMC. […] At the UvA, real estate governance is much more decentralised, with faculties having more say in how things are done, allowing end users to demand specific needs.*" The interviewee noted that these cultural differences initially caused friction in escalating issues and making decisions. On the research group level, shared areas are designed to encourage collaboration without departmental segregation, as every floor has labs and offices with a communal 'living room.' This approach, detailed by interviewee VU6, has improved inter-group interactions and spurred joint projects. An instance cited by interviewee VU6 involved a hospital team's advanced cancer treatment method enhanced by a university's analytical chemistry group, demonstrating the collaborative potential. However, interviewees VU2, VU6, and VU7 admit that blending different groups has introduced practical challenges, primarily due to the shift towards more communal and fewer personal workspaces.

4.3.2 Functional

The functional demand for O|2, and especially for the labs, stems from the shared concept of the building and the goal to provide a sought-after workplace for scientists (VU Amsterdam, n.d.-b). The brief for O|2 states that the facility must provide high-quality facilities that different researchers, regardless of the organisation they work for, can equally utilise (FCO VU, 2014). Interviewee VU1 explains the reasoning behind this: "*I believe that a design only fits initially, at the moment of its creation. After that, groups come and go. You have to focus on understanding what the primary facilities are and what additional layers are necessary for the development of an organisation, a university, or educational research.*" This brief, however, nuances the level of sharing: "*a fully ambulant working format, where users roam the building like nomads, is undesirable, as it may lead to the loss of internal cohesion and identity of sections/departments,*" FCO VU (2014, p. 8). Interviewee VU6 further clarifies that to realise generic labs, they had to make significant strides in examining the entire domain to determine the standard building blocks needed. "*This level of adaptability was unprecedented for this type of building, which typically demands bespoke solutions down to the last centimetre. Instead, we established robust foundations here, allowing for a wide range of research activities to take place,*" Interviewee VU6 stresses that a 95% accuracy rate isn't sufficient for a functional shared lab; precision is essential to meet user needs precisely. Interviewee VU1 adds that the unique part of a lab is not the space but the researchers and their equipment.

Users of O|2 transitioned from four separate buildings with their facilities to the new shared facility since individual workspaces weren't feasible anymore. Interviewee VU2 notes that the main challenge for most users is adapting from individual to shared spaces, requiring adjustments to routines and relinquishing territorial claims. This shift in behaviour is

unanimously regarded as the primary challenge in introducing the building concept. This transition also involved users feeling more like participants in the facility than owners, as mentioned by interviewee VU6. Hence, considerable time was dedicated to collaborating with users in existing facilities to effectively devise strategies for implementing shared spaces. Interviewees emphasise the significance of this process, highlighting that it does not occur automatically. Moreover, a shared service organisation was established to support the users, integrating IT, caretaker and facilities management.

4.3.3 Financial

O|2 was developed as a shared facility with several financial goals. It aimed to reduce TCO by increasing utilisation, integrating service and accommodation charges, and by reducing the total investment by building fewer squared metres (FCO VU, 2014). The setup allows for joint investments in equipment and specialised labs, offering cost savings compared to separate facilities. The concept also aims to lower financial risks. According to FCO VU (2014), lab research, often unpredictable due to its trial-and-error nature, can make planning and duration forecasting difficult. Sharing resources helps accommodate sudden shifts in research. Additionally, the building includes a 'lab-hotel' for flexible short-term rentals or expansion opportunities for O|2 occupants experiencing departmental growth.

Interviewee VU6 states that the building's shared nature significantly enhances its cost-effectiveness, even when accounting for the transition from old to new facilities: "*We've established effective space standards here for this type of research. […] Ultimately, you can achieve much more with your space, and because you also share many facilities that you would otherwise have made unique, operating costs are saved.*" The interviewees agree that financing is simplified when these organisations come together. Pooling resources and jointly using facilities present a stronger case to financiers like the European Investment Bank, making borrowing easier, as pointed out by interviewee VU6. Additionally, the interviewees confirm the implementation of cost allocation based on fte and space usage.

Concerning the reduction of risks, interviewee VU6 observes that they see that groups can operate within those frameworks: "*Of course, there are occasional wishes or needs that fall outside those frameworks, but generally, most adjustments can be realised within the existing structures.*"

4.3.4 Physical

The shared concept of O|2 adopts a unique approach to resource efficiency and adaptability. The first measure applied to save resources is by clustering functions at the exact location on each floor: "*In old lab buildings, each person typically had their own office, adjacent to a meeting room, and next to that, their lab. This pattern was repeated, requiring maximum technical specifications for floor loading, air circulation, and other aspects, which was costly. In the O|2 building, there is a compactness that significantly enhances efficiency,*" Interviewee VU1. Additionally, the concept diverges from the norm of using flexible walls or generic spaces for short-term modifications or the potential for complete functional changes in the long term. Interviewee VU6 explains they flipped this around: "*With a robust floorplan as the basis, you engage with users when they need a different space, and then we assess how we can redistribute on a building level. We wouldn't divide a large lab in half just because someone needs a smaller space. So, by having this mix of spaces and building blocks that align well with […] these research groups, we aim to avoid constant renovations,*" Interviewee VU6. This concept was also used during the project's development phase, allowing for the reassignment of groups to different locations within the building up to three months before its opening.

O|2's shared service organisation allocates space to research groups and ensures the building is optimally occupied. Years after its opening, when two new groups needed office space, the process proved challenging, as noted by interviewee VU7. Reallocating space among long-established groups is difficult, especially when initial usage agreements are no longer top of mind. Interviewee VU7 pointed out that previous space abundance led to territorial behaviour, undermining the shared desk policy due to a lack of incentive to comply. "*When groups need to be accommodated, as per the concept […], you naturally encounter situations where users have to give up a workspace, even though it was never technically owned but was appropriated due to the circumstances,*" Interviewee VU7. They believe that the frequent expansion and reduction of groups make it challenging to avoid difficult transitions without the right users' culture: "*The issue seems to stem from the building concept not being upheld over time, both in terms of occupants' behaviour and the actual number of people using the space. Initially, it started well, but maintenance of the concept has eventually faltered.*" Interviewee VU1 recognises this and points out the importance of continually explaining the building's shared concept to new users who may not be familiar with it. Additionally, "*maintaining a level of scarcity is crucial to ensure people are willing to share,*" interviewee VU1.

4.3.5 Tensions

Table IV-17 outlines goals identified from previous results, showing how they connect with campus management perspectives. This section delves into these relationships.

A tension between the goal of organisational growth and other perspectives is highlighted. Organisational growth leads to increased crowding, operational costs, and a larger footprint. The shared workspace concept also introduces tensions; users often expect to lose personal space or control of their working environment without gaining equivalent comfort, whereas from financial and physical viewpoints, these shared spaces are seen as cost-effective and resource-efficient. Moreover, the organisational perspective views this as a means to encourage interdisciplinary collaboration among users. Lastly, a tension

is created between the physical and functional perspectives in redistributing research groups during growth or shrinkage phases, as users accustomed to abundant space may resist reductions.

4.4 KPIs

Figure IV-33 and Figure IV-34 present the occupancy of O2, the only data collected for this case. The VU's 2023 occupancy data covers all offices and labs, excluding practical classrooms, due to their minor footprint in the building. This analysis includes 782 office spaces, 458 meeting areas, and 159 lab stations, monitored eight times daily over two weeks in the second semester of 2022-2023. Findings reveal desk space utilisation at 37.0%, meeting areas at 23.1%, and lab spaces at 28%. Peak usage occurs on Tuesday afternoons, with 20 labs averaging at least two people simultaneously. It's noted that researchers often alternate between labs and offices throughout the day, as depicted in Figure IV-34's graph. On floors 1, 7, 8, 10, 11, and 13, the number of people present in the labs exceeds those temporarily absent in the office environment. This may indicate that activities in a laboratory space cause temporary absence on these floors (VU Amsterdam, 2023a).

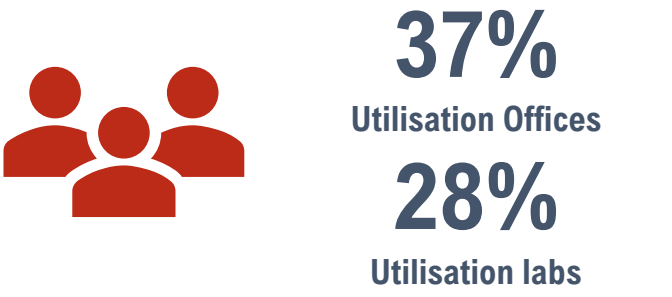


Figure IV-33: Occupancy O|2, based on VU Amsterdam (2023a, n.d.-b)

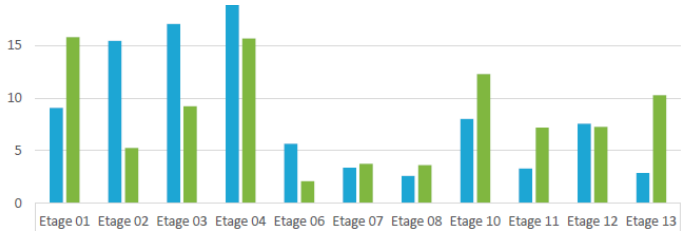


Figure IV-34: Individuals present in the laboratory environment (green) vs. individuals temporarily absent in the office environment (blue), by VU Amsterdam (2023a, p. 16)

4.5 Conclusion

The O|2 building introduces a novel approach to shared research facilities, promoting interdisciplinary work, efficient facility use and internal redistribution to match demand and space. It houses various life sciences groups, stimulating collaboration and shared projects. Despite its benefits and high-quality amenities, the shift to shared spaces caused challenges

Table IV-17: Goals, subgoals, value tensions and results for O|2 (Author)

Goals and subgoals *Derived from theory and case specific*		Values blue = no conflict (light)/shared (dark), red = conflicting	Results O|2 (✓ = match, ↻ = Semi-match, ✕ = no match, empty = uncertain)	
	Multidisciplinary organisation.		Various disciplines from different institutions are housed in this building, increasing the likeliness of multidisciplinary research.	✓
	Increased interaction, collaboration and innovation.		shared areas encourage collaboration without departmental segregation. This has improved inter-group interactions and spurred joint projects.	✓
	Safety and security.		The building has restricted access.	✓
	Enriching campus life, diversity and a vibrant community.		Not a goal for this building, as it functions mainly as a 9-17 office and attracts only those who work there, except for the café on the ground floor.	✕
	Users can find preferred facility for each activity.		Offices, laboratories, preparation areas, storage and living rooms are all present on each floor and facilitate all required activities.	✓
	Accessibility for all users.		Restricted access because of sensitive research, but all users have access to similar facilities.	✕
	Increased cost-effectiveness.		the building's shared nature significantly enhances its cost-effectiveness, even when accounting for the transition from old to new facilities.	✓
	Resilience for change, less costs when demand changes.		Generally, most adjustments can be realised within the existing structures which also mitigates the inherent uncertainty of academic research.	✓
	Costs shared with partners.		Resources from various partners were joined which presented a stronger case to financiers	✓
	Reduced footprint and energy consumption: High resource efficiency.		Transition from individual workplaces to shared offices and labs significantly reduced the footprint per user.	✓
	Higher utilisation rates.		The average utilisation of the building is 36,5%, but all spaces are occupied by research groups.	↻
	Physically flexible for change in demand.		The building concept relates to moving users instead of adapting the building Upholding the culture of shared use is a challenge.	↻
Case-specific	Realise additional capacity for research		O|2 accommodates growing and expanding research groups within the theme of Human Health and Life Sciences.	✓
	Thematic clustering of research themes		Many research groups from various disciplines within the theme of life-science have been established with O|2 as their home base.	✓
	Support user transition from individual to shared workplaces.		considerable time and resources were dedicated to collaborating with users in existing facilities to devise strategies for implementing the concept effectively.	✓

for its users.

Identified public values include resource efficiency and cost savings through communal facilities. Yet, this clashes with individual user needs, where some expect a loss of personal space. Space redistribution also leads to resistance, as users become attached to the amount of space they have. KPIs reveal moderate utilisation of desks, meeting areas, and labs, with specific peak times indicating the building's adaptability to diverse research tasks and the flexible work habits of its occupants.

Several lessons learned can be derived from this case concerning shared spaces on campus and the academic workspace. Firstly, pooling resources across organisations brings financial and spatial benefits, enhancing resource and cost efficiency. Secondly, grouping research teams from various organisations into a shared facility encourages complementary approaches and innovation. The VU organised thematic research groups based on similarities in facilities, accommodating them adjacent to these facilities regardless of their organisational structure. This approach prioritises the facility and inherently promotes shared usage. Interviewee VU6 suggests an even deeper integration by "*no longer looking at which department someone belongs to, but much more at who is working on which specific type of research and how to cluster them as individuals.*" Interviewee VU2 highlights the importance of identifying shared needs: "*It ultimately comes down to carefully examining the commonalities among various activities you want to take place in the same space. If you clearly understand those commonalities in a generic sense, you already have the flexibility to organise around them.*"

However, this model requires ongoing vigilance to ensure its success. Consistent monitoring and adjustment are essential to prevent and address space mismatches and keep up a level of scarcity: "*You need to stay vigilant once it's in use, ensuring that old behaviours don't resurface, but rather consistently assessing how groups shrink and grow over the years and whether they still have the right space,*" says Interviewee VU6. Ultimately, maintaining a sharing culture is effective if the users experience a certain level of scarcity in the available resources.

(O|2 Lab, Fokkema en Partners Architecten, n.d.-a)

(NU VU, Steinbach n.d.)

5. NU - VU

NU (Nieuwe Universiteitsgebouw) is the second step in a series of new buildings at the campus of the VU to replace the ageing W&N building. It includes faculty offices, study areas, classrooms, and lecture halls, which uniquely double as cinemas or theatres outside school hours. NU, therefore, stands out as the first university building in the Netherlands to share its spaces with such external entities. This section will focus on the academic workplace, lecture halls, and study spaces, emphasising the shared use with external users, drawing on document reviews, stakeholder interviews, and data analysis.

5.1 Data collection

The data collected for this case is similar to the O|2 case and comprises documents, interviews, and quantitative data. Table IV-18 shows the documents examined, while Table IV-19 shows the stakeholders interviewed. In addition to the interviewees for O|2, two students and a different external program manager have been interviewed.

5.2 Context

Urban context

NU is situated at the centre of the VU campus, next to the OZW building and the main building, as seen in Figure IV-35. The building houses public functions and has entrances on the Boelelaan and Campus Square. Below Building NU, there are public parking facilities and a bicycle storage area.

Campus context

The context in which NU was developed is comparable with O|2. It is a part of the VU Campus renewal, as depicted in Figure IV-31. Following the construction of the Initium building, the renovation of the Main Building, and the construction of the O|2 building, it is

Table IV-18: Documents included in analysis NU (Author)

Document	Ref.
Bezettings- en activiteitenmeting NU	Vrije Universiteit Amsterdam (2023b)
Building concept NU	Vrije Universiteit Amsterdam (2018)
NU Factsheet	Vrije Universiteit Amsterdam (2020a)

Table IV-19: Interviews conducted for NU case (Author)

	Interviewee	Stakeholder group	CRE Goals	
VU1	Policy employee VU	CRE Manager		Organisational, financial, physical
VU2	Asset manager VU	CRE Manager		Organisational, functional, financial, physical
VU3	Student	User		Functional
VU4	Student	User		Functional
VU5	Program manager	CRE-manager (External)		Financial, functional, financial, physical

Figure IV-35: NU (Red circle) at the VU Campus Amsterdam, by van Duijvendijk (n.d.)

the next step in the overall development of the VU Campus (VU Amsterdam, 2018).

Building layout

The New University Building is segmented into three areas: the plinth, base, and upper levels, as shown in Figure IV-36. The plinth is highly public, housing shops, eateries, a conference centre, and student association spaces (VU Amsterdam, 2018). The nine lecture halls span the ground to the fifth floor and are all equipped for teaching—two also function as theatres, and four as cinemas.

The base houses various sizes and configurations of educational facilities like study spaces, workshop rooms, and computer labs. Workshop rooms serve for traditional and group teaching, while interactive classrooms allow flexible setups for active learning and teamwork. Study areas vary, including quiet zones for solo work, relaxed study areas for quiet group or individual study, and project rooms for group work. The top floors are designated for research group offices and administrative functions.

5.3 Values

5.3.1 Organisational

Critical organisational goals and the integration of cinema

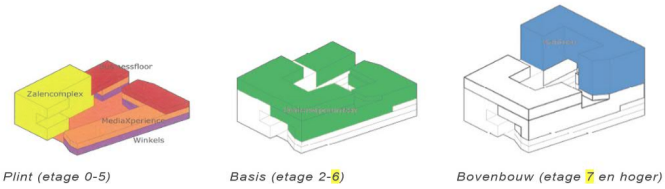


Figure IV-36: Plinth, base and upper levels of NU, in VU Amsterdam (2018, p. 10)

and theatre drove NU's development. The initial brief highlighted collaboration and interaction as central to NU's identity, aiming to merge education, science, and business, especially in beta sciences (van der Voordt, 2017; VU Amsterdam, 2018). The building had to encourage generic utilisation to ease collaborations between students, staff, and external knowledge entities or businesses. Another organisational objective relates to bringing culture onto the campus. According to interviewee VU2, this is supposed to expand students' offerings beyond their traditional curriculum and infuse vitality into the campus environment throughout the day.

NU houses the Griffioen Cultural Centre and Rialto Film Theatre within its auditorium complex of nine lecture halls, all equipped for educational purposes. Additionally, two halls are designated for theatrical performances and four for film screenings. Interviewee VU2 notes that these cultural activities align with the halls' primary educational use, enhancing campus life: "*With education during the day and cultural events in the evening, it enables multifunctional use while also fostering the vibrancy and dynamism we aim to cultivate on campus,*" Interviewee VU2. However, integrating these poses challenges. Interviewees VU2 and VU5 point out the need for audience adaptation to this unconventional cinema setting, distinct from Rialto's typical city locations. Furthermore, balancing educational priorities with cultural activities can be complex, as highlighted by Interviewee VU5, especially with increasing student numbers potentially necessitating space reallocation. The interviewees all confirm positive results in terms of campus liveliness. Interviewee VU5 mentions, "*You can see the Culture Café bustling; it's the go-to spot for students, and the cinema is also getting more popular. The theatre is also quite successful*"

Regarding student collaboration, interviewee VU4 observes that NU facilitates interaction across disciplines: "*Someone studying law is less likely to go to the W&N building, just like I never go to Initia. But indeed, I think almost everyone is almost always in NU, from multiple studies.*" Interviewees VU3 and VU4 note that NU draws students from other faculties: "*I've noticed that NU is the favourite spot for many VU students. Still, I've also noticed a preference for being in your faculty building,*" says VU4. However, they also mention that students often remain focused on their work, with little regard for their surroundings: "*For me, I'm usually just so focused on my tasks in NU that it doesn't matter much to me who is working around me.*" They even suggest that studying around their faculty building could be more beneficial, as it provides easier access to peers for questions.

5.3.2 Functional

From a functional perspective, this building facilitates a dual process, which is unique for a university building. The priority is education and research, as verified by interviewees VU1, 2 and 5. The second core process, however, relates to facilitating cultural organisations and LLO. Interestingly, these have been combined in the same spaces, and this section will delve into the functional consequences of this choice for both processes.

Education quality and spatial flexibility are critical objectives in NU to support diverse user needs; the equipment of the spaces shouldn't determine where specific education is scheduled (VU Amsterdam, 2018). These principles are incorporated into the lecture halls, classrooms, study places, and offices. Interviewee VU2 highlights the emphasis on spatial-functional requirements for quality

Figure IV-37: Bioscoopzaal NU, Rialto Film, n.d.

education from the design phase, stating, "*We've designed several what we call collaborative classrooms, primarily aimed at teaching in small groups, where you can break down into smaller teams. […] Additionally, the use of audio-visual resources […] allows for presentations to the whole group as well as for smaller groups to have their screen for projections.*" However, they mention that the facilities in these rooms are underused due to the lack of teacher guidance and a required change in teaching methods. Students VU3 and VU4 appreciate the room layouts' adaptability, allowing for both traditional and group work setups and enhancing their educational experience. They also value the building's diverse study spaces and facilities. VU3 notes the difficulty in finding available study spots, suggesting real-time occupancy displays could aid: "*In the main building, there's a large board at the entrance that shows how busy each building is, advising where you might want to avoid studying and which buildings are quieter and thus better options for study. The new building is always marked in red, indicating it's very busy. When I see that on the board, I know that finding a spot there will be nearly impossible.*"

Focusing on the lecture halls shared with Rialto and Griffioen, it's clear that combining education with cinema or theatre demands extra features. This need arises despite the apparent similarities that initially informed their selection, as interviewee VU2 explains: "*The spatial-functional requirements necessary for education have been taken as the basic starting point, and then, looking at both film and theatre, what additional needs are there to accommodate both functions? […] spatially and functionally compromises have emerged in the setups.*" Interviewees pointed out key differences between educational spaces and entertainment venues, such as the need for efficiency and effectiveness in education versus comfort for cinema guests, the contrasting colour schemes of light in lecture halls and dark in theatres, and the extensive audio-visual equipment necessary for a cinema. The result of these compromises is shown in the figure below.

The support required to make these spaces functional calls for an integrated approach to IT, AV and services, according to the brief (VU Amsterdam, 2018). In practice, interviewees VU5 and VU1 note that the organisation focuses on its core processes, education, and research instead of culture. This also applies to supporting departments such as facilities, audiovisual, maintenance, and IT: "*It starts with the fact that the core processes usually occur between 8 a.m. and 6 p.m. If you have issues after that time, there's nowhere to turn. This has been partly resolved, but partly not.*"

5.3.3 Financial

Financially, NU is the result of several key goals. Shared use is vital to mitigate risks associated with evolving needs or fluctuating group sizes (VU Amsterdam, 2018). Additionally, according to interviewee VU2, shared usage aims to enhance cost-effectiveness and save resources for education and research. Incorporating Rialto and Griffioen into NU also brings specific financial and legal implications, which are explored in the subsequent sections.

Sharing spaces outside regular hours is partly motivated by the potential for extra income, as noted by interviewee VU2: "*It's not just about financial benefits, but it's a win-win situation: we optimise the efficiency of our facilities while simultaneously bringing additional vibrancy to the campus.*" However, this approach required further investment in audio-visual equipment, soundproofing, and interior finishing: "*I think the extra investment has two main aspects. First, the physical space and the costs are comparable to a standard lecture hall. The significant expense comes from the seating quality, and the substantial expenses are for AV technology,*" Interviewee VU1. The interviewee admits that the spaces are probably not profitable when asked about the cost versus the added value. Still, they offer some nuances to this perspective: "*The previous culture centre at Uilenstede also wasn't profitable. The real question is whether these facilities are desired and what we are willing to invest in them. It wouldn't be feasible if costs were passed directly onto ticket prices. However, considering the marginal costs, such as the expense of leaving the hall empty for large parts of a week, helps in finding a financially viable solution.*" Additional complications arise from university funding regulations, which can create challenges when public and private resources are combined.

While sharing educational spaces within the same organisation is often regarded as a risk reduction, the situation where educational spaces are reserved for other activities during regular hours, in the long run, might bring additional risk. This is currently the case for the VU, as described by interviewee VU2: "*Allocating spaces to external parties has put pressure on our educational facilities, also due to student growth. Essentially, we've repurposed educational spaces for external use, necessitating potential reorganisation of education schedules. This situation stems from the agreements made with these external entities.*" According to interviewee VU5, an ongoing evaluation of cinema users versus educational tightness might lead to different choices on different days. Interviewee VU5 clarifies that "*as long as we can accommodate our activities effectively, we consider it important to have space for collaborations with other parties as well.*"

Effective collaboration is viewed as a prerequisite for sharing these spaces. Moreover, the VU feels it is also essential to feel responsible for the success of the non-primary processes: "*We are continuously engaged to improve and optimise the situation. It's not just about the financial and contractual aspects but also about the practical implementation of space usage. It's a continuous learning process for everyone involved,*" Interviewee VU2. Regarding the process, interviewee VU5 believes it would have been more effective to involve external parties at a later stage rather than from the beginning, as was done in this case: "*For future projects, the approach would be to fully develop the concept before involving external parties. Planning would commence about a year before final construction begins, or even consider a turnkey solution, given the clear requirements for facilities like a theatre.*" Other process-related issues relate to the different sizes and priorities of the involved organisations. This discrepancy leads to varied perspectives on financial matters, where some participants may be focused on large-scale budgets while others are concerned with much smaller amounts. This range in focus can make discussions at all levels challenging, with some seeing issues as minor and others viewing them as critical.

5.3.4 Physical

The considerations for NU in terms of the physical perspective mainly relate to the efficient use of resources. The brief states the

building should provide workspace and study environments that can be shared. Within the working environment, the VU considers sharing necessary for efficiency. For education, the policy is that the educational spaces can be used by the entire VU community, meaning teachers and students from programs not housed in the building also attend and teach classes there (VU Amsterdam, 2018). According to VU Amsterdam and VUmc (2014) this contributes to a decreased overall footprint. Moreover, the shared use of the lecture halls with external users prevents vacancy and intensifies space use.

The interviewees name several strategies that enhance NU's utilisation: Enabling overlapping use of the same physical spaces at different times during the day or week (Illustrated in Figure IV-39), allowing study access to empty classrooms (although interviewees VU3 and VU4 mention the reservation status is often unclear), and extending opening hours. As interviewee VU5 points out, thoughtful building compartmentalisation is crucial to facilitate these measures. In NU, the base and top floors can be secured after hours, and the parking garage is designed without direct building access, enabling public areas to remain open longer while securing private spaces.

The ambience of NU's public areas, serving both cultural and academic visitors, is another noteworthy aspect. Interviewee VU5 observes, "*When you're in the theatre hall, you feel like you're in a theatre. However, when you enter the building, it's a large educational facility.*" Balancing these distinct atmospheres is tricky, as Interviewee VU5 points out: "*From a cultural perspective, there's always a desire for more visibility, while from a university standpoint, it needs to be subtle, as there's also research and a business school housed there.*"

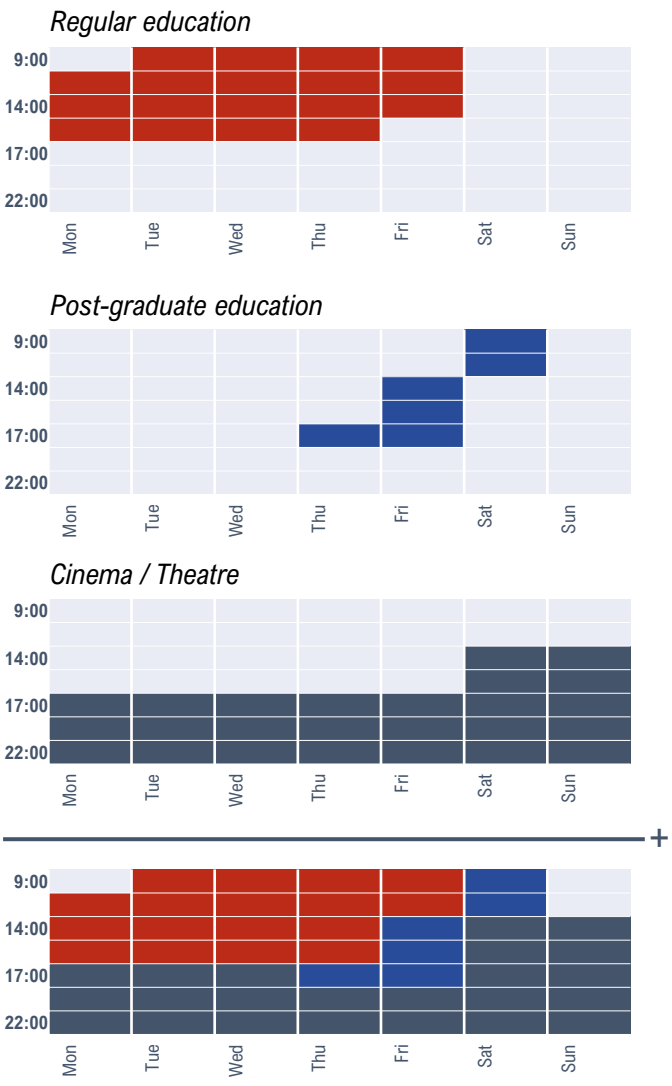


Figure IV-39: Enabling overlapping use of the same physical spaces by adding up separate timeslots (Author)

5.3.5 Tensions

Table IV-20 presents goals derived from the findings and their link to the perspectives on campus management. This section will explore these connections in more detail.

Financial considerations often conflict with other values, especially when incorporating cultural institutions into the campus, necessitating substantial equipment, finishes, and acoustics investments. Increased support services also raise operational costs. The data do not indicate whether additional rental income offsets these expenses. Furthermore, creating high-quality, flexible facilities is costly. The functional perspective, emphasising utility and comfort, can clash with financial and physical goals to reduce resource use, mainly if it results in crowdedness, less personal space, or loss of comfort.

5.4 KPIs

The KPIs for NU are shown in Figure IV-38, Figure IV-40 and Figure IV-41. Average office utilisation is 28%, but data for educational and study spaces wasn't available, though the occupancy of the lecture hall complex relatively high because of the use during evenings and weekend (Figure IV-39). This occupancy figure is based on eight daily measurements over two weeks in the second semester of 2022-2023, mirroring the approach used for O|2. NU's office area includes 483 workspaces and 394 meeting spots, with Tuesday emerging as the week's peak occupancy day, as illustrated in Figure IV-41.

Figure IV-40 illustrates the annual growth in student numbers and net floor space in all educational spaces at VU from 2018 to 2023. The red line on the graph indicates the net space available per student, highlighting that the increase in student numbers exceeded the expansion of new spaces, even after the opening of NU in 2020.

5.5 Conclusion

The development of NU on the VU campus represents a relevant example of introducing shared spaces in campus design as it combines academic and cultural activities in the same spaces. Fundamental public values driving this initiative include fostering collaboration among students and staff, offering cultural facilities, creating a more lively campus, and optimising resource use.

However, sharing academic spaces with cultural institutions presents challenges, such as balancing VU's educational focus with the cultural aims of Rialto and Griffioen, despite the seemingly functional similarities. Additionally, the shared-use vision faces hurdles from the costs of adapting spaces for both academic and cultural purposes. At the same time, it's unlikely that these additional

28%

Utilisation offices

Figure IV-38: Occupancy NU, based on VU Amsterdam (2020a, 2023b)

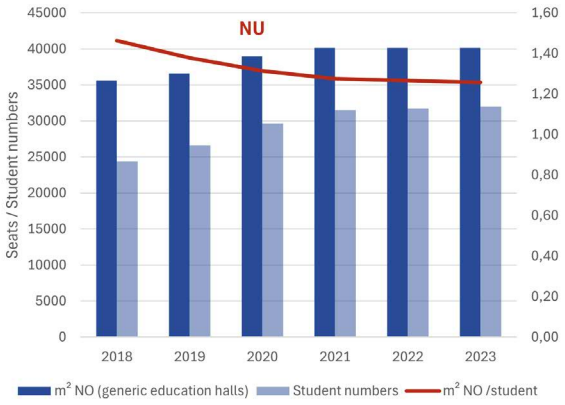


Figure IV-40: m2 NO per student for the VU (Author, based on (FCO VU, 2024))

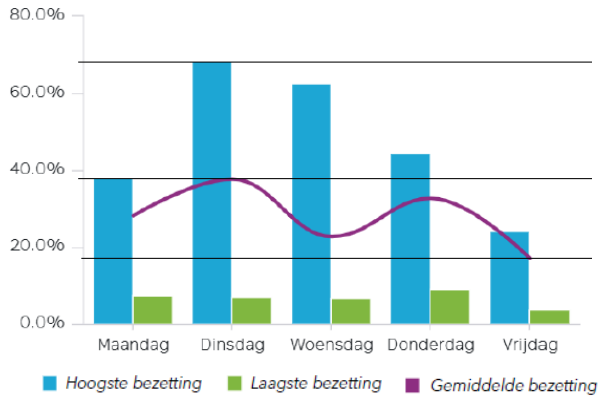


Figure IV-41: Average occupancy offices NU throughout the week, by VU Amsterdam (2023a)

costs are compensated with rental income despite an increase in occupancy.

Lessons learned pertain to prerequisites for sharing spaces with external users. First, it must be possible to compartmentalise the public and academic functions. It is essential to carefully identify the common elements of the activities intended for a space: "*If the generic shared components are clearly defined, that inherently provides the flexibility needed to adapt the space for different uses,*" Interviewee VU2. This clarity allows for further customisation. Next, ongoing evaluation and cooperation are essential to maintain a functional fit for all parties, and adapting the university's organisational structure to this model is also crucial: "*These secondary facets have been involved, but it's evident towards the end that it demands a lot to give them the same level of attention as the primary process,*" notes Interviewee VU5.

The case illustrates the multifaceted goals of integrating external users, which extend beyond financial gains and reduced vacancies to include creating a dynamic campus and broadening student experiences. Overall, the interviewees acknowledged that having external users use vacant space is sound and confirmed they would do it again if the choice was presented.

Table IV-20: Goals, subgoals, value tensions and results for O\|2 (Author)

Goals and subgoals *Derived from theory and case specific*		**Values** blue = no conflict (light)/shared (dark), red = conflicting	**Results NU** (✓ = match, ↻ = Semi-match, ✗ = no match, empty = uncertain)	
	Multidisciplinary organisation.		NU is used by students, teachers, researchers, study associations and participants in the life-long-learning programs of the university.	✓
	Increased interaction, collaboration and innovation.		Students mostly focus on themselves and their studies, and even prefer being near peers and teachers instead of students from other disciplines.	✗
	Safety and security.		*No specific comments related to this goal were made.*	
	Enriching campus life, diversity and a vibrant community.		Extended opening hours and culture attract users beyond standard opening hours. Visitor numbers of the cinema are below expectations yet increasing.	↻
	Users can find preferred facility for each activity.		The mix of different types of study places, cultural functions and catering create an effective environment for working and studying.	✓
	Accessibility for all users.		All campus users can use the facilities and the educational spaces are part of the education pool.	✓
	Increased cost-effectiveness.		Shared usage generates potential extra income, but the extra investments for cultural facilities require additional investment. Overall, no financial gain reported.	✗
	Resilience for change, less costs when demand changes.		Due to the genericness of the spaces these can be shared with a wide range of disciplines, group sizes and didactics.	✓
	Costs shared with partners.		Cultural partners pay for the use of the theatres and cinemas, but the investment in these spaces was for the VU.	↻
	Reduced footprint and energy consumption: High resource efficiency.		Stacking of functions throughout the day (Education, LLO, Culture) decreases the overall need to build more facilities.	✓
	Higher utilisation rates.		Educational spaces can be used by the entire VU community, shared use of lecture halls with external users intensifies utilisation outside of regular hours.	✓
	Physically flexible for change in demand.		Built according to standard office metrics enabling changes in layout and function in the future.	✓
Case-specific	Facilitate cultural function on campus		Organisation is still mostly attuned to the primary process of education.	↻

(Forum, Author)

6. Forum- WUR

Forum was built in 2007 as the first central education facility on the campus of Wageningen University. It is literally and figuratively the centre of the campus and was intended mainly for students and teaching staff. With Forum, Wageningen deliberately chose to cluster bachelor and master education separately from research activities. It contains a diverse and complex programme, including lecture halls, laboratories and the university library (Van Gessel Architecten, n.d.).

This part of the study explores Forum case by showcasing the findings from analysing documents, conducting interviews, and gathering qualitative and quantitative key performance indicators.

6.1 Data collection

The gathered data, like the other cases, encompasses a variety of documents and four interviews. These documents are listed in Table IV-21. A challenge faced during the collection of these documents was the considerable time that has passed since the development of Forum. Consequently, the real estate department could not provide the original program of requirements or outline the initial ambitions for this project. That is why interviews are the primary source of information for this case (Table IV-22). These were carried out with a policy staff member (WU1) responsible for overarching campus real estate policies and finances, the asset manager of the education buildings (WU2) who could address questions from the organisational, functional and physical perspective and two students who have regularly used Forum (as well as Aurora) to capture the user perspective.

6.2 Context

Urban context

Forum is strategically placed at the centre of the WUR Campus. It is in a park surrounded by other educational buildings and nature, such as Helix and Aurora (seeFigure IV-42). Forum's location in the centre of the campus underscores its role as a central hub for education.

Figure IV-42: Urban context Forum (Google Earth Pro, n.d.-c)

Campus context

When Forum was constructed in 2007, it marked the first time WUR concentrated its educational spaces in one location. Previously, educational spaces were scattered across various buildings and organised by different academic groups (Interviewee WU3). After this, the five academic groups all had to use Forum for education activities, which ties in with a specific educational philosophy that includes the use of central educational buildings (Interviewee WU1)

Building layout

Forum was designed to be the most central and public building of Wageningen University. The program spans over 33.500 m² and includes education halls, lecture halls, the university library, offices and a restaurant. It is described by Van Gessel Architecten (n.d.) as unequivocal and monolithic. Inside, however, is complex, with courtyards and various functions and activities. The central courtyard, which serves as the entrance to the building from both the north and south sides, is designed as a 'three-dimensional urban space'.

Table IV-21: Documents included in analysis Forum (Author)

Document	Ref.
Strategisch plan WUR 2007-2010	Wageningen UR (2007)
Forum- van Geffen Architecten	Van Gessel Architecten (n.d.)

6.3 Values

6.3.1 Organisational

According to WUR (2007), the primary objective of establishing Forum was to consolidate educational activities in one location and accommodate the expanding student body within a single facility.

Table IV-22: Interviews conducted for Forum case (Author)

	Interviewee	Stakeholder group	CRE Goals	
WU1	Policy employee WUR	CRE Manager		Organisational, financial, physical
WU3	Asset manager	CRE Manager		Organisational, functional, physical
WU2	Student	User		Functional
WU4	Student	User		Functional

Furthermore, it aimed to function as the principal educational hub, replacing the various educational spaces previously managed by individual departments. This implies that Forum facilitated this centralisation and unification as a single facility that could support the newly consolidated educational framework and scheduling system.

This centralisation has had several consequences for the university. First, the transition to a centralised organisation demanded cultural changes, according to interviewee WU3: "*Previously, each academic group had its facilities, which was a setup that had to be relinquished.*" Instead, the groups had to start sharing these spaces, which required a different working method. Additionally, interviewee WU3 explains the advantage for students having a building at their disposal that "*is dedicated primarily to their use, complete with various catering services and facilities, as well as spaces for hosting events*". Additionally, the interviewee expresses the view that "*centralisation and mix of functions enhances the vibrancy of the educational environment*". The interviews with building users confirm these advantages: "*The fact that people from all over the university gather in one place is something I really appreciate. It brings together a diverse group of individuals […]. This exposure to people outside of my own program prevents me from having a tunnel vision limited to my field of study,*" (Interviewee WU2).

Interviewee WU3 identifies a potential downside for students in the distance from the academic departments: "*Students are not housed within the departments, which some students might find less convenient as it reduces the likelihood of casual interactions with faculty members.*" Interviewees WU2 and WU4 explain that teachers mainly come to Forum for educational purposes. Still, when asked whether it's harder to get in touch with them, interviewee WU2 answers that they're unsure if this plays a significant role: "*It might not have been a significant issue for me. However, I think it could be more challenging for some people. I've noticed that teachers often linger after class or try to schedule their classes as much as possible in the same building on a given day […]. Teachers often go there for lunch, especially in Forum, where the large cafeterias are located so that you can contact them there. But aside from that, making contact might be more challenging.*" Furthermore, "*Access to academic clusters is restricted. […]if you wanted to, you couldn't just walk into these specific buildings.*" (Interviewee WU2).

Lastly, concerning the identity of the building, Interviewee WU2 answers, "*There wasn't a specific place I associated with my program where I could expect to find fellow students. However, since my program was large, it was common to run into fellow students everywhere. I didn't experience a strong sense of belonging, but I didn't feel a particular need for it*". The interviewee explains that the building facilitates casual encounters between students from different programmes, but structural collaboration

Forum Ground floor, Van Gessel Architecten, n.d.-a

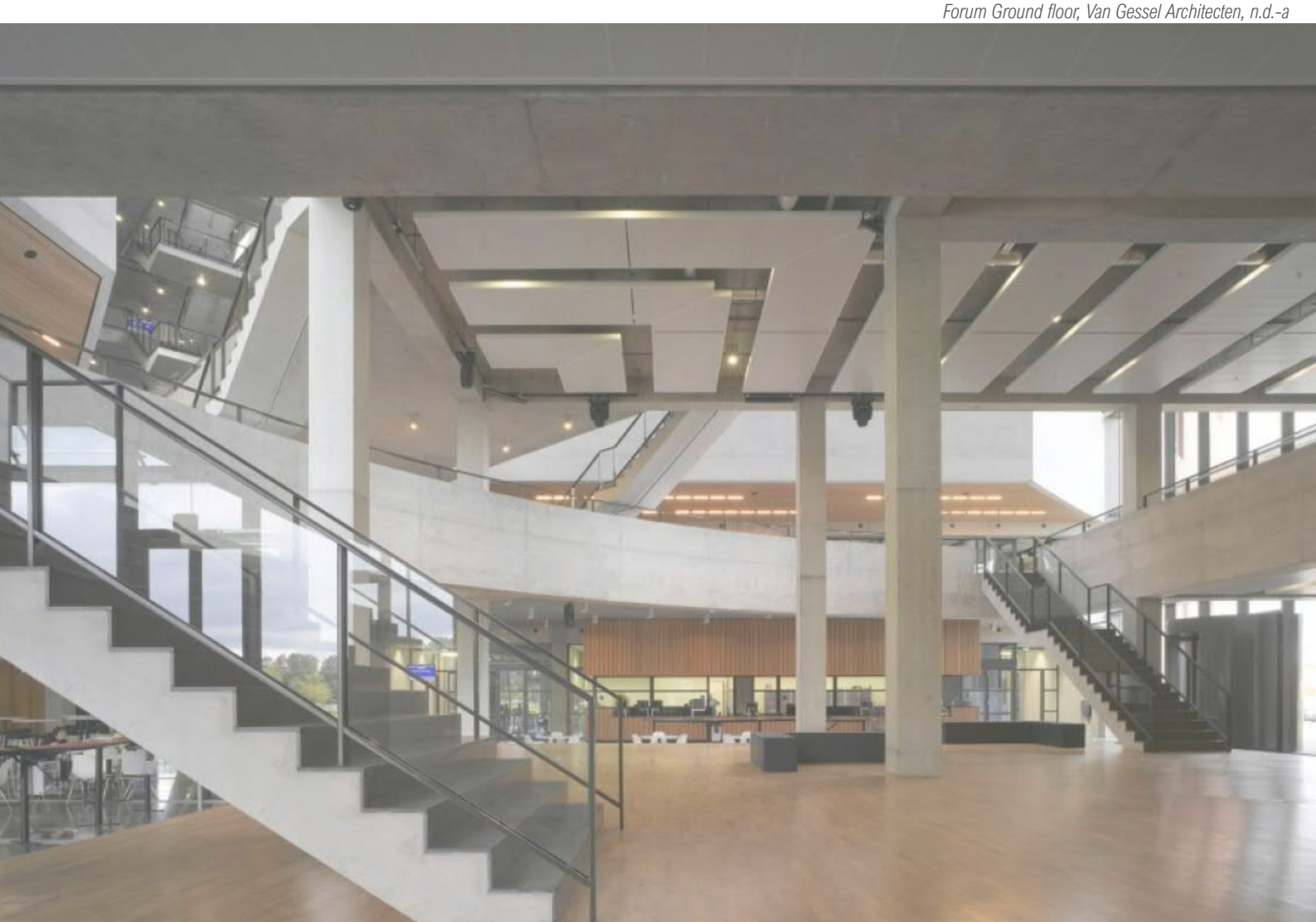


Table IV-23: Goals, subgoals, value tensions and results for Forum (Author)

Goals and subgoals *Derived from theory and case specific*		Values blue = no conflict (light)/shared (dark), red = conflicting	Results Forum (✓ = match, ↻ = Semi-match, ✗ = no match, empty = uncertain)	
	Multidisciplinary organisation.		Although all education is centralised in one faculty, students mostly interact with peers and teachers from their discipline.	↻
	Increased interaction, collaboration and innovation.		All education is centralised under one faculty meaning students from all disciplines use the facility; research happens in other facilities.	↻
	Safety and security.		*No specific comments related to this goal were made.*	
	Enriching campus life, diversity and a vibrant community.		Housing of various functions, such as student associations and the library in Forum contributes to the liveliness of this building and surrounding area.	↻
	Users can find preferred facility for each activity.		The building houses many functions that cater to student needs (library, catering, student associations, etc.) but users describe a lack of diverse study place types.	↻
	Accessibility for all users.		Facilities are accessible for all users.	✓
	Increased cost-effectiveness.		CRE employees report a higher cost-efficiency for shared facilities.	✓
	Resilience for change, less costs when demand changes.		The building is still in use and is popular amongst students, but the structure is rigid and inflexibility for varying group sizes is seen as an issue.	✗
	Costs shared with partners.		No specific comments related to this goal were made and the building is not shared with partners.	✗
	Reduced footprint and energy consumption: High resource efficiency.		Overall growth has led to an increase in footprint. Interviewees expect that the shared spaces in Forum eventually contributed to a decline in demand for m².	↻
	Higher utilisation rates.		On-going process. A measurement system is in place, optimisation needs to happen in scheduling to increase efficient sharing.	↻
	Physically flexible for change in demand.		The rigidity of the structure is considered a hindrance to risk control and functional changes.	✗
Case-specific	Realise additional capacity for organisational growth		Spatial demand was accommodated up to a certain point, after which other shared buildings were added to the campus.	✓
	Provide practical support to enable shared use for academic groups.		Practical support was provided and effective, as the centralised organisation is now considered second nature.	✓

with other disciplines is uncommon.

6.3.2 Functional

As mentioned in section 2.2, WUR has structured the organisation and campus to revolve around education. Forum was the first physical enabler of this student-focused strategy. One of the primary functional objectives described in the strategic plan 2007-2010 by WUR (2007) was to provide state-of-the-art facilities to support its high-quality education and research goals.

To facilitate the transition from individual facilities to shared facilities, the university

"*established practical support mechanisms, such as generic support services for all academic groups. Thus, academic groups were somewhat compelled and enticed to transition to this new arrangement,*" (Interviewee WU2). According to the interviewee, one factor that necessitated this approach was that the education was no longer near an office or laboratory. For students, interviewee TU1 thinks the availability of buildings dedicated primarily to their use, equipped with various catering services and facilities, as well as spaces suitable for hosting unique events, was the significant advantage of Forum. "*Student associations, for instance, are housed in Forum building, which adds to the vibrancy of the educational environment beyond just academic purposes.*" The interviewee also asserts that the building is the most favoured among students. Interviewees WU2 and WU4 corroborate this, noting that most students can be found in Forum. Nevertheless, they link this popularity not exclusively to the building's allure but also to its primary location for scheduling education.

Both interviewees WU2 and WU4 describe the spaces in Forum as inflexible and small-scale, but neither interviewee mentions any issues related to crowdedness or suitability for use. The latter aspect could result from FM maintaining close contact with the teachers and educational specialists to ensure the rooms are equipped with the appropriate audiovisual resources and related equipment, as mentioned by interviewee WU3. Interviewee WU4 also expresses that the type of study places offered is relatively homogeneous: "*There aren't as many areas with an abundance of tables where you can just sit down. The library in Forum is a space designed for silent studying. Along the corridors, there are some seating areas, but they aren't as specifically designed for studying.*"

6.3.3 Financial

Owing to the building's age, it was impossible to ascertain the specific financial objectives initially allocated to Forum. The strategic plan 2007-2010 does highlight the aim to commit as many resources as possible to communal use, in support of the university's 'business interests' (WUR, 2007). Beyond this, the documents do not cite any financial goals connected to the original intentions behind the development. Interviewee WU3 does note that the investments in a substantial educational building like Forum were significant for the university and required careful consideration due to the long-term nature of the investment.

Concerning current use, however, interviewee WU3 mentions

Forum Library, Van Gessel Architecten, n.d.-b

the goal of scheduling more efficiently to increase cost-effectiveness: "*It's important to verify if the actual attendance rates of students match the expectations. […] We've recently implemented a new system. We are currently reorganising it to improve efficiency in scheduling and tracking no-shows, as there are often cases where spaces are reserved but not used. […] The aim is to align the actual usage with the expected usage as closely as possible.*"

There was no initial plan for Forum to feature adaptable shared spaces tailored to varying group sizes or functional needs, which occasionally resulted in underuse and diminished cost efficiency, as noted by interviewee WU3. Moreover, the building wasn't explicitly designed to be flexible in the short or long term: "*To withstand intensive use and future changes in the program, we employ classic geometric shapes and sustainable materials. This results in a robust, sturdy building, also comparable to a castle, as the building is stronger than any potential future modifications,*" Van Gessel Architecten (n.d.)Lastly, Forum wasn't built to be shared with external users: "*There are no external users. We do host events that come close to involving external parties, but the building is purely for educational purposes. We are not set up to provide services to third parties. And naturally, there are no plans to change that,*" Interviewee WU3 said.

6.3.4 Physical

From a physical perspective, the development of Forum primarily emphasised the creation of generic, non-specialised facilities. This approach marked a departure from the previous arrangement, where academic groups had customised facilities, as noted by interviewee WU3. The educational spaces have been subject to several updates (such as updates to the AV system) to enhance their functionality and suitability for evolving shared space needs.

When the building was constructed in 2007, considerations regarding environmental sustainability and the building's impact on the university's footprint were deemed less significant. The decrease in the overall footprint of the university has, however, started to play a more critical role in saving resources. Interviewee WU3 explains that "*WUR specifically looks at the actual occupancy of the lecture halls […]. This is because there's an experience that the courses often over-requested rooms. If you can remove some of that over-requesting, reducing everything by 10 or 20 per cent, that saves many square meters.*"

Finally, from a physical standpoint, the quality of the environment provided in the shared spaces must be considered. Interviewee WU3 elaborates that consolidating all educational activities within a single shared building resulted in a notable

enhancement of quality, partly due to the pooling of financial resources. Nevertheless, owing to the building's age, interviewees frequently characterise the environment as darker, more static, and less inspiring than newer campus structures.

6.3.5 Tensions

Table IV-23 summarises the diverse objectives identified from the abovementioned results and their correlation with the four perspectives on campus management. This section will further elaborate on the nuanced relationships between public values.

The most outstanding tensions during the development and opening of the building arose from the organisational goal to facilitate the centralisation and unification of education. This initially led to friction, as students and teachers were separated from their 'own' facilities. The financial investment in Forum was considerable, and there was an initial increase in the university's overall footprint. However, initially perceived as a challenge, this transition was successfully navigated, resolving most of these tensions. Another tension emerges from the organisational aim to offer cutting-edge facilities. Although this value aligns with the organisational and, to some extent, the physical perspectives, the substantial investment required introduced tension with the financial perspective. It is possible this tension was overcome by sharing these facilities, leading to increased cost-effectiveness. Lastly, the previous section has shown that a subsidiary objective linked to the centralisation efforts at WUR around 2007 was to reduce the overall spatial demand for education by augmenting shared facilities. This objective clashes with the organisational and functional perspectives as it results in a reduction of space available for users and for facilitating top-quality education and research. However, the previous section illustrates that an enhancement in the quality of the facilities can mitigate these concerns.

6.4 KPIs

No data could be collected on Forum's occupancy rates. Moreover, the building's effects on a campus level can only be determined after its opening, as no data on student numbers was available before this period. These developments will be discussed in section 4 of the Aurora case.

6.5 Conclusion

To summarise the case study of Forum at Wageningen University, it's clear that the building has played an essential role in centralising the university's educational organisation and moving towards shared use of campus real estate. Forum was developed as a central hub for education and student and faculty interaction while accommodating the growing demands of an expanding student body.

The shift from a decentralised to a centralised educational organisation was challenging, as it necessitated a cultural adaptation. Despite initial resistance as described by interviewees WU1 and WU3, this centralisation has yielded notable benefits, such as its multifunctionality, its capacity to host a significant portion of the university's educational activities, its cost-effectiveness due to shared use and a contribution to decreased demand for space.

Challenges have been identified despite the success of facilitating a significant organisational and cultural shift towards shared and centralised space use. Several interviewees expressed that the physical separation between education and academic groups might lead to unintended distance between academic groups and students. Additionally, the interviewees associate the building with inflexibility and a homogeneous supply of spaces. This also challenges maximising space utilisation and sharing between diverse groups.

Lessons learned from this case highlight the importance of flexibility and adaptability in space design to accommodate fluctuating functional and organisational demands. If the building cannot adequately mitigate these uncertainties, the effectiveness of shared spaces might be reduced. Interviewee WU3 explains that to achieve this, "*considering a uniform design that meets the needs of all user groups is essential, but achieving this can be challenging due to the diverse requirements of each group. The key challenge lies in harmonising these varying needs and finding a middle ground. Compromises will inevitably be necessary, and not everyone will be fully satisfied with the outcomes.*" Achieving this compromise often involves "*open dialogue and collective decision-making to identify the best solutions for the group. It's crucial to ensure collaborative willingness to reach these compromises and to prevent the demands of one vocal group from dominating, potentially making the facilities less suitable for others*" (Interviewee WU3).

(Aurora, Author)

7. Aurora - WUR

Aurora is the third in a sequence of generic and communal educational buildings on the WUR campus, completed in 2021. It houses various educational amenities, including various classroom and lecture hall formats, practical classrooms, study areas, catering services, and support facilities. As Aurora follows Forum and aligns with the same campus strategy, it presents a valuable case study to understand how the building differs in functionality from Forum and to discern the lessons learned in the 14-year interval between the completion of these buildings.

Figure IV-43: Urban context Forum (Google Earth Pro, n.d.-c)

7.1 Data collection

Similar to previous cases, the gathered information includes documents (Table IV-24) and four interviews. Unlike the Forum case, the ambition documents for this case have been reviewed and will provide significant insights into Aurora's goals and intentions. Additionally, interviews with a member of the policy staff (WU1), who oversees broad campus real estate policies and finances, an asset manager for the educational buildings (WU2) who provided insights from an organisational, functional, and physical standpoint, and two students who frequently utilised Forum (and Aurora) are the primary sources of information for this case.

7.2 Context

Urban context

The urban setting for Aurora parallels that of Forum, with both buildings situated within the park that stretches across the campus. However, a distinction is Aurora's location near the campus's periphery rather than at its centre. It is bordered by a forest on one side and a research facility on the other, as depicted in Figure IV-43.

Campus context

Aurora was developed 14 years after Forum and eight years after Orion, the second shared educational facility for Wageningen University. This means Aurora was opened at a time when shared use of educational spaces was already rooted in the organisation and culture of Wageningen University. The main reason for constructing the building was, according to interviewee WU1, the need for additional space to accommodate the growing number of students on campus.

Table IV-24: Documents included in analysis Aurora (Author)

Document	Ref.
Ambitiedocument 3e onderwijsgebouw	Wageningen University & Research (2017a)
Integraal PvE Aurora	Wageningen University & Research (2017b)

Building layout

Aurora was designed to accommodate the increased demand for educational space. The building has added 14.050 m² to the campus real estate portfolio. It includes lecture halls, spaces for mixed didactical methods such as instruction halls, labs for teaching purposes, catering, group workspaces and study places. The largest lecture hall can hold up to 450 students and be divided into two separate spaces. These flexible walls have also been applied in other instruction halls (WUR, 2021a). Interestingly, Aurora was designed in three building phases. The first two (7.500 m² GFA and 6.600 m² GFA) have already been built, and the third can still be added to the building (Interviewee WU3). That means about 6.000 m² GFA is still unrealised and might be added when spatial demand increases.

7.3 Values

7.3.1 Organisational

The brief for Aurora mainly specifies cultural goals from an organisational perspective. The building has to facilitate chance encounters for students and staff from different programs and various nationalities and cultures by "*Making productive use of layout inefficiencies or cleverly introducing dual-purpose areas,*" (Wageningen University & Research, 2017). Additionally, the

Table IV-25: Interviews conducted for Aurora case (Author)

	Interviewee	Stakeholder group	CRE Goals	
WU1	Policy employee WUR	CRE Manager		Organisational, financial, physical
WU3	Asset manager	CRE Manager		Organisational, functional, physical
WU2	Student	User		Functional
WU4	Student	User		Functional

building needs to add 8.000-9.000 m² GFA of education in 2021, with the possibility to scale this up to 20.000 m² GFA in 2035.

According to Starink (2021), Aurora promotes chance interactions due to its transparent design, thereby enhancing opportunities for spontaneous encounters. Moreover, there is a diversity of study places in the circulation areas. Users describe another way encounters are facilitated in Aurora due to the scheduling and necessity to use certain facilities: "*For my study, we spent a lot of time in Aurora for the labs. You mainly encounter people from your own study due to the scheduling and the necessary facilities for your study, such as labs,*" Interviewee WU4. Interviewee WU2 describes they "*haven't engaged in collaborations across different disciplines in Aurora. It's more about casual encounters where you might ask someone about their program. It's not common to work with many different disciplines because you're typically focusing on specialising in your own field.*"

7.3.2 Functional

From a functional perspective, it is insightful to determine what experiences from previously constructed shared educational buildings have been integrated into Aurora's program. The brief for Aurora outlines the following criteria (Wageningen University & Research, 2017):

- The building offers optimal facilities for modern and continuously evolving education.
- Innovative teaching methods should be accommodated within the structure.
- The building contributes to the comfort and well-being of its users. In the building, the student is central.

With the move to Forum (and Orion), a significant shift in the approach to space allocation, moving away from creating spaces for specific purposes, had already been realised, according to interviewee WU3. In planning Aurora, "*there was a deliberate effort to understand which spaces were most popular in existing buildings and why they were favoured. Armed with this knowledge, the goal was to design areas in Aurora that would be as appealing to students,*" (Interviewee WU3). Examples named by the interviewees that enhance the shared spaces include an increase in reservable group study spots, adjustable desks and chairs, more expansive areas compared to Forum, flexible classrooms and lecture halls equipped with movable walls to accommodate varying numbers of students. Interviewee WU4 says, "*if there were fewer students in the lecture hall, they would suggest sitting towards the left side, and then they'd move the dividing screens to make the space feel less oversized.*"

Comparable insights have been used for the practical classrooms in Aurora, resulting in what interviewees WU3 and WU4 characterise as the optimal configuration for instructors and students in the current context. "Compared to Forum, the layout is more spacious, and they've ensured each desk has access to all necessary facilities. Unlike in Forum, where you might have had to share certain resources with adjacent groups, they've provided split outlets. Central tables are available for picking up ingredients or equipment and are large enough to accommodate all the needed products. This arrangement makes the labs more efficient," Interviewee WU4. Another functional amenity mentioned by interviewee WU2 is the lockers available outside the practical classrooms for everyone to use, as it is not allowed to bring any personal items inside. Lastly, to support the use of the facility by multiple groups, there's an independent coordinator responsible for the lab, overseeing the organisation of materials and ensuring everything is in its proper place. These coordinators are present regardless of the ongoing activities (Interviewee WU2).

7.3.3 Financial

Aurora was mainly constructed to accommodate the growing student body of Wageningen University. However, during the building's development phase, it was uncertain how these numbers would develop in the future. That is why the brief for the building asks for "*a flexible educational structure designed to accommodate the varying sizes of student cohorts and the changing interest in different fields of study by distributing the building mass across multiple blocks. Regarding dimensions and organisation, it is a flexible educational building that can adapt to function changes within 80% of its mass. The building's design, which allows for the coupling and splitting of spaces, further contributes to its flexibility,*" (Wageningen University & Research, 2017). This has resulted in a design that can be constructed in three phases, of which two have been completed. "*Only one phase was deemed necessary according to the first forecast. However, with new projections, it became apparent that two phases were required, leading to the simultaneous construction of both. There is still the possibility of adding a third phase to the building if needed,*" (Interviewee WU3). Additionally, the interviewee mentioned that the building might be turned into a different type of function in the long run, which is less feasible in Forum.

Lecture halls have been designed to be divisible, as highlighted in the preceding section, to cater to different group sizes within the same structure. Nonetheless, the cost-effectiveness of this feature is debatable, particularly in the scenario outlined by interviewee WU4, where the dividers reduce the room's perceived size, making it feel more appropriately scaled for the number of students who attend the lecture.

The main method to ensure flexibility in the practical classrooms is to "*outfit these spaces for the highest level of education possible. If you can facilitate this, these spaces can accommodate all other practical sessions. By designing the rooms to meet top-tier standards, you can host a wide range of practical sessions without being constrained by specific requirements,*" (Interviewee WU3). The users confirmed that the practical classrooms in Aurora are particularly well-suited for shared use across different disciplines, primarily because they understand equipment and resources required are expensive.

7.3.4 Physical

Aurora was built with two main goals from a physical and

architectural perspective. First, it should provide students and teachers with a pleasant and stimulating work environment. Second, it should achieve an excellent BREEAM score. Moreover, the university's general goal of efficient space use to reduce its physical footprint (section 2.2.4) must be considered.

Interviewee WU2 describes the ambience as "*quite distinct from that of Forum. Forum feels more static, being constructed from brick and appearing somewhat duller. In contrast, Aurora incorporates significant greenery, enhancing its overall appeal.*" Additionally, the building is described as more spacious and transparent. Regarding occupancy, the interviewees mention it's popular and often full, especially for individual study places. Interviewee WU3 describes that in their experience "*Aurora became increasingly busy as the academic year progressed, as people discovered it was a pleasant place to study […]. It was often busier from Monday to Thursday in the mornings than in the afternoons. Fridays are quieter.*"

7.3.5 Tensions

Table IV-26 summarises the various goals identified based on the results above. This section will further nuance the relations between public values.

Similar to the previous cases, the first tension is between the organisational goal to grow as a university by implementing another shared education building, the substantial financial resources required to do this, and the increased footprint this results in. Another conflict arises due to the organisation's goal of providing state-of-the-art amenities. While this objective is consistent with the organisational and, to a degree, the physical aspects, the significant financial commitment it necessitates creates friction with the financial perspective. This situation arises, for example, when the decision is made to equip all practical classrooms to the highest standards, which involves substantial expenses. Such high-end facilities may not be necessary for each study program, leading to a conflict between the goal of achieving top functionality and the need for cost-effectiveness. On the other hand, this lower cost-effectiveness in the short run might be offset if future developments in research can be accommodated without additional costs. However, whether this is the case is uncertain when the investment is made.

7.4 KPIs

Limited quantitative data was available for the Aurora case, similar to Forum. Key metrics like utilisation rates and annual capacity development of educational spaces at the campus level were not obtainable from the campus real estate department. Instead, the analysis used the gross floor area of three educational facilities to assess the impact of Aurora (and to some extent, Forum) on the campus. Figure IV-44 shows the total gross floor area per student in these buildings at WUR, with the space ratio per student calculated annually since 2008, the year Forum opened. Two main observations can be drawn from this data. First, the space ratio per student has declined since 2008, with significant drops between 2008-2012 and 2013-2020, as student enrolment growth exceeded new building construction. Second, each new building initially increased the space available per student, but this was

Table IV-26: Goals, subgoals, value tensions and results for Aurora (Author)

Goals and subgoals *Derived from theory and case specific*		**Values** blue = no conflict (light)/shared (dark), red = conflicting	**Results Aurora** (✓ = match, ↻ = Semi-match, × = no match, empty = uncertain)	
	Multidisciplinary organisation.		Although all education is centralised in one faculty, students mostly interact with peers and teachers from their discipline.	↻
	Increased interaction, collaboration and innovation.		Promotes chance interactions through clustered scheduling, but a segregation between teachers and student is mentioned.	↻
	Safety and security.		*No specific comments related to this goal were made.*	
	Enriching campus life, diversity and a vibrant community.		Minimal contribution to campus liveliness due to location, limited opening hours and monofunctionality.	×
	Users can find preferred facility for each activity.		Functional practicalities have been realised when designing the facilities.	✓
	Accessibility for all users.		Facilities are accessible for all users.	✓
	Increased cost-effectiveness.		CRE employees report a higher cost-efficiency for shared facilities.	✓
	Resilience for change, less costs when demand changes.		Best practices from other shared buildings were incorporated in Aurora. Lecture halls and teaching labs were built to accommodate changing functional needs.	✓
	Costs shared with partners.		No specific comments related to this goal were made and the building is not shared with partners.	×
	Reduced footprint and energy consumption: High resource efficiency.		Debatable whether spatial demand decreased, especially if flexible walls are used to reduce the perceived size of the room and not to accommodate more groups.	↻
	Higher utilisation rates.		Employees mention high utilisation, but this isn't backed up with measurements.	
	Physically flexible for change in demand.		Designed according to a phased construction, 80% of the building can adapt to function changes.	✓
Case-specific	Realise expandable capacity for organisational growth		The first and second phases (up to 14.000 m²) were realised, third phase can still be realised in the future.	✓

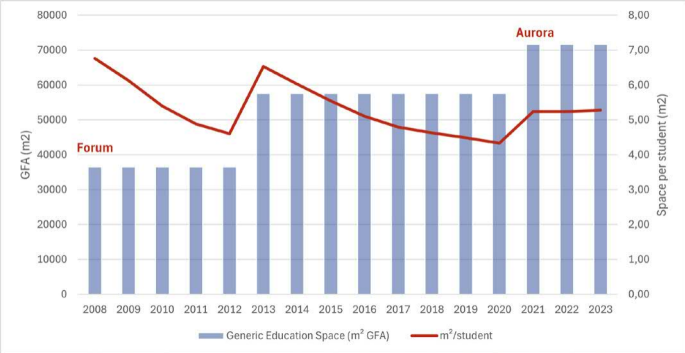


Figure IV-44: Number of m², student numbers and m² per student for Wageningen University, Forum and Aurora (Author, based on Pieck (2024); (Wageningen University & Research, 2017; WUR, 2021b, 2023a))

followed by a decline as student numbers continued to rise. Aurora has so far been an exception; since its opening, student numbers have remained stable, maintaining a consistent space-per-student ratio over the past three years.

7.5 Conclusion

Aurora was built as a shared facility with several key goals, including facilitating diverse educational facilities, encouraging interdisciplinary encounters, and maintaining flexibility to adapt to future educational needs. The building has a transparent design promoting spontaneous interactions, diverse study spaces enhancing user experience, and the capability to adjust to increasing student numbers through its phased construction.

Challenges emerge mainly from balancing growth and innovation objectives against financial and physical constraints. On the one hand, the university's ambition to expand and provide state-of-the-art facilities aligns with organisational and functional goals, aiming for an interdisciplinary campus and supporting innovative teaching methods. However, the financial implications of constructing such advanced facilities and the environmental impact of campus expansion create tensions. Specifically, the decision to equip practical classrooms to the highest standards underscores a conflict between aspiring for maximum functionality and the necessity for cost-effectiveness, given the substantial investment involved and the uncertainty regarding future utility.

The primary lessons learned resulted from examining the changes that occurred over the years between the construction of Forum and Aurora. The most significant development identified is the shift in the level at which sharing is implemented. In Forum, sharing was enforced at the building level, creating a multifunctional facility where various user groups could share the entire building. For Aurora, this principle has been applied at the room level, with most spaces intentionally designed to accommodate multiple user groups in terms of size and functionality in the short term, but with the potential to completely change their function in the long term: "*In designing […] Aurora, we aimed to incorporate flexibility and consider future usage from the outset,*" (Interviewee WU3).

Furthermore, this case underscores the significance of learning from past experiences related to using shared spaces. The lessons learned from the oversights in Forum were instrumental in refining the brief and design of Aurora. The successful elements of the earlier shared buildings were also incorporated into this project, demonstrating the value of building upon proven successes in developing shared facilities.

(Aurora, WUR, n.d.)

(Aurora, WUR, n.d.)

(Pulse Hall 1 TU Delft, TU Delft, n.d.-b)

Cross-case Analysis

8. Cross-case analysis

The case studies highlight the complex motivations for and methods of implementing shared space use on university campuses. This section systematically examines and compares the motivations for using shared spaces, the strategies employed, and the critical lessons from each case. The analysis begins at the campus level, comparing the real estate strategies and trends influencing the three studied universities, deriving public values associated with the campus strategy and providing an overview of qualitative indicators. This is followed by analysing the cases on a building level, exploring the public values and performance indicators associated with each building and summarising the lessons learned. This section aims to provide a comprehensive overview of all the cases to formulate a complete answer to the research questions in the final part of this thesis.

8.1 Cross-campus analysis

The campus level is crucial as it sets the case context and is instrumental in answering the research question. The real estate strategy reflects current and future trends influencing the university's operation. This strategy is an extension of the institution's central vision and supports it. This section will compare the real estate strategies of each institution and explore the factors influencing these strategies. Understanding these trends and how they lead to a shared space strategy will help address this research's first sub-question. The cross-campus analysis is shown in Table IV-27 on page 110 and will be discussed in the following sections.

8.1.1 Trends

Table IV-28 on page 111 lists the trends mentioned in each case study, derived from the literature in Part III of this thesis and supplemented by additional trends from the cases. The table summarises the most relevant trends for the cross-campus analysis. Table IV-27 on page 110 shows the frequency of trends related to the four perspectives mentioned in interviews and documents for each campus. The table also identifies which trends are mentioned and have a similar effect for all cases (indicated with a **=**) and which are mentioned but have a different effect for all cases (indicated with a ≠). The trends stated without an indication were only mentioned for one or two cases. Despite this, they might still be relevant to all cases if they represent a broad societal trend.

All universities anticipate organisational growth, though the specifics—whether in student numbers or research activities—vary by case. This growth is expected to lead to increased staff levels. A significant driver of this growth is the trend of internationalisation, which has attracted international students and researchers to the Netherlands. Additionally, the increasing complexity of society necessitates more interdisciplinary collaboration to address complex issues, a trend noted across all cases.

Functional trends common across all cases include gradual changes in the didactic forms used in university education, with a shift expected towards more personalised, flexible, and small-scale learning. Additionally, the societal trend of lifelong learning is noted, with VU most actively embracing this by offering post-graduate programs. The COVID-19 pandemic also significantly influences how university real estate is used, for example via hybrid working and a move back towards on-campus education.

Interviewees cite financial and physical trends as the original motivators for implementing shared spaces. Universities took over responsibility for their real estate in 1995, coupled with lump sum financing that included real estate costs. This led to a significant shift toward more cost-effective campus real estate strategies and a decline in the total cost of ownership. This shift aimed to conserve resources for core activities such as education and research. The need for cost-effective real estate has intensified over recent decades due to steadily decreasing government funding per student and increased research funding driven by heightened competition for research grants and organisational growth.

Physically, the studied universities have faced an ageing real estate portfolio, with the buildings on the VU and TU Delft campuses mostly stemming from the period between 1950 and 1980. This directly conflicts with a recent trend focussing on sustainable use of scarce resources and the energy transition, often a central ambition for universities who want to 'practice what they preach'. Additionally, a focus on efficient utilisation is noted in all cases. Low utilisation rates and quiet and busy days are leading trends caused by hybrid working patterns for students and teachers.

8.1.2 Strategy

Based on the trends and challenges described above, each university has developed a real estate strategy to address these issues and create a resilient real estate portfolio that supports the university's core activities. This section will explore and compare the strategies outlined in the 'Public values & Campus strategy' section ofTable IV-27 on page 110. By examining these strategies, insights will be gained into how similar societal trends have led to different approaches to sharing spaces on a campus level.

The VU has made shared spaces a central element of its real estate policy. At the VU campus, facilities are commonly shared and generic, with specialised facilities only when necessary; specific faculty buildings are no longer built. Initially driven by financial and spatial incentives, the organisation has adopted sharing to stimulate interaction among students, teachers, and researchers who would otherwise be isolated in separate facilities. This approach has led to strategically clustering research themes from different faculties within single facilities, as shown in the cross-campus analysis. The strategy involves grouping researchers who work on similar topics or use similar equipment rather than providing them with separate spaces. Additionally, educational activities related to these subjects are often located near these research facilities. Furthermore, all educational spaces are part of a centrally scheduled pool.

Like the VU, WUR has adopted a centrally scheduled pool of educational spaces shared across all types of education, facilitated by their central education organisation functioning as a single faculty. A distinctive feature of WUR is its strategy to segregate educational facilities from other academic buildings. This setup has resulted in dedicated student-focused facilities, while separate buildings

accommodate research groups and their offices and labs. In these research-oriented facilities, sharing remains a fundamental principle.

TU Delft stands out as the most faculty-oriented university. Although educational spaces are pooled similarly to other universities, TU Delft still develops faculty buildings and prefers to schedule classes close to the faculty's home base. This faculty-focused real estate approach may stem from the university's history of designated faculty buildings, the extensive size of its real estate and land holdings, which make sharing spaces across the campus less practical, or the specific needs of its engineering programs, which often require faculty-specific facilities. Despite this, TU Delft is also shifting towards more generic education facilities that can be shared across multiple faculties. These shared spaces host classes that do not need specialised setups, reflecting a strategy for greater resource sharing.

In conclusion, the real estate strategies employed by VU, WUR, and TU Delft showcase diverse approaches to managing shared campus spaces in response to similar societal trends. While the VU focuses on clustering research groups and their education programs, WUR opts for a more segmented approach that maintains distinct educational facilities. TU Delft's strategy seems to be a more hybrid approach, focusing on the existing faculty structure for specific facilities and generic facilities for education that doesn't require these particular facilities. These varied strategies highlight each university's response to balancing tradition with evolving academic and societal needs and provide context for the case buildings.

8.1.3 Key performance indicators

This section compares various performance indicators at the campus level, reflecting the effectiveness of different campus strategies. These indicators are primarily financial, as derived from university annual reports. Additionally, organisational and physical indicators will also be compared. Functional indicators, however, are more qualitative and are, therefore, not a part of this section.

Organisational indicators

The primary indicator of organisational growth identified in the data is increased student numbers, as depicted in the figure below. All three universities saw significant increases, ranging from 52% to 151%, with the most significant growth occurring at WUR. Additionally, the figure indicates that student numbers stabilised after 2020 for each institution.

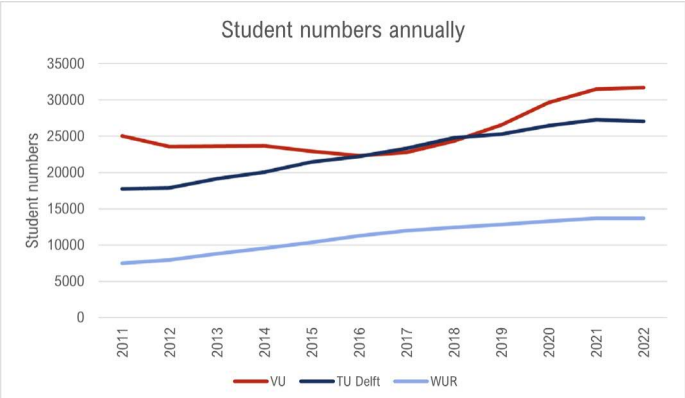


Figure IV-45: Student numbers annually (Author, based on Pieck (2024))

Financial indicators

The financial indicators for this thesis cover the period from 2010 to 2022 when most sharing strategies were introduced. The primary indicator used is accommodation expenses, which encompass rents, legal fees, maintenance, operation, energy, and other accommodation costs, with maintenance and operation typically constituting the most significant portion. Another indicator derived from the annual reports is total expenses, including personnel costs, depreciation charges, other expenses, and accommodation. Personnel costs are the most significant component of total expenses. Important to note here is

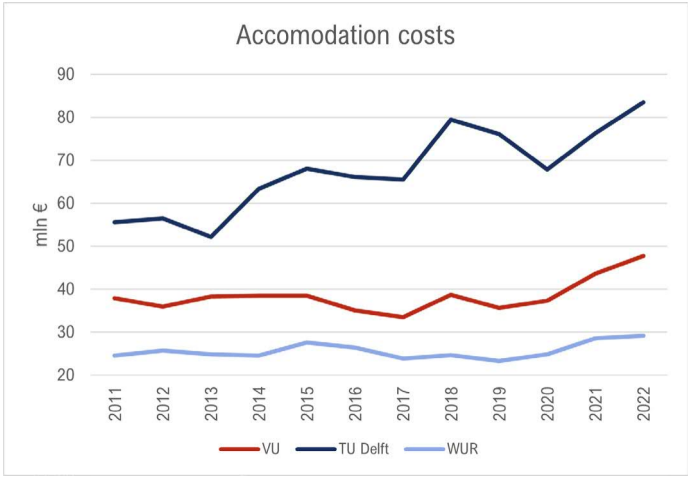


Figure IV-47: Accommodation costs 2011-2022 (Author, data derived from annual reports)

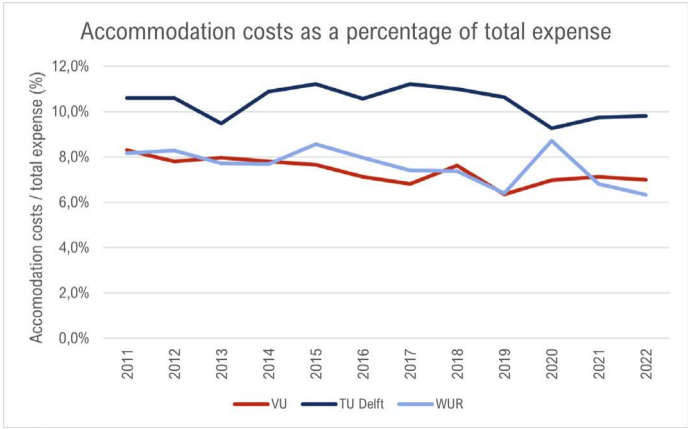


Figure IV-46: Accommodation costs as a percentage of total expenses 2011-2022 (Author, data derived from annual reports)

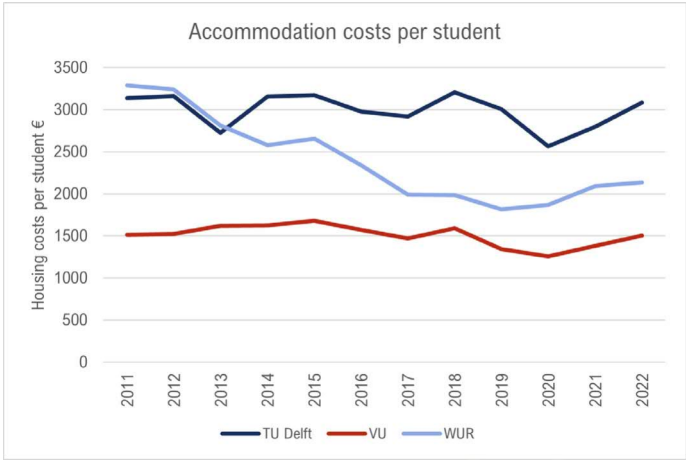


Figure IV-48: Accommodation costs per student 2011-2022 (Author, data derived from annual reports)

that these figures represent the entire campus, meaning that single facilities or typologies can't be singled out. This should be taken into account when interpreting the trends in the following sections. The discussion in Part V will also elaborate on this.

The indicators derived from the reports include accommodation costs (Figure IV-47), accommodation costs as a percentage of total expenses (Figure IV-46), and accommodation costs per student (Figure IV-48). Initially, VU and WUR displayed stable accommodation expenses, while TU Delft experienced a significant rise from 2011 to 2022. All three universities saw an increase in accommodation expenses starting in 2020. These figures, however, are absolute and should also be considered relative to each university's size and growth to make a fair comparison. Two additional indicators help contextualise this: accommodation expenses as a percentage of total expenses have declined for each university until 2020, albeit more gradually for VU. This suggests that universities have accommodated more primary activities with fewer financial resources, thereby increasing cost-effectiveness and freeing up funds for core activities.

The second indicator, accommodation expenses per student, helps compare the development of accommodation costs with organisational growth, often linked by interviewees to increased student numbers. Figure IV-48 offers an interesting comparison. WUR shows the most significant decline in accommodation costs per student, dropping from approximately €3,100 to €2,135 over 12 years, suggesting that its policy to centralise and share educational facilities was cost-effective. The declines at TU Delft and VU are less pronounced, about €100 over the same period, indicating less cost-effectiveness in their strategies. Additionally, the distinct nature of each university's research and education fields influences this indicator. TU Delft and WUR require more expensive practical classrooms compared to VU, where some programs demand less intensive (lab)facility use and thus lower accommodation costs per student. This helps explain the variations in cost-effectiveness per student across these universities.

Physical indicators

The data collected to assess the physical efficiency of educational space usage across various university campuses is fundamentally inconsistent. Additionally, these figures again represent data on a campus level, meaning single facilities could not be singled out. This leads to difficulties in drawing precise comparisons or conclusions, which will also be a part of the discussion in part V. Specifically, the metrics used to quantify space differ: TU Delft reported the number of seats available, VU provided net floor areas, and for Wageningen University, gross floor area calculations were used in the absence of better data. These disparate metrics make an exact comparison challenging, though a broad trend can still be discerned with careful interpretation.

Figure IV-49 illustrates a decline in the ratio of seats to students in all pooled educational spaces at TU Delft, suggesting that the increase in student numbers has surpassed the expansion in seating capacity. Figure IV-50 details the net floor area per student at VU, though over a significantly shorter timeframe. The data from 2018 to 2023 reveals that the growth in net educational space has not kept pace with the rise in student numbers. Meanwhile, Figure IV-51, which utilises the least precise metric of gross floor area per student for the three educational facilities at Wageningen University, also indicates a mismatch between the growth in student numbers and the addition of new academic facilities during the observed period.

These figures suggest a common trend across the campuses: the growth in student numbers has outstripped the construction of new physical assets. This trend may indicate that the strategy for shared spaces has effectively led to more intensive use of existing physical assets. However, it's important to note that these figures do not provide insights into the shared use of other academic spaces, such as offices or laboratories, which could also impact the overall utilisation of campus facilities. Thus, while the available data point to an overarching trend where the growth of student numbers outstrips the construction of new educational facilities, they offer a limited view of the total campus space management.

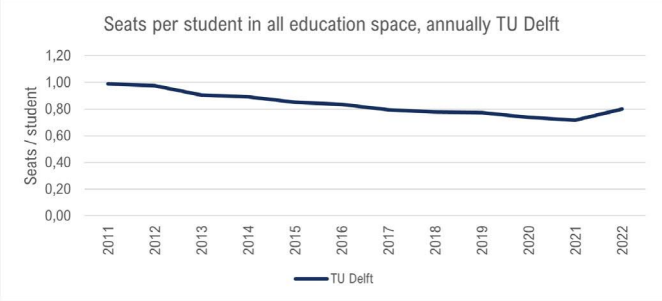


Figure IV-49: Seats per student in all education spaces, annually for TU Delft (Author, based on Valks (2024)

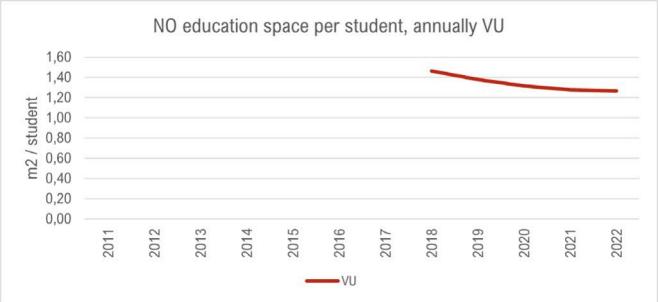


Figure IV-50: Net floor area in all education spaces per student, annually for VU (Author, based on Facilitaire Campus Organisatie Vrije Universiteit (2024))

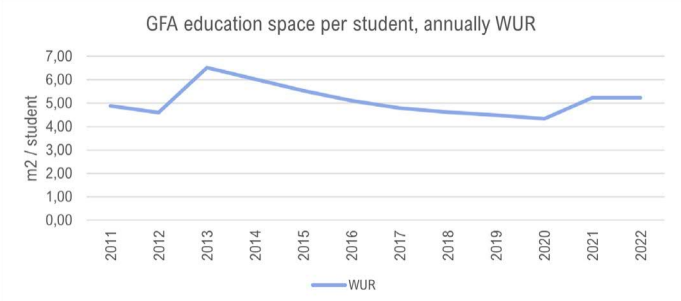


Figure IV-51: GFA per student in all education buildings WUR (Author)

Table IV-27: Cross-campus analysis (Author)

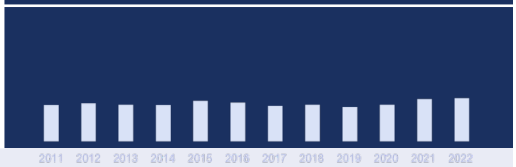
	Vrije Universiteit	Wageningen University
Key Performance Indicators		
Student numbers (2008-2023)		
Portfolio size	252.412 m² / 36 ha	250.000 m² / 120 ha
Accommodation costs (€mln)		
Trends		
Freq. mentioned	24 · 9 · 5 · 4	15 · 11 · 4 · 3
	• **Organisational growth =** • **Increased student numbers =** • **Increasing research and staff =** • **Internationalisation =** • **Inter-disciplinary collaboration =** • Complex society	• **Organisational Growth =** • **Stable student numbers ≠** • **Growth of research and staff =** • **Internationalisation =** • **Inter-disciplinary collaboration =** • Solving societal problems
	• **Personalised & flexible education =** • **Lifelong development and education =** • **Focus on wellbeing =** • **Hybrid working =** • On-campus education	• **Personal, small-scale & flexible education =** • **Lifelong learning =** • **Focus on wellbeing =** • **Hybrid working =** • On-campus education
	• **Decreased government funding =** • **Uncertain research funding =** • **Increased awareness of housing costs =** • Increased building costs	• **Stable financial inflow (financed by LNV) ≠** • **Increase in research funding ≠** • **Focus on cost-effectiveness =** • Increased competition for research grants
	• **Sustainable use of scarce resources =** • **Ageing real estate portfolio =** • Low utilisation • Busy and quiet days due to hybrid working	• **Resource efficiency =** • **Ageing real estate portfolio =** • Energy transition
Public Values & Campus strategy		
Most mentioned values	26 · 14 · 14 · 34	10 · 6 · 7 · 8
Campus models mentioned most	1. Liquid, 2. gas, 3. solid	1. liquid, 2. solid, 3. gas
Sharing strategy campus level	Clustering of research themes from different faculties per facility	Seperate facilities for education & research

Table IV-28: Trends mentioned per case, derived from theory (Part III) and cases (Author)

Trends mentioned per case *Derived from theory and cases*		VU	WUR	TU Delft
	Internationalisation	X	X	X
	Fluctuating student numbers	X		X
	Increased (short-term) research	X	X	X
	Temporary staff contracts			
	Need for interdisciplinary collaboration	X	X	X
	Organisational growth	X	X	X
	Complex Society & societal problem solving	X	X	
	Competition for academic talent			X
	Personalised learning	X	X	
	Flexible learning environment	X	X	X
	Small-scale education		X	X
	Hybrid working	X	X	X
	On-campus education	X	X	
	Lifelong development and education	X	X	X
	Focus on well-being	X	X	X
	Decreased public funding	X		X
	Increased academic competition	X	X	X
	Increased academic capitalism			
	Rising overall construction costs	X		
	Declining utilisation rates	X	X	X
	Environmental restrictions	X	X	X
	Sustainability goals	X	X	X
	Increased focus on resource efficiency	X	X	X
	Ageing real estate portfolio	X	X	X

8.2 Cross-building analysis

The cases studied in this research result from the strategies outlined in the previous section. With those strategies and the trends that underlie these strategies in mind, the next step is to analyse and compare the results of the case studies at a building level. Table IV-29 on page 114 presents the cross-building analysis detailing the general characteristics of each building. It also includes the public values associated with shared spaces on campus derived from Table IV-14, IV-17, IV-20, IV-23 and IV-26. The public values derived from the literature have been supplemented with public values found in and relevant to each case. The cross-building analysis colour-codes the performance of shared facilities: dark blue indicates a match, blue is a partial match, light blue is no match, and grey when assessment is impossible from the available data. This section will discuss the cross-building analysis results and the critical lessons learned.

8.2.1 Building characteristics & KPIs

Figure IV-52 shows that the chosen cases feature a range of functions. Most facilities provide study spaces, educational areas, and catering services. O|2, Forum, and Aurora offer practical classrooms, with O|2 also featuring research laboratories. NU stands out as the only building providing non-academic cultural amenities, and Forum is distinct as it also includes the university library. The least multifunctional buildings are Echo and Aurora, which are predominantly built for educational purposes.

The data collected for KPI analysis at the building level was inconsistent for two main reasons. First, the CRE departments sometimes couldn't provide the necessary information. Second, the information that was provided often used different metrics or methods. Only one case provided complete data on net functional spaces and useful space per seat, with two others providing partial data, leading to the exclusion of these KPIs from the analysis. Furthermore, while occupancy or utilisation rates were occasionally reported, they typically only covered specific areas like offices or were based on reservations rather than actual use, failing to represent building utilisation entirely. Office utilisation in O|2 and NU is 37% and 28%, respectively, while lab utilisation in O|2 is 28%. Utilisation of study spaces in Echo is 36%, and occupancy in lecture halls is 72%. Although these figures could indicate the physical efficiency of the cases, the KPIs are too inconsistent and have a too one-sided focus on the physical perspective to draw broad conclusions about their quantitative performance.

8.2.2 Public values and performance

This section will discuss public values and performance based on the qualitative data from the four perspectives.

Organisational

Four public values for shared spaces have been identified from an organisational perspective and confirmed through the case studies. The primary objective was to create additional capacity for organisational growth, a typical driver for such projects. This expansion also replaced existing facilities in the NU and O|2 cases. Another public value is using shared spaces to create a multidisciplinary organisation to enhance interaction, collaboration, and innovation. O|2 demonstrates success within the academic

Figure IV-52: Cross-case function comparison (Author)





		Echo	NU	OI2	Forum	Aurora
Education & student facilities		x	x		x	x
		x	X	x	x	x
				x	x	X
					x	
Academic workplace		x	x	x		
				x		
General facilities		x	x	x	x	x
			x			

workplace, with cohabiting research groups initiating joint projects. However, students tend to stay within their disciplines, suggesting that while shared facilities enable a multidisciplinary approach, disciplinary boundaries may persist if study programs remain segregated. Safety and security were less frequently mentioned as public values in the case studies. When addressed, they were often linked to building compartmentalisation and increased social oversight on campus, mainly when shared spaces draw users during evenings and weekends.

Functional

All interviewed CRE departments emphasised the functional goal of creating a lively campus. There are no clear indications that Aurora and O|2 significantly contribute to this goal, as their operations are mainly during standard academic hours, and they cater to a specific user group due to their mono-functionality. Echo, primarily an educational facility, is credited with adding to the campus liveliness due to its extended opening hours, which attract users during typically quiet times. NU and Forum have extended opening hours and are multifunctional, which positively affects their surroundings. Notably, NU, with its cinema and theatre, brings people to the campus who might not visit otherwise, enhancing campus liveliness outside of traditional academic activities. Interviewees also attribute the appeal of Echo, NU, Forum, and Aurora to the variety and accessibility of facilities that allow students to select their ideal study environment for different activities. In contrast, access to O|2 is more restricted due to the sensitive nature of some research projects. Nonetheless, basic facilities are accessible on most floors.

Lastly, from the functional perspective, several cases showed the importance of user guidance in the transition to shared facilities. This was especially relevant in the case of O|2, where the culture of shared usage was still non-existent when the new users moved in. The case also shows it's pertinent to actively maintain the shared culture of the building, either through scarcity or active management, to prevent users from reverting to individually claimed workplaces. For most study facilities, this shared culture is inherent to a certain extent, meaning the focus is mostly on practical support. Incorporating non-academic functions, as seen in NU, does seem to require a significant shift in allocating support resources to non-core processes.

Financial

From a financial perspective, the public values for shared spaces are cost-effectiveness, risk management, and joint investments. Most CRE departments conclude that building a shared, generic facility is more economical and reduces TCO. The benefits of such spaces include flexible space allocation leading to more intense use, clustering of similar facilities for operational efficiency, and shared access to costly research equipment. However, the downside is the more significant initial investment needed for these versatile spaces. This is particularly evident in the laboratories, which must comply with stringent standards to support diverse research activities, as seen in the O|2 case. The nuance, however, can be found in the total cost of ownership: A generic facility will significantly save on future redevelopment costs if a change in function or a different research group can be accommodated in the same space.

Resilience to change is categorised into short-term and long-term adaptations, and the interviewees report the success of shared spaces hinges on this. In the short term, educational facilities must support different group sizes and teaching methods. Solutions like movable walls and furniture and using classrooms as study spaces when not in use have been effective. In the workplace, as demonstrated in O|2, short-term flexibility often involves shared desks and hybrid working models. However, laboratories mainly face challenges in long-term flexibility due to the extended duration of research projects. This requires labs to be sufficiently generic to accommodate various research groups and equipment if a redistribution is needed.

The literature suggests that shared spaces can offer the financial benefit of splitting investment or operational costs with partners. However, this is not observed in three of the cases studied. Only the cases from the VU shed light on how this could work: O|2's construction was co-financed, the exploitation costs are allocated to each research group proportionally, and NU generates extra income by leasing spaces to otherwise empty partners. In NU's case, the VU covered the additional costs of equipping lecture halls for dual use as theatres or cinemas despite the slim chance of recouping this investment through rental income.

Physical

From a physical perspective, the overarching goal across the cases appears to be high resource efficiency. There is a consensus in the results that the shared use of spaces has decreased overall demand, particularly when individual facilities are constructed. When reviewing this, a distinction should be made between educational spaces and the academic workplace.

If designated groups exclusively used educational facilities, most would remain unoccupied for long periods. However, shared use is feasible because, on an institutional level, there is sufficient flexibility to identify non-overlapping schedules, allowing different groups to use the same space without interference. Central scheduling has been implemented for educational spaces in all cases. NU has taken this concept a step further than the other cases. Its CRE department has successfully combined very different functions in the same spaces that do not overlap. It allows lecture halls or classrooms to be utilised during evenings and weekends—times they would otherwise be empty. This approach to 'pooling' functions significantly enhances the resource efficiency of the organisation by optimising the use of available space.

In the academic workplace, shared usage has been adapted due to resource scarcity and overall low utilisation, with all cases adopting a shared desk concept to improve office space utilisation. It was no longer feasible to provide each user with a personal workspace. However, short-term lab space sharing is often impractical as research setups cannot easily be dismantled after a

Table IV-29: Cross-building analysis (Author)

	Echo	NU
General characteristics & KPIs		
Opening hours	8:00-0:00 (mon-sun)	7:00-0:00 (mon-sun)
Function(s)	Education, study, office, catering	Education, study, office, catering, culture
Gross Floor Area (m²)	8.300 m²	31.100 m²
Net Floor Area (m²)	4.520 m²	25.000 m²
Opening year	2022	2020
Utilisation / Occupancy rate (2022)	Lecture halls: 72% (Occupancy) Study places: 36% (utilisation)	Offices: 28% (Utilisation)
Public values & shared spaces		
Frequency mentioned	16 · 39 · € 23 · 35	38 · 32 · € 23 · 37
Most frequent public value	Functional	Organisational
Public values associated with shared spaces on campus & results — Realise additional capacity for organisational growth.	Accommodates growing student body in shared spaces.	Partial replacement of W&N building realised in generic educational spaces.
Multidisciplinary organisation.	Users focus on their own expertise and segregation is still experienced.	Used by students, researchers, study associations and life-long-learning.
Increased interaction, collaboration & innovation.	Segmentation is still experienced; users focus on their own studies.	Segmentation is still experienced; users focus on their own studies.
Safety and security.	Compartmentalisation possible during evening hours.	
Enriching campus, diversity & vibrant community.	No current external user organisations, attracts users in evening and weekend.	Cultural amenities & extended opening hours.
Users can find preferred facility for each activity.	Suitable for mixed didactics and multiple types of study places.	Suitable mix of study places, education spaces, culture and catering.
Accessibility for all users.	Open to all campus users, accessibility of classrooms for studying can be improved.	Accessible to all campus users & part of education pool.
User support and a sharing culture.	Facility management specific for education functions.	organisation is mostly attuned to the primary process of education.
Cost-effectiveness.	Building a generic facility is seen as more cost effective than faculties.	Increased investment costs to facilitate multifunctionality, rent income.
Resilience for change in short term.	Spaces are adaptable to changing group sizes through movable separations.	Generic facilities mitigate risks stemming from changed group sizes.
Resilience for change in long term.	Functionality can be changed if necessary.	Allocating spaces to external parties decreases flexibility and increase risks.
Costs shared with partners.	No partners.	Partners pay for use of the spaces, but initial investment was not shared.
High resource efficiency.	Overall footprint increased due to organisational growth.	Decreased overall need to build facilities because of stacked utilisation.
Efficient utilisation rates.	Seats vs actual occupancy can be improved. High average occupancy.	Shared use intensifies utilisation outside of regular hours.
Physically flexible for change in demand.	Short-term and long-term transformations are possible.	Built according to standard office metrics enabling changes in layout and function.

PV match
PV semi-match
PV no match

O|2	Forum	Aurora
7:00-22:00 (mon-fri) (24/7 with authorisation)	8:00-23:00 (mon-fri) 10:00-18:00 (sat-sun)	8:00-19:00 (mon-fri)
Education, lab, office, catering	Education, study, library, catering	Education, study, catering
33.000 m²	36.500 m²	14.050 m²
Unknown	Unknown	8.8450m²
2018	2008	2021
Labs & offices: 37% (utilisation)	Unknown	Unknown
25 44 € 11 35	12 17 € 5 14	9 28 € 14 23
Functional	Functional	Functional
Accommodates growing demand for shared research labs and offices.	Increased spatial demand was initially accommodated through shared usage.	Current demand is facilitated, option to expand to facilitate future demand.
Shared at institutional level, co-locates similar research groups.	students from all disciplines use the facility; research is in other facilities.	students mostly interact with peers and teachers from their discipline.
shared areas encourage collaboration without departmental segregation.	Housing of various functions contributes to the liveliness of the building.	Possible segregation between teachers and student is mentioned.
Restricted access.		
Not a goal for this building; 9-17 office.	Facility contributes to the liveliness of the campus.	Building attracts students during the day, closed in the evenings/weekends.
All amenities present on most floors and facilitate all required activities.	Multifunctional building suitable for various user activities.	Multifunctional building suitable for various types of education.
Restricted access.	Accessible to all campus users & part of education pool.	Accessible to all campus users & part of education pool.
A lot of support before opening, less attention to user guidance afterwards.	Effective practical support was provided for users.	
Significant increase in cost-effectiveness reported.	The step towards centralised education increased overall cost-effectiveness.	CRE employees report a higher cost-efficiency for shared facilities.
User groups can be redistributed in case of changing demands.	Generic spaces allow multi-functional use; not adaptable to group size.	Spaces are adaptable to changing group sizes through movable separations.
Monofunctional but can adapt to different types of research.	Rigid structure hinders long-term adaptability.	Functionality can be changed, if necessary, expansion possible.
Shared investment with different partners.	No partners.	No partners.
Significant reduction in footprint per user and layout reduces material use.	Growth led to an increased footprint, overall long-term demand declined	Match between group size and space size can be optimised.
All spaces are allocated, average utilisation levels	Actual attendance vs expected attendance can be optimised.	
Adaptable to various types of research.	Rigid structure.	Functionality can be changed, if necessary, expansion possible.

few hours. Instead, sharing support areas like preparation places and storage within labs is feasible and common in O|2. Another strategy implemented in O|2 involves vertically clustering facilities with similar construction requirements in the building's floor plan. This approach conserves materials by ensuring not all floors and installations meet the highest lab standards. For example, areas requiring only office installations are built with less stringent specifications, optimising resource use and reducing costs.

The level of physical flexibility to adapt to future changes in demand indicates a building's potential for shared use. This flexibility varies significantly among the cases studied. NU, Echo, and Aurora are considered highly flexible due to their standardised specifications, which could easily accommodate changed uses in the future. Conversely, Forum is perceived as less flexible or even rigid, as described by some interviewees. Despite being the oldest building in the case selection, it remains fully utilised and popular among users. Its continued relevance and rigid structure may reflect more on the pace of educational developments than the building's flexibility. O|2, designed specifically as a monofunctional facility, also doesn't easily allow for changes in lab functions. However, interviewees express confidence in its lab facilities' adaptability and generic nature to accommodate future research developments, suggesting a potential for physical flexibility within its specialised design.

8.2.3 Tensions, nuances and solutions

This section summarises three important tensions between public values: resource scarcity versus growing demand, user preferences versus institutional resilience, and external users versus the primary process. It discusses how shared spaces can either resolve existing tensions or create new ones, along with possible nuances or solutions.

Resource scarcity versus growing demands

The financial and physical perspectives often conflict with organisational needs such as growth in students, staff, and real estate, which is resource intensive and costly, while funding per student also declined. Shared spaces could help resolve these tensions by increasing utilisation and potentially reducing the overall footprint. However, this requires an initial investment in flexible and generic facilities accommodating shared use. Only after this investment can the potential to mitigate spatial demand be realised.

While shared spaces can initially ease tensions resulting from organisational growth, they also introduce new ones due to the required investments in shared spaces. These spaces often need a level of standardisation to serve diverse user groups. For example, Aurora shows that designing generic practical classrooms for all programmes demands high standards. These high-end facilities might not be necessary for each study program, leading to potential inefficiencies. A nuanced view is needed when considering this tension:

- Firstly, if the costs per m² increase, but the total required m² decrease significantly due to shared use, the m² x costs / m² decline;
- Second, TCO declines if future educational or research developments can be accommodated without further financial or physical investments;
- Third, the initial investment could be recouped over time if operational costs decline through increased efficiency.

While most cases are too new to make definitive statements about long-term developments, Forum suggest that such benefits are achievable if the building continues to serve the institution and its users.

User preferences versus institutional resilience

The cases also show that the functional perspective often clashes with the other perspectives when introducing shared spaces. A distinction must be made between students or teachers using academic workspaces for educational purposes and by researcher staff. Students generally appreciate the improved quality of shared educational spaces, but tensions arise with the organisational goal of increasing cross-discipline interaction. Despite the intention behind shared spaces to foster interactions across different disciplines, student behaviour shows they often concentrate on their studies and programs. When students seek interaction, they find it more practical to connect with peers from their program, as it simplifies asking questions and receiving help. Consequently, they either seek out study spaces near their program's home base or use digital communication to connect with classmates in a shared space.

When introducing shared work concepts in the academic workspace, more evident tensions seem to arise, as showcased in O|2 and the campus-level analysis. While users recognise the benefits of cross-disciplinary collaboration and the need for greater efficiency, they initially expect a loss of personal space and control over their work environment without receiving equivalent comfort or practicalities. The heart of this conflict stems from differing perspectives on where flexibility should be provided within the organisation. When shared spaces are introduced, the first reaction from many users is to see this as a restriction on their personal space and freedom. This is especially true in research environments where individual researchers or teams may be accustomed to having their dedicated work areas. They might perceive the shared space model as a constraint that limits their ability to control their environment, leading them to overlook the potential benefits.

Conversely, the controllers, engineers, and policymakers view flexibility differently. They advocate for shared spaces as a strategy to increase flexibility at a larger scale, such as across the entire building or campus. Their goal is to optimise resource use and the institution's adaptability, which they see as beneficial for overall operational efficiency and the capability to respond to changing needs.

This difference in perspective between individual users and organisational controllers might look like a fundamental challenge, though this doesn't have to be the case. If shared spaces are introduced without sufficient inclusion and communication with the

users, it can lead to dissatisfaction and resistance. Users may feel that their specific needs and preferences are being overlooked in favour of broader institutional benefits. To bridge this gap, proper guidance and communication are crucial. It is essential to actively involve users in shared spaces' planning and implementation phases. This involves showing them advantages, such as how these new arrangements can preserve their flexibility and increase their comfort rather than diminish it.

External users versus institutional resilience

As highlighted in several case studies, introducing external organisations onto campus, particularly those with non-academic purposes, can create tension. While integrating external entities with academic objectives may cause minimal disruption, the presence of organisations with different core processes can lead to challenges. No external organisations are currently housed in Echo, Aurora, and Forum because the CRE department has chosen to prioritise educational quality and maintain the flexibility of academic spaces. They believe that involving external users, though culturally and societally beneficial, could compromise the quality of education; for example, using lecture halls for non-academic events could disrupt classes the following morning. Conversely, NU houses external organisations with a more culture-oriented focus, leading to several side effects. This arrangement necessitates additional unfavourable financial and physical investments from these perspectives. It also requires more support, increasing operational costs and diverting resources from primary educational activities. This example highlights the tension between openness to external engagement, increasing campus liveliness, and committing to the core academic process.

Conclusion

The cases show how introducing shared spaces in academic settings can resolve and cause tensions. Balancing these perspectives is also complex because of the conflict between short-term costs and potential long-term benefits. The tensions in the case studies necessitate strategic considerations and careful stakeholder management to balance the four perspectives.

(Echo debate hall, van Oosten, n.d.-a)

8.3 Key Lessons learned

To answer how universities are implementing shared spaces in their real estate portfolio and to explain how shared spaces can be aligned with the needs of the university and campus users, it is pertinent to identify the key lessons learned from the case studies for sharing spaces on campus. The key lessons from each case have been combined and summarised in the figure below.

Table IV-30: Key lessons learned from the case studies (Author)

SHARED SPACES ON CAMPUS

Key Lessons Learned

1 Designing for generic use
Shared spaces should be versatile and adaptable to accommodate the diverse needs of various users, now and in the future. Providing a range of facilities at the building level offers users the choice of facilities that suit their preferred activity.

2 'Pooling' functionalities
By identifying non-overlapping schedules and defining generic shared components for all potential users, with special requirements added as needed, it is possible to pool different activities in the same space where different groups can conduct their activities without interfering with one another.

3 Facilitate cross-discipline interaction
Shared spaces can facilitate cross-disciplinary collaboration by bringing together research groups or educational programs. Whether this interaction occurs also depends on an organisational approach that supports such collaborations. Shared spaces are just one of several necessary prerequisites.

4 Continuous Monitoring and Adjustment
It is essential to remain diligence and adjust shared spaces to meet users' needs and prevent old behaviours from resurfacing in the academic workspace.

5 Resource scarcity and sharing culture
A culture of sharing, accompanied by a certain level of resource scarcity, can help maintain the functionality of shared spaces, especially in the academic workspace.

6 Collective Decision-Making and Compromise
Achieving a balance between varying needs requires collective decision-making instead of top-down decision-making. Engaging user groups is crucial to ensure that the solutions adopted are suitable for the majority and not dominated by a vocal minority.

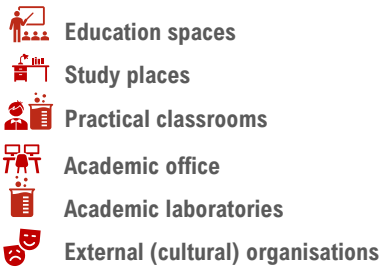
7 Integrated governance model
It is crucial to take an integrated approach that considers all aspects of building use, from student space to pedagogical needs. This requires effective communication and collaboration among various departments, such as real estate, HR, ICT, scheduling, and FM.

8 Resource Efficiency
Pooling resources across different organisations within shared facilities can enhance financial clout and spatial efficiency. Additionally, sharing spaces can lead to a declining demand for space, which has the potential to reduce the total footprint of the organisation.

9 Consider total cost of ownership
To determine the impact of shared spaces TCO should be considered: If the costs per m² increase, but the total required m² decrease due to shared use, total investment declines. Also, TCO declines if future changes can be accommodated without further financial or physical investments.

10 Learning from Experience
Using lessons and applying best practices from past experiences in shared space management can lead to better designs and functionalities in new projects.

Relevance per typology *(Red = extra relevant)*	Inverse effects
	Without versatility and adaptability, shared spaces cannot accommodate various activities and user groups, limiting user satisfaction and utilisation potential.
	When different activities have distinct functions or schedules, sharing spaces becomes more complicated.
	If the organisation doesn't support collaborative activities or interactions, this facilitating purpose of shared spaces becomes obsolete.
	If activity patterns or user groups change, FM should signal this and redistribute resources accordingly; otherwise, the efficiency of shared spaces will decline.
	If group sizes decline, users may become accustomed to abundant space, potentially leading to conflicts when more users are added.
	If some user perspectives are excluded or become too dominant, generic functionality might decline, reducing overall user satisfaction and utilisation potential.
	Without an integrated approach, some functionalities may not be optimal, leading to a decline in user satisfaction.
	If multiple organisations use a facility but only one invests in it, ownership interest might decline. Additionally, financial clout decreases when fewer organisations invest.
	Considering only the building costs per square meter is too shortsighted and may lead to reluctance in investing in shared spaces.
	If past experiences and best practices in shared space management are ignored, new projects may lack efficiency and functionality.



8.4 Patterns and Connections

This final section of the cross-case analysis will describe the observed patterns and connections derived from the case study. This includes insights from the cross-campus analysis (Table IV-27 on page 110), the cross-building analysis (Table IV-29 on page 114), and data from AtlasTI. First, the connection between the various trends that have resulted in shared spaces on campus will be visualised. Then, possible connections between public values will be discussed based on the co-occurrence of these public values.

8.4.1 Identified trends

Table IV-31 shows the co-occurrence of trends across the four perspectives throughout the analysis, indicating co-occurrence when a trend stems from multiple public values. The distribution of co-occurrences is even across the values, except between organisational and financial perspectives. This exception is explained by universities consistently noting the contradiction between increasing student numbers and decreased funding per student. The table primarily illustrates the interconnectedness between trends and public values.

Table IV-31: Co-occurrence trends, derived from the analysis in AtlasTI (Author)

	Financial	Functional	Organisational	Physical
Financial		4	10	4
Functional	4		4	3
Organisational	10	4		4
Physical	4	3	4	

Figure IV-53 maps various trends and factors influencing the need for sharing space on a university campus. Key drivers impacting the demand and supply of shared campus spaces are at the diagram's centre. These key drivers are linked to secondary factors, which represent trends on an institutional level. The lines connecting the boxes show how they contribute to or affect each other. Following these cause-and-effect lines eventually leads to the tertiary factors, which are the societal trends defined in section 8.2.1. For example, internationalisation /globalisation leads to increased (short-term) staff numbers, which, along with growing student numbers, contributes to increased demand for space.

The diagram conveys that the relationships between trends and factors are dynamic and can influence each other in complex ways. This suggests that changes in one area could have ripple effects on others, which helps to understand the complex reasons behind introducing shared spaces on campus. It also highlights that managing shared spaces involves considering these trends and their interconnected pressures, which cannot be isolated. The model illustrates the complex factors influencing the university context and the multi-dimensional impact of societal trends stemming from and affecting multiple public values simultaneously. It also shows the complicated relationship between institutional trends that can influence the demand for and supply of shared space in various ways.

8.4.2 Public values

Table IV-32 displays the occurrence of public values from the four PRE perspectives across each case and the entire analysis. A detailed explanation of the codes used is available in the codebook in Appendix E. The study reveals that most public values were coded in the case of NU, with fewer coded in the Forum and Aurora cases. The public value 'user' was coded most frequently, followed by 'cultural', 'resource efficiency', and 'risks'. The least coded public values are 'image' and 'architectural'. The occurrence of these values may indicate how closely the concept of sharing space on campus is associated with each public value.

Similar to the previous section, Table IV-33 displays the co-occurrence of the public values. A co-occurrence is indicated when a statement relates to multiple public values. The user value shows the highest number of co-occurrences, suggesting a strong influence of the user perspective in managing shared campus spaces, mainly

Table IV-32: Occurrence of public value coded per case and total, derived from analysis in AtlasTI (Author)

	Societal	Cultural	Image	User	Legal	Financial	Risks	Resource efficiency	Environmental	Architectural	**Total**
Echo	2	11	5	39	1	4	21	22	10	7	**122**
O|2	6	21	2	49	0	6	9	36	2	0	**131**
NU	10	28	3	36	5	11	15	33	5	6	**152**
Forum	2	11	1	17	0	1	4	12	2	1	**51**
Aurora	3	6	1	28	0	3	11	13	7	6	**78**
Total	23	77	12	**169**	6	25	60	**116**	26	20	534

Table IV-33: Co-occurrence public values derived from the analysis in Atlas.TI (Author)

	Societal	Cultural	Image	User	Legal	Financial	Risks	Resource efficiency	Environmental	Architectural
Societal		15	11	3	1	4	3	4	0	1
Cultural	15		15	33	1	3	5	10	4	2
Image	11	15		5	0	3	3	1	0	1
User	3	33	5		0	2	12	49	17	15
Legal	1	1	0	0		0	2	0	0	1
Financial	4	3	3	2	0		10	14	1	1
Risks	3	5	3	12	2	10		26	4	4
Resource efficiency	4	10	1	49	0	14	26		5	3
Environmental	0	4	0	17	0	1	4	5		5
Architectural	1	2	1	15	1	1	4	3	5	

related to cultural value and resource efficiency. Another notable co-occurrence is between the physical/resource efficiency and financial/risks perspectives, explained by their shared interest in optimising the use of financial and physical resources through increased space sharing. Overall, the table highlights the interconnectedness of public values in the context of shared spaces, emphasising that these values are often interrelated.

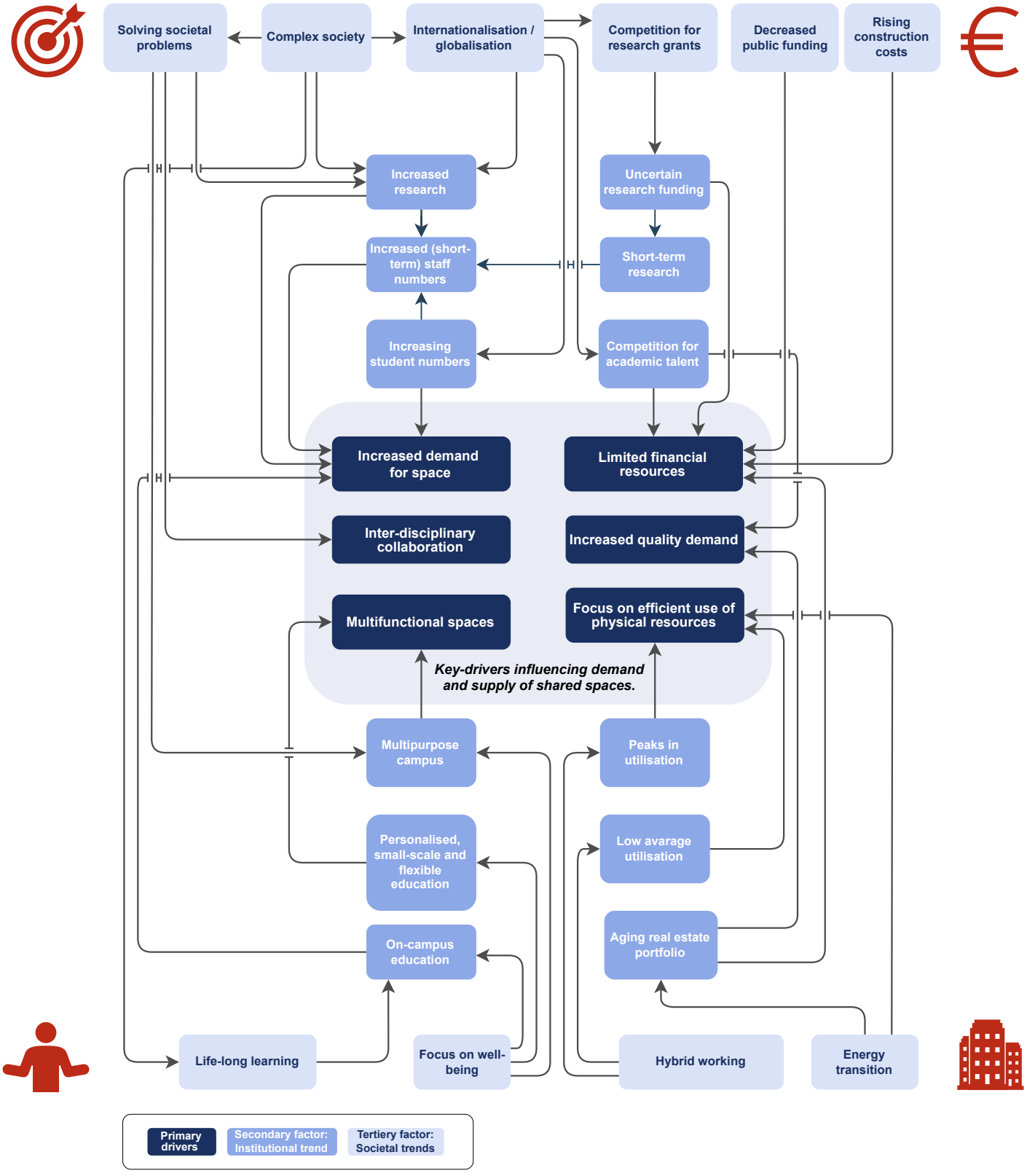


Figure IV-53: System map of trends resulting and affecting shared spaces on campus (Author)

Part V

Conclusion & Discussion

(New University Building VU Amsterdam (interior), CSM Stravitec, n.d.)

1. Conclusion

This master's thesis provides a detailed analysis of the role of shared spaces on university campuses by investigating their alignment with organisational, functional, financial, and physical real estate objectives. This conclusion answers each of the sub-questions and the main research question.

SQ1 What trends can be discerned influencing university real estate objectives, and the demand for and supply of shared spaces on campus?

The study has identified trends affecting university real estate goals in the cross-campus analysis of Table IV-27 on page 110 and in the trends mentioned per case in Table IV-28 on page 111. These trends collectively result in drivers and catalysts influencing demand for and supply of shared spaces on campus, as shown in the system map in Figure IV-53 on page 121. Campus managers have been facing increased financial constraints and pressure for more efficient physical resource management due to underutilisation, sustainability demands and an ageing real estate portfolio. At the same time, there is a growing quantitative demand for space and a qualitative demand for high-quality, flexible spaces that support interdisciplinary collaboration. This has resulted in scarcity. Dealing with this has inevitably lead to increased sharing practices, both as a necessity and an opportunity. This trend started when Dutch universities gained control and ownership of their real estate and is still ongoing.

This shift indicates campus management is transforming from being demand-driven to supply-driven. As shown in Figure V-1, physical and financial scarcity on the supply side can be seen as drivers for implementing shared spaces on campus, and users and organisations must adapt to these changes. Furthermore, specific demands from organisational and functional perspectives also push for more shared spaces on campuses and act as catalysts. These elements collectively shape the demand and supply of shared spaces on campuses.

Figure V-1: Drivers and catalysts influencing university real estate objectives and the demand for and supply of shared spaces on campus.

SQ2 How are universities implementing shared spaces and buildings in their real estate portfolio and what characterises these facilities?

Universities have increasingly incorporated shared spaces into their campuses, including educational areas, offices, and labs. These shared spaces are often introduced when departments relocate to new or renovated buildings. While shared usage in education has been part of campus culture through centralised scheduling for about fifteen years, educational buildings shared across faculties or programs can be relatively new for faculty-oriented universities. Campus spaces are typically shared internally and among groups, but there is a cautious trend towards more intensive use by allowing external users, despite the challenges this may bring. This approach is feasible due to the relatively predictable and standardised nature of academic activities, allowing for effective combination with external schedules and functionality. At the campus level, promoting sharing involves creating generic spaces open to internal and external users. These areas are not tied to specific individuals or groups, which requires them to be flexible and adapt to various users over time. The effectiveness of these shared facilities often depends on their ability to be functionally generic and spatially flexible, catering to a diverse range of groups and activities, as explained in the key lessons learned in Table IV-30 on page 118. The effectiveness of shared concepts hinges on their versatility, but also on the flexibility of the organisation. While an emphasis is often on the functional, financial and physical implementation of shared spaces, promoting shared spaces demands organisational flexibility too; a comprehensive institutional strategy is required.

SQ3 How can shared spaces be aligned with the needs of the university and campus users?

To effectively align shared spaces with the needs of the university and campus users, it is essential to understand the distinct public values of the four perspectives. These have been shown in Figure V-2 and are derived from the cross-building analysis in Table IV-29 on page 114. The physical, organisational and financial interests often lie in optimising resource use and TCO, enhancing cross-disciplinary collaboration, and ensuring institutional resilience. Campus users, on the other hand, seek personal flexibility, comfort, and specific functionalities supporting their tasks and research activities. They often expect the move to shared spaces to reduce personal space and control, focusing mainly on discomfort and practicality issues while overlooking potential benefits or considering a nuanced perspective. This difference in perspective between the institutional perspectives and its users may pose an initial challenge. Still, this change can be managed by actively engaging users in the planning and implementation stages. Effective communication should clarify the necessity and advantages of shared spaces, possibly enhancing user comfort while improving institutional resilience. The research shows users are more likely to accept shared space practices if campus managers can clarify that the alternative is either declined quality or no (new) facilities at all.

A multifaceted approach is essential to meet diverse needs and address the challenges of shared spaces, including differences in work culture, the need for a home base, and a sense of reduced control. Universities want employees to have a home base with a limited degree

Figure V-2: Public values of shared spaces on campus (Author)

of territoriality, not to be fully nomadic; a sense of territory and belonging is needed for both satisfaction and efficiency. Involving stakeholders in planning through participation, collective decision-making, and compromise before moving into shared spaces is a prerequisite to align operational strategies with user preferences. This approach aims to meet the needs of most users and gain their support, although satisfying everyone is often impossible. Continuous monitoring and adjustments are necessary to address changing requirements and user concerns about flexibility and comfort. Promoting a sharing culture, managed by resource scarcity, encourages efficient use and aligns operational efficiency with user behaviour. An integrated governance model is crucial to bridge the gap between operational needs and user preferences. Additionally, organisational initiatives are a prerequisite for promoting a more collaborative environment. Lastly, continuous improvement through learning from experience and applying best practices is vital, as sharing space is inherently a learning process.

RQ: How do shared spaces on the university campus align with organisational, functional, financial and physical real estate objectives?

Shared spaces on university campuses can be aligned with organisational, functional, financial, and physical real estate objectives through a series of strategic implementations and prerequisites of public values, as discussed in the previously answered sub-questions. This study has found a complex interaction between demand-driven trends, supply-driven real estate management, and the institution's and its users' needs.

Organisational Alignment: Universities are shifting towards more flexible and interdisciplinary research and education to meet evolving societal needs. Shared spaces are increasingly integrated into the campus for accommodating more users and a wider range of academic activities, supporting diverse user groups and encouraging cross-disciplinary interaction. This shift can help achieve organisational goals by improving the adaptability and resilience of institutions to changing academic demands and external pressures, provided the organisation also becomes more flexible. It involves more than physical arrangements; it requires a comprehensive institutional strategy.

Functional Alignment: The functional characteristics of shared spaces are tailored to support various activities, to make them adaptable and versatile. These spaces are designed to be sufficiently generic to accommodate multiple uses. This can help aligning with the functional requirements of different user groups. Despite possible resistance in the academic workplace, users can benefit from customising these spaces to fit their specific activities and needs. However, this depends on user behaviour and adaptability. Shared spaces can boost user satisfaction and productivity by offering flexibility, comfort, and quality, provided effective change management is implemented and a sharing culture is maintained during and after the transition to shared facilities. If this transition is not managed effectively, shared spaces can result in user dissatisfaction and resistance.

Financial Alignment: Financial constraints and the need for cost-effectiveness have driven universities to implement shared space strategies; indidivual spaces are in many cases no longer financially feasible. Shared spaces can lower TCO by accommodating more users per square meter which can reduce the need for additional construction, by mitigating the future need for extensive renovations and by lowering operational costs on a campus level. Sharing educational spaces on an institutional level can lead to declined accommodation costs per student and increases flexibility which mitigates risks from fluctuating student numbers or research projects per discipline. Furthermore, in academic offices, shared spaces can partially address low utilisation issues caused by hybrid working, though this hinges on user behaviour. Through effective financial alignment of shared spaces, the cost-effectiveness of the campus increases, and more resources can be allocated to the primary process.

Physical Alignment: Shared spaces contribute to physical and environmental objectives by increasing the potential to use physical resources efficiently. An improvement in occupancy reduces spatial demand, lowering the need for new construction and minimising the university's environmental footprint. Through an effective physical alignment, a growing organisation can thus be accommodated with relatively fewer physical assets if more spaces are shared. This optimised utilisation of univeristy buildings can potentially contribute to the demand-side mitigation of the built environment mentioned in IPCC (2023).

Overall, a strategic and integrated approach to campus management aligns shared spaces with organisational, functional, financial, and physical real estate objectives, and has the potential to mitigate downsides of increased shared space practices. This alignment optimises resource use and enhances university campuses' functionality, flexibility, and sustainability, ultimately supporting the institution's primary academic objective and operational efficacy.

2. Discussion

In the discussion chapter of this thesis, the essential findings and their contributions to understanding the research problem will be discussed. These findings are then interpreted, and their relevance to existing theories and previous studies is discussed. The implications of the results for practitioners and academics are then explored, considering potential applications. The study's limitations are acknowledged to provide context and transparency about the research constraints, including methodological limitations and generalisability issues. Finally, the areas for future research that could yield further insights are addressed.

1.1 Key findings

This thesis explored why Dutch universities are integrating shared spaces into their real estate strategies. It examined the motivations for this trend, analysed the functionality of shared spaces within campuses, and evaluated their effectiveness in achieving university real estate goals. The research also assessed the public value of these spaces by identifying perceived benefits, drawbacks, and challenges from stakeholder perspectives.

In addition to these goals, the study aimed to find a substantiated definition of 'shared spaces on campus'. Based on the results presented in part IV, this thesis has found that on a campus level, this strategy involves creating generic spaces accessible to internal and external users. These non-territorial spaces are not dedicated to specific individuals or groups, allowing adaptability to accommodate various users in the short and long term. Introducing such spaces aims to improve resource efficiency, flexibility, and interdisciplinary collaboration. Although a definition was established, defining whether a space or building is shared can be complex due to varying usage patterns and the multifaceted nature of campuses. This determination is not straightforward but rather a spectrum based on interpretation and scale. For instance, a faculty building space might be shared among various research groups, yet considered a dedicated facility on a campus level. The dynamic nature of academic and administrative needs means spaces initially intended for one purpose may become multifunctional.

When considering the motivations for implementing shared spaces on campus, the results in the system map of Figure IV-53 on page 121 show these are often complex and interwoven, stemming from both societal and institutional trends. Each university studied in this research has intentionally developed a distinct strategy to manage shared space use based on these factors, as shown in the cross-campus analysis (Table IV-27 on page 110). These strategies also reflect the institutional structure, history, existing facilities and vision of education and include most university real estate, ranging from classrooms to lecture halls, offices and laboratories.

Furthermore, the research shows that the identified strategies for sharing spaces on campus impact many public values, often simultaneously highlighting their interconnectedness as shown in the cross-building analysis in Table IV-29 on page 114. Specific interventions in shared spaces must be viewed from multiple perspectives as they can both solve and create tensions among public values. Long-term planning is essential since benefits like reduced operational costs and improved flexibility often appear over time.

When considering environmental sustainability, this research has found shared spaces can contribute by reducing the need for additional construction. By optimising the use of existing buildings, or by optimising the size of new facilities, shared spaces minimise the demand for raw materials and the energy required to build new structures. This reduction not only lowers the carbon footprint associated with construction activities but also conserves natural resources. Additionally, shared spaces often lead to more efficient energy usage, as heating, cooling, and lighting can be centralised and better managed in a single location. In this way, shared spaces can play a significant role in creating a more sustainable campus.

Lastly, the cross-case analysis demonstrates that lessons from past experiences with shared buildings can enhance new facilities as shown in Table IV-30 on page 118. Based on these case studies, this increases the likelihood that shared spaces will contribute to a positive user experience and achieve university real estate goals.

1.2 Interpretations

The research approach states that this thesis is exploratory and aims to examine how shared spaces align with university real estate objectives. It seeks to identify the match and mismatch between the future demand and the current supply of these spaces. This section will interpret the key findings, determine if any patterns or relationships emerged from the data, and discuss their placement within the theoretical context and previous research into sharing spaces.

1.2.1 Patterns and relationships

The first pattern identified from the results supports the initial assumption that there is a structural shift towards shared spaces on campus. The case overview (Table IV-1 on page 58) shows several examples from the past decade of shared buildings in Dutch universities. While there are international examples, the trend has only been confirmed for the Netherlands, which shows a strategic move towards increased shared use in each university examined.

Another expectation was that the size of these shared buildings would be smaller compared to traditional faculty buildings. The case overview and studies (Table IV-29 on page 114) reveal that shared facilities are generally smaller than the average faculty building, as defined by Den Heijer (2011). However, their size can still be substantial, ranging from 2,000 to 42,000 m² GFA. The size of these facilities often correlates with the number of functions they accommodate; facilities with more functions tend to be larger than those dedicated solely to education. This leads to another pattern that can be identified based on the case overview, which shows that shared facilities are often more multifunctional than anticipated. However, the multifunctionality assigned to shared buildings seems to depend on an institution's existing real estate portfolio.

Universities with a strong focus on faculty-specific buildings tend to create monofunctional shared facilities for education. Conversely, universities with less emphasis on faculty-specific buildings are more likely to combine multiple shared facilities in one building.

The cross-campus analysis in Table IV-27 on page 110 reveals that similar trends influence decision-making across the studied universities. This suggests that the contexts in which these universities operate are mainly identical, as they also share a societal context. Variations often arise from specific types of research and education, historical backgrounds, and locations rather than from societal, financial, economic, or regulatory differences.

The cross-building analysis in Table IV-29 on page 114 highlights patterns and gaps in the collected data. Qualitative data at the campus level shows increased student numbers until 2020, after which they stabilised. Financially, there is a general decrease in accommodation costs as a percentage of total expenses and per student since 2011, despite yearly fluctuations. Additionally, data on physical efficiency in Figure IV-45 on page 108 suggests that student growth has outpaced the construction of new facilities, suggesting that the strategy for shared spaces has led to more intensive use of existing physical assets. Lastly, the analysis highlights the interconnectedness of public values and trends.

1.2.2 Theoretical context

The most significant model applied in this research are the four perspectives on the public real estate by Den Heijer (2011). This tool has been instrumental in structuring the various values involved in managing shared spaces, making it highly applicable to this research. In addition to the public values outlined in "Table III-2: Elements of the four-perspective PREM model (Den Heijer, 2021)" on page 39, the values 'legal', 'risks', and 'resource efficiency' were added (Also see "Appendix D - Coding Scheme"). Although these could have been included under the original public values of the model, having specific codes for these values provided a more precise structure for coding. These values apply to shared spaces on campus but are probably less essential for the general model. For example, the value 'legal' was used to identify statements about the agreements with external organisations sharing spaces. The public values of architecture, image and society turned out to be the least mentioned in relation to to shared spaces on campus.

The model has been effective in identifying tensions between public values, which often align with the tensions that campus managers face, as determined by Den Heijer (2021). These tensions include conflicts between the financial and other perspectives concerning the costs of real estate decisions and between the functional and organisational perspectives when the university needs to expand. The findings indicate that campus managers have been using shared spaces to solve these tensions. Sharing spaces allows more users to be accommodated in the same facility, facilitating, for example, organisational growth without substantial additional investments or increasing the physical footprint.

The results also confirm the statement by Den Heijer (2021, p. 103) in *Campus of the Future*, '*it takes a generalist to play the role of the campus manager*'. Understanding and affinity with the four perspectives are crucial for creating adequate shared spaces due to their interconnectedness and the generic nature of these spaces, which are critical to their purpose. Campus managers must identify each activity's standard requirements in such spaces. While users often view their activities as singular, managers must distinguish between what can be generic and what is truly unique. Usually, the uniqueness of space is more about the people using it and the instruments they bring rather than the space's specifications.

The other significant model for this research is the solid-liquid-gas model by Den Heijer (2021), which describes the changing campus. The liquid model is particularly relevant to shared spaces, though results also show an affinity with the gas model. The shift towards shared space mainly marks a transition from solid to liquid, emphasising a dynamic academic community, centralised spaces, and an open academic workplace, all typically liquid. Additionally, shared spaces can shift towards gas when external organisations use these spaces, integrating the city into the campus. Shared spaces are least associated with the solid model, which represents separate facilities per faculty. As detailed by Den Heijer (2011) and presented in Table III-4 on page 40, the associations with the liquid model were confirmed mainly by interviewed stakeholders, though not all were deemed as relevant to the shared spaces in this research context. For instance, the university as a world player, and safety, security, and social control are mentioned less frequently. Positive associations confirmed are the multidisciplinary potential, a flexible workforce, campus and community vibrancy, higher utilisation, higher quality facilities, reduced footprint, adaptability to demand changes, resilience to change, and increased feasibility of the academic business case. Negative associations with shared spaces include decreased faculty identity (if this identity was present, to begin with), reduced privacy, the need to consider other users' demands, increased building costs per square meter, and more intensive use of human, financial, and energy resources to maintain flexibility. Some associations from the original model were contradicted by the results or found less relevant than expected. For example, increased mobility was not mentioned as an issue from a user perspective, and the expectation that shared spaces foster interaction, collaboration, and innovation is contingent on whether the organisation supports these outcomes.

Three strategies from the book *Campus of the Future* reflect the shift towards more shared spaces. The first shift is from a demand-driven to a supply-driven strategy. Previously, user needs dictated the strategy, adjusting the functional, physical, and financial supply accordingly (Den Heijer, 2021). Shared spaces result from this shift, driven mainly by resource efficiency, requiring organisational and user flexibility. While some values, like interdisciplinary collaboration, act as catalysts, accelerating the transition, the primary drivers of this strategy originate from financial and physical perspectives. The second strategy shifts focus from the quantity to the quality of space. The results indicate that heightened quality demands encourage increased sharing because these demands are

often only feasible through savings in other areas, such as reducing the footprint of new construction. Interviewees also confirmed that enhanced spatial quality fosters support for sharing spaces. Furthermore, the book *Campus of the Future* describes a 'bipolar challenge' where functional demands present contrasting needs that are difficult to mix and should be separated in space or time (Den Heijer, 2021). Sharing spaces addresses this challenge by allowing conflicting activities to occur in the same space at different times, provided appropriate facilities are available, as shown in "Figure IV-39: Enabling overlapping use of the same physical spaces by adding up separate timeslots (Author)" on page 92.

1.2.3 Research context

The theoretical framework explores several instances of previous research into shared spaces, both in an educational and broader societal context based on several earlier researches by Beckers et al. (2015), Den Heijer et al. (2016), Rytkönen et al. (2017), Curvelo Magdaniel et al. (2018), Van Sprang et al. (2019) Valks et al. (2021) and Last et al. (2023). Trends influencing the fluctuating quality and quantity of demand and supply for space on campus were identified from previous research and compared with trends found in empirical research. This research categorised these trends into societal and institutional trends to distinguish between primary and secondary influences. The causal relationships between these trends were also mapped, illustrating how they lead to strategies for creating more shared spaces. Trends not explicitly mentioned in previous research but identified in Table IV-28 on page 111 of this research include organisational growth, complex society, competition for academic talent, on-campus education, lifelong development, focus on well-being, rising building costs, and an ageing real estate portfolio. Trends mentioned in previous research that are found to be less prevalent in the results include temporary staff contracts and academic capitalism. The differences between the literature and research findings are likely due to the primary focus of the interviewees. For instance, the interviewees did not cover topics like staff appointments, which are typically related to HR. Similarly, financial issues such as academic capitalism are pretty distinct from the areas of expertise of the real estate employees interviewed.

Shared spaces are also explored in previous research on the sharing economy, reflecting the trend of increased institutional sharing and centralisation of facilities in sectors beyond education. It's insightful to compare whether lessons learned from the case study research in educational settings align with those from other sectors. For instance, lessons derived from a case described by Weatherhead (1997) to avoid providing excessive space were also mentioned by one of the interviewees as a way to maintain a sharing culture. Other strategies used in the private sector, such as extending opening hours, embracing shared desks, centralising facilities to reduce discipline fragmentation, and smoothing out peaks in utilisation, are also applicable to educational institutions. Lessons from previous research in the public sector that can be applied to education include focusing on cost efficiency to garner support for shared academic workspaces, centralising to create a more compact organisation, and adopting new work methods to save space. Although sharing space between different organisations is being considered in several instances, as described in the research by Brinkoe and Nielsen (2017), it remains an exception in education. The main hesitation currently stems from the potential divergence from the primary educational process.

Previous research has explored shared space practices in education, identifying motivations such as risk control, optimising resource use, and adapting to evolving learning methods, all supported by the research findings of this thesis. Additional motivations listed in Table IV-29 on page 114 include accommodating organisational growth within the same real estate portfolio and promoting interdisciplinary interaction. Previously identified space-sharing methods in the *Campus NL 2016* research include centralised scheduling, central libraries, and shared laboratories. The research also highlights that despite a 22% increase in student numbers, the gross campus floor space remained virtually unchanged, underscoring a significant increase in spatial efficiency primarily attributed to the increased number of shared spaces (Den Heijer et al., 2016). This study has explored these trends in Table IV-27 on page 110 on an institutional level, supporting the conclusions quantitatively for the pool of educational spaces and qualitatively by exploring the motivations and mechanisms behind this trend. On an institutional level, analysis of the ratio of seats per student or square meters available per student in academic spaces across the case studies shows a significant decline attributed to rising student numbers. Additionally, the continuous increase in space usage reported by Den Heijer et al. (2016) up to 2020 has flattened, according to findings from this thesis. This change is explained by a stabilisation or slight decline in student numbers and, in some cases, the construction of new shared buildings.

Previous research has also explored methods to facilitate and encourage the use of shared spaces among different user groups within the academic community (Part III, section 4.4). These studies consider obstacles to shared usage, means of facilitating shared usage, and stimulation of shared usage. Den Heijer et al. (2016) notes that differences in work culture, the need for a home base, and some degree of territoriality can hinder increased sharing. This research confirms these challenges, particularly in laboratory-office environments. However, the cases also demonstrate that these obstacles can be overcome by providing sufficiently generic and high-quality spaces and offering guidance to users transitioning to shared workspaces. Continuous supervision has been identified in the key lessons learned in Table IV-30 on page 118 as essential for sustaining a thriving culture of sharing. This also underscores previous research by Søiland and Hansen (2019) which shows the importance of addressing cultural and collaborative dynamics between user groups. Moreover, the results suggest that the need for a home base and territoriality is less of an issue in student and educational environments, where a culture of sharing has, to some

extent, always been a part of how students interact with each other.

Several studies on shared spaces in section 4.4.2 of the literature review emphasise that their success can be facilitated by transparent information on availability and booking systems, reducing auditory distractions, and optimising proximity between different activity zones to cater to diverse needs. While these studies typically focus on the academic workspace, this research aligns with those findings. Interestingly, mentions of real-time utilisation availability systems were primarily in the context of student study places, with no similar references for offices, meeting spaces, or laboratories. This could be due to the predominance of student interviewees, though campus managers also rarely discussed this practicality. Overall, the results underscore that practicalities are essential for successfully implementing shared spaces, ensuring that each type of user can utilise the space or facility effectively and with minimal difficulty. The cases illustrate that success largely depends on identifying the necessary elements for generic spaces to accommodate a wide range of activities and providing a robust support structure for users.

The reviewed studies in section 4.4.3 of the theoretical framework emphasise that merely facilitating shared spaces isn't sufficient; the organisation must play an active role in promoting their use (Den Heijer et al., 2016). The findings of this thesis confirm the importance of actively stimulating shared usage. While the campus manager can provide the infrastructure for shared spaces, it is ultimately up to the organisation to ensure they are utilised effectively. This is illustrated by the observation that students mainly focus on their studies in shared spaces and seek out peers from their program when they need more interaction, despite organisational intentions to foster interdisciplinary engagement. Even though shared spaces are designed to facilitate interaction, this interaction isn't likely to occur unless the organisation actively works to bring different groups together.

1.3 Implications

This thesis provides new insights into the strategic integration of shared spaces in university real estate, offering a nuanced understanding that can help future campus research, planning and management. These theoretical and practical implications will be discussed in the following sections.

1.3.1 Theoretical implications

This thesis contributes to understanding CRE management by focusing on strategically integrating shared spaces within universities. The research supports the theoretical notion of a structural shift towards more shared, non-territorial spaces on campuses in previous campus research by Den Heijer (2011, 2021); Den Heijer et al. (2016). This thesis uses a multi-case study approach to examine this trend on both a campus and building level, offering a different approach to campus research, which usually focuses on a national level or concentrates on single institutions.

The patterns and relationships identified in for example the system map of Figure IV-53 on page 121 or the cross building analysis (Table IV-29 on page 114) of this research can help to structure future campus management research. The study shows complex motivations behind adopting shared spaces, supporting the literature that calls for a view of management that considers all perspectives on campus management in decision-making. The findings indicate that shared spaces stem from a supply-driven real estate approach, marking a shift from demand-driven to supply-driven real estate decisions, which requires users to be more adaptable and flexible.

1.3.2 Practical implications

This thesis highlights practical implications for the profession of campus management. The shift towards more shared spaces has been underway for some time and remains ongoing and relevant. Many Dutch universities have ageing real estate portfolios, indicating that significant redevelopment efforts will continue in the coming years. Given constraints such as limited public funding, the need for environmental sustainability, and institutional growth, a resource-efficient and flexible real estate strategy becomes crucial for feasibility. Despite the rise of hybrid working and learning models, the current preference for on-campus interaction underscores a sustained demand for campus space. Adopting shared spaces is beneficial and necessary for the future viability of university campuses in the Netherlands.

This thesis can guide practitioners in integrating best practices into campus management strategies as shown in the case studies and the key lessons learned of Table IV-30 on page 118. This goes beyond physical redesign to include a cultural shift towards sharing and collaboration, aligned with long-term strategic goals. Successful implementation of shared spaces requires long-term planning and strategic management. This thesis provides campus managers with actionable insights and lessons from various contexts and functionalities by showing how shared spaces meet diverse stakeholder needs and support institutional objectives in several cases.

1.4 Limitations

This section examines the limitations encountered in this thesis, which are essential for interpreting the results and guiding future research. Despite the comprehensive nature of the study, certain constraints related to the scope, methodology, and comparative analysis have impacted the depth and scope of the findings. Recognising these limitations provides clarity and transparency and helps understand the areas where further research may yield additional insights.

1.4.1 Scope

It is essential to recognise the study's boundaries and focus, including the selection of cases and the generalisability of the findings to other contexts or university settings.

The primary focus on three universities in the Netherlands and five buildings was chosen to simplify data collection and ensure a consistent societal context. However, this limits the generalisability

of the results to other countries or different educational institutions within the Netherlands. The international examples found in the case overview weren't explored in depth meaning the scope was limited to the Netherlands. Additionally, for TU Delft, only one building was studied which limited the scope for this campus. These priorities were necessary due to the complex factors that influence campus research, the provision of shared spaces on campus, and the practical constraints of resources and time.

Another limitation is the initial decision to focus the case study research at the building level. While this allowed for a detailed exploration of individual buildings, it initially restricted the extent to which campus-level insights or other significant spaces identified during the research could be included. As a result, a more elaborate section on campus-level strategy was added than planned. This was necessary because it was found that shared spaces are more integrated into the broader campus environment than anticipated, and the qualitative impact of buildings and strategies was often found on a campus level, making it essential to analyse the campus context to fully understand the functioning of these facilities. That is also why the preliminary interviews with campus managers conducted at the beginning of the study eventually played a much more critical role than anticipated.

Focusing on a building level also complicates the analysis because results are in some instances compared to a hypothetical non-shared facility. Since this facility was never built, establishing a definitive baseline is challenging. This hypothetical scenario introduces uncertainty and subjectivity, relying on assumptions and projections. Consequently, any cost-benefit analysis or performance evaluation of the shared facility versus the non-shared alternative must account for this speculation, potentially undermining the findings' robustness and objectivity.

The research relied on an existing database of university buildings to identify shared facilities for study, which limits the scope. The database is not exhaustive, although newer buildings were added to expand the sample size. This likely led to excluding other significant buildings from the case overview in Table IV-1 on page 58, particularly international examples, limiting the validity of conclusions about the trend towards shared spaces on campus and necessitating a degree of generalisation.

The selection of interviewees also restricts the scope of this research. Although approximately four stakeholders were interviewed per case, focusing on similar roles to enhance generalisability, the data predominantly comes from campus managers and students. This may have introduced a selection bias and limited the ability to make statements from other perspectives to the general knowledge of the campus manager. While their perspective is convincing and sufficiently plausible, exploring additional viewpoints from teaching staff, HR employees, schedulers, designers or financial experts could have broadened the scope.

Lastly, the scope of the research was expanded due to the increased complexity of the interrelation between public values and trends affecting shared campus spaces as shown in "Figure IV-53: System map of trends resulting and affecting shared spaces on campus (Author)" on page 121. Consequently, not every educational and research development influencing sharing could be thoroughly studied. For instance, developments due to the COVID-19 pandemic, which significantly altered working and teaching approaches, were not fully explored. While trends from this period were examined and found to affect spatial demand on campus substantially, the primary focus of the research was not on studying these impacts.

The limitations in scope required generalisation to make statements about the trend of shared spaces and the applicability of practical recommendations for campus space sharing. Blaikie and Priest (2019) note that generalisation involves forming judgments based on understanding the traits of a specific case and the group it represents. In this research, generalisation is feasible because the cases are thoroughly understood within their particular campus contexts, which are then contextualised within the broader framework of campus management. This was achieved by selecting diverse cases and universities for study and understanding these case studies in the wider framework of campus management through reflection on existing campus research.

1.4.2 Methodology

To understand the research limitations, this section evaluates the methods employed, discussing potential biases and the limitations inherent in the chosen approaches, including data collection and analysis techniques.

A building-level case study approach was chosen for several reasons. Firstly, case studies are an established method in real estate management research. While campus research typically focuses on the institutional level, focusing on the building level allowed for more targeted insights, increased efficiency of data collection, and concrete lessons learned per case. Despite this, the approach limits generalisability. However, according to Blaikie and Priest (2019), a case study's reliability is more important than its generalisability if detailed descriptions are provided. This allows others to assess if the findings apply to their situations, shifting the burden of proof from the researcher to the user. Additionally, theory was used to make links between case studies, which provides a kind of analytical generalisation according to Yin (2018).

While each case was thoroughly described and analysed, there were setbacks in data collection that affected reliability. Though unavoidable, reliance on campus real estate departments for cooperation posed significant challenges. For example, limited access to data at WUR resulted in less depth in those case studies, as evidenced by the fewer codings in Table IV-33 on page 120. Additionally, the age of the buildings impacted data collection. Due to their recent construction, assessing the long-term effects of buildings like Echo and Aurora was challenging. Conversely, collecting data on an older building like the Forum was difficult because current campus managers were not involved in the original development.

Another methodological limitation arose in collecting

quantitative data, which proved complex for several reasons, especially on a building level. The data was inconsistent for three main reasons. First, the CRE departments sometimes couldn't provide the necessary information, leading to data gaps. Second, the information that was provided often used different metrics or methods. Only one case provided complete data on net functional spaces and useful space per seat, with two others providing partial data. Furthermore, while occupancy rates were occasionally reported, they typically only covered specific areas like offices or were based on occupancy rather than utilisation. Third, although campus-level data can be obtained from annual reports, assessing the impact of this data presents challenges. For instance, accommodation expenses are one indictor that encompass various expenses, such as energy and maintenance costs. Moreover, these figures represent the entire campus, making it difficult to isolate the impact of specific shared space typologies. This also makes comparing the three universities difficult, as no distinction can be made between more expensive typologies such as laboratories to explain the more significant accommodation spending of TU Delft compared to VU. As discussed in section 8.1.3 of the emperical research, these trends should thus be interpreted cautiously, and were therefore always interpreted alongside insights gathered from interviews. Additionally, the building-level KPIs primarily reflected physical space efficiency and provided limited insights into actual usage.

These issues led to most building-level KPIs mentioned in Table II-3 on page 31 being excluded from the final analysis, increased reliance on qualitative data and campus-level KPIs discussed in section 8.1.3 on page 108 to bridge gaps. While campus-level KPIs were sometimes limited, they tended to be more reliable and easier to collect. They often involved publicly accessible information and could include financial and organisational perspectives. However, functional indicators were found to be more qualitative and excluded from the quanitative analysis. Quantitative data at the campus level proved more helpful in analysing the impact of various strategies. In contrast, qualitative data was found to be more insightful at the building level, which also led to the shift in the scope of qualitative data collection to the campus level, as mentioned in the previous section.

The reliability of the qualitative data in this thesis is anticipated to be higher than that of quantitative data, despite Blaikie and Priest (2019) noting that a fundamental limitation of qualitative research is the inevitable influence of the researcher's biases on the process and the outcomes. Additionally, the uniqueness of social situations encountered in this research impedes replication (Blaikie & Priest, 2019). Several strategies were employed to enhance the reliability of the qualitative data. Uniform interview protocols ("Appendix C - Interview Protocol") were used across interviews to maintain structural consistency while allowing room for necessary elaboration or clarification. Analytical consistency was ensured by applying the same method to both interview responses and document analysis, and triangulation across various data sources was implemented to strengthen validity. Furthermore, where feasible, an external perspective was introduced in interviews to verify the trustworthiness of the statements provided by internal interviewees. Lastly, the interviewees were asked to give feedback on the processed content to confirm an accurate processing of their perspectives and prevent bias.

1.4.3 Unanswered problems

With the essential findings and limitations discussed, it is now possible to summarise what questions or problems remain unanswered from these results.

- Firstly, the research does not determine the extent of the trend toward shared spaces internationally or compare trends and impacts in Dutch universities with those in other countries. The international cases in the overview are not explored sufficiently thorough to make credible statements.
- Secondly, the study cannot definitively assess the impacts of the COVID-19 pandemic on shared space practices or predict the specific long-term effects on the design and use of shared spaces.
- Additionally, the research does not address how the varied metrics and methods used by different campus real estate departments can be standardised for more consistent data collection and analysis.
- The results also raise the question how to accurately analyse and compare the performance and benefits of shared facilities versus hypothetical non-shared alternatives. The challenge lies in establishing a definitive baseline for these hypothetical scenarios, as they introduce uncertainty and subjectivity due to reliance on assumptions and projections. This uncertainty highlights the need for methods to reduce speculative elements in such analyses.
- Furthermore, the study does not explore what insights could be gained from including a broader range of stakeholders in the interviews, such as teaching staff, HR employees, and financial experts.
- Lastly, the results do not extensively elaborate on how to resolve the practical challenges of implementing shared spaces through for example change management to ensure user satisfaction and facilitate effective cultural shifts towards sharing.

1.5 Recommendations

This final section of the discussion outlines recommendations derived from the findings of this thesis, aimed at enhancing the integration of shared spaces in university campuses and broadening the existing knowledge in the field of campus management.

1.5.1 Recommendations for further research

As this thesis's generalisability is limited, and a few questions and problems remain unaswered as mentioned above, there is a need for broader research into the trend of shared campus spaces at both institutional and national levels. Expanding the scope of the study would provide a more comprehensive understanding of this phenomenon and its effects across various settings. Exploring how factors outside the educational sector influence shared space strategies is also advisable by extending to other public real estate

sectors. Such an approach would fill a current gap in research and offer a more comprehensive understanding of the role of contextual factors.

Moreover, examining the presence and characteristics of shared spaces across different educational institutions, such as the Dutch mbo and hbo sectors, could yield important insights. Taking this research to an international level could also help understand the motivations and impact on an international scale and identify specific challenges and opportunities in diverse societal contexts.

This study gained significant insights from including the student perspective, which is often excluded in campus real estate studies. To form a holistic picture, it is recommended to consistently involve this viewpoint since students are significant users of campus facilities despite the high turnaround of this group. Additionally, utilising different research methods, including quantitative, could increase the validity of results on student needs and experiences.

1.5.2 Practical recommendations and integrating shared spaces on campus

This thesis on integrating shared spaces into Dutch university real estate strategies offers practical recommendations to improve campus management and planning. These address the trends, benefits, and challenges associated with shared spaces.

Due to the increasing uncertainty campus real estate managers face, alongside the need for resources and cost efficiency, it is advisable to develop a long-term campus strategy that includes shared spaces as a fundamental element. This approach will provide future flexibility and risk mitigation while potentially reducing the use of financial and physical resources, freeing up more resources for education and research. When creating shared spaces, it is recommended to design them as multifunctional and generic to accommodate a variety of users and activities. Increasing utilisation beyond standard academic hours by incorporating a broader range of functions can enhance their value. Additionally, providing different activity zones can cater to diverse user preferences, and renting spaces to external users with different operational times but similar functional needs is recommended to enhance occupancy and campus liveliness. However, developing shared spaces alone is insufficient. Promoting a sharing culture in academic workspaces requires regular assessments of the real estate portfolio to reduce underused spaces and maintain a level of scarcity that supports this culture. Organisational policies should complement these efforts to enhance effectiveness. Therefore, promoting shared spaces demands organisational flexibility too, as this approach involves more than just physical arrangements; it requires a comprehensive institutional strategy.

Lastly, the case studies underscore the importance of campus managers thinking creatively to meet challenges and enhance the university campus through expertise, research, and experimentation.

3. Reflection

This reflection chapter is an integral part of my graduation thesis. It outlines the development and results of my research and design work. It assesses the effectiveness of the methodologies and strategies, explains their rationale, and evaluates their impact.

Context topic

The initial stages of choosing a topic to graduate on proved challenging. While a broader topic of real estate management in the context of an educational campus was selected, the precise focus was initially unclear. Beginning with a broad exploration encompassing flexible space use, the focus transitioned to organisational flexibility before converging on shared spaces in a campus context. This also shows that the topic has been constantly developing and diverging, going from being very broad to more specific. Especially after the P1, the scope became more apparent when considering research methods.

Looking back, some initial topics made it into the final thesis, but others did not. Narrowing the scope was challenging due to uncertainties about data availability, but the support of my graduation company helped to do this. However, this refinement added clarity and purpose. I initially thought the research scope would stay the same after the P2, but this wasn't entirely the case. Combining various factors and using a qualitative research method led to expanding the research from the building to the campus level. This shift also highlighted my initial lack of understanding of the complex factors that govern public real estate management. Moreover, the interviewees' knowledge at the campus level enabled me to adjust the scope to this broader perspective.

My graduation topic finds itself in the area of real estate management, one of the core MBE themes. Within the master track architecture, urbanism and building sciences, this thesis focuses on accomodating the users of the built environment, considering changing goals in society and organisations, sustainability requirements and feasibility with an integrated approach. This thesis is part of the 'user perspectives' graduation lab, which emphasises user experience in real estate management. Participation in this lab shaped my research, prompting me to include students, a group often overlooked in campus research and management. Including student perspectives offered significant insights and contributed to a more comprehensive understanding despite their high turnover. However, this focus on students meant other stakeholders were not as thoroughly considered as I would have liked.

Scientific relevance

This thesis enhances public real estate management by exploring the strategic integration of shared spaces within campus settings. It has a twofold scientific relevance. Firstly, it builds on and extends the theoretical frameworks on non-territorial space management suggested by Den Heijer (2011, 2021); Den Heijer et al. (2016) through a multi-case study approach. This method examines shared spaces across multiple campuses, moving beyond the usual scope of campus research on national trends or a single institution, and therefore provides a different perspective on the shift towards more communal and flexible space usage. Secondly, the study reveals complex motivations for adopting shared spaces, indicating a shift from demand-driven to supply-driven real estate strategies in educational settings. By identifying these patterns and relationships, the thesis contributes to a framework that can guide future research in campus management and ensure that decisions incorporate all stakeholder perspectives.

Methodology and data collection

Overall, the data collected was sufficiently substantive for this research. The methodology did, however, turn out to have its limitations. Before P2, the expectation was that quantitative data could play a significant role. This focus shifted following my graduation company's supervisor's advice, who anticipated challenges in measuring KPIs in such a complex environment. Indeed, after P2, the scope of qualitative data collection is to maintain feasibility. Additionally, it was found that the initial list of KPIs stemmed from a physical perspective, contrary to the integrated approach of this research and necessitating KPIs from other perspectives. It also turned out to be difficult to gather this data from campus managers, and when provided, the scope and measurement criteria often varied significantly between cases. Consequently, the research gradually shifted towards more intensive qualitative data collection, supported by qualitative data on campus instead of on a building level. This approach proved more valuable, offering depth through detailed interviews and a comprehensive explanation of influencing factors by the interviewees. This shift in methodology was a significant learning experience while conducting the research.

Gathering qualitative data was considerably less complicated, mainly due to the connections provided by Aestate and my graduation mentor, both well-established in campus management. This access allowed me to focus more on data collection rather than spending time searching for and contacting potential interviewees. Conducting interviews was a learning experience, and I became more skilled at following up on interviewee statements, which enhanced the quality of later interviews. However, this also highlights a limitation in the early interviews, where my developing skills may have affected data depth. The interviews clearly distinguished between campus managers, who often had intense, informed opinions on shared spaces, and users, particularly students unrelated to the built environment, who required more explanations to understand the topic.

Document collection also went well, though newer cases had more information available than older ones, adding complexity to the research. Despite this, the additional data and verification were valuable in concluding.

Transferability

As demonstrated by ongoing projects like *Campus NL* and various university management publications, campus management frequently evolves through research. In interviews, campus managers show a noticeable enthusiasm for improving and innovating university campuses and sharing insights with partners. Many believe university campuses are crucial in pioneering public real estate management, as universities are natural hubs for innovation. This research primarily explored the innovation of shared spaces on campuses, offering

insights for future shared space concepts. The practical value of this thesis could be significant, provided campus managers are willing to apply these lessons and continue innovating. Additionally, the ongoing *Campus NL* research focuses on transitioning from a solid to a more fluid or gas campus model, likely to include shared space concepts to a certain extent. This suggests that the findings could be widely applicable, and it would be interesting to see if the *Campus NL* project yields similar lessons or conclusions.

Ethical issues and considerations

Few ethical issues arose during this research, as most interviewees were open and cooperative, offering valuable insights into their projects and thought processes. However, campus managers often focused primarily on the positive aspects of the cases. Direct questioning was frequently required to encourage critical thinking and evaluate the negative aspects thoroughly.

All interviewees signed an informed consent form, allowing their information to be used in the research. None of the interviewees expressed any objections to the processing and analysis of the interview data. Some interviewees, however, requested to review the transcript to prevent publishing sensitive information, and these requests were honoured to enhance transparency. Moreover, all campus managers were allowed to review the case chapters featuring their perspectives, ensuring accuracy and transparency.

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5. List of Figures and Tables

Part VI

Appendix

Data Management Plan - A

Graduation Plan - B

Interview Protocol - C

Coding Scheme - D

Informed consent form - E

Appendix A - Data Management Plan

Plan Overview

A Data Management Plan created using DMPonline

Title: Master Thesis

Creator: Maik Kocken

Principal Investigator: Maik Kocken

Data Manager: Maik Kocken

Project Administrator: Maik Kocken

Affiliation: Delft University of Technology

Template: TU Delft Data Management Plan template (2021)

ID: 141069

Last modified: 28-12-2023

Master Thesis

0. Administrative questions

My first and second graduation mentors, Alexandra den Heijer and Michaël Peeters.

2024-01-24

I. Data description and collection or re-use of existing data

Type of data	File format(s)	How will data be collected (for re-used data: source and terms of use)?	Purpose of processing	Storage location	Who will have access to the data
Existing database on university buildings	.csv	Campus of the future FAIR datasets (10.4121/17c8452a-a937-46a5-9693-f8212655779f.v1) (data publicly accessible)	get an overview of the trend and recent examples of inter-faculty education buildings and their basic characteristics	TU Delft Onedrive	Project team
Documentation cases	.pdf	Collection from campus real estate departments and publicly accessible documents on the internet	Gather case-specific data on the campus, related policy and building specifications.	TU Delft Onedrive	Project team
Data reservation systems universities	.csv	Collection from campus real estate departments	Gain a systematic, nuanced understanding of the day-to-day functioning of inter-faculty building utilisation.	TU Delft Onedrive	Project team
Interview data	.txt	Interviews with CRE managers, schedulers and FM staff related to the cases	Gain a deeper understanding of the experiences, perceptions, and attitudes of CRE manager, schedulers and users regarding inter-faculty building use	TU Delft Onedrive	Project team

- < 250 GB

II. Documentation and data quality

- Data will be deposited in a data repository at the end of the project (see section V) and data discoverability and re-usability will be ensured by adhering to the repository’s metadata standards
- README file or other documentation explaining how data is organised
- Methodology of data collection

III. Storage and backup during research process

- OneDrive

IV. Legal and ethical requirements, codes of conduct

- Yes

- No

- No, I will not work with any confidential or classified data/code

The datasets underlying the published papers will be publicly released following the TU Delft Research Data Framework Policy. During the active phase of research, the project leader will oversee the access rights to data (and other outputs), as well as any requests for access from external parties. They will be released publicly no later than at the time of publication of corresponding research papers.

V. Data sharing and long-term preservation

- All data (and code) underlying published articles / reports / theses

- I will upload the data to another data repository (please provide details below)

TU Delft education repository

- < 100 GB

- At the end of the research project

- CC0

VI. Data management responsibilities and resources

- Yes, leading the collaboration - please provide details of the type of collaboration and the involved parties below

The other involved party is the graduation company: Aestate

Graduation mentors

4TU.ResearchData is able to archive 1TB of data per researcher per year free of charge for all TU Delft researchers. We do not expect

to exceed this and therefore there are no additional costs of long term preservation.

Appendix B - Graduation plan

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	**Maik Kocken**
Student number	4782720

Studio		
Name / Theme	User perspective	
Main mentor	Alexandra Den Heijer	Public real estate management
Second mentor	Michaël Peeters	Real estate management
Argumentation of choice of the studio	Opting for the 'User Perspective' graduation lab was driven by the lab's emphasis on understanding how individuals experience and interact with real estate and how real estate can support their activities.	

Graduation project	
Title of the graduation project	Shared Spaces in Campus Real Estate: Enhancing the University Campus through Inter-Faculty Building Utilization
Goal	
Location:	Not applicable
The posed problem,	Dutch universities face challenges aligning their real estate with changing demand, leading to uncertainty. This study investigates the integration of inter-faculty building use into university real estate strategies, aiming to understand its rationale, functional aspects, and impact on achieving goals. The research addresses gaps in the literature, exploring the evolving trend towards 'liquid' campuses and the effectiveness of inter-faculty building utilisation from diverse perspectives.
research questions and	How does inter-faculty building utilisation on the university campus align with and impact organisational, functional, financial and environmental real estate objectives? SQ1: What trends can be discerned influencing university real estate

	objectives, and the demand for and supply of centralised, flexible and multi-purpose spaces on campus? SQ2: How are universities implementing inter-faculty building use in their real estate portfolio and what characterises these facilities? SQ3: How can inter-faculty building use be aligned with the needs of the university and campus users?
design assignment in which these result.	Not applicable

Process

Method description

This study will apply a case study research approach, and is explorative in nature. Mainly qualitative research will be used to find an answer to the research question which is supported by some qualitative data. Desk research will be focussed on exploring the field of inter-faculty building use prior to the empirical research. Then, with desk research as a starting point, case study research will be used to better understand a select number of cases within the field. The case studies aim to get comprehensive insights by analysing documents, interviewee perspectives and KPI's.

Literature and general practical references

To provide the research with a theoretical background, a literature review will be conducted. This review intends to shed light on the topic mentioned above by collecting data through academic research databases, such as Scopus and the TU Delft Library. Important theories include the Design and Accomodation Framework by De Jonge et al. (2009), four perspectives on campus management by Den Heijer (2011), Campus of the Future by Den Heijer (2021), sharing economies and shared spaces on campus.

Reflection

In the initial stages of my graduation process, the trajectory of my research within the broader topic of campus real estate management has been shifting. Beginning with a broad exploration encompassing flexible space use, the focus transitioned to organizational flexibility before ultimately converging on shared spaces in a campus context. This also shows the topic has been in constant development and divergence, going from very broad to more specific. Especially after the P1, when thinking about research methods the scope became a lot clearer.

In retrospect, certain initial topics have found a place in the final research proposal, while others have been left behind. The process of narrowing down the scope presented challenges, particularly in light of uncertainties related to data availability. Nevertheless, narrowing down provided purpose and structural clarity. I anticipate further adjustments and refinement based on empirical observations in the next stages of the graduation process.

Reflecting on the laboratory's structure, I am pleased that I began contemplating a potential topic before the semester started, and that I had already talked to a possible graduation company in advance to give me some more inspiration. Already starting to work at the company before the start of my graduation process also gave

me the opportunity to talk to my supervisor about my company and get a sense of what they could help me with in terms of data gathering, which I believe has been really helpful.
My graduation topic finds itself in the field of real estate management, which is one of the core MBE themes. The graduation lab is called 'user perspective', which is an indication of the focus of real estate management on the user experience when providing real estate. Within the master track architecture, urbanism and building sciences, this thesis focuses on housing the users of the built environment, taking into account changing goals in society and organisations, sustainability requirements and feasibility with an integrated approach. The societal significance of this research lies in its exploration of how inter-faculty building utilization influences the various perspectives of campus real estate management. From an academic standpoint, the thesis contributes by offering insights, accounting for institutional differences, providing clear definitions, and evaluating the implications of inter-faculty building. The journey has been interesting, and I look forward to further exploration in the upcoming phases.

Appendix C - Interview Protocol

Interview Protocol

		Beleidsmedewerker	Asset-manager	Gebruiker	Program manager ext.
Introductie					
	Vanaf dit moment wordt het gesprek opgenomen. Hartelijk welkom, [naam van de deelnemer], en bedankt dat u deel wilt nemen aan dit interview en mijn afstudeeronderzoek. Mijn naam is Maik, en zoals u weet, richt mijn onderzoek zich op de ontwikkeling van gedeelde ruimten en gebouwen binnen universiteitscampussen. In dit onderzoek analyseer ik verschillende case studies, waarbij de project(en) 'naam project(en)' van de 'Universiteit'. *Voordat we aan het interview beginnen, wil ik u nogmaals vragen om toestemming voor het opnemen van dit gesprek en om officieel deel te nemen aan dit interview. De informatie die u verstrekt, zal uitsluitend worden gebruikt voor het onderzoek zoals ik het heb beschreven, met de nadruk op uw ervaringen. stemt u daarmee in?*	x	x	x	x
1	Kunt u uw rol binnen de [onderwijsinstelling] beschrijven?	x	x	x	
2	Kunt u kort wat vertellen over wat deze werkzaamheden inhouden?	x	x		x
3	Kunt u aangeven waarvoor u [GEBOUW] gebruikt en wanneer?			x	
4	Wat maakt volgens u een gebouw geschikt voor gedeeld ruimtegebruik tussen gebruikersgroepen of faculteiten? Wanneer is iets 'gedeeld'? Wat zijn volgens u kritische succesfactoren om dit mogelijk te maken? Wat is het resultaat dat dit in uw ogen oplevert?	x	x	x	x
Campus & trends					
1	Kunt u aangeven welke delen van de campus momenteel geschikt zijn voor gedeeld en non-territoriaal ruimtegebruik tussen verschillende faculteiten, organisaties of gebruikersgroepen, zowel op het niveau van de ruimte als op het niveau van het gebouw?	x			
2	Kunt vertellen welke rol gedeelde gebouwen spelen in de huidige campusstrategie?	x			
3	Welke (toekomstige) trends in de vraag naar ruimte op de campus zullen leiden tot een toenemende of afnemende vraag naar gedeelde gebouwen?	x			
4	Hoe verwacht u dat toekomstige trends in de vraag naar gedeelde ruimte op de campus zich zullen vertalen naar concrete projecten voor de campus? Welke risico's voorziet u?	x			

5	ik zou nog in willen gaan op de waarden die in uw ogen worden gehecht aan gedeelde gebouwen op de campus. Wat zijn de voor- en nadelen voor de universiteit en haar gebruikers bij het gebruik van gedeelde gebouwen? Zitten hier nog spanningen tussen? *-> Hoe beïnvloeden de gedeelde ruimtes samenwerking en synergie tussen verschillende faculteiten, afdelingen en organisaties op de campus? Is hierbij verschil naar ruimtesoort en / of met wie gedeeld moet worden te onderscheiden?* *-> Wat zijn de ervaringen van docenten, studenten en andere gebruikers met betrekking tot de gedeelde ruimtes? Is hierbij verschil naar ruimtesoort en / of met wie gedeeld moet worden te onderscheiden?* *-> Hoe dragen deze gebouwen bij aan duurzaamheid?* *-> Wat zijn de financiële consequenties van dit type ruimte of gebouw?*	x		
6	Zijn er specifieke uitdagingen of successen geweest bij het gebruik van de gedeelde ruimtes / gebouwen? Zo ja, kunt u daar voorbeelden van geven?	x		
7	Zijn er specifieke KPIs die u gebruikt om de prestaties van deze gebouwtypen te meten?	x		

Gebouw				
1	Kunt u de fysieke kenmerken van het gebouw beschrijven? Denk aan ligging, bouwjaar, ruimtesoorten, omvang, functies, etc		x	x
2	Kunt u aangeven wie van dit gebouw gebruikmaken? (Studentengroepen, docenten, personeel, externe partijen).		x	x
3	Van welke ruimtes maakt u zelf gebruik? Wanneer maakt u hier gebruik van?			x

Organisatorisch				
1	Wat waren de belangrijkste doelstellingen van dit gebouw toen het werd ontwikkeld? Hoe verhoud dit zich tot de doelen van de universiteit?	x	x	x
2	Kunt u beschrijven hoe dit gebouw wordt beheerd? Hoe is de organisatie gestructureerd en welke ondersteuning is er beschikbaar voor het beheer ervan, inclusief roostering en toegangscontrole tot de ruimten? *Vervolgvraag: Zijn er recente wijzigingen geweest in het beheer van het gebouw die van invloed zijn op het gebruik en de functionaliteit ervan?*		x	x
3	Zijn er specifieke voorzieningen of faciliteiten binnen het gebouw die zijn ontworpen met het oog op gedeeld gebruik tussen verschillende gebruikersgroepen?		x	x
4	Wat is de invloed van dit gebouw op (bijvoorbeeld) samenwerking tussen gebruikersgroepen of disciplines, flexibiliteit van de organisatie, sociale controle, veiligheid en sociale cohesie binnen de campus? *Vervolgvraag: Zijn er verschillen in de impact van het gebouw op deze aspecten tussen verschillende ruimtesoorten of gebruikersgroepen?*		x	
5	Zijn er uitdagingen of obstakels geweest bij het implementeren of handhaven van gedeeld ruimtegebruik binnen dit gebouw, en zo ja, hoe zijn deze aangepakt?	x	x	x
6	Zijn er beleidsmaatregelen of initiatieven om het gebruik van gedeelde ruimtes binnen dit gebouw te bevorderen of te optimaliseren? Zo ja, kunt u hier meer over vertellen?	x	x	x

Functioneel

0	Verkennende vraag: Wat zijn in uw ogen de positieve en negatieve aspecten van dit gebouw? Hoe verhoud dit zich ten opzichte van andere gebouwen op de campus?		x	x
1	Hoe ervaart u de kwaliteit van de verschillende ruimten in termen van functionaliteit en comfort? Zijn deze geschikt voor verschillende werkvormen zoals geconcentreerd werk, groepswerk, colleges, werkgroepen en onderzoek? Voldoen ze aan uw verwachtingen en behoeften? *Vervolgvraag: Zijn er specifieke aspecten van de ruimten die u als bijzonder positief of negatief ervaart?*		x	x
2	Hoe ervaart u de bezettingsgraad van het gebouw? Merkt u variaties op in bezettingsniveaus tussen verschillende ruimtes of op verschillende momenten van de dag? *Vervolgvraag: Zijn er tijdstippen of dagen waarop de bezettingsgraad significant hoger of lager is en wat denkt u dat hiervan de oorzaak is?*			x
3	Hoe toegankelijk zijn de verschillende werkplekken in het gebouw voor jou? Ervaart u bijvoorbeeld moeilijkheden bij het vinden van een plek of het reserveren van een ruimte? *Vervolgvraag: Zijn er bepaalde voorzieningen of hulpmiddelen die het gebruik van de werkplekken zouden kunnen verbeteren?*			x
4	Voelt u zich thuis in dit gebouw? Ervaart u een gevoel van saamhorigheid en verbondenheid met de omgeving? Hoe verhoudt dit gebouw zich tot andere gebouwen op de campus, bijvoorbeeld uw faculteit? *Vervolgvraag: Zijn er specifieke aspecten van het gebouw of de omgeving die bijdragen aan dit gevoel van saamhorigheid?*			x
5	Is het gemakkelijk om met mensen van andere disciplines samen te werken in dit gebouw? Ervaart u een open en stimulerende sfeer voor samenwerking?			x
6	Hoe heeft het gebruik van dit gebouw uw mobiliteit beïnvloed? Bent u meer of minder tijd aan het reizen tussen verschillende gebouwen op de campus? Hoe ervaart u dit? *Vervolgvraag: Zijn er aspecten van de locatie of de bereikbaarheid van het gebouw die van invloed zijn op uw mobiliteit binnen de campus?*		x	x

Financieel				
1	Maken meerdere organisaties gebruik van dit gebouw?	x	x	x
	a. Zo ja, welke afspraken zijn gemaakt om dit goed te laten verlopen en welke uitdagingen zijn hierin ondervonden?	x	x	x
	i. Hoe zijn de verantwoordelijkheden en kosten verdeeld tussen de verschillende gebruikersorganisaties?	x	x	x
	ii. Zijn er juridische overeenkomsten of contracten opgesteld om de samenwerking en gedeeld gebruik van het gebouw te regelen?	x	x	x
	iii. Zijn er verschillende financieringsmodellen overwogen en zo ja, wat waren de overwegingen daarbij?	x	x	x
	b. Zo nee, zijn er toekomstplannen voor gedeeld gebruik en hoe zouden deze het beste kunnen worden geregeld? Welke juridische of financiële aspecten moeten worden overwogen bij het plannen van toekomstig gedeeld gebruik van het gebouw?	x	x	x
2	Hoe verhouden de huisvestingslasten van dit gebouw zich tot andere gebouwen en de campus als geheel? Zijn er plannen of initiatieven om de efficiëntie van de kostenallocatie te verbeteren?	x	x	x

3	Zijn er specifieke kenmerken van het gebouw die bijdragen aan relatief hogere of lagere kosten?	x	x		x
4	Zijn er faciliteiten binnen dit gebouw die een gedeelde investering tussen meerdere organisaties vereisen? Hoe worden investeringsbeslissingen genomen en op welke manier worden de kosten gedeeld tussen betrokken partijen?	x	x		x
5	Hoe kan binnen dit gebouw worden ingespeeld op een veranderende ruimtevraag? Kunnen ruimtes gemakkelijk worden aangepast naar een ander type ruimtegebruik?	x	x		x

Fysiek					
1	Wat is de invloed van dit gebouw op de totale voetafdruk van de universiteit in m2? Wordt er bijvoorbeeld efficiënt omgegaan met beschikbare ruimte en zijn er maatregelen genomen om verspilling te minimaliseren? *Vervolgvraag: Zijn er plannen of initiatieven om het ruimtegebruik verder te optimaliseren met het oog op duurzaamheid en efficiëntie?*		x		
2	Hoeveel ruimte is er per gebruiker toegewezen in dit gebouw en hoe verhoudt dit zich tot andere gebouwen binnen de organisatie?		x		
3	Zijn er bepaalde tijdstippen of periodes waarin het gebouw intensiever wordt gebruikt door specifieke gebruikersgroepen, en zo ja, wat zijn de redenen hiervoor? Verschilt dit nog per ruimtesoort? *Vervolgvraag: Worden er maatregelen genomen om de piekbelasting te verminderen of te spreiden om efficiënter gebruik van de ruimte te bevorderen?*		x		
4	Hoe is de bezettingsgraad van dit gebouw in vergelijking met andere gebouwen van de universiteit? Worden er maatregelen genomen om de bezettingsgraad te optimaliseren en leegstand te minimaliseren? *Vervolgvraag: Zijn er technologieën of systemen geïmplementeerd om het gebruik van ruimtes te monitoren en te optimaliseren?*		x		
5	Hoe draagt dit gebouw bij aan de duurzaamheidsdoelstellingen van de universiteit, met name op het gebied van energie-neutraliteit en vermindering van de uitstoot?		x		

Afsluiting					
1	Dit waren de inhoudelijke vragen van mijn kant. Is er nog iets wat u wil toevoegen of kwijt wil qua informatie voor dit interview?	x	x	x	x
2	Vragen contactgegevens vervolginterviews / data / documenten m.b.t. gebouwen.	x	x		
	Dit betekent dat we aan het einde van het interview zijn gekomen. Ik wil u hartelijk bedanken voor uw tijd en deelname aan dit onderzoek. Ik zal u de transcriptie van dit interview sturen ter goedkeuring, en aan het einde van mijn onderzoek ontvangt u ook de resultaten. Als u geen verdere vragen heeft, zou ik het interview nu graag willen afsluiten. Mocht u later nog vragen of opmerkingen hebben, aarzel dan niet om contact met mij op te nemen. Nogmaals bedankt voor uw deelname!				

Appendix D - Coding Scheme

Transcript and document analysis

The following tables show which labels or codes are used in AtlasTI when certain characteristics are mentioned in the transcript of the interviews or in the analysed documents. These codes are based on the theories that are discusses in Part III of this thesis. For categorization, the following codes have been applied:

- Stakeholder group: Policy Maker (SH_Policy-Maker), Engineer (SH_Engineer), Users (SH_User), Controllers (SH_Controller), CRE Manager (CRE_Asset-manager, CRE_Policy-empoyee, CRE_Program-manager-internal, CRE-Program-manager-internal).
- Important quotes (!_Quotes) or preliminary conclusions (!_Conclusions).
- Campus : Wageningen University (CP_WUR), Vrije Universiteit Amsterdam (CP_VU), TU Delft (CP_TUD)
- Building: NU (BD_NU), O|2 (BD_O2), Forum (BD_Forum), Aurora (BD_Aurora), Echo (BD_Echo)

Changing campus models

Step	Coded when spoken about…
Solid (CM_Solid)	• Hierarchy • Small academic communities • Territoriality • Separate facilities per faculty • Cellular offices
Liquid (CM_Liquid)	• Horizontal organisation • Dynamic academic community • Shared and centralised facilities • Open office
Gas (CM_Gas)	• Bottom-up organisation • Anywhere-off campus community • Off-campus facilities • Work-from-anywhere

Trends

Perspective	Coded when spoken about trends affecting demand and supply of space on campus, concerning…
Organisational (TR_Organisational)	• Internationalisation • Student numbers • Research • Staff contracts • Interdisciplinary collaboration
Functional (TR_Functional)	• Individual user needs • Learning environment • Demand for space per student or staff member • Working patterns • Use of facilities
Financial (TR_Financial)	• Funding • Academic competition • Academic capitalism • Utilisation rates • Supply of space per student or staff member
Physical	• Environmental restrictions

Transcript and document analysis

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Appendix E - Informed consent form

Geïnformeerde toestemming

Delft, 5 mei 2024

Geachte heer/mevrouw,

De vraag naar onderwijs verandert, en universiteiten moeten hun gebouwvoorraad daarop aanpassen. De uitdaging hierbij ligt in onzekerheid als gevolg van veranderende vraagpatronen en een relatief statische portefeuille. Eén van de geïntroduceerde oplossingen is een strategie die zich beweegt in de richting van een aanpasbare en gecentraliseerde campus met gedeelde ruimtes. Deze verschuiving omvat generieke onderwijsgebouwen, een strategie die het loslaten van territorialiteit en samenwerking tussen diverse groepen gebruikers, zowel intern als extern stimuleert. Dit onderzoek wil de motivaties voor deze keuzes analyseren en de vereisten van belanghebbenden voor effectief gebruik achterhalen.

Daarom hoor ik graag over uw ervaringen met en meningen over met deze typen gebouwen en ruimtes en de rol die ze binnen uw organisatie vervullen. De verschillende ervaringen die in dit onderzoek worden verzameld vormen een overzicht van de verschillende rollen, en de voor-en nadelen hiervan voor gedeeld ruimtegebruik op de universiteitscampus.

De interviews worden uitgevoerd door Maik (M.F.A.) Kocken, als afstudeeronderzoek voor de mastertrack Management in the Built Environment bij de faculteit bouwkunde aan de Technische Universiteit Delft. Prof.dr.ir. A.C. (Alexandra) den Heijer (TU Delft), Dr. Ir. M.U.J. (Michaël) Peeters (TU Delft) en Dr. Ir. Dr. Ir. P. (Pity) Jongens – van der Schaaf (Aestate) begeleiden dit onderzoek.

Het interview wordt afgenomen door Maik Kocken en duurt ongeveer 45 minuten. Om het interview achteraf uit te werken zou ik dit graag op willen nemen (audio). De resultaten van het onderzoek worden gepubliceerd in de openbare TU Delft repository. De audio opname zal na afloop van het onderzoek, of eerder wanneer mogelijk, worden vernietigd en zal geen onderdeel uitmaken van de publicatie.

Vanuit de universiteit is het beleid om nog eens apart te vragen of u mee wilt doen aan het onderzoek en of u het goed vindt om dit interview op te nemen. U bent niet verplicht om mee te doen aan het onderzoek. U kunt altijd uw medewerking aan het onderzoek zonder opgaaf van redenen intrekken en vragen om uw gegevens te vernietigen. U mag ook iedere vraag die wordt gesteld, weigeren te beantwoorden.

Als u meedoet, wil ik u vragen om uw handtekening onderaan deze brief te zetten en een pdf aan mij te retourneren. Ik zet dan ook mijn handtekening, zodat u zeker weet dat er vertrouwelijk wordt omgegaan met uw gegevens en antwoorden. Zoals hierboven vernoemd zal uw naam in het onderzoek worden geanonimiseerd, maar graag vraag ik toestemming om uw functie en organisatie wel te publiceren, zodat het duidelijk is wat de ervaringen van ieder type stakeholder bij het gebouw is. Uw naam en contactgegevens worden meteen na afloop van het interview vernietigd.

Als u vragen heeft over dit onderzoek, kunt u contact opnemen via email (…) of telefoon (…)

Als u mee wilt doen aan dit onderzoek, wilt u dan de bijgaande verklaring invullen en ondertekenen?

Met vriendelijke groet,

Maik Kocken

	Ja	Nee
(1) Ik verklaar dat ik de informatiebrief d.d. 5 mei 2024 heb gelezen of deze brief is aan mij voorgelezen. Ik heb deze informatie begrepen. Daarnaast heb ik de mogelijkheid gekregen om hier vragen over te stellen en deze vragen zijn naar tevredenheid beantwoord.	□	□
(2) Ik verklaar hierbij dat ik vrijwillig meedoe aan dit onderzoek. Ik begrijp dat ik mag weigeren om vragen te beantwoorden en dat ik mijn medewerking aan dit onderzoek op elk moment kan stoppen zonder opgave van reden. Ik begrijp dat het meedoen aan dit onderzoek betekent dat mijn antwoorden worden bewaard.	□	□
(3) Ik begrijp dat de transcriptie van het geluidsmateriaal en de overige verzamelde gegevens uitsluitend voor analyse en wetenschappelijke presentatie en publicaties zal worden gebruikt.	□	□
(4) Ik begrijp dat de opgeslagen gegevens onder een code worden bewaard en anoniem worden verwerkt, en dat deze gegevens na afloop van het onderzoek worden vernietigd.	□	□
(5) ik geef hierbij apart toestemming dat de geanonimiseerde gegevens in de toekomst ook door andere onderzoekers mogen worden gebruikt.	□	□

Graag ontvang ik aan het eind van het onderzoek een korte samenvatting van de resultaten van het onderzoek. Om deze reden verleen ik toestemming om mijn naam en adresgegevens tot het eind van het onderzoek te bewaren (JA / NEE)

Handtekeningen:

Plaats:	Plaats:
Datum:	Datum:
_ _	_ _
(Volledige naam, in blokletters)	(Volledige naam, in blokletters)
_ _	_ _
(Handtekening geïnterviewde)	(Handtekening interviewer)

'Ik heb toelichting gegeven op het onderzoek en waardoor de deelnemer vrijwillig toestemming verleend. Ik verklaar mij bereid nog opkomende vragen over het onderzoek naar vermogen te beantwoorden.'

Shared Spaces in Campus Real Estate

Leveraging shared space strategies to align resource constraints with institutional challenges

Maik Kocken

Campus managers are increasingly required to manage dynamic and uncertain demands for space due to fluctuating student numbers, changing educational models, and interdisciplinary research needs. Traditional campus real estate strategies, often characterised by fixed and dedicated spaces, have become unfeasible. Shared spaces offer a viable solution by creating flexible, multi-purpose environments that diverse internal and external stakeholders can use. This research analyses the motivations driving this integration, establishes a precise understanding of this particular approach to real estate management and identifies essential stakeholder requirements for practical use. The study applies a case-study research approach to better understand a select number of cases within the field. Methods include literature study, interviews, existing data analysis and usage data analysis.

The results show that financial constraints and the need for resource efficiency have forced universities to shift towards shared spaces. This shift is supported by functional and organisational demands, creating generic, versatile spaces that facilitate various activities. The results emphasise the importance of continuous stakeholder engagement and integrated governance in ensuring shared spaces effectively meet university and user needs in a dynamic campus context.

This study expands the theoretical understanding of campus management and offers practical insights for better campus planning, including shared spaces. Further studies examining shared spaces across educational and societal settings are encouraged. For practitioners, the results stress the importance of adopting shared spaces for the future viability of Dutch university campuses, emphasising a shift towards sharing and collaboration. Campus managers are provided with practical insights and best practices from various contexts to support diverse stakeholder needs and institutional objectives.

TU Delft BK Bouwkunde
Department of Management in the Built Environment

aestate /ontrafel experts