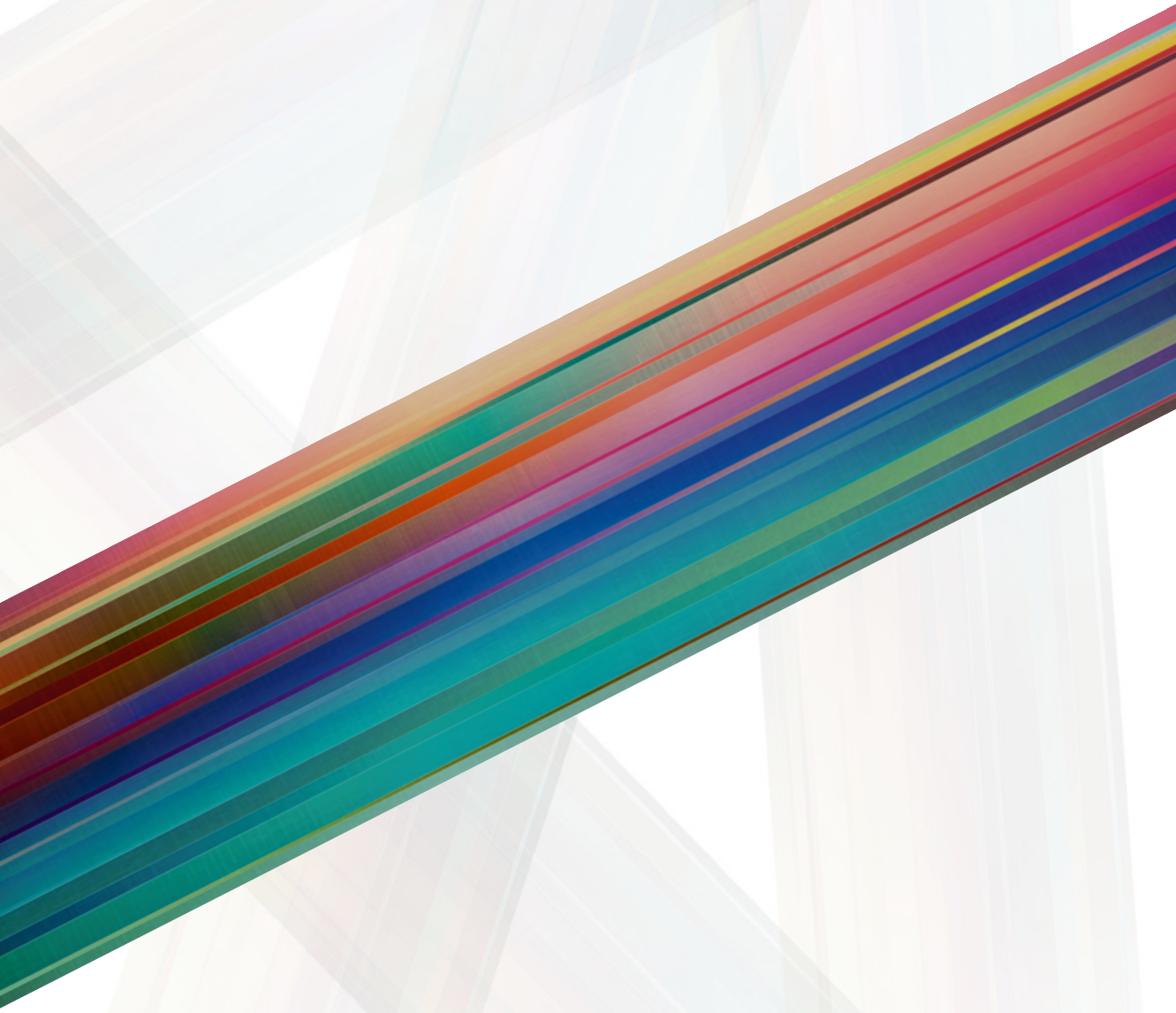

City of the Future Graduation Lab

Experiences in Multidisciplinary Education

Editors
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"Our first, last and constant task is never to allow our fore-having, fore-sight and fore-conception to be presented to us by fancies and popular conceptions, but rather to make the scientific theme secure by working out these fore-structures in terms of the things themselves."

—Martin Heidegger, Being and Time, p. 153

Colophon
City of the Future Graduation Lab: Experiences in Multidisciplinary Education

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City, Future, Multidisciplinary, Multidisciplinarity, Design, Education, Engineering, Graduation Lab, Built Environment, Architecture, Urban Design, Management, Geomatics, Transport, Infrastructure, Logistics, Collaboration

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As part of their graduation projects, some parts of the texts written by the former students can be found in the repository of the TU Delft.

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Mesut Ulkü

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Preface

How to prepare our students for their future work? Where climate change, biodiversity and inclusiveness are key challenges. Where they will be working on complex tasks, such as the need for additional housing, liveable cities and sustainable transport.

These societal challenges call for integrated approaches, where people from different organisations and with different disciplines work together. That means people from different backgrounds, ways of working, and each with their own language. That is both challenging, and inspiring. This requires professionals to bring in their own expertise and interest, have an open attitude and be able to work together. That they look to problems and solutions beyond their usual scope of work. Professionals with T-shape skills: the vertical the depth of their knowledge, which must be kept up to date, the horizontal their ability to collaborate, which is increasingly challenged. The emphases may be different for each of us, on a scale from specialist to generalist, but we all need the skill to work together.

In our education at Delft University of Technology we try to facilitate these two skills, on the one hand by disciplinary courses, on the other hand by a multidisciplinary approach and teamwork. To be honest, our institution is not completely prepared for this second type of 'problem-based' education. And we recognise that we are not the only one. Often our work is driven from silos that do not necessarily strive for integrated approaches, to put it mildly.

In that respect, we are proud of the Cross Domain City of the Future Graduation Lab, where students of different master tracks study together in their own graduation studio. In which they try to really understand current and future problems, oversee them and come up with inspiring, integrated solutions. The approach is multidisciplinary, innovative and can be visionary, as well as down to earth. Important in the studio is the participation with practitioners. What is so nice to see, is that they inspire each other, and not only the students learn, also the practitioners.

What you hold in your hand or see on your screen, is a wonderful browsing book that you can pick up again and again for inspiration and insights. The core of the book are the designs with beautiful graphics, centred around the six themes: natural systems, economy, infrastructure and mobility, society, digitisation, and resources and circularity. When looking at each of the twenty designs, a word from each that caught my eye: combine, collaboration, resilient, interconnection, future scenarios, mixed-use, diversity, integrate, human needs, flexibility, impact, creating, connect, identities, interactive, inclusive, forged into, context, imagining, adaptable. I can also highly recommend the interviews, the introductions to the themes, the essays, and last but not least, the eight bullet points (also on the back). So many insights and perspectives. So much to see, read, think about, and reflect on your own work.

From the TU Delft DIMI (the Delft Deltas, Infrastructures & Mobility Initiative) we are honoured that we were one of the initiators of the design study Stad van de Toekomst/City of the Future, that served as an inspiration of this graduation studio, which we also sponsored. If you, as a student or professional, have become enthusiastic about our multidisciplinary approach, we look forward to getting into contact with you, and seeing how we can work together to make our built environment a pleasant place to live for everyone.

Prof.dr.ir. Marcel Hertogh

Full professor Infrastructure Design and Management, TU Delft
Chairman of TU Delft Deltas, Infrastructures & Mobility Initiative (DIMI)
Full professor Resilience Convergence and Design, Erasmus University

This book presents a reflection of the works of graduates and practitioners within the City of the Future (CotF) Graduation Lab based in the Faculty of Architecture and the Built Environment at TU Delft. The studio has been a pioneer in experimenting with a multidisciplinary approach to education on the built environment. Students from different backgrounds and master degree tracks work on common challenges around the future of the city during their graduation theses, with support from a multidisciplinary range of tutors, experts and practitioners. Drawing upon this experience over the last years, this book reflects on multidisciplinarity in the built environment. How to approach multidisciplinarity in education and practice? What are its core elements, benefits and challenges? By answering those questions, the book aims to inform future students and practitioners in the realm of the built environment and in this way contribute to a humane and sustainable city future.

The debate disciplinarity × multidisciplinarity

A long-standing debate refers to the boundaries between disciplinary and multidisciplinary work.[1] Scientific and practical methods naturally evolved around specific objects, giving rise to disciplines. Each discipline created its own set of methods, concepts and approaches tailor-made to its object of study. Sociology, for instance, deals with the study of society; geography, with the study of space; chemistry, with the study of substances etc. Hobbes, the well-known English philosopher, uses the metaphor of a clock: "As in a watch, or some such small engine, the matter, figure and motion of the wheels cannot well be known unless it is taken apart and viewed in pieces."[2] On the same note, Santos mentions that "knowledge requires analysis and analysis requires division. (...) Thinking totality without division is as if we empty it of movement."[3]

On the other hand, if reality is composed of various objects of study, an understanding of its totality demands multidisciplinarity. This comes from the very nature of knowledge as a never-ending dialectic cycle from general to particular and particular to general. Sartre, in his book *Search of a Method*, mentions that "particular facts do not signify anything; they are neither true nor false so long as they are not related, through the mediation of various partial totalities, to the totalisation in process."[4] Godelier mentions that "every system and every structure must be seen as mixed and contradictory realities of objects and relationships."[5]

Further than a pure discussion on philosophy of science, the debate of disciplinarity vs. multidisciplinarity has conquered its place in daily research, education and practice. In research and development, some scholars defend that innovations are increasingly likely to occur in the interstices of disciplinary knowledge.[6] On the other hand, deep research on a single topic can create breakthroughs with large implications for other disciplines.[7] In educational programs such as design and engineering, the debate is present for instance in the definition of scope, in which multidisciplinary design tasks create better-fitting solutions whereas it also complicates the design process and its learning by students.

What is then the balance between fragmentation and holism, verticality and horizontality, disciplinarity and multidisciplinarity? These questions are addressed throughout the book's contents.

Contents

The book is divided into four chapters. Chapter 1 *Insight on multidisciplinary education* presents the educational framework of the studio, touching on principles, goals and organisation. This part is written by the studio coordinators.

Chapter 2 *Designing the city of the future* presents the outcomes of the first three studio editions (2018 to 2020). Graduation projects are the core of this chapter, presented around six themes: natural systems, economy, infrastructure and mobility, society, digitisation, and resources and circularity. Each theme contains a similar structure—an introduction written by a graduate, graduate projects, interviews with graduates, and an independent essay written by an academic expert on the theme and involved in some way with the studio.

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1. Frodeman, 2017; Doucet & Janssens, 2011
2. Hobbes, 2020 (p. xv)
3. Santos, 2020 (p. 118)
4. Sartre, 1968 (p. 30–31)
5. Godelier, 1966 (p. 254-255)
6. Pinson, 2004
7. See for example the electricity or the computer. These innovations provided techniques of use in every single discipline today.

Chapter 3 *Perspectives* presents positions, opinions and experiences of graduates and practitioners on multidisciplinarity in the built environment. The chapter starts with a graduate essay jointly written by all graduates participating in the book, followed by a series of interviews with six practitioners encompassing professors, architects and university administrators. Interviews are structured with the same overarching questions, making them easily comparable to each other.

The book ends with a conclusion in which all chapters are synthesised into eight points on the future of multidisciplinary education in the built environment.

The network

The main message of the book is that multidisciplinarity is a prerequisite for any effective intervention in the built environment. We thus make the statement of uniting all main concepts presented in the whole book in a network diagram. This network is fully horizontal, without hierarchy or differentiation, and composed of a total of 50 concepts (nodes) and 631 connections (edges). Connections can be direct (thick lines) or indirect (thin lines). The network is used as the backbone of the book, first presented complete in this introduction, then presented in Chapter 2 as opening of each theme with the concepts of this theme highlighted, and, finally, presented after the conclusion.

We sincerely hope you find this research inspiring in your studies, practice or everyday life.

The editors

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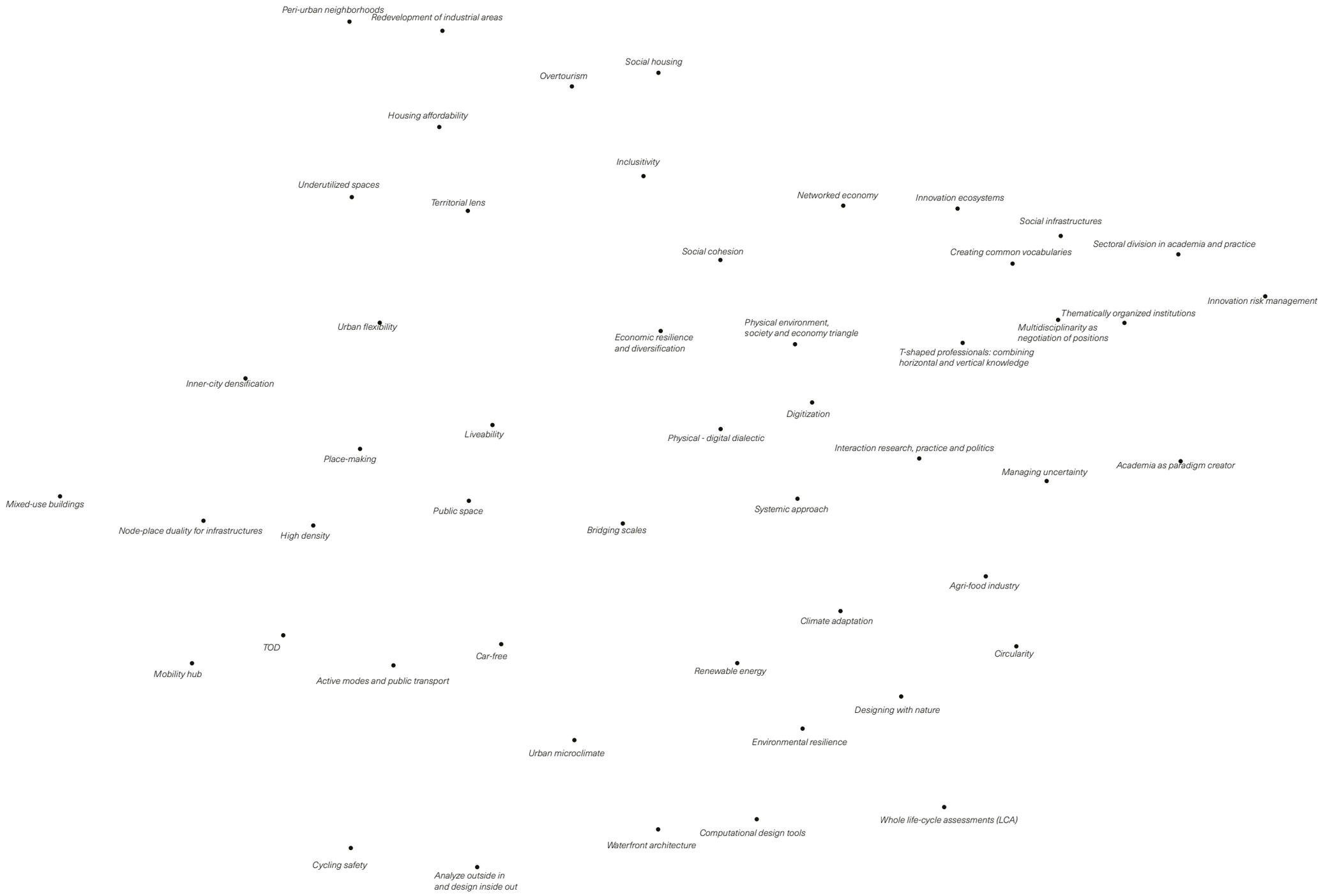

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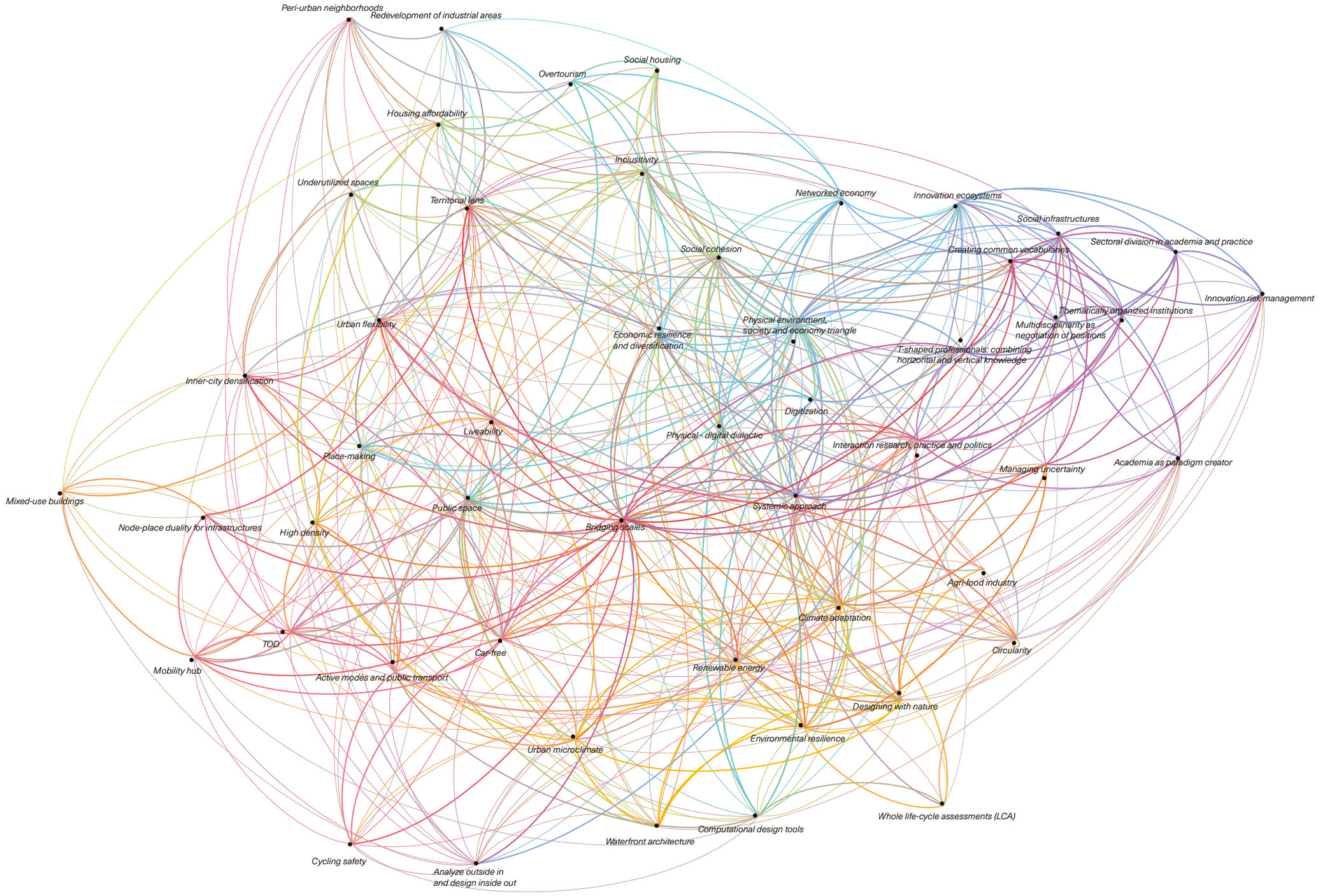

Image by Marcelo Carreiro Matias, Mesut Ulkü and Sonja Drašković

1

Educational framework

The world urbanises. More and more people move to cities and cities grow increasingly. Consequently, global urbanisation is becoming a pressuring issue. This has a direct influence on the functioning of urban systems such as mobility and accessibility, food and waste cycles, energy supplies, infrastructure, as well as well-being, social connections and inclusiveness, and the way people work.

Future cities must cope with several pressing challenges, whereof the first and foremost is the need for space. Where do we build homes and facilities that are needed to house everyone? How do we ensure a good business climate? How do we deal with the displacement of people? And how do we make sure that all these transformation tasks are carried out compactly, preventing undesired effects on existing urban fabrics and landscapes? In addition, we also live in times of major innovations: e.g., in the field of energy, traffic, transport, circularity, automation, and digitisation, where major system changes are coming to the fore. Yet, uncertainties and unpredictable events will more and more raise the degree of difficulty in facing those issues. In other words: what will future cities look like?

The City of the Future Graduation Lab is a multidisciplinary graduation studio focusing on these challenges and other questions related to the transformation of our cities towards attractive and inclusive future urban environments. This studio is a special thesis laboratory for students that would like to develop their own research and design fascinations in a multidisciplinary setting. Students with different backgrounds and from different master degree tracks work on common challenges, while sharing insights, approaches, and methodologies proper of their disciplines.

The Graduation Lab and its position

Within the Faculty of Architecture and the Built Environment, the City of the Future Graduation Lab holds a peculiar place within the two-year master program.

The master curriculum of our faculty offers five tracks: Architecture, Building Technology, Geomatics, Landscape Architecture, Management in the Built Environment, and Urbanism. When starting the first year of one of these domains, students have the freedom to investigate different specialisations and themes—but only within the track of their choice. After that, in the second year, students have to pick, logically, a graduation studio within that same track.

During their master education in Delft, except for a few elective courses, students would only study and learn together with students within the chosen track's discipline. Throughout the curriculum, there are no possibilities to meet and study with students from the other tracks—at most at extracurricular activities.

But working on the built environment in practice, especially when working on the aforementioned City of the Future, reflects a different reality. The current and future transformation of cities and its many challenges in the built environment are not only to be solved by one (spatial design) discipline. Architects need to talk to architectural engineers, and urban designers interact all too often with managers of the built environment. In fact, the professional field of work is already multidisciplinary by nature and if we look into future perspectives on the matter, its multidisciplinary character is only growing and evolving.

The City of the Future Graduation Lab offers students of different master tracks the opportunity to study together in their own graduation studio. And even beyond the faculty, students can be part of this multidisciplinary lab. In the past three editions of the studio, we have had students from Architecture, Urbanism, Management in the Built Environment, Geomatics, but also from Transport, Infrastructure and Logistics—a combined master track of the Faculties of Civil Engineering and Geosciences; Mechanical, Maritime and Materials Engineering; and Technology, Policy and Management—and Construction Management Engineering.

'Multidisciplinarity'

The framework of a collaboration among *disciplinaries* consists of a constellation of different flavours collected under the common denominator multidisciplinarity. Besides the—in our faculty's often interchanged—crossdisciplinary approach, we also consider inter- and transdisciplinary as parts of this family.[1]

This all starts off with intradisciplinary work that occurs within the boundaries of a single discipline. Towards the most complex entity of the disciplinaries the multidisciplinary approach follows, focusing on the juxtaposition of knowledge: students working together, but drawing only from their own disciplinary knowledge. Crossdisciplinary thinking approaches one's discipline through the perspective of someone else's perspective. Interdisciplinary collaboration truly integrates methods and knowledge from other disciplines, working towards an interacting synthesis. And finally, transdisciplinary: merging intellectual frameworks beyond the individual disciplinary perspectives towards one network of interaction between all involved disciplines.[2]

In the discourse of the disciplinaries, the use of mainly crossdisciplinary and interdisciplinary approaches positions the Cross Domain City of the Future Graduation Lab relatively in the middle of this hierarchy. Even though students are willing to collaborate and share their expertise on their discipline as much as possible, they still need to deliver an individual thesis project as part of the final examination. And that project is bound to each master track's individual and intradisciplinary study goals, rules, and regulations. Nevertheless, the collaboration with our colleagues on the other master tracks is outstanding and is of a true interdisciplinary nature.

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1. As a matter of fact, a plethora of disciplinaries come up after searching for cognates of "Disciplinary" within the academic field: Interdisciplinary, Transdisciplinary, Crossdisciplinary, Intradisciplinary, Subdisciplinary, Postdisciplinary, Unidisciplinary, Pluridisciplinary, Extradisciplinary, and Metadisciplinary (Bardecki, "Multi-Disciplinarity"), 2019.
2. Mehta, 2019; Jensenius, 2012.

Educational structure

This interdisciplinary studio setup starts already in the very first weeks of the Graduation Lab. In the first semester, students explore their own fascinations, being responsible for their program and agenda. On top of that, the studio offers a range of lectures, a seminar, and masterclasses. Invited colleagues from within and outside the faculty share their knowledge in the academic field and guest lecturers from practice provide insights into the actual practice of their discipline.

Because mutual criticism and collaboration are central means of interdisciplinary education in this lab, students are expected to be working together as much as possible throughout the graduation year. Therefore, students also organise workshops for each other and invited guests, in which their bundled disciplines are shared with a faculty-wide audience. A student-driven multi-day excursion to a European metropole gives all studio participants, working on their various themes, the opportunity of sharing insights and perspectives on the multifaceted future challenges of cities.

Finally, there is a connection with national and international design studies that brings practice, other institutions, and academia together. The Graduation Lab always participates in such a study, providing the students a unique opportunity to directly connect and collaborate with the professional field.

Not only within the Faculty of Architecture and the Built Environment, but throughout Delft University of Technology, the City of the Future Graduation Lab proves to have a truly unique position. It is a laboratory where students are challenged to think beyond their own discipline, creating an interdisciplinary synergy between different fields of expertise in order to find solutions for the City of the Future.

Interview

Roberto Cavallo
Associate Professor, Chair group Architectural Design Crossovers, and Head of the section Theory, Territories, Transitions, TU Delft

Roberto Cavallo is an Associate Professor at the Department of Architecture where he is currently head of the Section Theory and Territories and chair of the group Architectural Design Crossovers. He has been Director of Education for the Faculty of Architecture and the Built Environment, Delft University of Technology, between 2014–2019. From 1999 onward he has been the main graduation tutor for over 150 students. Registered as a licensed architect, he has also several years of experience in practice.

- ***What was the motivation and idea behind creating a cross-domain studio? What were the initial intentions and expectations you had of the studio?***

The idea of the Graduation Lab started with the participation at the research project *City of the Future*, co-organized by the Delft Deltas, Infrastructure & Mobility Initiative (DIMI). We were invited to bring different perspectives and expertise from all kinds of institutions and practices. The idea was then to create something that would combine practitioners with students, which is still essential in today's studio. A very important motivation for this studio is that students of today and future generations will constantly need to expand their pool of knowledge because in practice they will find themselves going back and forth in studying again and enlarging their knowledge. Therefore, it is beneficial for them to already have an understanding of methodologies and approaches from different disciplines.

- ***Do you recognise visible influence of multidisciplinary work in the outputs of graduation projects?***

I can give an example of collaboration between one architecture and one geomatics student in the first edition of the studio. They worked together in framing their projects, how to use data and how to translate information as input for design. It was very tangible how this enriched their projects.

- ***Have you seen the need for multidisciplinary education in practice?***

Definitely. In Europe, approximately 90% of architects end up working alone or in pairs according to ACE, the Association of Architects of Europe. If you are working in a small firm it is essential to know how to connect to other small firms. What I find interesting is that I see in the City of the Future studio a huge variety of projects and personal signatures, just like in the practice. Even the type of drawing schemes can be completely different per student. That is why it is important to experience this in your studies.

- ***What is your approach or opinion towards multidisciplinarity? How was this integrated in the methodology of the studio?***

A good starting point is to have a multidisciplinary inflow. We introduce this in the studio this with seminars led by a diverse group of professors and colleagues. They contribute with their expertise, their view, their operational modes, their interests and fascinations, and their thoughts on the future. This kaleidoscopic multidisciplinary inflow serves as ground and inspiration for the students. There is no fixed structure for the seminars. Flexibility enables matching the learning environment to the specific group of students in each year. Every group is diferent, since students have their own interests, backgrounds and speeds.

- ***Such multidisciplinary seminars take place in the initial stages of the studio. How do you see it developing towards the end as the students start to focus more on their own thesis?***

We try to encourage and help students to find tutors that match their topic of interest. If we see that there are more students interested in a certain matter presented at the beginning of the semester, we try to bring this back in the following part of the semester. However, there are always limitations because we cannot cover all topics and sometimes the experts do not have time or interest in joining. Also, it depends on the group of students; some groups are a bit more keen to meet, exchange and collaborate than others.

- ***You mention the freedom available to students in deciding their own projects. Why did the studio choose for this instead of a set up where everyone works on the same case, but from the perspective of their own discipline?***

We made a conscious choice for students to have their own topic and location. We find problem-setting important because we are always talking about solutions when many challenges start with framing the problem. And this requires

freedom. On another hand, we do find this type of problem-defined exercises useful in preparing students for their projects, so we try to meet this need in other formats, for instance, workshops and visits like the Venice Biennale.

- ***What were some of the challenges present in cross domain education, and how can we use this to further shape multidisciplinary education?***

The biggest challenge is that our institution is not completely prepared for this type of education, as the university is organized by disciplines. At TU Delft the approach is more traditional, in wich students students can choose courses entailing a certain pool of topics coming from outside, mainly companies. I think we should also give space for students to put forward their own challenges.

One of the conflicts we face today is that our knowledge is getting more and more specific whereas the outside world is asking for people who can jump between disciplines, who are agile to undertake every pathway of knowledge. Fruitful knowledge is located in between disciplines. This requires agility and a spirit of adventure to establish a conversation with one another. Not everybody feels comfortable with that. I think that, in the university of the 21st century, these kinds of uncertainties have to find their place. We cannot keep operating only by means of what we know. We have to jump into the unknown.

Institutional constraints are the largest constraint because we have conflicting schedules across master programs. Also, students from other master tracks are being asked to do compulsory activities from their tracks, which makes it more difficult for them to participate in the studio. But this will get better. TU Delft is harmonizing the schedules of all masters. And within a couple of years, all masters will have a 5th quarter when these experimental Cross Domain projects can more easily occur.

- ***How would you dream the studio to be in 15 years from now?***

I would see myself in each one of your projects at the exact location in real-time! That would be fantastic. Every Friday we could go to a different project location, where we would do visits or perhaps develop challenges together like lowering your carbon footprint. That would be great because then you see the future developing in front of you. Each one of our futures.

- ***How would you see multidisciplinarity education in relation to the design needs of Cities of the Future?***

One essential aspect in the design of the City of the Future is to distinguish between design and solution. There is currently a lot of emphasis on the solution and using design as a step to get to this solution. I think design should have a role much earlier. Design can be used to understand the needs of the people in the Cities of the Future; to set the problem before jumping into a solution.

This step requires setting up education in a slightly different way in order for us to be able to truly engage with external parties. We need to bring the things happening in education and practice closer together. Design is key to this because it establishes a common language, including for non-design fields. In education, for instance, we are slowly starting design-driven PhDs, which use design as a fundamental tool for generating, verifying and questioning in a cyclical way.

2

Designing the City of the Future

What is intriguing in designing the “City of the Future” is that there is no absolute. The *zeitgeist* of each era is constantly evolving with time and the city embeds such ever-changing paradigms in its built form.

This visionary exercise is approached by the CotF studio in a pragmatic manner that acknowledges the complexities of institutional structures of the present and identifies the core challenges they must collectively resolve. In this way, the CotF studio functions as a platform for discourse between visionary perspectives of various expertises, encouraging interaction and co-creation of innovative solutions to the built environment. The interdisciplinary approach of the studio is precious because the scope of each independent research is not limited to its own field, but rather to be found in the intersection of multiple disciplines around a common topic of interest. If we are to imagine the built environment as an organism and each discipline as a tissue (a group of cells that have a similar structure and function), the focus of the studio is on how cells of one tissue can form a symbiotic relationship with cells of another tissue to improve the functioning of the whole organism.

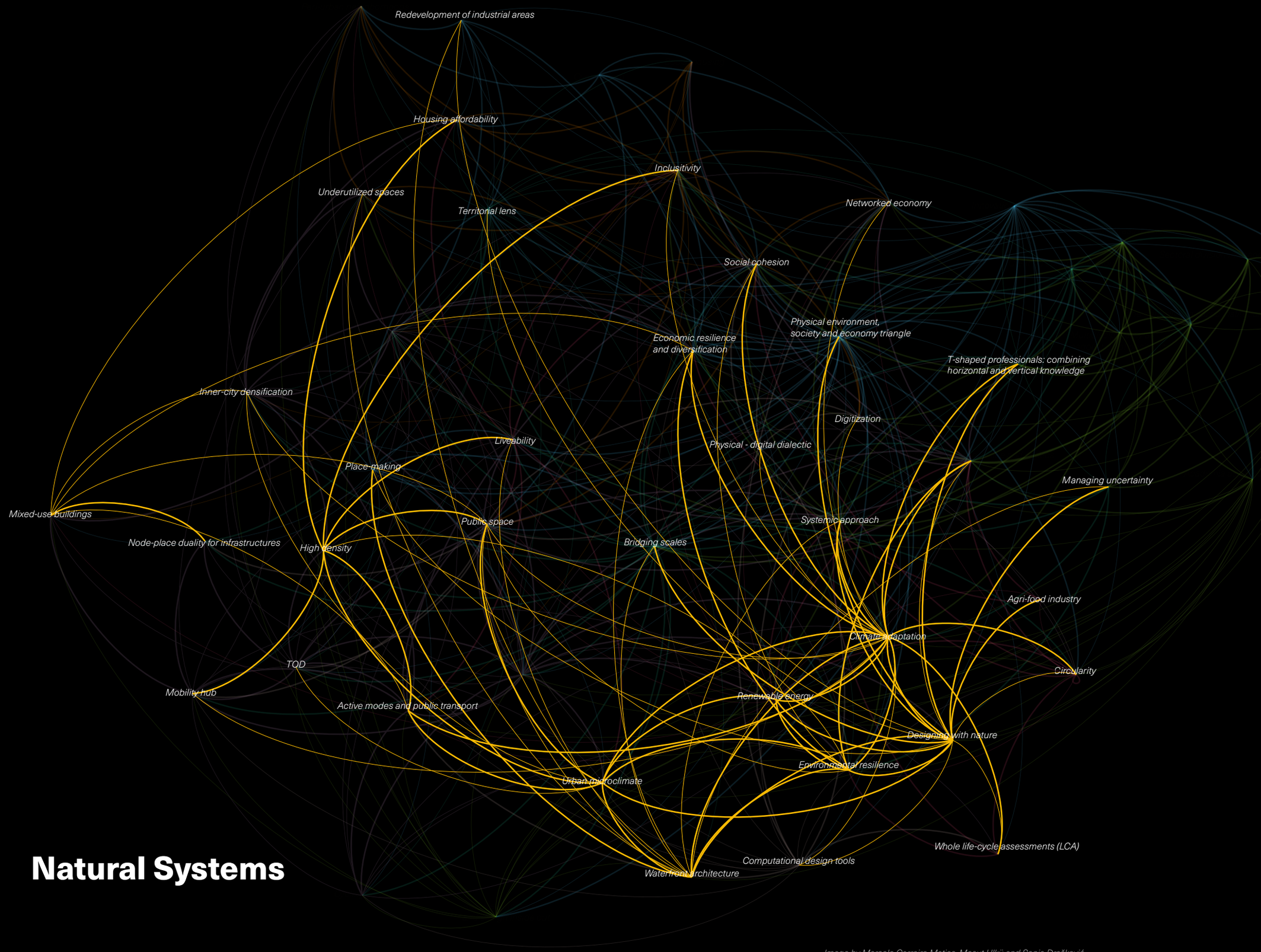
In the following chapter, graduate projects of three studio generations are presented. Through reflecting on the publications of each graduate, we were able to observe six key themes that, from the graduates’ perspective, shape the City of the Future: Natural Systems, Economy, Infrastructure and Mobility, Society, Digitisation, and Resources and Circularity. These themes are in dialogue with each other; one theme can only be fully understood in connection with other themes. Therefore, we invite the reader to focus on the interface between themes. To do so, the reader can make use of the network diagrams presented

in the introduction of each theme, which contain the concepts and connections of this theme highlighted. By comparing these networks, the reader can easily track the relationships among themes.

Since projects are driven by a mix of personal fascinations, collective inspirations and the educational process, this Chapter presents a unique collective point of view of the City of the Future.

In each project, the reader will find that every author adopts different approaches. In doing so, they also draw conclusions for their own practice or discipline. It is important, when going through each project, to critically examine the process that each author undertook to arrive at their conclusion. Every research process has a dose of non-linearity embedded in the research process, in which core assumptions are repeatedly contested with new information and insights. You will find that, at the end of each chapter, there will be questions unanswered or critiques on approaches, methodologies and products.

We invite you as a reader to participate in the discourse; to take and make these ideas your own; and to push forward the agenda of reinventing and reshaping the built environment for a brighter future for all.



Natural Systems

Image by Marcelo Carreiro Matias, Mesut Ulkü and Sonja Drašković

Introduction

Rick Schoonderbeek

The process of urbanisation has long followed an unsustainable path. The current rate of space and resource consumption relies on over-exploitation of vulnerable systems. in cities, there are huge effects on the environment, the living conditions, climate conditions, ecology, etc. In the current time, it is impossible to ignore the impact humans have on the planet.

Natural systems

Cities can be approached as a group of organisms living together in a system[1] composed by ecosystems, ecology and nature.[2] The natural ecosystems within cities manifest many attributes of sustainability and they are readily accessible. However, original natural ecosystems were destroyed many centuries ago. The green elements you can easily see in the city (parks, street trees and gardens) are almost completely artificial. There is little place for anything truly natural.

1. Bradshaw, 2003
2. Austin, 2014

Designing with or against nature?

At the moment, natural systems in the city are approached as a complication, an obstacle to its development instead of an asset or opportunity. For example, architects design with water by separating it from land and treating it as a threat and a resource. In other words, there is a need for adaptation strategies on top of mitigation strategies. These strategies mostly refer to a 'natural' system, where planners and designers need to actively design with the natural environment instead of trying to mitigate the changing environment.

Student projects

Across the City of the Future Graduation Lab, students have shown that there is no single solution to environmental challenges. Thinking strategically, few questions arise in this realm. In which directions are future cities going, which steps should we take towards the goals, and who do we need for that and how can designers create flexibility in their strategies?

The first project, *Hybrid Morphologies* by Sonja Drašković, looks at the relationship between, policy, architecture, infrastructure and landscapes in the context of climate change. The project applies a multidisciplinary approach to designing with nature, in an attempt to change its perception within design practice. The second project, *Climability 2100* by Rick Schoonderbeek, focuses on the climate effects and the influence on liveability towards 2100 with a case study in Milan. The project sees climate as the determining factor for the use of urban outdoor spaces and a core takeaway is that environmental design is not so much about creating more green, but about creating effective green. The third project, *Eco-Inclusive Opportunity* by Thomas Dillon, presents an eco-inclusive design for resilient densification. Through exploratory research targeting the relationship between the socio-economic and the natural, the projects highlights that environmental assets can also contribute for durable liveability.

Hybrid Morphologies

Sonja Drašković

An Interdisciplinary Model for Water-front Architecture—The Case of Zwijndrecht

Hybrid Morphologies investigates the relationship between, policy, architecture, infrastructure and landscapes, in the context of climate change. In the Netherlands, the phenomenon of flooding became a serious issue that policies, water management, and design have to deal with. Architects are designing with water, by separating it from land and treating it as a threat and a resource. The project creates a cross- and interdisciplinary approach to designing with nature, in an attempt to change our perception and relationship to it. The urban matrix proposes a spatial reprogramming of an industrial waterfront area in Zwijndrecht, by integrating landscape, architectural and infrastructural strategies that follow the adaptive cycles of ecology and the water cycles of this area. The design depicts a site of constant change, one that acts as a filter and buffer and transforms itself through fluctuating water levels. And the architecture in its form and program presents itself in a state of constant flux, it caters to the open-ended ecological process of the site, the changing water levels, seasons and programmatic needs.

The location of my project is in the Netherlands where there is a strong focus on climate-proofing and water robustness of delta areas to upkeep the quality of life in long-term planning. However, is this a sustainable way of dealing with water and flooding, or is it perhaps short-term planning?

By looking at the core of the problem we are looking at our relationship with nature. We can begin by questioning our perception of water, nature, natural cycles, and environmental changes, as they are shaped by the way we design. Anuradha Mathur once said that we are the ones responsible for designing our enemy, water.[1] By treating nature as an enemy, threat, and resource we have limited its flow through artificial borders. A river, following its natural Hydrological Cycles, can be perceived as water that flows outside of its parameters (perception from above) or as a rise and fall of water (perception in section) (figure 1).[1] Designers think they design with nature when in reality we treat nature as a threat and our built environment reflects this.

What is the role of architecture, landscape,

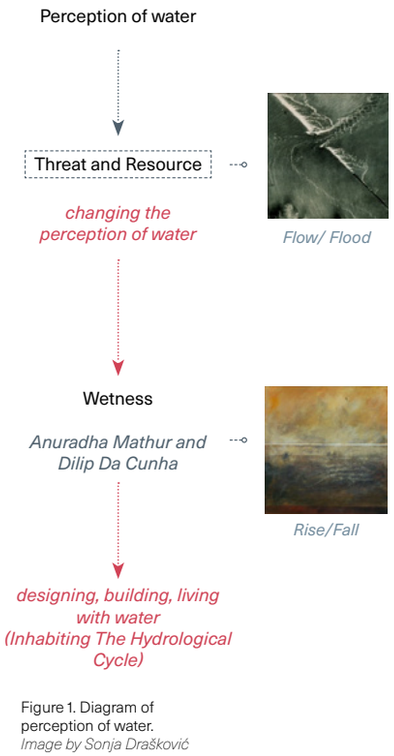


Figure 1. Diagram of perception of water.
Image by Sonja Drašković

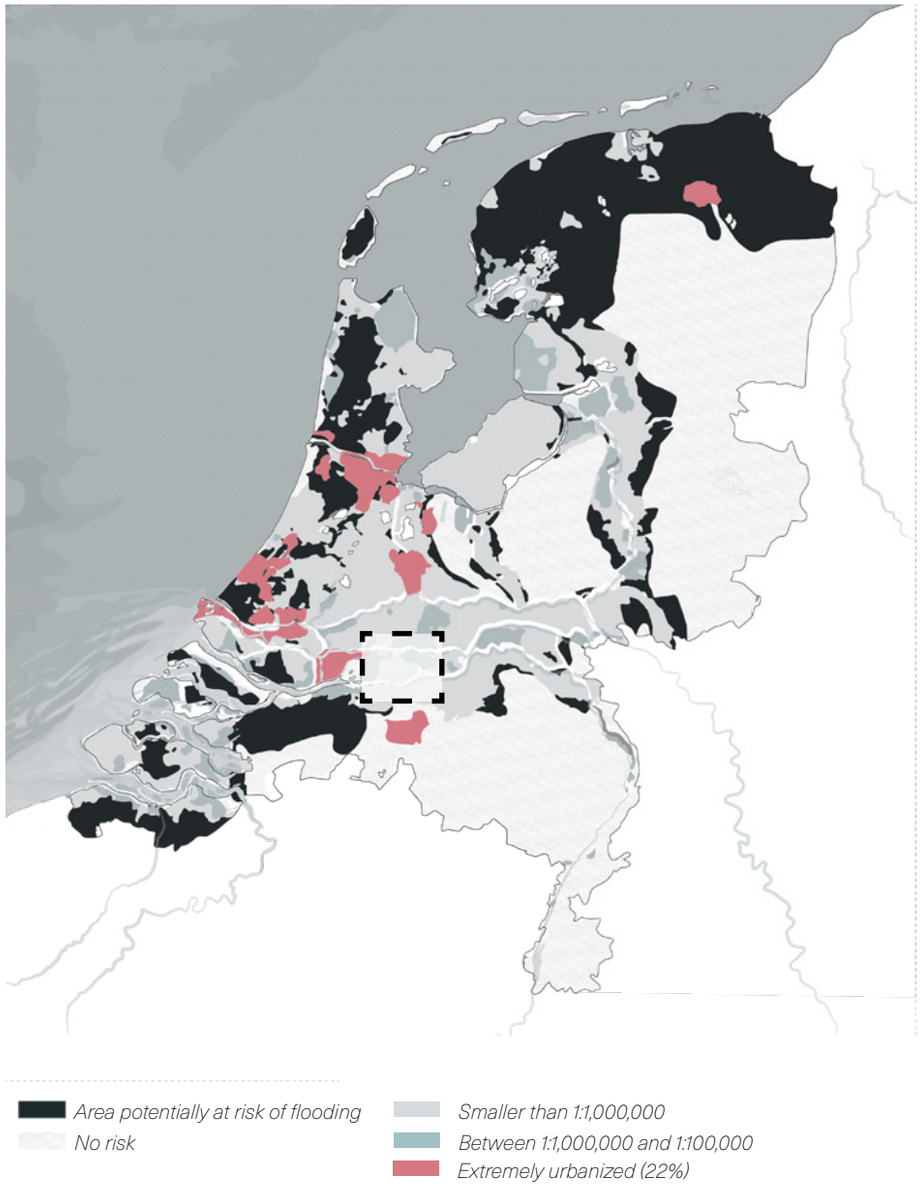


Figure 2. Map of flood protection in 2050 and extremely urbanized areas.
Image by Sonja Drašković

1. World Architecture, 2020

and infrastructure in building sustainable solutions for our cities on water? These different design disciplines are never seen in their singular form. For example, designing dwellings and trains on top of dikes. This is why it is important to acknowledge the hybrid form the built environment creates when coming together. I assume that these disciplines are too busy curating nature in the desire to accommodate human needs, that they forgot about the cultural consequences spatial manifestations will have on people. Spatial elements are physical manifestations of policies and our relationship with nature, they reassure society of their safety and protection against our “enemy”. This has significantly hindered our responsibility for our safety concerning climate change, and we became less aware of actions that we can take. From my research, I focused on identifying the key policies, and water management programs in the Netherlands, in particular the multi-layered safety approach which is applied in the city and island of Dordrecht (figure 2). Dordrecht, London and Hamburg are three cities part of the UFM-project working together to develop a sustainable urban flood management.[2] And Dordrecht is also part of the MARE project, Managing Adaptive Responses to changing flood risk.

Both these programs allowed a new approach to safety that combines, dike reinforcement, vertical evacuation and spatial reorganization. These three principles are reflected in my design as the three key elements. Exploring how these policies apply to the island of Dordrecht and the areas around it, I drew conclusions based on my research and site visits. The out-of-dike areas are considered to be the least safe areas to live and build as they are zoned to be under the four meters Normaal Amsterdams Peil (N.A.P.) safety measure. The areas of investigation and my site were artificially raised above four meters making these areas safe to build on. However due to the existing policies, this information is not taken into consideration and therefore these areas are also considered unsafe, restricting the program to private residences, industries, and sports fields (figure 3).

My research approach was to combine site visits with cartographic research allowing me to identify different policies in a spatial form. For example, during the site visits, I came across many new vertical extensions (staircases) which were added later on to pre-existing buildings. This allowed a vertical escape to the roof in case of a flood. In Dordrecht, this was part of the new policy of vertical evacuation following the data that showed that only 11 % of the population would be

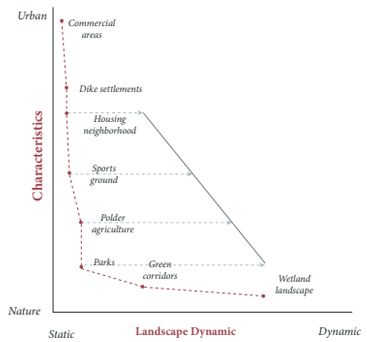


Figure 3. Diagram of landscape-dynamic areas vs. urban characteristic.
Image by Sonja Drašković

2. Kirchengast, 2012

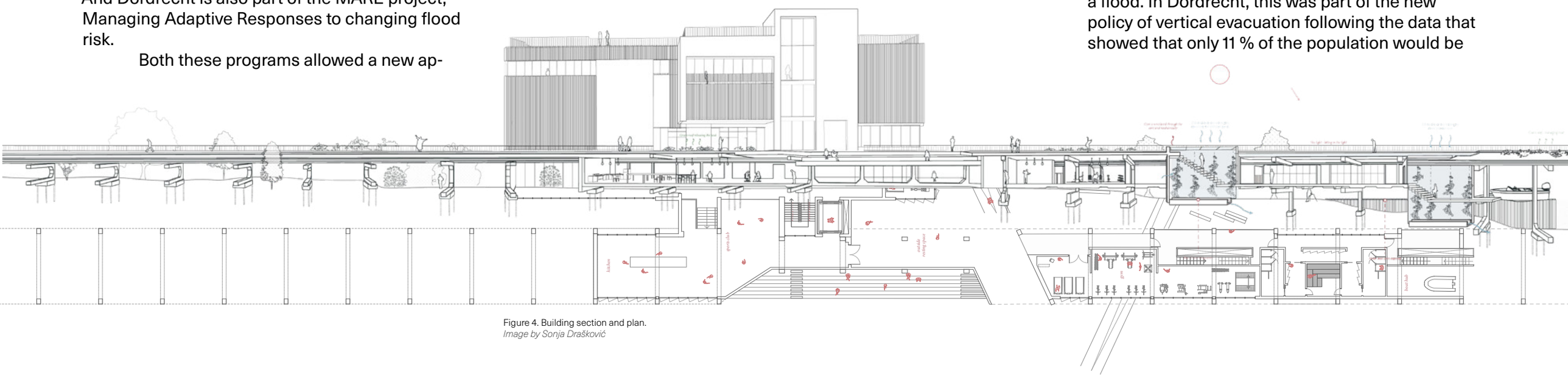


Figure 4. Building section and plan.
Image by Sonja Drašković

able to escape Dordrecht during a flood. After data analysis and cartographic research, I was looking into several areas which have great potential to build and experiment with water management and safety. In my first two site visits to Dordrecht, I conducted several interviews and combined a photographic journal of different areas prone to flooding, depicting their architectural, infrastructural and landscape qualities. The criteria for my site was to choose a site outside of the dike that is considered prone to flooding, and that would also allow me to design a public program. This narrowed my search to an industrial area outside of the dike in Zwijndrecht. Through my research, I was able to determine that the site was elevated as a means to create grounds for different industries. I chose this site as it is a crossroad between an existing sports park (south), shipping industries (north), birdwatching island (east) and residential areas (west), creating a perfect focal point in the site that can bring together different programs and audiences. The site is in the outside dike area in the city of Zwijndrecht and is surrounded by a great portion of blue and green scape.

Site strategy
My ambition for this site was to combine an architectural intervention with a landscape strategy. Given the site's scale and existing landscape, there was a perfect opportunity to apply the knowledge of different landscape strategies. The five main principles are 1. Connectivity, 2. Open Ended Flexibility, 3. Landform as Failsafe + Buffer, 4. Integrating Green, Blue + Gray, 5. Landscapes as a filter. The landscape strategy of the peninsula was to create a dynamic between artificial and natural water bodies. The site is dug to create a rowing track, bioswales for water filtration, a small river which leads the water outside of the rowing club, and a buffer zone where water can overflow. From my research into the ecology and adaptive cycles, I looked at creating a more dynamic fluvial ecosystem which naturally responds to the change in water level. They serve the site by filtrating the greywater from the runoff and the buildings around the site. The filtered water can then be used as 1. Fresh water supply in my building 2. Landscape irrigation 3. Ice skating in winter. This allows me to partially disconnect my building from the critical infrastructure of water, and close the water cycle in my building. The building program itself was a response to the site conditions and existing site opportunities. I wanted to design a public program accessible to all.

Landscape program
Looking at the landscape of the site I saw an opportunity to dig out part of the landscape and create a 1 km long rowing track, which is not appropriate for Olympic training but rather for leisure and recreational practice, symbolically pushing the program for all people. The program also connects rowing and soccer fields with shared sports facilities. Furthermore, the site also provides a beautiful journey through landscapes, the landscape being both productive and natural. I address this through the program of ecology. The ecological research centre provides several laboratories, depositories and working spaces which allow ecologists to explore the sites around them, and use the landscape as a testing ground. The large site left almost untouched is a jungle of curiosity for visitors, creating adventures and exciting visits.

Building program
Combining the programs of sports, and ecology I came up with two building masses (figure 5). These two structures follow different structural and programmatic logics, however, their unity is formed through the concept of the multi-layered safety policy. The design logic was derived from the three elements of safety: dike reinforcement, vertical evacuation and spatial reorganization. The hori-

zontal building (figure 4) becomes an extension of the dike, following the principle of water filtration, connectivity and green, blue and grey integration. The building connects the urban side of Zwijndrecht and the river, creating mobility, spatial program, filtration, recreation, biodiversity, etc. The vertical building symbolically refers to the vertical evacuation policy, where the program changes throughout the different levels demonstrating the relationship between verticality and safety. The program organization was placed from the lowest level being the least safe and the highest being the safest area. The lowest levels of the building are the most regulated and controlled, creating a static organization to it, whereas gradually going up, the spaces become more open and more dynamic in the program, symbolizing greater freedom in movement in safe environments. The counterbalance of my design is the atrium. On the first two floors, the atrium is used to store, exhibit and repair boats. The rowing boats can be delivered from the ground level and lowered down to reach the lowest level of the rowing club. The architectural intent here is to create a vertical stacking of safety, where boats that are suspended are safer than the ones below, in flood scenarios. On the top two floors, the atrium is used to ventilate the auditorium and some working space, serving as a means to bring in light and fresh air.

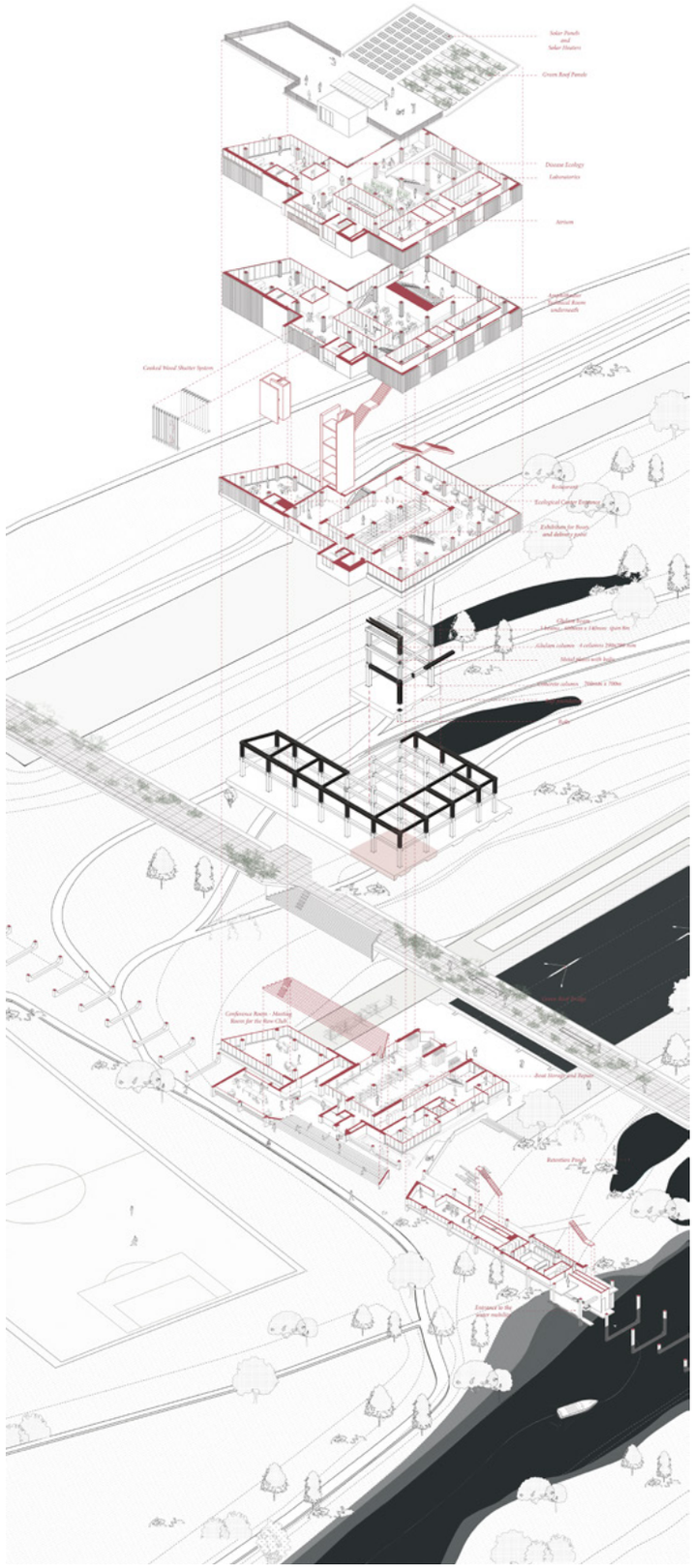


Figure 5. Axonometric of the Hybrid Morphologies.
Image by Sonja Drašković

Climability 2100

Towards a liveable urban microclimate

Nowadays we live in a world together with around 7.3 billion other people and our world is facing many problems. The biggest problem is the growth of the world's population which will increase to 11.2 billion in 2100.[3] With a growing population and the aim to protect rural areas, governments think that the solution is to densify the cities, which is called urbanisation. These trends will have a big impact on future generations and cities will have an important role in future development. "Urbanization can be critical for economic growth, for reduction of poverty, for stabilization of population growth and long-term sustainability."[4] By 2050 68% of the world population will live in cities, while today that amount is 55% of the population.[5] These trends of growth will change the landscape of human settlement, with remarkable implications for the living conditions in cities, and huge effects on the environment and development in different parts around the world.[6]

With a growing population living in cities, the pressure on these cities and their environment will increase. More people in the same city will mean that more people have to share the same amount of space. This will have potential effects on the liveability in the city, like high levels of noise, limited space and the perception of overcrowding.[7] Moreover, more people can increase the effects of climate change, because more people means more activity which leads to more urban heat which increases the climate effects.[8] There is a necessity for adaptation strategies in cities to cope with future weather conditions caused by climate change. Global warming causes changes in climate conditions and this would have a significant effect on the urban microclimate and therefore the liveability.[9]

3. UN, 2019

4. Martine et al., 2008

5. UN, 2018

6. UN, n.d.

7. Kennedy & Buys, 2010

8. Tumini & Rubio-Bellido, 2016

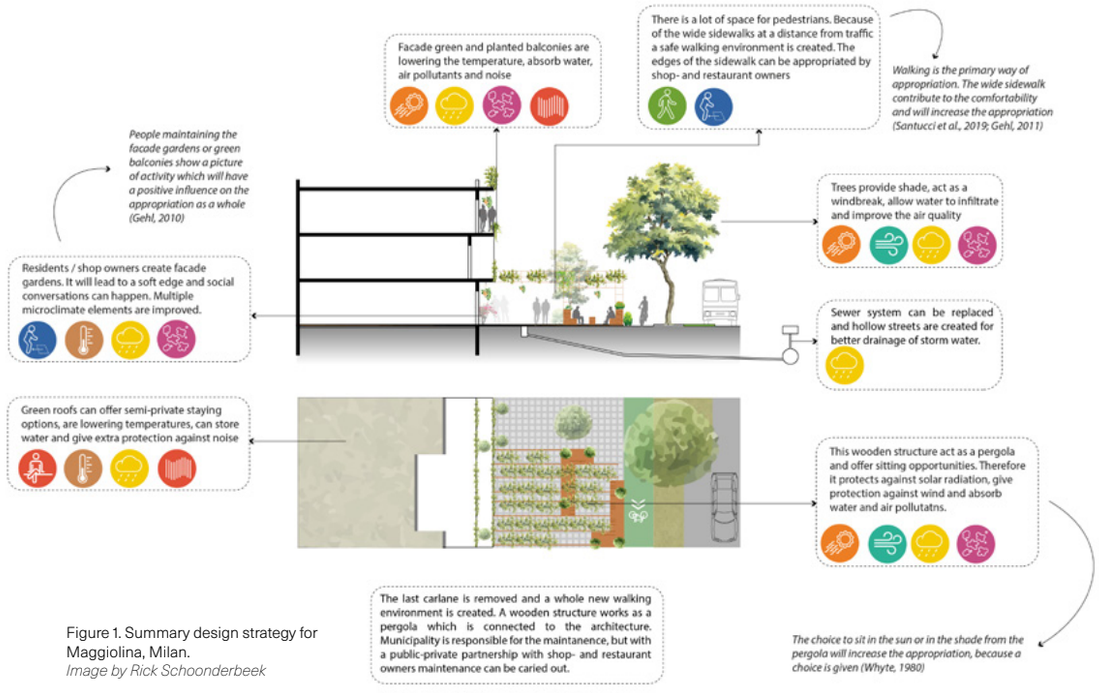


Figure 1. Summary design strategy for Maggiolina, Milan.
Image by Rick Schoonderbeek

However, the positive effects of the natural climate are much of the time ignored in urban development that causes residents to rely on air-conditioning for thermal and acoustic comfort and the low amenity of the urban outdoor space. Liveability is directly related to population growth and has a strong connection related to the effects of climate change. This research project focuses on these climate effects and their influence on live-ability with a case study in Milan. So what happens if we see the future cities as natural systems and designers are going to design strategies regarding these themes?

First of all, for the research, a literature study provided the required knowledge about the topics of urban design, urban microclimate and (temporary) appropriation. At the same time, the topics of urban microclimate and (temporary) appropriation are researched in a case study where problems and opportunities are spatially identified.

This is important for urban designers because social- and environmental problems can be solved by spatial interventions. Not only Milan will be researched as a case study, but also other projects will be researched. These will be projects that have the same issues or provide solutions regarding urban microclimate and appropriation. With the knowledge of other projects interventions for these projects can be created and the aim is to prevent the same problems as in other projects.

For the research project, the following problem is stated: Climate is the main factor that determines the use of urban outdoor spaces. The (temporary) appropriation of — and the climate conditions in — urban outdoor spaces are decreasing because of the changing climate. If urban designers are not taking measures towards 2100 to stimulate the appropriation of urban outdoor spaces and to improve the urban microclimate quality of life will decrease more.

So, first of all, there is a trend of a growing population and urbanisation in the world that will not stop in the upcoming decades and which is happening in Milan (Italy) as well. This urbanisation has some challenges for sustainable development in the future. From all these challenges this project focuses on two main effects of this urbanisation: climate change and liveability. These topics will be researched in the context of urban outdoor spaces in Milan towards 2100. There can be seen that the quality of life is decreasing because of a change in the climate conditions and negative trends for the appropriation of urban outdoor space. There is a risk for cities that life on the streets will disappear because of changing climate conditions and the deterioration of urban outdoor spaces for people. While thermal comfort in indoor environments can be very well designed this is more difficult for the outdoor environment. When the outdoor conditions are poor people will look for pleasant indoor conditions. The urban microclimate is fundamental in giving quality to urban life. To enhance the quality of life in the future urban designers can play an important role in the (temporary) appropriation of urban outdoor spaces by looking into the urban microclimate. There is lacking knowledge among urban designers about designing the urban microclimate. To bring in the perspective of the people urban microclimate is combined with (temporary) appropriation where the behaviour of people and use of spaces is considered. Talking about climate change often the big picture is taken into mind, however, the small-scale climate is the one people perceive. The relationship between urban design and architecture can show how designers and developers could collaborate to create sustainable city development.

Figure 2. Future impression of Maggiolina, Italy.
Image by Rick Schoonderbeek

From the guidelines from the literature, a designtoolkit is made where interventions are shown and assessed on the different categories for appropriation and urban microclimate. The interventions can happen at different scale levels, from district level to materialization. Most important is to show the interventions that combine the positive effects of appropriation and urban microclimate and to show the relations at different scale levels. Moreover, it is clear that buildings, and therefore architecture, play an important role in designing a better urban microclimate and stimulating the appropriation of urban outdoor spaces. That's why this City of the Future lab makes the perfect fit; it shows the relations between urban design and architecture and the ways how they can make each other stronger. Each intervention in the toolkit is assessed on the different elements of appropriation and urban microclimate to give an idea of what the effects of the intervention would be. In short, there are given some examples of how the intervention could have a positive or negative effect.

We would like to answer the main research question of "how can urban design improve the (temporary) appropriation and the urban microclimate in urban outdoor spaces to contribute to a sustainable Milan towards 2100? There is no one answer to this question, where sustainable development can be achieved in many different ways. However, to answer this question in the context of this research project different topics were researched where urban design guidelines were made from. These guidelines are spatially translated into a toolkit that shows interventions which improve both appropriation and urban microclimate and which is called "climability solutions for urban design". These solutions are applied to three projects in Milan to show how the transition to sustainable development is made.

9. Lara-Hernandez & Melis, 2018

10. Gehl, 2011

11. Whyte, 1980

Literature shows that temporary appropriation of urban outdoor spaces contributes to the social sustainability of places and therefore, urban designers should create conditions to stimulate this appropriation[9]. This can be achieved by looking into three different categories of appropriation: walkability, places for staying and soft edges of urban outdoor spaces. For the walkability of an area, the most important aspect is to create space for pedestrians.[10] Pedestrians should have a higher priority in urban planning. Urban designers can create pleasant conditions for pedestrians by designing wide sidewalks and safe crossings, interesting pedestrian routes and avoiding obstacles like height differences or elements on pedestrian routes.[4] Pleasant walkability will contribute to the quality of spaces and in that way to the appropriation of urban outdoor spaces. To stimulate the appropriation in terms of staying, urban designers should create well-protected places to stay. Moreover, urban designers should create a wide variety of opportunities for sitting and this means a combination of primary seating, like benches, and secondary seating, like stairways or ledges.[11] A good design of the edges of urban outdoor spaces stimulates the appropriation of those spaces. (Semi)private options, like balconies or front gardens, create an opportunity for interaction in the street and therefore contribute to the social sustainability of urban outdoor spaces.[4,6] Regarding edges, the relation with the architecture is very important because a connection between inside and outside improves the activity level. The most important conclusion regarding appropriation in the context of social sustainability is that designers should integrate choice in their design of urban outdoor spaces. People like to have many options that suit their preferences. Urban designers can provide these choices by analyzing urban outdoor spaces to see what is needed and by critically planning sitting options, options to cross the street and prioritizing the pedestrians in the urban outdoor

spaces. When people feel comfortable in the space they will appropriate it, and for a longer period, which in turn will stimulate others to appropriate the space and so on. In this way, the activities support the social life and social sustainability of the urban environment.

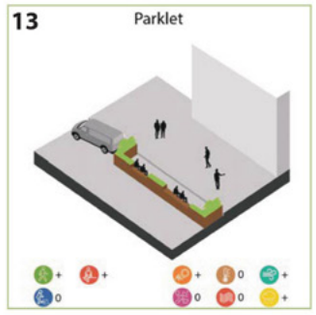
Literature shows that the design of the urban environment highly influences the microclimate which is perceived by people.[12] So, for each climate element different guidelines are important that urban designers should take into consideration. However, sometimes the guidelines are in contrast with each other. Therefore, it is important to see what is needed in that specific area, where we now know that the microclimate is different in each place in the city.[13] Important to know is that the presence of the sun is appreciated during the cold winter, while it should be avoided during the hot summer. So urban designers should create places with the opportunity to walk or sit in the shade. Regarding wind, high wind speeds should be avoided, while during the summer a cool breeze is very welcome.[13] Urban designers should consider the heavy precipitation events more in their design, so places to store the water should be created. There are tools that urban designers can use for designing the urban microclimate, where it can be difficult to apply all the guidelines for each climate element. Digital programs can help to analyze the site and can improve the design when it is used during the design process. Moreover, urban designers can use the maximization method where first the ideal situation for each climate element is drawn on the site after which compromises should be made to maximize the design of the urban microclimate. The knowledge of urban microclimate is available and the design methods to apply this knowledge are still under development every day. Now, urban designers, developers and politicians should see the importance of environmentally sustainable development of future cities. In other words, cities should become more climate aware to enhance the quality of life in urban outdoor spaces.

12. Pijpers-Van Esch, 2015

13. Brown, 2010

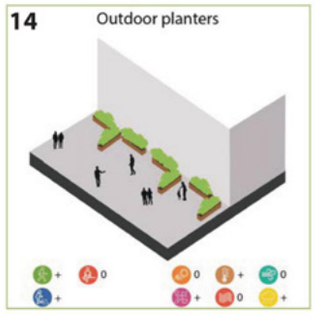
Urban microclimate has many different effects on the appropriation of urban outdoor spaces. Urban designers should aim for solutions that improve the urban microclimate on the one hand and the liveability on the other and there are many ways to do that. First of all knowledge about the microclimatic conditions of the area is needed as the behaviour of people according to those conditions. With that knowledge designers can create pleasant conditions in the urban outdoor space and the users can appropriate it in their way. Greenery, for example, has a lot of advantages for appropriation and microclimate. However, it is not so much about creating more green, it is more about creating effective green. Therefore, a strong analysis of the site is needed and designers can create adaptable and flexible solutions for the problems and opportunities. The most important lesson urban designers should take from appropriation and urban microclimate is that choice should be integrated into a design. Many different people are appropriating urban outdoor spaces and all these people have different preferences. In general, elderly people prefer to sit in the shade whereas other people like a bench in the sun. To make cities sustainable interventions for appropriation and urban microclimate are needed and for the implementation of the design solutions, this should work at different scale levels. The interventions should take place at the scale of the district towards the building. This will mean that each intervention has different periods for implementation, different stakeholders and costs. So urban designers need to know which stakeholders they should integrate into the process to make an intervention successful. Therefore a good collaboration between actors should be integrated into the design process. The municipality can make improvements on a large scale, while residents can make differences on the smallest scale. It is possible that small-scale interventions are easily created, cheap and possible with

only the cooperation of residents, while large-scale interventions require a lot of planning, participation between a lot of stakeholders and cost more. Urban designers can steer a bit in this process. They can create the conditions in urban outdoor spaces so that the residents can fill it in as they prefer while the desired outcome is accomplished. In the end, designers should create choices for people. In this way, users can make the most of the space, socially and environmentally.



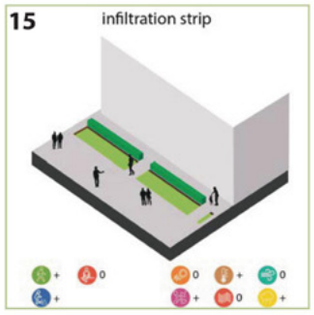
13 Parklet

General information:
Parklets are a (temporary) transformation of parking spaces into pocket spaces along the sidewalk. It can be seen as sidewalk extensions with the purpose of creating places for staying.



14 Outdoor planters

General information:
Outdoor planters are there in many ways, according to the preferences of the residents. This makes it very suitable for appropriation. Plants have many advantages for the urban microclimate.



15 infiltration strip

General information:
Infiltration strips are lower placed, green surfaces next to paved surfaces where rainwater can be (temporary) stored and slowly infiltrated.

Figure 3. Climability solutions on the scale of the street.
Image by Rick Schoonderbeek

Eco-Inclusive Opportunity

Thomas Dillon Peynado

Operationalising environmental assets towards a resilient densification

What is the position of the Urbanist? I believe that Urbanism consists of an interdisciplinary field that requires an understanding of the physical environment and its base and effects on socio-economic and environmental conditions. This reflects the Value-based development paradigm pursued at TU Delft, founded on the pillars of people, planet and prosperity requiring a strategic interdisciplinary approach. Considering how our process of urbanisation has long followed an unsustainable path, and how the current rate of space and resource consumption poses significant challenges to continued liveability, while stimulating the creation of vulnerable environments reliant on the overexploitation of vulnerable systems,[14] we're at risk. Especially in the face of climate change and the growing scarcity of resources.[15]

Our influence as a species has been very profound, to the extent of us caused the start of a new epoch, the Anthropocene. Now with humanity itself being a sizeable force of nature,[16] we can no longer ignore the impact we have on the planet's systems and our societies. Meanwhile, major cities are still experiencing an increase in population, creating the complex challenge of housing increasing populations in a way that increases liveability in the long term. With such a daunting task ahead of us, I would like to quote Christiana Figures, the former UN High Commissioner responsible for the Paris Climate Agreement: "Impossible isn't a fact, it is an attitude".

The Randstad metropolis in the Netherlands, thriving within a once hostile environment dominated by peat marshes, is an excellent example. This is all the more apparent in the city of Amsterdam, a city that has had to find ways to thrive in these

14. Harvey, 2012

15. Smolders & Struijs, 2011

16. Hamilton, 2017

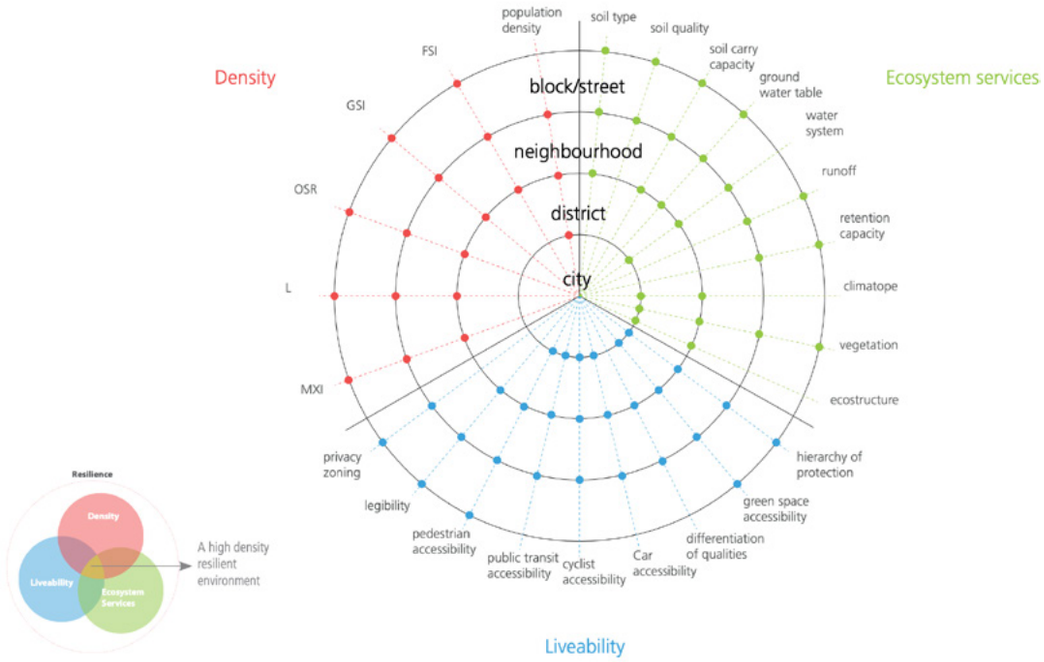


Figure 1. The project aim and the performance indicators derived from the research to uncover the important criteria.
Image by Thomas Dillon Peynado

17. Hooimeijer, 2014

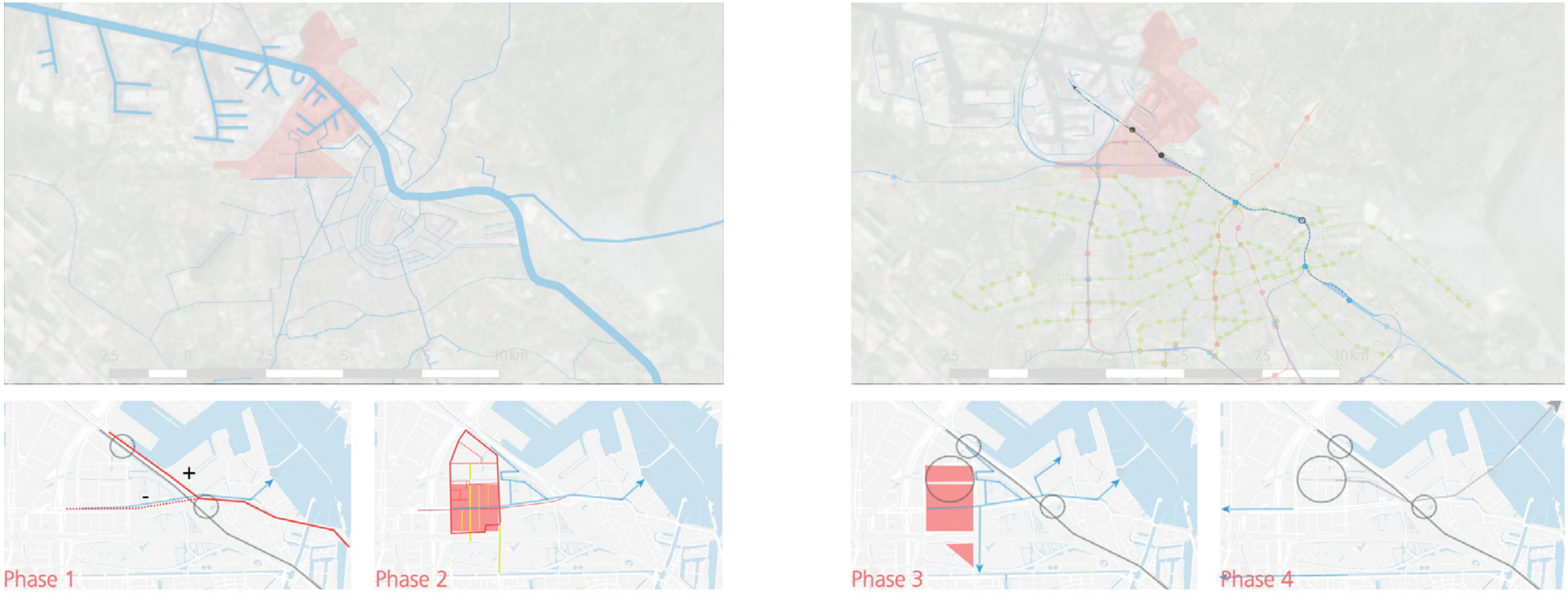
inhospitable conditions. In the last two centuries, affluence and technological progress[17] have relieved the city of this need to actively engage with the natural environment. The city's and its citizens' needs and desires have reshaped the environment with spatial planning facilitating it. Now we have a living environment in which the natural systems underlying the city are approached as a complication, a constraint to its development, rather than as an asset or opportunity. It is within this context that the city of Amsterdam is expected to reach a population of over one million by 2040, all the while having limited space for development, leading to ambitious proposals, with the transformation of part of the harbour into the new district of Havenstad being the most significant.

Developing a resilient high-density environment is key here. Through exploratory research, targeting the relationship between our ongoing socio-economic changes and our relationship to the natural environment, this project is meant to contribute to a shift away from predatory horizontal urbanisation. By making the connection to the hybridization of functions, e.g. the combination of civil, logistics and environmental services with our

living and interaction environments density can once again be perceived as an asset, rather than a risk to liveability. The concrete aim is to explore how to achieve a high density in a transformation area while stimulating a high liveability. Here, Haven-Stad, an existing commercial/industrial area envisioned as a high-density mixed area will be the test case for the new approach to integrating ecosystem services and high density.

To address this challenge, the following main research question was formulated: How can a resilient high-density environment be developed, utilising the environmental conditions of Haven-Stad, to achieve a high liveability? The study was divided into three main parts in subsequent order. Here a literature study forms the foundation of the research. During this study, the definition of resilience and the relationship between density, liveability and ecosystem services are explored, to identify the important criteria and develop guidelines for the design. These criteria are then used to develop the performance indicators. To design this city of the future, we must first dispense with the notion that this is a completely novel endeavour, especially since the city of Amsterdam has had at least three different iterations of this concept in the last century, in particular Berlage's Plan Zuyd, Van Eesteren's Algemeen Uitbreidingsplan (AUP) and Nassuth's Bijlmermeer. Considering how the three

Figure 2. The mobility proposals on the city level. From expanding the navigable canal system to introducing an "S-Bahn" with Hemweg and Westerpark stations, and the phasing of the transformation of Havenstad starting with the infrastructure changes. (the canal system, transforming Hemweg and Transformatorweg, as well as digging the canals. Phase 4 shows potential further expansion.
Image by Thomas Dillon Peynado



have aged considerably differently, with Plan Zuyd currently being a popular area, while the Bijlmermeer's public perception rapidly declined, notable hurdles exist.

Interestingly, the area that is to become Haven-Stad, is a part of the AUP which was designated for industry, separated from the other areas by a green area, the Westerpark. Its proposed transformation to a mixed environment is actually in line with the development proposed for the other parts of the AUP. However, the initial success and later underperformance of the previous attempts of the city to develop a city of the future raise questions about how much Haven-Stad can be designed, for our current needs, as future needs are not all yet known. Instead, the city should be a city designed for the future, allowing for flexibility, while offering a framework for development.

In defining the themes, the spatial definition for density is taken from the work of Berghauser Pont et al[18] and that of Van den Hoek,[19] this is done as their definitions are being more widely used and they are suited for quantitative analysis. The definition of resilience as the capacity to overcome system failure after a calamity[20] is taken as the base for the ambition of a resilient environment. For liveability a distinction is made between objective performance in categories such as safety and education, as defined by the Economist,[21] and more subjective performances relating to affordances, dividing outdoor activities into necessary and optional activities, with social activities being strongly dependent on the quality of the space.[22] The scale of the building blocks' work regarding so-called Privacy Zoning was taken into account.[23] Ecosystem services are classified following the approach of McPhearson, Kremer and Hamsted,[24] with the categories being provisioning services, regulating services, support services and cultural services. This is all done to pursue a social-ecological approach.[25]

18. Berghauser Pont & Haupt, 2009
19. Van den Hoek, 2008.
20. 100 Resilient Cities, 2018
21. The Economist Intelligence, 2018
22. Gehl, 2011
23. Wal et al., 2016
24. McPhearson et al., 2013
25 Barthel, 2013

After the first phase with a strong emphasis on theoretical research, the second phase is conducted through designerly research. Informed in part by the criteria from the first phase, the analysis phase applies a combination of design and analytical methods to further understand the area and develop the design. These consist of spatial analysis, network analysis and quantitative research, applying the layered approach among others. This phase resulted in the development of the performance indicators as well as the technical and functional profiles.

This project intends to arrive at an evidence-based design vision. With this intention in mind, it combines the space matrix approach by Berghauser Pont et al[18], with ecosystem services and a technical profile. By doing so, it attempts to include environmental opportunities to allow for durable liveability. It further proposes to utilize the block approach developed by the Netherlands Environmental Assessment Agency (PBL)[26] to not just determine the performance regarding spatial density, but also as a carrier for the environmental and spatial performance indicators. Doing this is expected to not only allow for an insight into the individual performances of the blocks, while serving as a base for additional indicators, and facilitate the communication and comparability.

The spatial analysis of the city consists of a synchronic qualitative analysis to identify spatial qualities that could serve as assets when using the "opportunistic approach",[27] in which various natural elements and infrastructures are approached as an opportunity instead of an impediment. Depending on the scale of the analysis, the methods include either mapping, creating sections eventually creating a technical and functional profile. This approach, showing the various layers of infrastructure relevant to the area and their correlation, allows for a better insight into the area while facilitating the determination of threats and opportunities to be taken into consideration during the design.

26. Harbers et al., 2019
27. Ahern, 2007

Considering green/blue spaces as part of the performing landscape offers new ways to organise the urban environment, while allowing for the perception of its function, contrary to common practice where it remains hidden from view, resulting in unexpected conflicts.[28] The spatial analysis is accompanied by quantitative spatial analysis following the space syntax methodology. Here the variables derived from the literature and the reference study are applied in GIS models of the Amsterdam metropolitan region. The variables taken for density are calculated according to the space matrix approach developed by Berghauser Pont et al[18]. Here GIS models are used to combine various data, such as that concerning density and accessibility. Connecting these to the variables concerning liveability and ecosystem services using space syntax methodology[29] makes it possible to qualify the qualities of various areas.

The final phase consists of the Design lab. Here the input from the foundation, the analysis, the block performance and the design guidelines is used to guide the design process. The potential profiles helped to determine the best locations for certain interventions while the three design variants Intensity, Nature and Accessibility) helped to explore a different aspect of a resilient high-density environment to develop a design vision and a development timeline for Haven-Stad.

The first variant, Intensity, aims to develop a high-intensity environment. Through a high density, a mix of functions and multipurpose use of space a new type of interaction environment is proposed. The main point of focus here has been the metro station as it attempts to fully embrace Transit-Oriented Development and the multifunctionality of buildings and infrastructures. The second variant, Nature, aims to develop an environment high in ecosystem services. To do this the current ecosystem services provided in Westerpark are taken and strengthened through integration with the district of Haven-Stad. A multipurpose green structure connects the blocks of the area. This variant strives to incorporate the park and by doing so offers the opportunity to future inhabitants to live in Groot-Westerpark themselves.

The latter, Accessibility, aims to develop a highly accessible environment with a hierarchy of spaces and routes, integrating transit in the design proposal. To do this, the variant proposes a far-reaching version of Transit-Oriented Development development, integrating the various hubs within the urban fabric. In this variant, the station becomes the veritable centre of the Haven-Stad development. From here the connections emanate into the rest of the neighbourhood. The focus is on the human scale, so the hierarchy of spaces, legible privacy zoning and the use of the canal as a new connection to the rest of the city are central. This all comes together in the final design vision, of an eco-inclusive Haven-Stad, with aspects from the three variants, being an increase in interaction and density of activities, reconnecting the city to the natural systems and increasing the permeability and connection to networks.

On the city level, some major changes occur. Before the expiration of the covenant that limits housing development in 2029, the major infrastructure changes begin, starting with the Transformatorweg canal, the downgrading of the Transformatorweg and the upgrading of the Hemweg. This also requires an overhaul of various junctions, with the potential to vastly improve the spatial quality of the area. In addition to that, an “S-Train”, similar in type to the S-Bahn model applied in Germany, that uses the existing rail infrastructure is introduced and the Westerpark and Hemweg stations are built. This also offers the opportunity to add one additional station further east. The S-train will be using some of the rail capacity that becomes available due to the transfer of trains to Amsterdam Zuid.

28. Bacchin et al., 2014

29. Al-Sayed et al., 2014

While the area needs more internal waterways to deal with the extent of rainfall and a high groundwater table, this also allows for the opportunity to reintroduce shipping as a viable, and potentially main, form of transport, through the creation of navigable canals throughout Haven-Stad. These two changes connect the area to the rest of the city via water and rail. Part of the mobility shift for Haven-Stad consists of the shift in priority from Transformatorweg to Hemweg. Through the adaptation of the existing road system, the suitability of the roads bisecting the Haven-Stad development is strongly decreased, in favour of traffic headed towards the area itself. At the same time, the area remains accessible for personal cars and emergency vehicles.

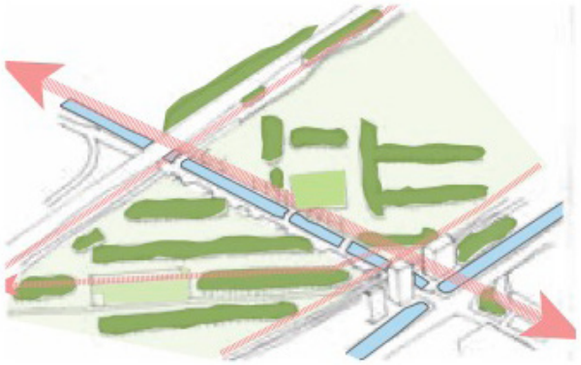
By strengthening the structure of the Westerpark into Groot Westerpark, an area with a variety of green-blue landscapes is created in conjunction with new areas for living and businesses. The area can benefit not only Haven-Stad but also potentially improve the liveability of Spaarndammerbuurt and Houthavens. Meanwhile, connecting the canal system southward, allowing for a connection to Amsterdam West and allowing this new connection to become a “stadsstraat” like Transformatorweg offers new possibilities. As corridors share a central function with the mobility hubs, as well as connecting the green-blue grid and increasing climate resilience and a voluntary modal shift. In the longer term, when an extension of the metro line becomes feasible, the S-train can be kept, allowing for a connection to the North of Amsterdam and the proposed line to Zaandam, further integrating Haven-Stad into the urban system and allowing development throughout the city.

On the district level, the spatial densities and block typologies depend strongly on the qualities of the various performance indicators, such as those for the soil, the position within the mobility system and the spatial framework, i.e. the functional need and the potential to combine various functions. The North, Neptunushaven, becomes an area for the Circular economy and sports in a green-blue grid, and the areas along the highway keep their focus on enterprise. For that, the closed block typology offers a large amount of space and flexibility, while strongly defining the open space, as does the closed courtyard block. The other blocks offer a varying definition of the public space, be it more urban and defined, or more park-like. The blocks possess a gradual transition in privacy zoning, with communal space within the buildings. And the rainwaterplan includes a cascade of failure, with the impermeable pavement being the last to flood to allow for evacuation in a calamity, whilst offering a special experience during different levels of rainfall, featuring a waterstreet that eventually transports water to the canals and is usable for emergency services. When considering the project’s ambitions of developing a high-density resilient environment, with the potential to operate as a city in the future, the combination of the three themes of density, liveability and ecosystem services proved to be a main part of the project.

Before a design for a city for the future can be elaborated, the correlation between density, liveability and ecosystem services had to be truly understood. This allowed for a design vision and development priorities, that in a further elaboration of this project could be developed into a pattern language for the resilient high-density city. Developing a city for the future, capable of incorporating changes within its fabric, requires a transition from planning based on current socioeconomic patterns, towards an approach based on performative design. Adopting such a strategy, with a strong focus on the performance of the design, requires an integrated strategic approach, based on the potential development.

Therefore this project has mostly focused on the infrastructure on which to base the development of the area as this allows future flexibility for the development. One of the project ambitions, namely the development of a more standard approach to urban design, proved a lot more challenging than was priorly envisioned. In the end, it may have been a bit too ambitious to not only research how to integrate density, liveability and ecosystem services towards a more resilient system but also develop an evidence-based approach to the design.

However, this could be considered the groundwork, or foundation on which to base such a further design, allowing for a further elaboration of climate resilience in the spatial design. Additional considerations pertaining to themes such as the circular economy could in the future also be part of the approach.



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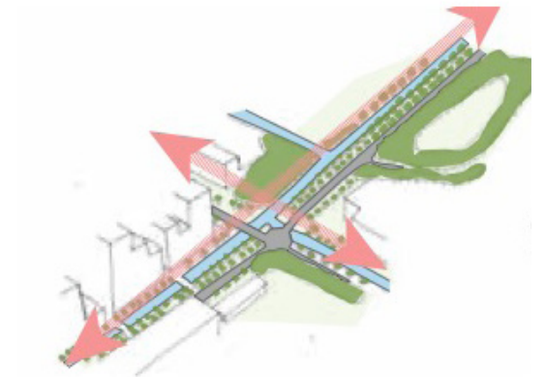

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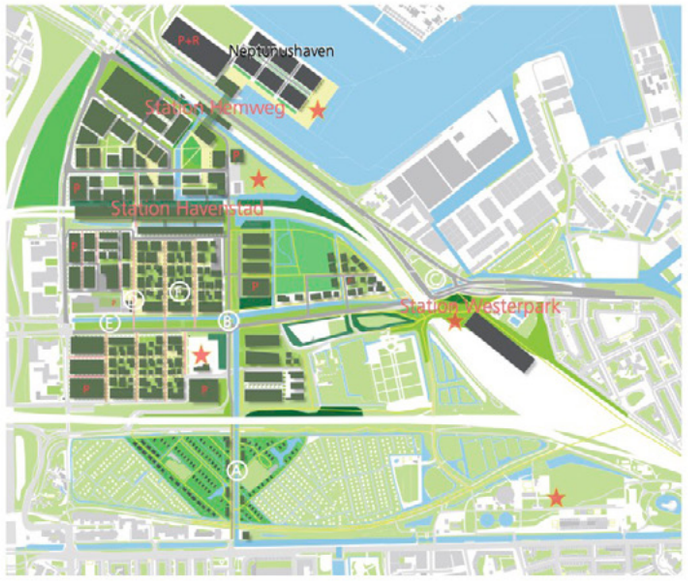
Figure 3. The new design for various nodes/intersections in Havenstad, prioritising active mobility, enabling water mobility and connecting green-blue networks.
A: the new Westerpark Canal
B: Transformatorweg Canal
C: Westerpark station with Transformator-weg canal and the new Hemweg traffic junction.
Image by Thomas Dillon Peynado



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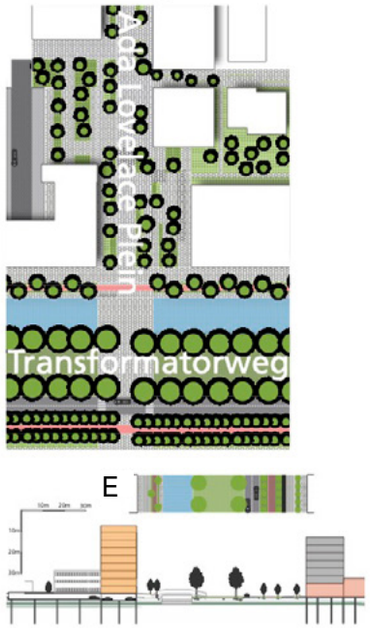

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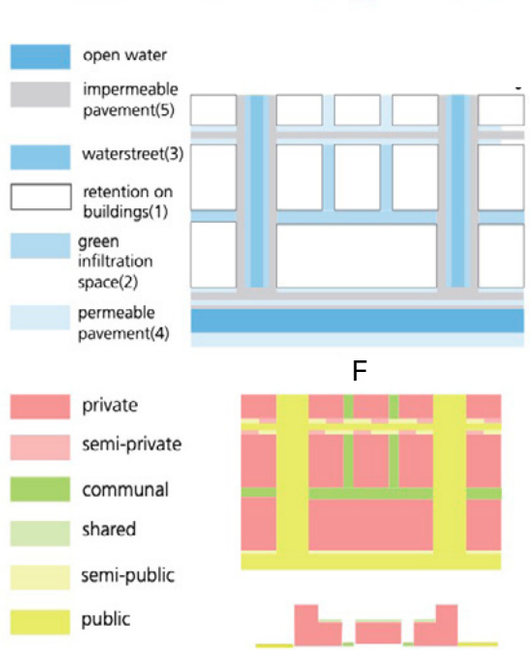

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Figure 4. The design vision for Havenstad on the district, the neighbourhood and the block level, showing the varying block typologies and spatial densities, climate resilience applications and privacy zoning, as well as a section and plan for Transformatorweg and Ada Lovelace square (formerly known as Isolatorweg).
Image by Thomas Dillon Peynado

Interview

Rick Schoonderbeek
Urbanism graduate

Introduction

My name is Rick Schoonderbeek. I did my bachelor in Architecture and my master in Urbanism. I joined the City of the Future in its second generation. After graduation, I started with a traineeship in Rotterdam, a two-year program working at four different companies. The traineeship consists of LOLA Landscape Architects, ECHO Urban Design, the Municipality of Rotterdam and Rho Adviseurs. Now I work at ECHO urban design as a project leader and urban designer.

Motivation [pre-phase]

What motivated you to choose the studio?

In between my bachelor and my master, I did an internship in an urban design office. They made designs 20 years ahead but not looking any further. I was always intrigued by the theme of climate adaptation and greenifying cities. Then in my master, I did a project with Maurice and Roberto in which we went to Boston and this was already very multidisciplinary. In my thesis, I wanted to look into the far future and work interdisciplinary within the triangle of architecture, landscape and urban design.

Experience [process phase]

How was your experience with the educational setup of the studio?

In the beginning, we had to read all kinds of literature and sometimes it was difficult to see what you could take out of it for your project. But it was also a motivation to dive into theoretical research.

We went to the Politecnico in Milan where we had lectures and site visits. This was great for me because I chose to do my project in Milan. I got information and knowledge there about all kinds of topics, plus I built great relationships with colleagues and fellow students.

How did you integrate other disciplines in your project? How was the multidisciplinary interaction with fellow students and lecturers?

In the beginning, whilst doing theoretical research, all students helped each other and by getting to know your topic they provided advice and book suggestions. The tutors gave directions from the perspectives of different disciplines. I had Maurice as my supervisor for urban design, Roberto for architecture and a third mentor for climate. All these things came together within my project, in which I looked into the influence of microclimate on appropriating urban outdoor spaces.

How was your studio experience in general?

It was a great experience. In the beginning, students were able to help each other with the theoretical research part and the initial design phase. Then unfortunately COVID came and we had to work from home so we lost a bit of the connection. Due to COVID, I had to change my research method several times because I wanted to go another time back to Milan and that was not possible. So I had to quickly adapt to the new situation.

How did the studio influence your choice later on of what you wanted to do?

The interest in landscape architecture and urban design is still with me after graduation. The broadness of our working field is interesting. I would say that for the coming period, I would like to be better in all fields and disciplines. It makes me sharp in designing and I don't think I would focus on one discipline or one theme. It's part of our job as urban designers to be more generalists than specialists.

The project [post-design phase]

In what ways does your project answer to the studio's theme?

What I especially learned is to make strategies for the future. A step-by-step approach of what can be achieved within 10 years, 20 years, 40 years, 50 years and so on. This was a new perspective for me. I also enjoyed integrating landscape and architecture solutions within my urbanism toolkit. I was looking into the strategy and making timelines. I chose to work on three locations within the city instead of a detailed design for one location, so that clearly shows the blend between all these approaches. This also gives a toolbox to address different scales. If you talk about the city scale in terms of microclimate, you are thinking about road layout and positioning buildings, while on a neighbourhood scale, you would think about placing water squares to buffer rainwater. On a building level, you would think of greenifying balconies. Each scale has its strategies that are unique but related.

Why did you select Milan as your case study?

I knew I wanted to research climate adaptation, so I was reading about European cities and their climate problems. Milan came up as one of the most difficult cities for climate adaptation. It was an interesting challenge for me to write my thesis about an unknown city so I decided to take Milan as my case study.

Cities of the Future: On nature and the grammar of design

Daniele Cannatella
Lecturer in Landscape Architecture, TU Delft

In his book, *The sense of style* [25], the cognitive scientist Steven Pinker argues that the categories of grammar reflect the four building blocks of thought: time, space, causality, and matter. Coincidentally, these building blocks are the same ones that dictate the grammar of spatial design. In them being absolute categories, they describe well the way architects, designers, planners and landscape architects perceive, investigate and intervene in the reality around them.

Nowadays, the degree of complexity of what is perhaps the greatest challenge of all time—the climate crisis we are currently enduring—implies a profound reflection on the conceptual and operational tools that designers and planners have at their disposal to turn a world-scale issue into an opportunity for local sustainable development. However, this is a cumbersome task, as it forces us to question a relationship that has roots in the deepest layers of human history: the one between man and nature. As a matter of fact, the climate crisis confronts humanity with two major revelations.

The first concerns the reconsideration of our position in relation to nature. We can no longer make the mistake of considering ourselves detached from natural processes; on the contrary, we are more than ever bound to the cycles and flows of water, soil, and vegetation. And this is even more true for our 'natural' habitats, cities.

The second revelation is that a perception of reality based on dualisms and opposition is no longer sufficient, if not dangerous, to effectively boost the resilience of urban systems.

The study of nature suggests many ways to unravel such complexity and rethink the way we design our cities. The urban project itself is no longer conceived as a mere blueprint, a fixed end point to aim for; rather, it is a point of convergence between the past and a desirable, open-ended future. Designing then is a multifaceted task that takes place at different scales in space and time. Looking at the past we can understand why and how certain areas are prone to flood, or how the hyper-engineering of the landscape led us to water scarcity and increasing droughts in the built environment. Interventions to mitigate flood risk or urban heat island effect look at different scales—from the water catchment to the single plot—and their impacts are explored on disparate systems and under different climatic circumstances.

In (re-)designing a piece of a city, questions are asked not only about what programmes and functions it can accommodate in the short term, but also to which extent it can be readapted to changing socio-economic conditions. Furthermore, they increasingly address the life cycle of its parts and the possibility to recycle, downcycle or upcycle them.

Creating new landscapes in the light of such complexity implies taking conscious and informed action to adjust flows by deliberately forming new space to speed up or slow down the paces of natural processes.[26] This integrated body of knowledge of natural processes into spatial design has accelerated the consolidation of an exquisitely cognitive landscape aesthetic.[27] At the same time, this drift is leading more and more towards another type of aesthetics, the performative one, which looks at the services that ecosystems provide to people.

However, if this is the first step towards reconciliation with nature, it is still not enough. The role of design then should also be to redefine new narratives into a novel, more balanced coexistence between nature and man.

To do so, it must propose spatial solutions that emphasise the cycles of nature, materialise them on a scale accessible to the individual, and suggest new programmes and uses for public space, laying the foundations for a new and more conscious landscape aesthetic.

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25. Pinker, 2015
26. Jackson, 1984
27. D'Angelo, 2009

Economy

Image by Marcelo Carreiro Matias, Mesut Ulkü and Sonja Drašković

City and economy

Now, more than ever, cities are beating hearts, and the economy must keep pumping blood around the system. Cities and economies are naturally intertwined; cities bring together economies of scale, job opportunities, and economic growth. Urbanisation, the shift from rural to urban areas, is a driving force for economic development and it consequently produces physical transformations in cities. These transformations are influenced by underlying factors, namely social-economic, political, and environmental aspects.

Actors make decisions based on physical and socio-economic conditions and those decisions in turn shape economic dynamics. The city is continuously changed by the financial decisions we make every day, driven by a diverse range of interests. For example, actions are done according to where we live, where we work, and how we move from one place to another, amongst other things. On the other hand, investors and developers hinge their real estate strategies on work-living trends, public infrastructure plans or financial incentives. Either way, cumulative decisions in the city have implications across the whole system.

The future economy

We have the ambition to reach a stable and certain economic environment in which investments in the built environment can, with a certain degree of certainty, have positive future outcomes. However, history has shown that the future is anything but certain. Take the COVID-19 pandemic as evidence of how unpredictable circumstances can destabilize economies. However, the future takes form from the overlap of plausible scenarios. Then, if there is not a single future, how can we define the economy of the city of the future? How can we deal with the uncertainty to make investment decisions? Past and present trends of the city steer the economic conditions of the future. These trends are the basis of models, visions, and scenarios used to transform uncertainties into manageable risks and opportunities for the future.

The status quo of the economy is inevitably changing due to new social developments and the urge to revive the economy, pressing on the stability of the system. In particular, the emergence of the network economy, the digital revolution, and the empowerment of virtual communities are transforming markets. The surging diversity of interests calls for new products and services that respond quickly to changing demands. For instance, the shift from owning to sharing models or the rise of decentralized decision-making is creating new opportunities. The diversification of the economy should start from the exploration and visualization of these opportunities in the city of the future.

Diversification

How can we fulfil the changing demands of the economy at a fast pace? We cannot design the physical without the digital realm. The economy transcends the built environment, it goes beyond the city itself. Besides, it is in constant change, a change that is faster than the ability of the built environment to adapt. Therefore, technology and the environment are already forcing designers to internalize the externalities in our design process. In other words, we must certainly expand the criteria in their decision-making to discover new alternatives. Throughout the following sections, it is important to consider the system relationships between economic factors and the built environment, and the impact of diversity on the design of the city of the future. Does diversification drive cities to innovate for the future?

Student projects

The intriguing question of the future of the economy from the lens of the built environment is well addressed by the three student projects in this section. Tim Li's project *The Maker's Paradigm* addresses the influence of the built environment in innovation culture. By applying an original approach drawn from anthropology, the project investigates the spatiality of innovation culture and develops a framework for interventions in Urban Innovation Districts, using the former industrial area of Binckhorst, The Hague, as case study. Also attentive to industrial area transformations is Carlos Lüchau's project *Place-making with the makers*, which explores place-making strategies within urban regeneration initiatives. The research applies an urban development management approach to assess redevelopment plans of industrial areas, using the Schieovers Noord area in Delft as case study. Finally, Fabrizio Chiappe's project *Towards a Resilient Venice* explores another facet of the economy, resilience, using the well-known case of overtourism in Venice. The overreliance on a single economic activity has created gentrification and economic long-term risks in the city, which the project tackles by designing strategies to support economic diversification and adaptive reuse.

The Maker's Paradigm

Tim Li

Spatializing Innovation Culture for a Resilient and Innovation Driven Economy

The advent of the COVID-19 pandemic has fundamentally changed the way we work, learn, live, and play. Although its disruptions have severely impacted traditional business practices and processes, the pandemic has also expedited innovation. Entrepreneurs, SMEs, and large enterprises, out of necessity, are quickly learning, adapting, and creating new ways to collaborate. These developments demark a transition from Industry 4.0 to Industry 5.0, an industrial vision defined by the European Commission as one "that aims beyond efficiency and productivity as the sole goals and reinforces the role and the contribution of the industry to society." The critical shift lies in the focus on people, partnership with digital technology, research and innovation as a way to build a sustainable, human-centric, and resilient industry.

The Maker's Paradigm is anthropological-based research on spatializing innovation culture for a resilient and innovation-driven economy. It establishes a position that, although it is impossible to predict the future, architects, urban planners and policymakers can work together to cultivate the socio-economic conditions for innovation and as a result empower individuals and populations. Thanks to the studio's interdisciplinary nature, this project took a multidisciplinary approach from sustained dialogue with students from Urbanism, MBE, Geomatics and TIL.

The key aim of the project is to answer the question How can we transform the built environment to optimize innovation? with core themes of inclusivity, diversity, inequality, and equity. To answer these questions, the project is divided into three parts.

Figure 1. Gathering of perspectives. Where people and diversity collides, new ideas and innovations are born.
Image by Tim Li

Part 1: Establishing the Innovation Ecosystem Framework.

The first part of the project carries out phenomenological literature research on the emergence of innovation spaces and anthropological literature research on innovation culture. The goal is to understand why new typologies of urban spaces such as incubators, flex spaces etc are emerging and how they can attract, build, and sustain communities.

Through the research, an Innovation Ecosystem Framework for Urban Innovation Districts (UID) was developed. This framework is a model of how to accelerate innovations to meet the socioeconomic needs of the population. It stipulates that there are three interconnected constituents of innovation culture: people, socio-economic forces and physical environment. They can be spatialized by identifying the socio-economic needs of a neighbourhood (people & forces) and embodying those into four layers in the built environment–work/dwelling environments, program interconnection, outdoor spaces and external connection. Each of these layers has the potential to provide a unique set of social and economic assets to the public that can encourage self-induced and self-centred economic activities. The four layers of the social network systems are as follows:

Workplace/Dwelling
Workplace and dwelling are physical spaces where a person spends most of their time. As such, it is the primary level of the network system within the Innovation Ecosystem Framework. Pluijmen[1] draws on the importance of new working/living typologies. Flexible workplaces and affordable dwellings are critical physical, economic and social assets for user groups of UID. Contrary to traditional working and dwelling spaces, the clear distinctions between the two areas have become more blurred. There is a growing complexity in shared and combination spaces, where the public can engage in an active environment. The diversity required of UIDs calls for new typologies in both mixed-income and mixed-function typologies.

1. Pluijmen, 2017

Program Interconnection
Program interconnection refers to the prevalence of amenities and services and how they are linked to the larger urban framework. It is the secondary level of the Innovation Ecosystem Framework and is critical as mediatory spaces where UID user groups have common interests. Van der Zandt, in her praxeological research on the user groups of Strijp-S, an Urban Innovation District in Eindhoven, classified three types of amenities: functional, recreational and cultural.[2] Functional amenities are facilities for daily activities, such as supermarkets, whose affordability can be critical for UID user groups. Recreational and cultural amenities are facilities such as exhibitions, gyms, bars or cafes, which are pivotal social assets for UIDs.

2. van der Zandt, 2018

Outdoor Spaces
Outdoor spaces connect the entire urban framework of UIDs. Mitigating the transition from outdoor space to semi-outdoor space to the interior spaces of buildings is critical for encouraging positive social interaction between UID user groups. Pluijmen[1] stressed the importance of encompassing a diver-

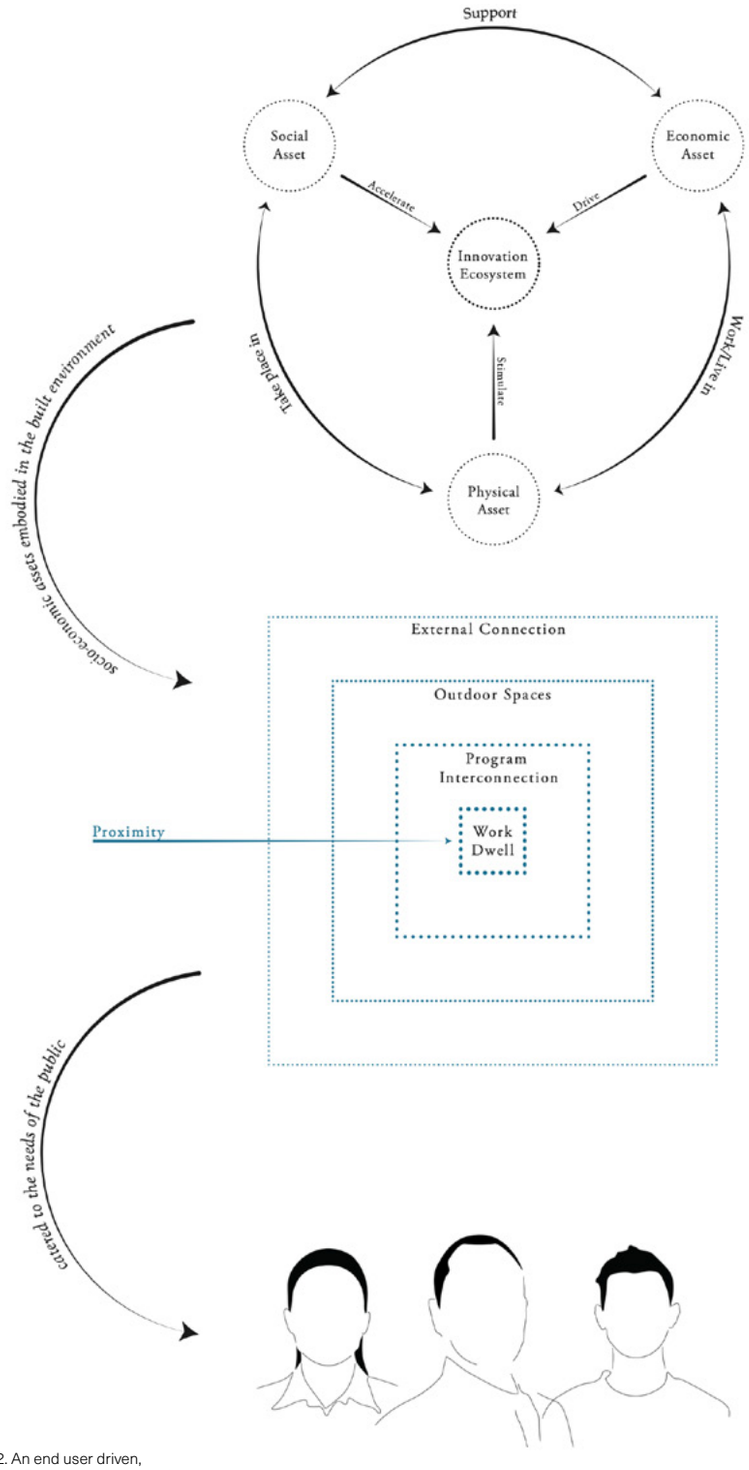


Figure 2. An end user driven, Innovation Ecosystem theoretical framework.
Image by Tim Li

sity of open spaces, from small-scale plazas and parks to accommodate cultural events and activities, to more intimate pockets of spaces that have relations to the interior of buildings on the ground floor.

External Connection
External Connection refers to the external relations of the UID concerning the rest of the urban context. In a study conducted by Wagner & Watch, all user groups find the diversity of transport systems critical for UIDs.[3] This ranges from private transport to transit systems such as trams and buses, and bike/pedestrian paths from neighbouring districts. The external connection however relates to more than sheer accessibility. The planning of transport systems has a significant impact on the walkability and cyclability of UID's which have been widely confirmed as key determinants.[3] Furthermore, critical nodes, such as drop-off points, bus, tram and train stations, can be prime locations for cultivating social interaction of UID's when designed properly in conjunction with amenities.

3. Wagner & Watch, 2017

Part 2: An Ethnographic Study of the Site
The second part of the project applies the Innovation Ecosystem Framework to an empirical, place-based site study on the former industrial site Binckhorst in The Hague, which the Municipality aims to transform into an Urban Innovation District. Interviews and questionnaires were conducted along with demographic data analysis of the surrounding neighbourhoods. This methodology enabled the superimposition of a top-down site analysis with a bottom-up field study on the needs of each income group community. Socio-economic strengths, weaknesses, and opportunities of the area were derived based on the four scales of socioeconomic networks. Urban and architectural parameters for intervention were then created where the common needs of each income group community coincided.

Part 3: Design for Inclusivity and Diversity
Designing for inclusivity and diversity goes far beyond a simple architectural intervention. As dictated by the research, the transition of Binckhorst from an industrial to an urban innovation district calls for intervention in various scales and timeframes. The proposed development of Binckhorst was then broken down into four phases. Phase 1 focuses on external connections and outdoor spaces to enable easy access into the district, at the same time providing attractive social spaces that can be enjoyed by all income groups. Phase 2 focuses on work/dwelling and program interconnection to provide economic functions and amenities that accommodate the needs of different income classes, as well as various functions to further activate the open spaces. Phase 3 focuses again on external connection and outdoor spaces to integrate the new developments with the existing amenities in Binckhorst. Finally, Phase 4 focuses on the Innovation Factory, a new building typology in the heart of the district that provides publicly accessible amenities, services and technologies that the public would otherwise have not been able to afford or have access to.

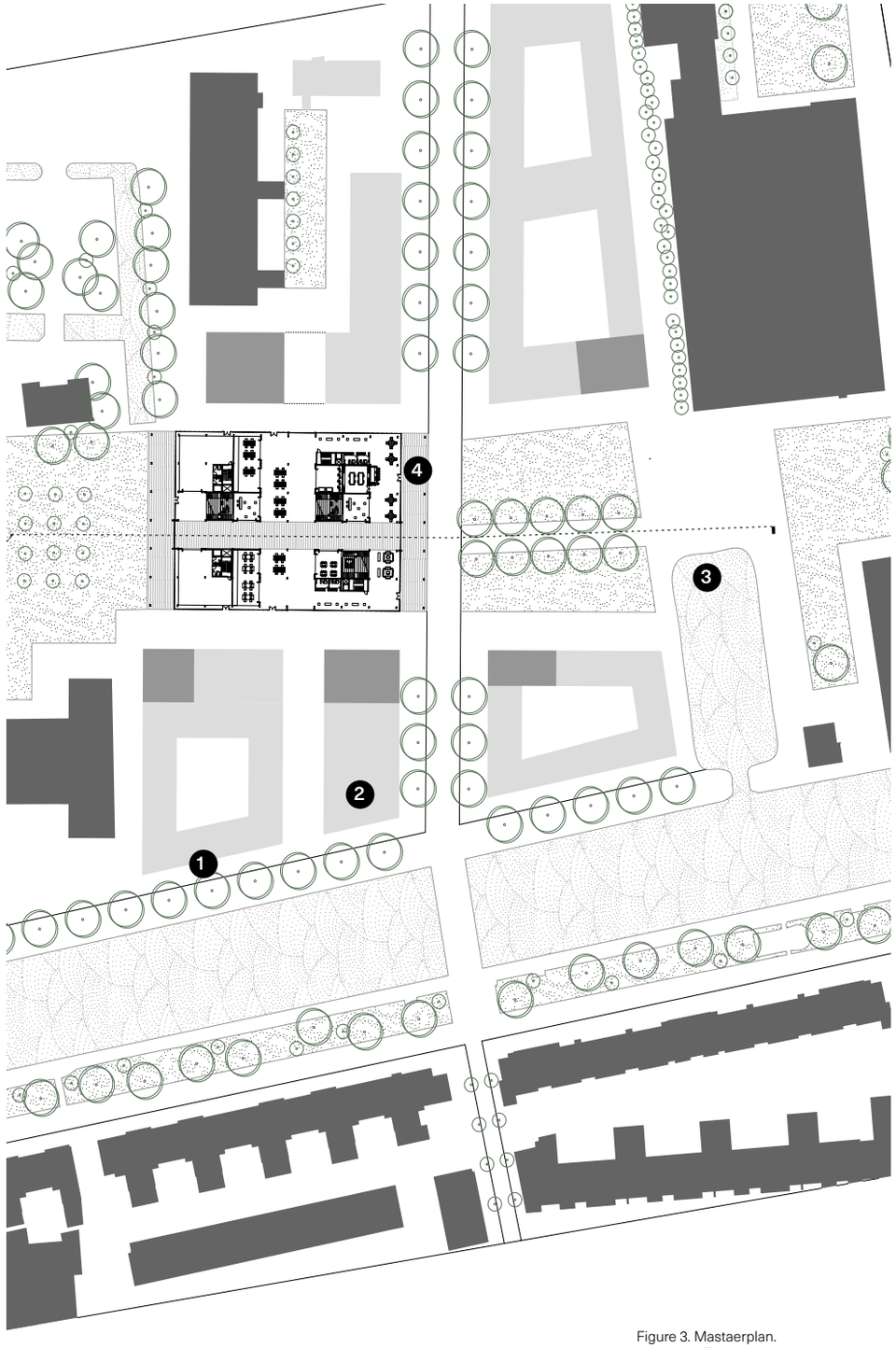


Figure 3. Mastaerplan.
Images by Tim Li

1

Phase 1: Urban Renovation - Social External Connection & Outdoor Spaces

The promenade is first developed as a social asset for the public. This can help raise social awareness of the development of Binckhorst, provide a common space for people of different income class, ethnicity and education to come together, and connect with the other neighbourhoods in the near vicinity.

2

Phase 2: Urban Renovation – Economic Work/Dwelling & Program Interconnection

Next to the promenade will be a mixed used development. The ground floor will be activated with various various functional and recreational amenities, while the upper floors will be designed to accommodate for different income classes and demographics.

3

Phase 3: Urban Renovation – Social External Connection & Outdoor Spaces

A path will be developed to connect the existing functions in Binckhorst. The North of the site next to the castle will be developed as a quiet nature retreat, while in the south next to the port will be developed as a recreational port, complementing the existing restaurants that reside there.

4

Phase 4: Urban Renovation – Social & Economic Program Interconnection

At the heart of Binckhorst will be the Innovation Factory. The building has a central passage that opens during the summer, connecting the North and South of the site. The central passage is a flexible area that can host various exhibitions, with many different workshops and technologies that are open for the public to use.

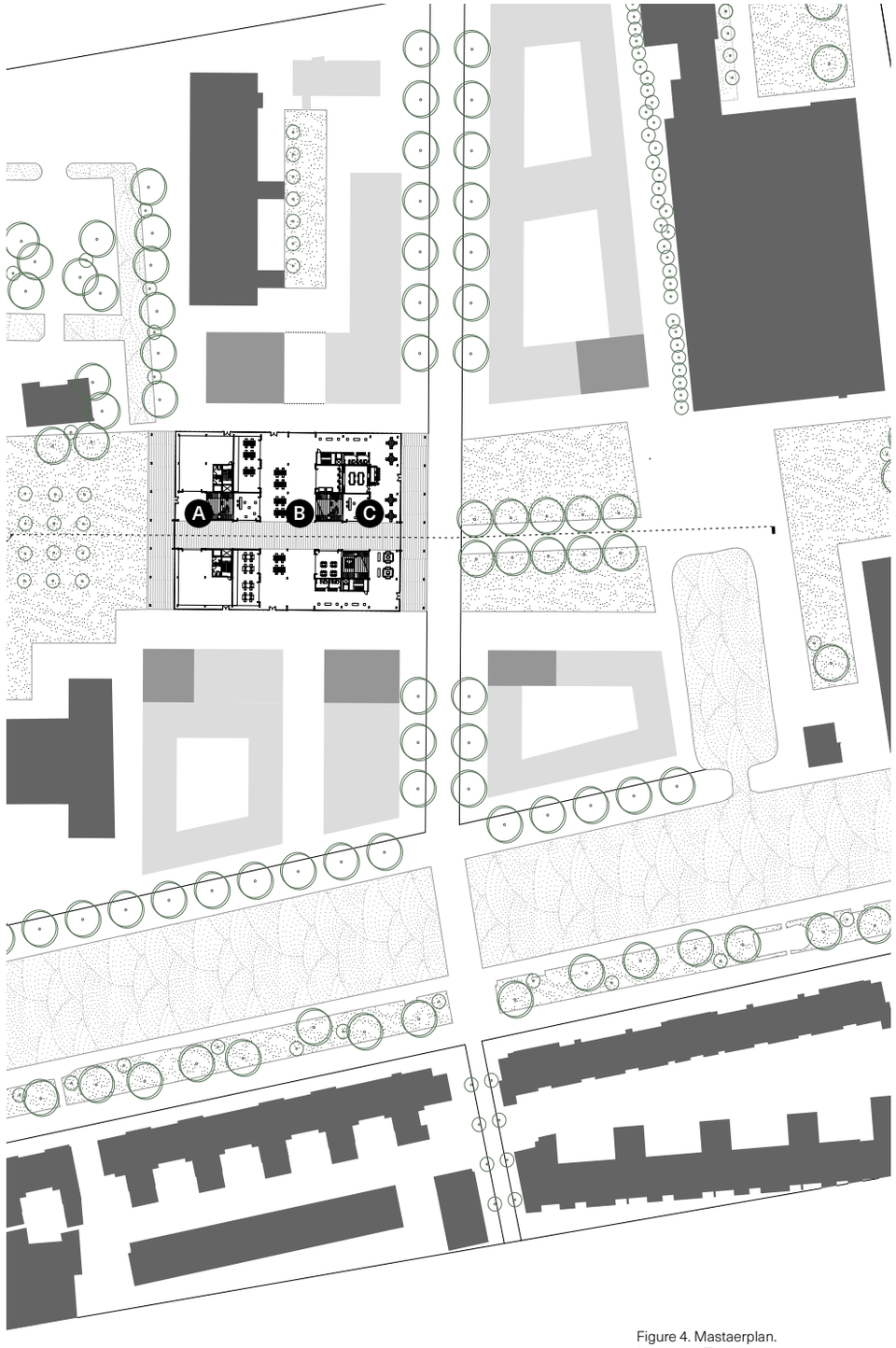


Figure 4. Mastaerplan.
Images by Tim Li

Activated void space (north)

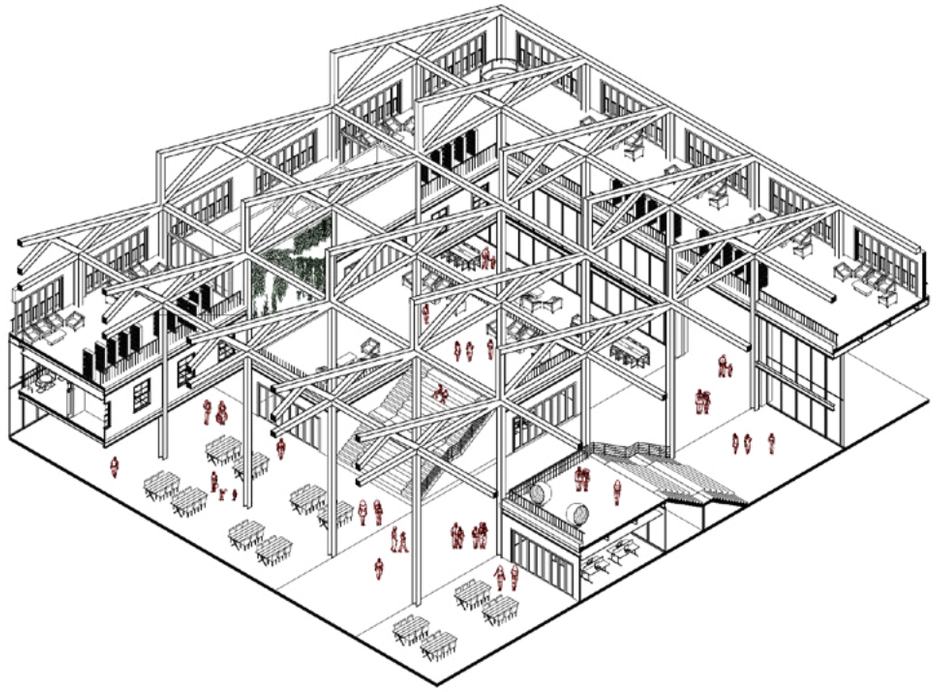
A

Activated void space (mid-section)

B

Activated void space (south)

C



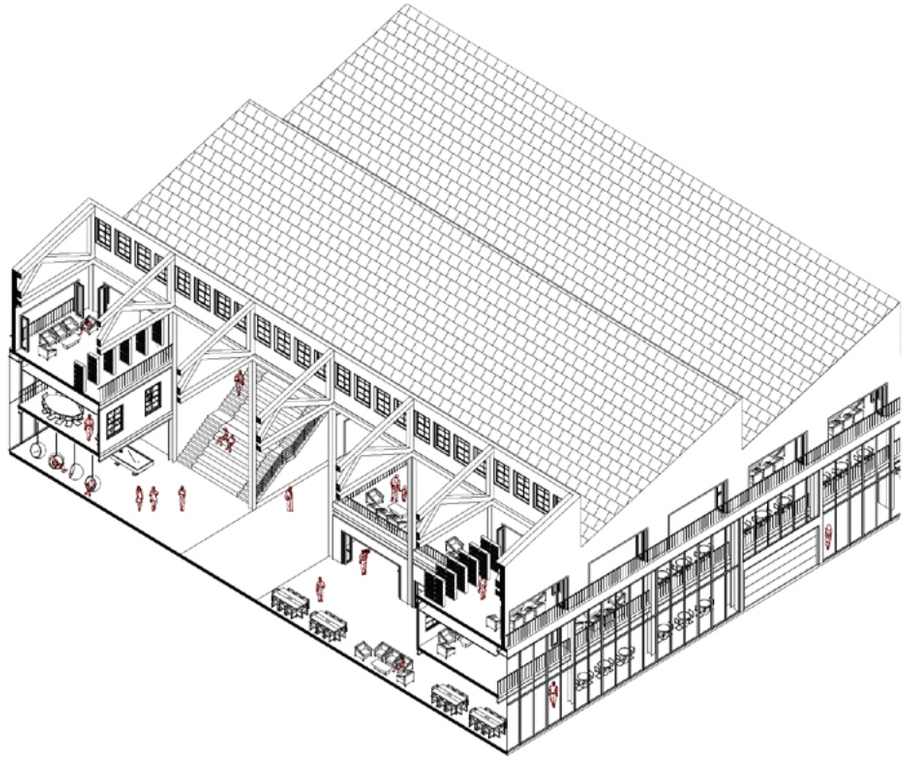


Figure 5. The Innovation Factory: A diversity of space accomodating for different needs, interconnected by central passages and voids as the heart of the urban fabric.
(Open (left) and closed (right) isometric)
Images by Tim Li

Towards a Resilient Venice

Transforming the urban environment after the COVID-19 Pandemic as a way to tackle overtourism

Venice and the tourism industry

The city of Venice had a central role in the development of northern Italy since its foundation more than 1600 years ago. This situation was possible due to its strategic location in relation to ancient trading routes, and unique physical characteristics that allowed it to survive through dire periods. Therefore, creating exceptionally good conditions that fostered economic, cultural, and urban developments in the city. As a consequence of these inherited traits, the basic urban and social structures that now characterize Venice were created, laying down the foundations for its intrinsic architectural beauty and attractiveness. However, in modern times, these very same attributes slowed down the evolution of the city, as it became a heritage site in which industrial activities were not acceptable. As a result, during the 70s the city administration was forced to shift its economic model from the productive sector to the tourism industry.

Consequently, in its early stages, tourism offered a solution to the urgent need for new economic activities for Venice; as it provided a new kind of socio-economic development, as well as unparalleled international recognition. Nevertheless, after years of impulsive growth, tourism has reached unwary numbers. Recent reports show that the city attracts approximately 25 million visitors each year, therefore, not only being one of the most popular destinations in the world but also embodying the dreaded term 'overtourism'.[4] Among its many social and environmental consequences, the main problem of Venice's overtourism is the displacement of locals to make space for new touristic amenities—also known as tourism gentrification.

4. Bardavid, 2020

Figure 1. Walking into the unknown.
Image by Fabrizio A. Chiappe

This phenomenon accounted for the a reduction of the archipelago's population from 175,000 to less than 55,000 residents in the last 70 years.[5] While at the same time promoting tourism-related activities to increase exponentially, nowadays representing 65% of the city's total revenue.[6]

Hence, it is commonly agreed that Venice's gentrification is the main consequence of the tourism monoculture and its lack of economic diversity. This is due to the reduction of job availability for residents, while also having a constant increase in prices for local housing, goods, and recreational activities. Furthermore, as the numbers of tourists continue to rise, the carrying capacity of the city has been long surpassed, therefore being unable to provide basic services for both visitors and locals. This situation is also generated by economic market trends and a lack of regulations that allow for the depletion of public services and amenities, as a result of its systematic conversion into tourism services, as well as a similar transformation of residential dwellings into lodging facilities. All in all, it is possible to say that this situation is created due to the absence of managerial strategies, and the inevitable existence of unregulated markets that fill

5. Mangiapane, 2019

6. Saini, 2020

these voids. Accordingly, this situation also creates a general nuisance in the community, as residents see a lack of governmental initiatives for taking care of its citizens while seeing an increasing number of policies that protect visitors and foster tourism-related activities.

Pandemic onset

The start of the COVID-19 pandemic marked an important shift in Venice's characteristics, as the tourist market was greatly disrupted by these events. In general terms, it is possible to say that around 80% of the social and economic activities were negatively affected.[7] Consequently, two early economic effects of the pandemic were particularly felt in Venice. As it was identified by local stakeholders, the first one was the sudden stop of all tourism-related activities; while the second one was the resulting increase of real estate assets that became available for sale, as owners decided to sell their properties due to the decline of tourists in the city. Thus, creating different types of market reaction's. On one side, there was an increasing number of properties being bought by foreign investors, betting on the long-term recovery of the tourism market. And, on the other hand, multiple properties were offered to local entrepreneurs to foster the development of alternative uses aiming at bringing new social qualities to the city. A similar situation was seen in the housing market, as the gradual closing of lodging facilities prompted owners to decide between waiting for the pandemic to be over or shifting into student and long-term rental markets.

Moreover, it is also important to highlight some social effects that this disruption generated in Venice. As it was revealed by its residents, the city became virtually empty due to the low presence of people and activities. This fact had a profound impact on the community, as it made them realize that Venice needs a greater diversification of the economy and residential markets to have a healthier environment. Furthermore, this very same situation made residents understand that an urgent transformation is needed, therefore, sparking a sentiment of hope around the idea that the pandemic will create a permanent change in the city by bringing new opportunities for the community.

7. Batty, 2020

Potential improvements

The sudden stop of tourism activities created the perfect occasion to restructure how the leisure industry is organized, making Venice more sustainable in the process. For instance, several residents and investors are now wondering how to create a balance between respecting the environment and reviving the economy once the emergency is over. Correspondingly, local universities and grassroots organizations began discussions with the regional government on how to make tourism less taxing and more beneficial for the urban infrastructure and its local inhabitants. In general, they expect that, after the pandemic, an economy that does not revolve entirely around tourism can be developed; for instance, one that would attract international workers and students.

For this reason, this study concluded that a possible managerial strategy—composed of two simultaneous approaches—would be useful for the local municipality to take advantage of this situation. In this strategy, first, a top-down approach is proposed focusing on resilience, and then a bottom-up approach is suggested for implementing adaptive reuse. The objective of fostering state-led and community-led strategies concurrently is that the negative effects of overtourism can be tackled simultaneously from different points of view, hence providing better opportunities for success.
In essence, the importance of resilience resides in the capacity of individuals, communities, and businesses within a certain territory to remain functional and quickly recover from any type of

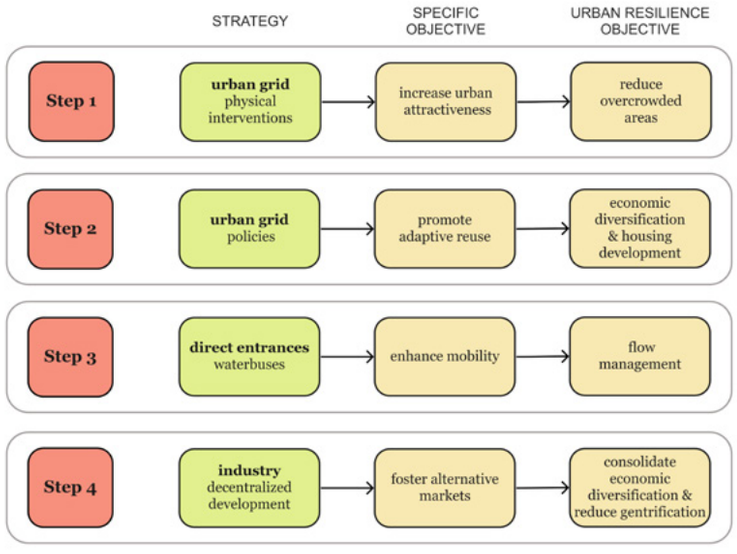


Figure 2. Strategy theoretical overview.

note: Four steps with their respective strategy, specific objective, and urban resilience goal.
Image by Fabrizio A. Chiappe

Figure 3. Strategy physical overview

Note: urban grid (magenta), area of effect (blue), and new & existing direct entrances (orange).
Image by Fabrizio A. Chiappe

detrimental situation—such as the COVID-19 pandemic. Therefore, this trait is presented as a desirable urban characteristic. Thus, the key to improving resilience is to create government policies that can build local capacity to deal with gradual and unexpected changes at multiple scales. On the other hand, adaptive reuse revolves around the idea of promoting initiatives able of bringing new life to old buildings, either by revitalizing their original use or by transforming them. Although the degree of intervention can vary according to specific projects and local regulations, the core objective remains the same; allowing for a better use to take place and contribute to the community's needs. Therefore, these two complementary approaches offer a high degree of interdependence that strives for urban and social regeneration, and consequently, also pushes towards achieving tourism sustainability.

Moreover, it is known that forcing tourist-driven cities to renounce their main source of income is not a feasible solution. For this reason, despite knowing about the disparities that the tourism industry brings along, this in-between time should be used as an opportunity to reimagine the relationship, thus developing a living organism that is more balanced and future-proof. In most situations, a mutually beneficial outcome can be achieved by linking tourism with other traditional aspects of cities, hence valorizing, and preserving not only the physical heritage but also safeguarding intangible cultural traits and virtues that derive from it.

Consequently, for a better implementation of the suggested approaches, it is recommended to blend them with inherited traits from the local culture. This can be done by embracing embedded characteristics to strengthen alternative solutions, without using alienating strategies. For example, in the case of Venice, enhancing the existing relationship between the city and its surrounding

lagoon, as well as stressing the connection between residents and its unique built environment. Likewise, allowing for a future that can host cross-systems of life and work based on new economic markets and diversification. As a result, having urban and tourism resilience policies as basic guiding principles, while also functioning as enablers for community-led initiatives. Therefore, as it is possible to see in the following overviews (figures 2 & 3), this strategy consists of 4 steps that contribute toward the creation of better urban resilience qualities in Venice. Nevertheless, each one has a unique approach that addresses specific objectives to solve intrinsic problems that the city is facing. For instance, the first step suggests the implementation of an urban grid utilizing physical interventions (top-down approach) aimed at increasing the urban attractiveness of neglected neighbourhoods to spread tourists and, thus, reduce overcrowded areas. Similarly, the second step encourages the introduction of state-led policies that promote and facilitate adaptive reuse initiatives from the community (bottom-up approach), complementing and speeding the previous step while also striving for higher economic diversification and improving housing availability. Likewise, the third step recommends the introduction of direct waterbuses entrances to the city (bottom-up approach) as a way to enhance mobility, bypass overcrowded areas, and thus, achieve better flow management of people and activities. Finally, the last step suggests the creation of alternatives economic markets by promoting the decentralized development of industry (top-down approach), to shift the existing economic model further away from the tourism industry.

International applicability

Finally, due to the current global situation, it is deemed to be a great time to study, raise awareness, and look up for possible solutions that can foster sustainable developments in other urban environments. Even though this research revolves around Venice, the broader goal was to develop a framework that could also serve as an example for other cities experiencing similar situations. Consequently, the following diagram is proposed as a guideline that functions as a tentative municipal tool for steering future urban developments. As can be seen below, this process starts with the understanding inherent problems and needs of a specific city to develop a theoretical study of the issues identified for the area and its corresponding possible solutions. Then, an empirical analysis of the affected area and its main stakeholders is required to validate the information obtained before. Later, the creation of future scenarios can start with trends derived from underlying problems and their projected market evolution. Finally, by taking into consideration intrinsic characteristics that the city already possesses, a feasible and integrated approach can be developed, therefore, establishing a comprehensive strategy for the short- and long-term future.

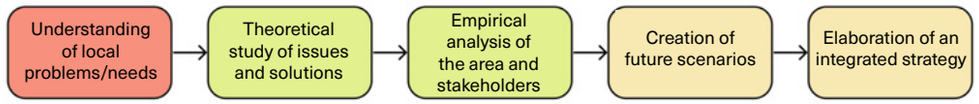


Figure 4. transferability guideline.

Note: Identifying the issue (red), acquiring knowledge & data validation (green), proposing a solution (yellow).
Image by Fabrizio A. Chiappe

Figure 5. Strategy visualisation.

Note: Imaginary city of Venice, in which multiple uses and economic activities coexist with tourism; and public spaces and mobility are given priority.
Image by Fabrizio A. Chiappe & Akshit S. Parmar

Place-making with the Makers

Carlos Lüchau

Place-making strategies in redevelopment of urban industrial areas

The future of urban areas is uncertain; as cities continue to expand and transform, unforeseen changes in daily life make our actions unpredictable. So, are we shaping places (un)intentionally? The development of urban areas has become a complex process given the dynamic forces of people's behaviour, environmental and health challenges, local ambitions, and global trends. Let's make it concrete. In the Netherlands, especially in the densified Randstad region, challenges are accentuated due to the rapid urban growth and diverse ambitions. While the region tries to overcome living and environmental issues for the upcoming years (e.g., housing and nitrogen crisis), each city has distinctive long-term visions given its challenges and opportunities. Similar to other cities in the region, Delft confronts a housing shortage and rapid urbanisation; though, it aims to differentiate by becoming the high-tech capital of the Netherlands through an innovative manufacturing industry and the redevelopment of the industrial area Schieoevers Noord.

Due to the scarcity of land and the urge for available infrastructure, industrial urban areas have attracted interest in redevelopment and transformation into mixed-use areas. These transformations have been associated with the process of place-making to create attractive and successful places with a strong identity and high quality. Place-making aims to make distinctive places through conscious decisions of intervention that are otherwise created through traditional development.[8] This process is a continuum of shaping space for use and through use, especially related to urban design and actor involvement, creating a better sense of place and encouraging local distinctiveness.[9] However, conflicts arise when dealing with the redevelopment of these industrial areas since the ambition to foster new higher-yielding activities (e.g., housing and commercial) is assumed to clash with the existing and future manufacturing activities associated with given areas. Manufacturing is affected by the normative perception of its environmental nuisance plus its low yield compared to other uses.[10,11] Although these other activities are drivers in achieving sustainable and mixed-use areas, the tension has exposed the vulnerability and limited leverage of manufacturing activities in urban areas. Even if manufacturing is protected from urbanisation through economic policies or spatial planning, there is no certainty of a successful mixed-use area or industrial business growth after redevelopment.[12]

Urbanisation is contributing to economic growth through economies of scale by increasing productivity and reducing costs to fulfil the demand from the market. Although manufacturing has transformed cities into "great machines of production and opportunity",[13] economies of scale have led to spatial uniformity and places that do not represent

8. Adams & Tiesdell, 2012

9. Carmona, 2010

10.Hatuka & Ben-Joseph, 2017

11. Hill, 2020

12. Davis & Renski, 2020

13. Croxford et al., 2020

Figure 1. Schieoevers noord is defined by underlying spatial and socio-economic conditions for manufacturing activities.
Image by Carlos Lüchau

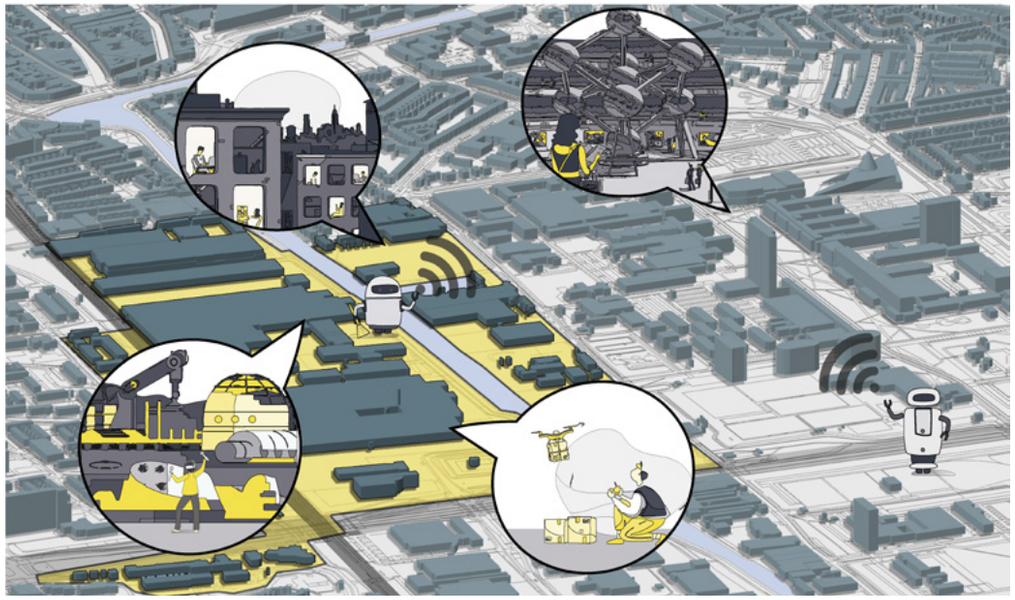


Figure 2. Scenario e-Cosystem: in a scenario with low proximity and high diversity, collectives should establish collaborative agreements and a decentralised network for investment and development.
Image by Carlos Lüchau

the local economy, resulting in standardised landscapes and the notion of placelessness.[14] This results from the obsession to make places that respond quickly to urbanisation, without analysing the diverse decisions that steer developments towards future physical and nonphysical outcomes. Thus, exploration is needed over the decision-making environments where place-making strategies become suitable and effective strategies for these industrial urban areas.

14. Verheul, 2015

Methodology

The research approach has been done through the lens of urban development management, a field that combines concepts from urban planning, design, and property development.[15] This approach allowed having an integrated approach to spatial, social, economic, and environmental dimensions. Therefore, the case study was analysed through a holistic model involving the actors, area, outcome, and strategies of the project. Given the nature of the issue at hand and its "wicked" problem, it was decided to follow the research as research

15. Van Bueren et al., 2016

16. Berkers et al., 2019

17. Daamen, 2010

by design, which facilitated transcending from conventional frameworks of area development and urban design. Research by design allows for uncovering challenges and issues from the decisions taken by the involved actors.[16] To follow this approach, the theoretical framework is based on the decision-making environments as interrelated arenas in which actors from different networks are encountered to handle specific issues and take action.[17] The arenas are: "Urban Area Development", where actors, for instance, policy-makers, developers, and planners, shape space for use through vision, design, negotiation, and policies, amongst others; "Mixed-use Area", where space is shaped through use by actors like residents, workers, commuters and managers who operate, adapt and appropriate in daily occupation; and "Urban Manufacturing", where space is shaped through use by actors involving the operation of business networks, in particular producers, service providers, suppliers, and clients.

Actors make decisions within a dynamic system that is in constant continuity and change. Therefore, the research approach involves a process of scenario planning to describe plausible future scenarios, supporting the nature of the studio (i.e., City of the Future). The plausible future scenarios for Schieoevers Noord were explored through the relation between proximity and diversity, and their impact on area conditions and decisions taken by actors. This process resulted in four scenarios, namely Economic Hotspot, Mix & Make, e-Cosystem, and Local Leverage. Each of them presents an alternative future with different implications for the strategies.

To support the research, data was collected from in-depth interviews and case documentation of Schieoevers Noord. Public documents of authorities and developers were used as the main source to understand the context, vision, and actors

involved. Moreover, participation meeting reports of the redevelopment process were taken as a first step to grasp qualitative data and analyse stakeholders' perspectives. In-depth interviews with several of these stakeholders were conducted through an inductive approach to reinforce data collected from the meeting reports. Finally, some interviews with experts facilitated the research theory and process validation.

Results

The results of the case analysis presented a reference point for plausible future scenarios in the area. After the process of scenario planning, the scenarios to consider are Economic Hotspots (low proximity, low diversity), where global strategies are implemented to boost the local economy, resulting in an autonomous area with economic growth and the presence of large corporations; Mix & Make (high proximity, high diversity), in which local authorities gain power through zoning plans and environmental frameworks to regulate activities while integrating the area to the urban fabric and empowering place-based organizations; e-Cosystem (low proximity, high diversity), a scenario where the business association steps in to make a collaborative agreement that establishes a virtual decentralised network for investment and development; and Local Leverage (high proximity, low diversity), where policies are implemented to promote local production, a 15-minute-city and special local regulations to combine living and working.

Based on empirical findings and these future scenarios, opportunities and challenges were revealed within the three arenas, namely Urban Area Development, Mixed-use Area, and Urban Manufacturing, which can be managed through effective strategies.

First, in Urban Area Development, opportunities to be exploited concern having positive relationships between actors, in particular local authorities, developers, landowners, and investors. It is essential to portray local companies or organisations as business ambassadors of the area. Besides, there is potential to promote co-creation with the community to develop connectivity as a whole. Thus, the creation of meeting places and public participation should continue as a means of the redevelopment process. Challenges to overcome are the dependency on private land ownership or reliance on public support, leading to vulnerability to market shifts or political interests.

Second, in Mixed-use areas, opportunities are revealed to enhance communication and implement proper operation management. Discussion, interaction, and involvement of different actors are key to mixing living and working. Besides, these actions encourage to develop awareness of the existing businesses. Barriers to overcome are the lack of consideration of some activities and meeting places during decision-making while relying on private events and interventions as sole place-making strategies. Coordination, allocation of activities, and decision-making could be done as a collective to consider a decentralised curation.

Third, the arena of Urban Manufacturing shows the opportunity to involve knowledge actors to innovate digital and high-tech operations. The presence of related services and institutions facilitates proximity to clients, knowledge development, and human talent. On the other hand, reduced space availability and affordability are challenges to overcome through space optimization in large-scale businesses.

To overcome future challenges in the redevelopment of industrial urban areas into mixed-use areas, place-making strategies should be implemented promptly, within the relevant arena and involving the respective actors. Not every strategy

can be implemented simultaneously or immediately, thus directing a strategy can facilitate unlocking new opportunities for further strategies. In an industrial urban area, it is essential to start with strategies that activate businesses across all industries and scales to exploit positive interests and prevent place-breakers, in particular those actors that have higher leverage due to land ownership. Strategies based on building business ambassadors, developing awareness, and operational innovation start with policy changes, capacity building, and financial incentives to stimulate immediate investments through physical and non-physical means. On the other hand, strategies like co-creation, decentralisation, and space optimisation take more time but can facilitate community engagement and socio-economic interaction throughout the process.
Place-making of industrial urban areas is a process that takes a long-term commitment and an acknowledgement of business operations, in particular manufacturing activities. Therefore, overcoming shifts of plausible future scenarios can be done by properly managing actors and their interests. In other words, place-making strategies differ in arenas where space is shaped for use (e.g., Urban Area Development) than when it is shaped through use (e.g., Mixed-use Area and Urban Manufacturing). Besides, actions taken in the daily occupation between living and working are different than the ones within the business network; thus, strategies should fit the purpose. Nonetheless, the implementation of strategies over all arenas can enhance the effectiveness to overcome future challenges in the redevelopment of these areas.

Conclusion

Several aspects are relevant and compelling to consider. Findings revealed the dependency on private land ownership and public support. Nevertheless, the rise of decentralised networks in the economy, technology and social platforms due to industry 4.0 has opened the way to explore business models on decentralised ownership and financialisation. Public funding should not be taken for granted and innovative business models should be explored to implement the given strategies or other actions within area development in industrial urban areas. Given the rise of the virtual world, the concept of proximity to other people, e.g., neighbours, clients and knowledge actors, among others, should be touched upon to understand the qualities of proximity in the physical and nonphysical dimensions. Last, COVID-19 has exposed several challenges for participation and close contact between stakeholders, for instance, the increase of stress and uncertainty, and the ineffectiveness of online participation meetings. While participation processes have good intentions, most of the time they are followed as informing sessions rather than authentic participation and delegation of decision-making. COVID-19 has brought radical changes in the way to interact with others, though it has sped up new technologies and virtual tools that can facilitate better participation and interaction in the process of design and development. Therefore, efforts should be made in research and practice to find possible implementations of new virtual participation tools and collaborative platforms for redevelopment processes.

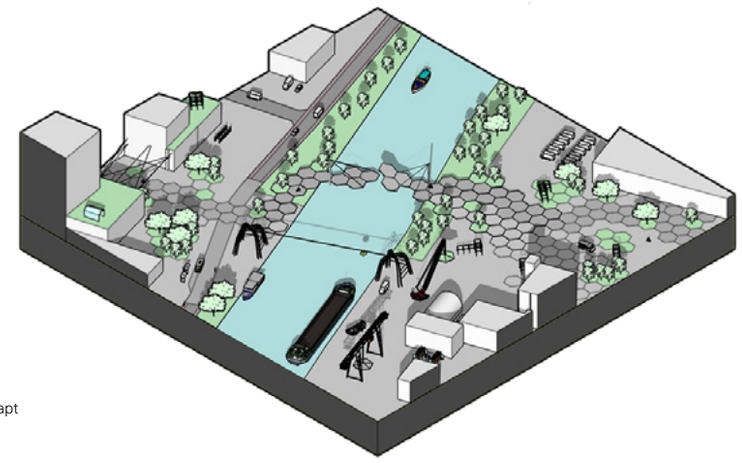


Figure 3. Co-creation is needed to connect people and space, and adapt continously to diverse demands.
Image by Carlos Lüchau

Interview

Carlos Lüchau
MBE graduate

Introduction

I am Carlos. I have a background in Architecture and I joined the MSc Management in the Built Environment. I joined the 3rd generation of the studio. Now I'm working as an architect in my own studio, which I started six years ago.

Motivation [pre-phase]

What motivated you to choose the studio?

It was certainly curiosity. I was looking for a studio that allowed me to blend design and management. After practitioning architecture for some time, I noticed the recurring challenge of speaking with clients or developers. They seemed to speak a different language and I needed to understand them to be able to assess whether my architecture proposals were feasible or not. So that brought me to study management. My special interest was to understand how management decisions create outcomes in design.

How was your experience with the educational setup of the studio?

I've been quite curious about how cities evolve. When I'm visiting a place, I like to walk around the areas that are actually not touristic, because when you go into the touristic areas, museums and everything, it is quite beautiful. But I like to go to the backstage of the city. Where things are made. I've been always curious about how cities change.

Experience [process phase]

How was your experience with the educational setup of the studio?

What I truly like about the studio is that it gave me the opportunity to compare and contrast my interests and knowledge between management, architecture and urbanism. We had all kinds of lectures from practitioners from different fields. It was quite interesting to watch a lecture from an architect and think: what is my perspective on this lecture as a manager? And then be able to ask questions from a manager perspective and see how an architect replies. Questions such as: who makes the project? Who will pay for the product?

Unfortunately, during COVID, it became harder to share ideas and see people's work. We had to connect mostly virtually, which was not ideal.

How did the product approach from management influence your design? And how would your thesis be different if you only graduated within the MBE track?

You can clearly see that architecture projects are way more specialized in design visuals, while management projects are about using scientific methods to design processes, so it's a reading/writing exercise. But I think both MBE and architecture are ways of designing. It was enriching to combine both; from management to design, I worked on making something visual. At the end of the day the client wants to visually see the outcome of everything.

From a process perspective, how was it to join management and design?

You have to know when you put your hat as a manager or developer or client and when you put your hat as an architect. Sometimes if you try to work at both you will delay your decisions. You can't do both at the same time. If you have to make a decision in architecture, you have to become an architect and start thinking about it as an architect.

It's interesting, but it has been more challenging than I expected. One of the challenges was to stop writing and start designing something visual. I think it's that tension between the two professions that will demand each of us to go beyond our professions to ultimately create a real product.

Could you give an example of this interaction between management and architecture in your practice?

Uncertainy is a good example of how these disciplines interact. While management handle these through robust strategies, numbers and projections, the creative profession (architecture) quickly explores alternatives and brings in innovation to deal with uncertainty.

The project [post-design phase]

In what ways does your project answer to the studio's theme?

I explored the future of an industrial area in Delft. I`ve always been interested in manufacturing and craftsmanship. There's a vision for this area to become the most innovative capital in the Netherlands. But how can a city of 100,000 people achieve that?

The approach of the studio to see things as systems of systems is interesting. How a place can create change in a city, a region and even a whole country. A manufacturing site in a specific place can impact and be impacted by changes in country-level. Few examples in the Netherlands would be the housing issue or nitrogen restrictions. I created four scenarios of how this industrial area would develop. In one of the scenarios, the area would become a complete economic hotspot while in another scenario the area would be a place where local residents would have small workshops. Then I designed adaptation strategies for them. In the workshop scenario, for example, I proposed flexible workshop spaces that would change according to the development of new technologies.

When you look back at your project, what touched you the most?

I think you have to enjoy the process because the outcome, to be honest, can be any outcome. I enjoyed the process of challenging myself and I love the debate I had with myself as a designer and as a manager. If you enjoy the process, you will probably enjoy the outcome!

Interview

Fabrizio Chiappe
MBE graduate

Introduction

I`m Fabrizio, I come from Peru and I'm an architect. I studied architecture for five years back in Peru and then I worked as a designer for an architecture studio for 6–8 months. After that, I took an extra year to get certified as an architect. Right after, I started working as a freelancer for a couple of years, from project design to construction and final delivery. After realizing I needed more construction experience, I worked part-time as a construction supervisor, and then I decided to learn more about management so I decided to enrol for the master in management at TU Delft. I joined the third generation of the City of the Future studio.

So you came to the studio already with a good multidisciplinary experience?

Yes, one of the things that characterize me is that I like to try new things. I also work as a teacher back in my home university for example. So it was a little bit of academia, a little bit of construction and design management. I was trying everything related to architecture and trying to find my way.

Motivation [pre-phase]

What motivated you to choose the studio?

I thought the MBE master would be more related to architecture design than it is. It was more related to financial and stakeholder management. As an architect, I was missing the design component. Working in the studio with urbanists and architects would give me the option to develop my thesis in this direction, even though I knew my thesis would be policy-related. That's why I decided to join the studio.

Plus, my career goal is to make an impact and work for a municipality. Not just as an urban designer, but maybe also as an urban planner or policymaker. How to placemake the city and enhance the relationships with other stakeholders. And I saw the studio as a first step in this direction.

How did the multidisciplinary environment influence your research and thesis?

The other students definitely influenced me. Seeing other projects pushed me to go a bit further than policymaking. Professors encouraged me to also tackle urban design aspects.

Experience [process phase]

How was your experience with the educational setup of the studio?

Some of the lectures were helpful, others not that much. Most of them were very focused on theoretical design, which reminded me of my time as an architecture student. But I also remember this lecturer from TPM that talked about transport policy and management. This gave an extra layer of complexity to my project.

The workshops were more on soft skills. Creating, developing ourselves, and how we interact with other people. It was nice because during the thesis we tend to work by ourselves and we forget about interacting with others, which is essential when you start working, especially on multidisciplinary projects.

Did you find the tutors from different fields helpful?

One of my tutors was from MBE and the other from Urbanism. I was lucky because they allowed me to explore and try what I wanted to do. They were always checking and giving suggestions that made me discover new things outside my MBE point of view. I'm grateful for how open they were towards new ideas.

How did these different disciplines help you develop your topic and your final outcome?

For my thesis theme, in MBE you work from a policymaking perspective, developing a management plan and a financial report. I was pushed by my mentors to also do a little bit of design. They challenged me to imagine the city from a designer perspective, how things would look like in reality. And that was very important for my thesis.

If you took another course from MBE to graduate in, how would your thesis differ?

We do have a course in MBE which was similar to what I was aiming for in my thesis, but it was on a smaller scale. We worked on a policymaking plan for TU Delft. The big difference was that in the studio I was always in contact with design proposals from different students so that gave me new ideas that normally I wouldn't think of.

The project [post-design phase]

In what ways does your project answer to the studio's theme?

In my project, I started by proposing solutions for vacant real estate from a financial perspective. How to make it more rentable, and how to increase the profits while reducing vacancy. From there I worked on how I could use this to deal with other necessities for the city: the urban environment, public space, and mobility. I created a plan that addresses both issues. This integrated urban and social perspective was the biggest contribution of the studio. The studio also helped my project to deal with time scales. In MBE, we usually design policies so we focus on the long term, 5–10 years. With the design component, I was able to tackle the short term by working with temporary solutions that can be implemented immediately or in a few months.

How did the graduation studio shape your career direction?

Before joining the studio, I had an idea that I wanted to work with projects that have an impact on the city. Now after the studio, I see clearly that I want to work for the municipality. I want to be able to put different specialities together and be able to create a final product for a city scale.

Cities of the Future: Towards Sustainable City Economies

Erwin Heurkens
Assistant Professor of Urban Development Management, TU Delft

It goes without saying that cities of tomorrow face numerous challenges that will change their appearance drastically. We only now begin to notice a gradual change towards climate-adaptive cities, inner-city renewable energy production, and more healthy urban environments by re-naturing our public realm and buildings as well as accommodating societal initiatives within urban neighbourhoods. Such sustainability transitions within the built environment unfold in front of our eyes and are as appealing as urgently needed to make our cities liveable and thrive. Nonetheless, the physical transformations that come with such changes are also driven by economic factors and conditioned by financial aspects less visible and tangible. Yet, unquestionably, they help drive and support such sustainability transitions and built environment transformations. So how can we conceive of the economic factors shaping the city of the future?

It is paramount for any city to be economically resilient. This means that it can bounce back from shocks and hazards such as climate change impacts. This can best be established by betting on different horses, allowing cities to be economically diverse by accommodating a variety of economic sectors within the urban fabric and city regions. Detroit and Liverpool have shown that overreliance on a single economic sector has devastating effects on the social and environmental resilience of cities, such as increased unemployment and poverty and 'ghost neighbourhoods' with boarded-up homes. This entails that city policy-makers must carefully consider what type of economic clusters and expertise are present and which ones are needed to improve the economic DNA of their cities.

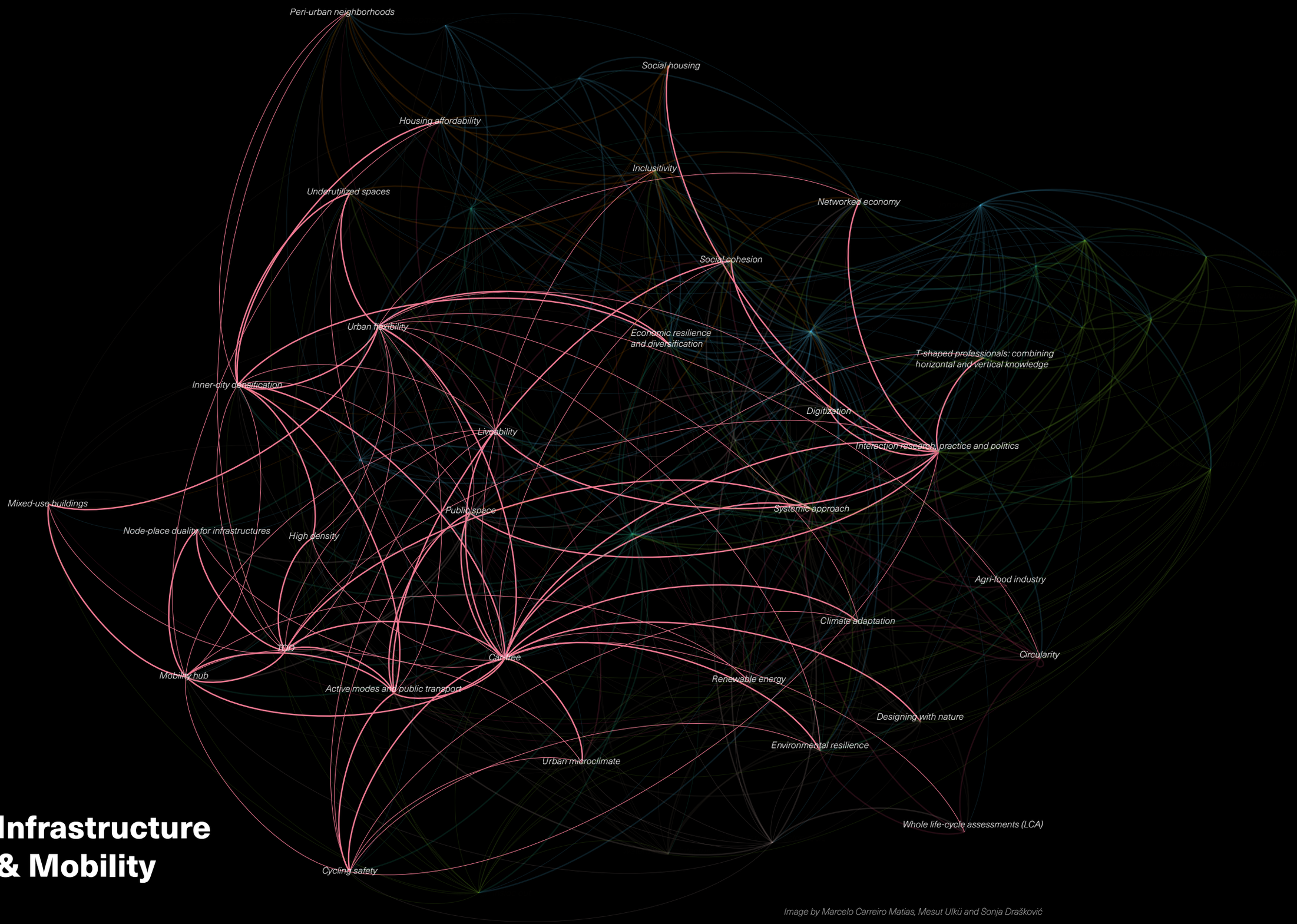
By attracting 'new economies' that build on existing economic strengths, cities can become more resilient. Diversifying city economies, however, also comes with physical changes. 'Innovation' for instance is not reserved for out-of-town high-tech campuses but requires physical space within our inner city as it is the place where people from all sorts of life mingle and interact. Therefore, displacing business or industrial and manufacturing activities from cities to the periphery in favour of housing is an unsustainable choice. We need city planners, architects, developers, businesses and citizens to develop ideas for spatial functional co-existence, and mixed-use places with room for living, work, and leisure. However, from a financial perspective, this is easier said than done.

Public policy ambitions for more sustainable cities nowadays focus on intensifying infrastructure use and development and, foremost, densifying cities through urban transformations. This comes at a financial price though. It is far more complex and costly to develop inner-city brownfield sites than greenfields. Land must be acquired from landowners, polluted soil must be remediated, and (opposing) interests of citizens must be taken aboard in lengthy participation trajectories. It is not uncommon that inner-city developments are financially unfeasible, the costs transcend the benefits, and that housing becomes unaffordable as a result.

For such occasions, the Pavlov reaction from involved stakeholders is to call on governments for financial subsidies to improve the project's balance sheet and realise plans, or to lobby for greenfield developments. Although such subsidies can be justified by governments as they might assist in fulfilling urgent housing and sustainability needs, they can be considered low-hanging fruit in terms of financial innovation.

Currently, financial arrangements for urban transformations that seek to combine public values with private returns have come to fruition, such as Area Improvement Districts (AIDs). AIDs are built upon a collective designated area fund, filled by (proportional) fees from existing real estate owners and tenants as well as financial contributions from developers or collectives that initiate new developments, to be invested in 'hard' and 'soft' public realm improvements such as climate-adaptive urban plazas and community-led place-making initiatives. Ultimately, such arrangements on the one hand enable existing stakeholders to become more economically and socially engaged with the places they live, work or leisure in, and on the other hand encourage newcomers to co-invest in the area rather than making a one-time profit.

In brief, it is therefore my belief that future sustainable cities require experimenting and studying the redevelopment of urban transformation sites as continuous dynamic (economic) endeavours aimed at mixing physical functions, integrating actor needs, and coupling various financial investment streams. Only then can future cities become more economically sustainable and resilient.



Infrastructure & Mobility

Image by Marcelo Carreiro Matias, Mesut Ulkü and Sonja Drašković

Introduction

Jasper Rouwenhorst

Our cities are a dense multitude of places connected as a network. When designing a city from scratch, planners draw several plots, create zoning plans and provide infrastructure. But what happens when zoning changes? If a city densifies for new types of urban dwellers? Or if new technologies radically change the way we transport ourselves in the city? In realising that contemporary urban developments do not merely impact the plots that they occupy but also the composition and functionality of the city, spatial design for the city of the future will mean considering integrated developments beyond the plot, considering the changing interaction between the place and the supporting network. Herein lies, as our theses will show, the beauty of the subject of mobility within the City of the Future Graduation Lab: how the multidisciplinary setup allows us to show the necessity and potential of the integration of these disciplines?

City and infrastructure

The city and its infrastructure are in mutual interaction. Today, as the Netherlands urbanises and a pressing housing shortage emerges, more needs to be built in existing urban areas whilst maintaining living quality. This, in turn, requires rethinking established infrastructure patterns. Will this be tackled by expanding the city? Or does the answer lie in developing around existing infrastructure? How do these choices impact the way people live and can use the city? In an established urban system, a great deal of creativity and careful consideration is required to both tackle current issues and project future use of both buildings and infrastructure. In short, how do we ensure a future-proof discipline of integrating the development of mobility and the built environment?

Student projects

Due to the research-based approach and the multidisciplinary setup of the studio, the student projects shown have invited a range of different scales of visions and scenarios that may include new directions in urban planning, the importance and impact of new mobility as a basis for urban design, or questioning the way we use and live with our modes of transport. Even though the students working within this theme come from different fields of study, their theses can sometimes nicely complement and provide each other with a fitting and reinforcing context.

Within the contemporary challenges created by the urbanisation of the Netherlands and beyond, the potential created by Transit-Oriented Development (TOD) is explained by Davide Massa's project *Getting the Still and the Moving Together* from a transport policy point of view, advocating the integration of urban and mobility planning and highlighting important factors that need to be addressed to successfully implement TOD. Meanwhile, both Jasper Rouwenhorst's project *Between Dwelling and Rail* and Mesut Ulkü's *Project HUMAM* focus on TOD from an architect's point of view, showing the urge for an integrated approach to densification around public transport nodes to elevate the quality of life in this local area in both the private and public sphere.

Focusing on transport planning, Marcelo Carreiro Matias' project *Built (Im)permanence* is inspired by new types of urban developments are dynamic in form, function and time and thus can rapidly change the pressure points in infrastructure networks. He aims to define how the infrastructure network as a rigid structure, should be able to handle these changes and offers advice on resilient infrastructures. On a different scale, Leanne van Bentem's project *Safe cycling infrastructure* complements this by focusing on the safety of cyclists within this urbanising environment. She aims to create a model to assess the risk of bicycle accidents in relation to infrastructure design, as most traffic collisions include this vulnerable mode of transport that is vital to a sustainable urban city of the future.

Thus, in the following pages, different student projects with different approaches to the same challenges show how closely urban development and mobility studies work together and what opportunities an integrated approach can offer towards a more efficient, safe and liveable city of the future.

Getting the Still and the Moving Together

Davide Massa

How Transit-Oriented Development benefits the city of today and tomorrow

Urbanisation: challenges and opportunities

Every social group dwelling in the same territory is composed of a variable number of individuals sharing common interests and making up what is defined as a society. Their proximity is determined by any sort of convenience to hold themselves together. For humans, gathering in increasingly larger numbers has historically resulted in the process of urbanisation. Villages first and cities later have experienced a continuous albeit irregular expansion that for the time being sees no reasonable forecasts of a slowdown, let alone an inversion. Various achievements could be selected to describe this trend, two of which I want to mention here: Rome as the first city to reach the threshold of one million inhabitants in the first century AD,[1,2] and 2007 as the first year in history with a majority of the global population living in cities and urban areas.[3]

Understanding the urbanisation process is crucial to develop efficient strategies in terms of both urban and transport planning. These two disciplines have long evolved independently, often causing unbalances in the built environment that a coordination of the same two could have avoided. But where can coordination take place, and how? The first question is easily answered by considering the intersections between what I like to define as the still and moving components of cities, namely what allows urban-based activities to take place, and what allows displacements between such activities to happen. Two main intersections exist: mobility hubs and Transit-Oriented Development. The former comprehends public transport stations and stops, as well as ports, airports and any mobility interchange solution; the latter has the same core while covering a wider scale and is discussed in this chapter.

1. Modelski, 2003
2. Morris, 2010
3. United Nations, 2007

Figure 1. Example of TOD: metro station and adjacent mixed development (Kista, Stockholm)
Image by Davide Massa

The recipe of TOD

Transit-Oriented Development (TOD) can be thus described as one of the most significant attempts to combine creation of urban and transport projects in an interactive and sustainable way, where the specific interests of the user–thus any person living, working or travelling within the project area–are put at the centre. While the definition of TOD, dating back to the 1980s and early 1990s, is relatively recent, most of its key principles have found earlier applications, especially during the post-World War II demographic and urban boom in Central and Northern Europe, East Asia and, to some extent, in the then Soviet Bloc. The main idea of TOD lies in the planning and construction of mixed-use areas, encompassing residential, commercial, institutional, cultural, and leisure options, all characterised by convenience and effectiveness of sustainable transport modes choices, with a pivotal location in each area, called hub, centred on a public transport facility.

This set of principles was elaborated by American architect Peter Calthorpe, who studied the feasibility of neighbourhoods where different transport modes — private and public — complement each other. The private, namely mostly the car, is therefore not banned, rather destined to the trips that may actually require it; the public, instead, is organised to provide accessibility to the users who, for any reason, do not own a private vehicle, and that are hence put in the condition of not needing one, thanks to a planned maximum walkable distance of 600 to 800 meters between any function within the project area and the hub or any complementary transit stop. Thereby, the so-called last mile issue is addressed sustainably, and various development patterns originate, including densification and land value increase, often together with the phenomenon of residential self-selection, with people relocating to areas more in line with their travel preferences.

There exists clear evidence of the TOD principles evolution way before their actual definition a few decades ago. Following the Industrial Revolution, ideas of a multi-central city and distributions of functions along specific axes were part of the Garden City and Linear City models. Back then, multi-centrality and linearity were seen as necessary due to the high urbanisation trends together with the way lower private transport affordability and popularity; with actual TOD, instead, the main driver becomes the chase after a more sustainable and convenient lifestyle for the users, as well as a more logistically effective and thus economically convenient approach for the involved stakeholders. A few decades later, in the early 20th century the movement of Futurism also played a defining role for TOD in the conception of multimodal transport hubs. The unexpected challenges of modernity pushed a number of artists like Italian architect Antonio Sant'Elia towards the imagination of new solutions for cities, including on how to efficiently combine different urban and transport issues that had begun to show that cooperation was inevitable. Although such futuristic projects were never realised as World War I outbroke, they enlighten us on how an integrated design would prove beneficial and make a difference.

The genesis of TODs varies according to the chronological presence of the two main components, namely buildings and transport infrastructure. Three main cases may be usually encountered. Most frequently high-density areas can be found where transit is brought, like a new metro line with the new stops converting themselves into TOD hubs; on the contrary, there can exist low-density areas where transit is already present with one or more stops, which brings more functions and eventually increases the density; finally, albeit rare, stands what could be defined as an original TOD, with both the development and the transit being projected and realised altogether. From which pat-

tern a specific TOD derives depends on the nature of the selected area and the involved stakeholders' interests combined with the responsible political structure and its attitudes and intentions.

A fundamental aspect of TOD lies in the mutual benefits that sensible urban and transport planning bring to each other. From the planning perspective, the choice towards a mixed development sets the ground for a more even usage of an area that is not circumscribed to the nights, early mornings and evenings, as in purely residential zones, or to the daytime only, as in industrial and service-related zones. From the transport perspective, the choice of frequent and reliable public transport modes allows users to travel quickly and conveniently to other zones of the same city. To guarantee a good level of service, the best modes are rapid rail transport like metro and suburban lines, but also tram and bus lines, especially when upgraded to light rail and bus rapid transport (LRT and BRT), characterised by higher capacities and speeds made possible by exclusive right of way, with the vehicles travelling as separated as possible from the remaining traffic. Starting from the hub, modes belonging to a lower hierarchical level may be considered to reach more distant points of interest, and they can be traditional buses as well as shared options belonging to the Mobility-as-a-Service (MaaS) family. Making the right choices on the two described perspectives usually produces a feeder effect, a virtuous circle where an improvement of one of the two has a positive relapse on the other, and vice versa, fostering the TOD site convenience.

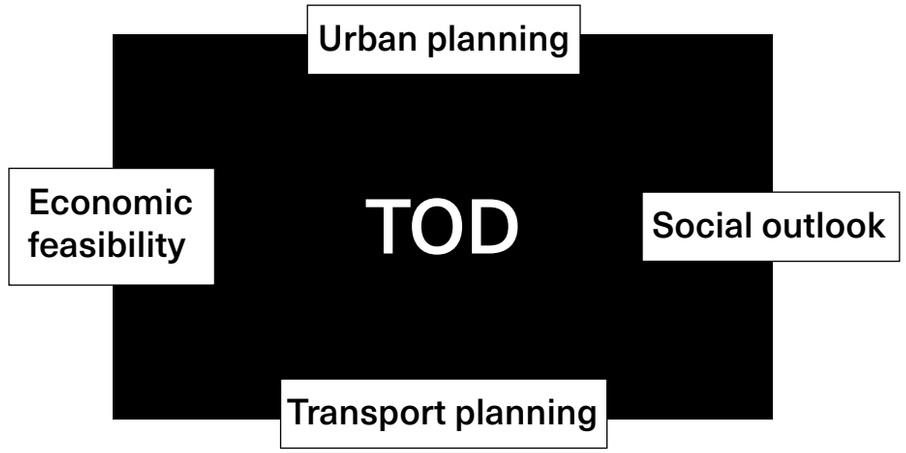


Figure 2. The recipe of TOD
Image by Davide Massa

TOD as a wise combination of common principles

Urban development and transport infrastructure projects around the world that are modelled after the TOD principles share some common features: first, the urban form develops according to the hub location because of planning laws and regulations, but also due to the proven convenience of doing so; second, real estate prices reflect the commodity of transit access, with higher values in the hub proximity and then a negative relation between the hub distance and the prices themselves, especially after the walking distance threshold is reached; third, residents of different income levels happen to share the same area due to the diverse mix of functions that such an area offers, which may prevent the growth of ghettos; and fourth, more bi-directional travel patterns can be encountered during more periods, increasing transit patronage and reducing peak crowding issues. Furthermore, three positive externalities of TOD may be observed: a pollution decrease caused by a reduced number of cars (and in case of electric/non-polluting cars, the less land subtracted by parking to better functions), a convenience not to overspread urbanisations causing the inconvenient urban sprawl phenomenon, and a general land value increase.

When focusing on the TOD defining principles, one will most likely happen to encounter a series of typical characteristics described with words starting with the letter “D”. While such an approach is far from scientific, it can nonetheless be useful for description and categorisation purposes. Five Ds—density, diversity, design, distance, demand—are then selected and discussed according to their TOD relevance:

1. Density is a key feature of a successful TOD. A high density allows hosting more functions in less space, which is advantageous in an era of significant urbanisation trends. High density is also reflected in more users, with positive effects on well-planned transit systems. A virtuous circle is immediately born: more density usually determines more transit patronage, which should push transit agencies to provide a better service, which makes it possible for more users to travel to and from the area, which is related to even more density, and so on.

2. Diversity allows a TOD to expand its catchment, not simply geographically–for which good transit is mainly rather also socio-economically. A diversity of functions attracts different users, at different times and for different durations, being they residents, workers or visitors and non-regular attendants of the neighbourhood. Moreover, diversity makes an area more self-sufficient, meaning that more of the functions that a user typically needs for a living are present within a smaller radius. This is a relevant issue as it helps avoid unnecessary trips, no matter how sustainable they are; furthermore, the related time saving becomes a positive externality.

3. Design has a fundamental role to guarantee that a TOD works. It involves both the hubs and the street network configuration in the area. Both of them need to always focus on the users by putting them at the centre of any decision and intervention, concerning efficiency, comfort, as well as safety and security. The main station-hub should provide the smoothest possible interchanges between transport modes, becoming the connection point between the higher hierarchical layer of transport, namely the one linking a TOD to other TODs or other parts of the city in general, and the transport options within the selected TOD. Then, the streets branching out of the hub need to be inclusive towards all the modes, with separated walkways and bike lanes.

4. Distance is naturally connected to the previous D of design, in relation with the way the urban form varies in a TOD, but it is also linked to the distribution of more TODs along a transit axis or concerning other parts of a city, notably its historical centre. When considering the distance, it is useful to establish a set of thresholds calculated as radii from the main station hub as well as from any eventual secondary TOD stop. Such thresholds represent the maximum distance which is considered to be walkable to reach transit, usually spanning between 600 and 800 meters. This means that no location within a TOD should be farther than the threshold, from the hub or an additional stop. It is important to notice how said thresholds can increase when other modes are considered; cycling, for example, allows higher radii, as long as the infrastructure design features are carefully taken care of.

5. Demand can be now described as a result of the previous 4 Ds. With a high density, a diversified offer of functions, a user-friendly design and some well-planned travel distances, the demand for space and transport in a TOD naturally increases, since it is driven up by a positive combination of all the mentioned elements. Demand is not considered as the ultimate aim of urban and transport planners, however, it can be argued that high demand is positively related to efficient and sustainable urban and transport planning. It can also be argued that TOD reduces the transport demand when some trips are avoided, or when longer trips get shorter; in all these cases, though, the displacements become more sustainable, which is also among the TOD scopes.

Proved convenience, convenient approval
While examples of Transit-Oriented Development are spreading around the globe both in frequency and in popularity, some obstacles remain for it to become the standard planning framework for the cities of the future. The presence of a large number of involved stakeholders, together with their own often diverging interests, has been hindering the implementation of TODs in many situations. Moreover, the long-term essence of a TOD approach is naturally linked to a higher degree of uncertainty. As it has been evident during the last years of the pandemic, sudden economic fluctuations and unforeseen variations in demand and supply may take place, which could inhibit some of the stakeholders from orienting themselves towards picking this planning option, investing in it and pushing it forward. To cope with such issues, an increasing number of sources and references proving the fitness for purpose of TOD is to be made available. The logical, or at least optimistic consequence would be that, with a greater consensus being reached on the related undeniable advantages, the popularity of TOD should steadily increment across the entire world.

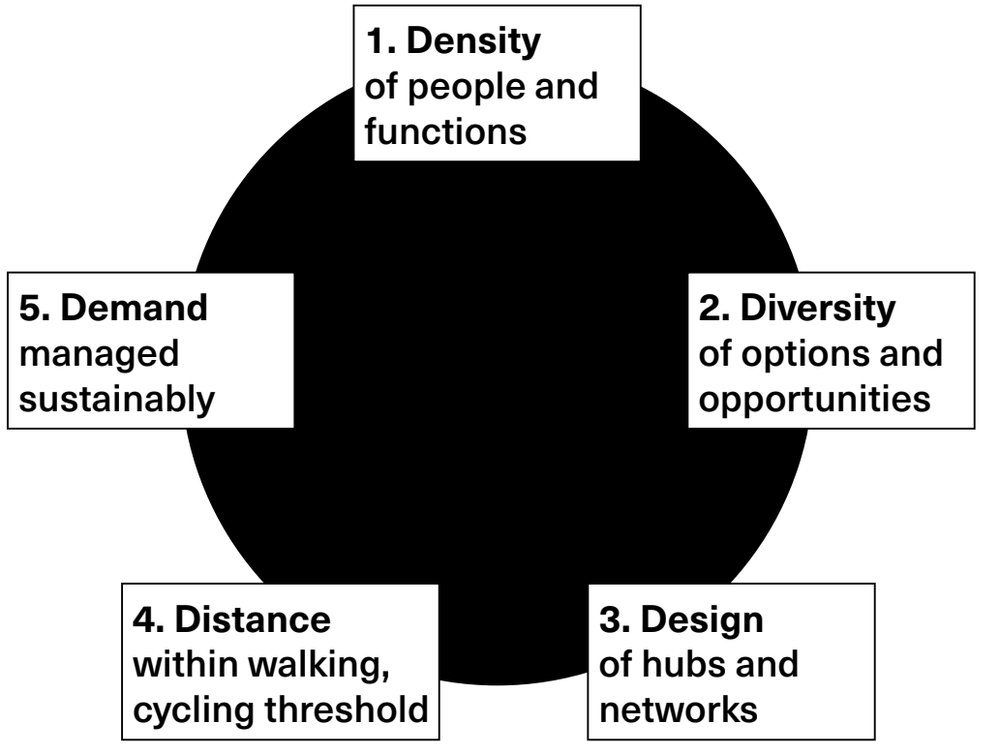


Figure 3. The 5 D's
Image by Davide Massa

When looking at developing countries, where TOD has hardly ever been properly adopted so far, a policy shift towards it would prove particularly beneficial to address the strong imbalances in demand and supply of both housing and transit. In terms of equity, it could also be considered among the best local government strategies to support the provision of similar opportunities to every citizen, thanks to the guarantee of a good degree of accessibility for every citizen to every available function. Concerning sustainability, the reduction of unnecessary trips together with the transport modal shift towards more environmentally friendly modes would have an impact as well. These two positive externalities have been noticed across existing TODs and there is no hint that they would not be also encountered in developing countries. The economic feasibility of this type of project remains an expected drawback, though. Although further research would be needed to support the stated convenience, it is already possible to affirm that most if not all involved stakeholders obtain benefits when the five D's are carefully managed. A card that can be played is therefore to propose every new TOD as an investment for the developers: an investment with fruitful outcomes not just for their pockets but also for their fellow citizens and the common good.

Figure 4. View on the Kista district TOD in Stockholm
Image by Davide Massa

Between Dwelling and Rail

Jasper Rouwenhorst

When a peri-urban neighbourhood meets an acceleration of TOD

Our cities have always been defined by their networks. Networks of productivity and supply chains, networks of riches and politics, of people and their places. In this first chapter, we focus on the veins that define and bind these networks together. As cities grow, their infrastructure system becomes a defining factor of their character. They have always been: from the Castra's of the Roman empire, Hausmann's famous urbanism for Paris, to modern-day examples like Amsterdam's AUP (General Expansion Plan) and the influences of TOD initiated by the contemporary renaissance of the railway system throughout Europe, represented in the Netherlands by the Nieuwe Sleutelprojecten (NSP, 'newkeyprojects'). The impact of these developments is massive: take for example the urban layout surrounding the Rotterdam Central Station, or simply compare its size from above to the city centre itself. As we, architects urbanists and planners, start defining station quarters and districts in a way that gives them a typology and urbanism of their own, I become interested in the space where TOD meets the city around it: how will the station change the city, and how will the city be able to include the future station in its existing character?

For my project, I visited the peri-urban area of Amsterdam Nieuw-West, to be precise the existing railway station of Amsterdam Lelylaan. While the railway station did not come into being before the 1980s, the neighbourhood was part of the post-war AUP that defined a new standard of living in Amsterdam: air, light and space with an urban layout defined by car-centred streets going west to east for a connection to the city, and south to north for a connection to the harbour, filled with copy-paste apartment blocks separated by patches

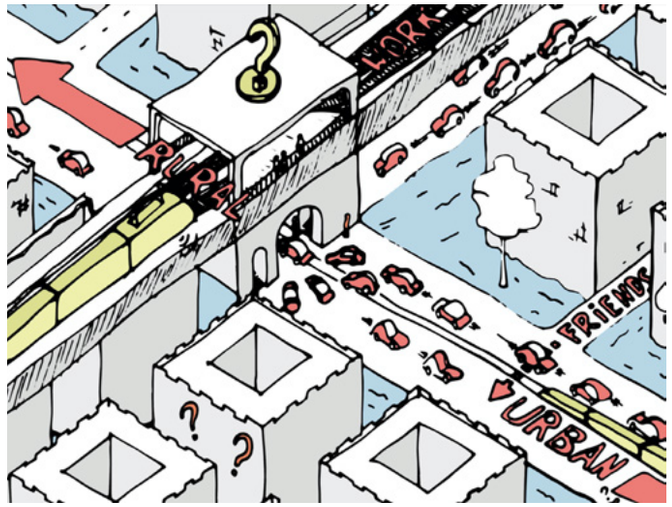


Figure 1. Infrastructure-centreed neighbourhoods can be so dominated by structure that it leaves no room for building local identity.
Image by Jasper Rouwenhorst

of green. In visiting this area, I found a neighbourhood that struggles to define itself independently from its planned infrastructural destiny. With my design project, I aim to reinvent the station area as a multi-faceted neighbourhood heart that goes beyond the rush of transit and offers a way for the area to define the station rather than the other way around.

Just beyond the edge of the urban centre, dense dwelling developments next to station areas are offering many more inhabitants the benefit of living in the city, through the infrastructure network: living somewhere, travelling and working somewhere else, connected on a city scale. The municipality of Amsterdam for example has designated several areas around peripheral railway stations as primary densification locations and aims to develop 50,000 new dwellings in these areas by 2030.[4]
These developments however strongly contrast the current state of many, if not all, of these peripheral railway station areas: the stations are small and outdated, and often unappealing or even unsafe, which in turn reflects onto the quality of their surrounding public space.

Thus, a great challenge is taking shape for the peri-urban railway station in specific: on one hand, there is the realisation that we need to integrate the station into its local environment to enhance the quality of the surrounding public space

4. Gem. Amsterdam, 2016

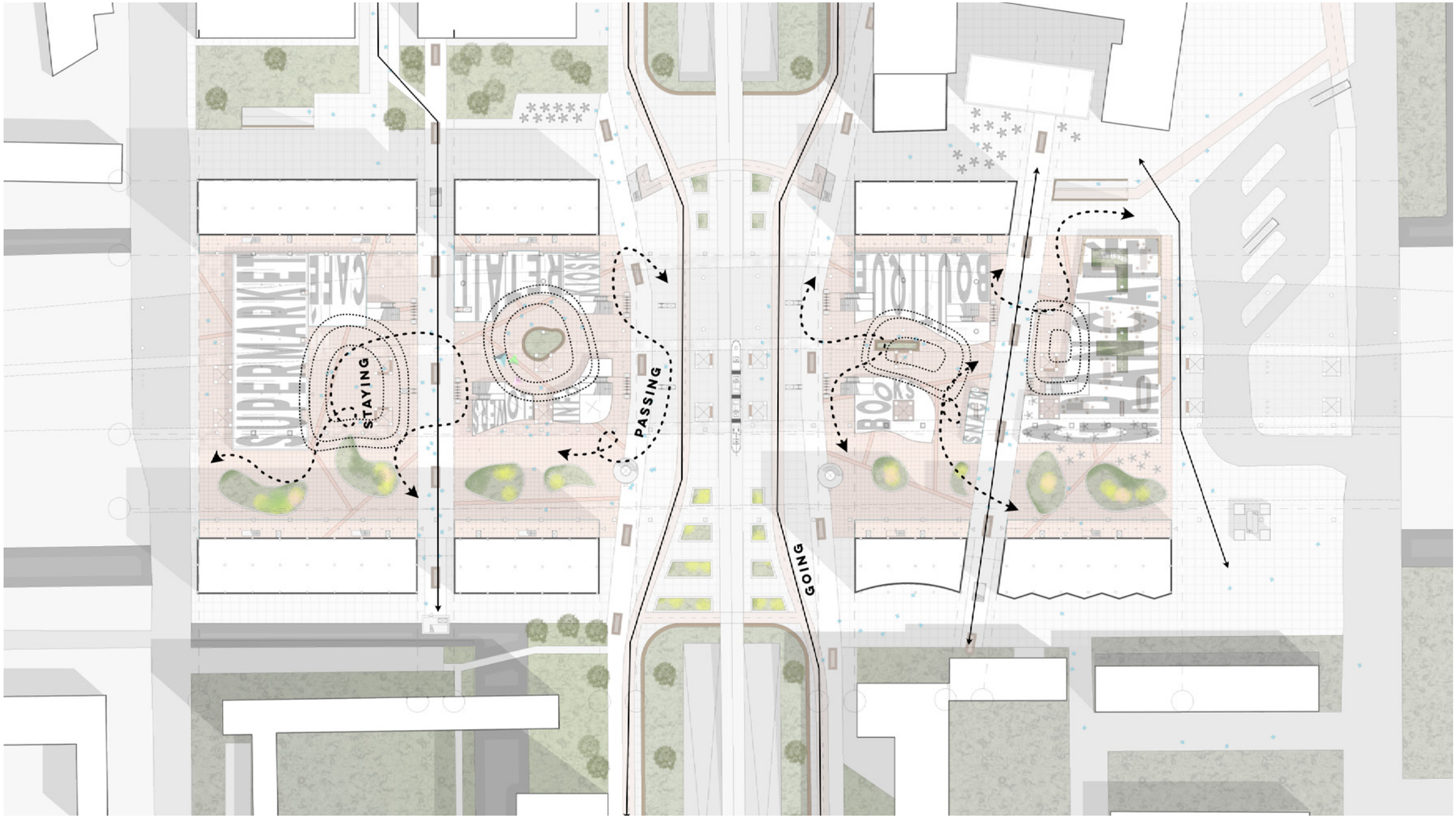


Figure 2. A spatial configuration of going, passing and staying defines a specificity of the designed station tailored to functions and life in its context.
Image by Jasper Rouwenhorst

and liveability of the neighbourhood. On the other hand, these stations and new urban developments are advertising connectivity and mobility within the city network as a new way of living, a diversification of peri-urban life through the possibilities of the Transit-Oriented Development city and the spaces that it offers, outside of the local sphere. This paradox is leaving an ambiguous space between these two very different factors, the space between dwelling and rail. I believe there is much potential in this area, a potential that is the precise result of this Transit-Oriented Development condition that surrounds it.

In his essay 'A city is not a tree', the architect and design theorist Christopher Alexander already pleaded against the monocentric structured urban expansions that were the result of the post-war housing crisis, claiming "our modern attempts to create cities artificially are, from a human point of view, entirely unsuccessful.[5] Designed en masse for the new wealth of the car-owning single-family home, expansion areas were functionally ordered in an urban configuration of car traffic converging on main roads to get anywhere needed. Even in those years, while organisations like CIAM pleaded for a functional and spatial systemization of cities, fears arose that this kind of urban planning would negatively impact the liveability of our cities, and even lead to mental health issues related to this promising segregation of demography and functionality.

This monocentric and functional principle that is still shaping our cities is an increasing problem. A problem of traffic congestion in and around our city centres, and a problem of poor public life and little diversity in our peripheral residential neighbourhoods. These are serious problems and will only get worse if we persist with this unbalanced monocentric city model. Luckily, there is change on the horizon. More and more, urban planners focus on creating functional diversity in their plans, for example combining housing with linked leisure and business opportunities, or designing mixed-use buildings offering flexible functionality and commercial venues, beyond their residential function. Campuses and innovation districts arise and claim their role as specialized centres within the larger city. This is a more polycentric principle that can be described as a "decentralised centralisation" of activities.[6]

The peri-urban structure can be considered unique in that it is shaped by factors external to its development: the functional dependency on the urban centre is the main motive behind its spatial layout which is primarily shaped by infrastructure. However, Peterek describes how this practical and infrastructural layout gives way to a multitude of 'centres' like business, green leisure and shopping. This is what we see in many of our urban fringes, and Joe Ravetz[7] describes this phenomenon as 'frontier capitalism': large economic players find in the peri-urban area a fine balance between the benefits of being part of the metropolis and the (inter)city network and the benefits of the spacious layout and organisational freedom of the peri-urban opposed to inner-urban areas. This is a strong aspect that should be considered when talking about future strategies towards more polycentricity within our cities.

Within this polycentric concept, I would like to pose the railway station as a centre of social activity, rather than travel efficiency. The station is the place where people come together in a common mindset, whether to meet, travel or commute. We can view individual railway stations within a city network as these centres for their neighbourhoods and see the qualitative decay of more peripheral stations in the context of the before discussed monocentric city model. The peripheral railway station is treated only as a necessary modal change as opposed to the city's central station as part of the 'destination'. The peri-urban station's role as a necessary modal change can be linked to its

5. Alexander, 1965

6. Peterek & Bürklin, 2014

7. Ravetz et al., 2013

poor-quality public space and its inability to engage with the local surroundings on a social level. Seen as an infrastructural node, the railway stations that are located in these kinds of areas are at a non-local distance from the local context.[8] They are often located either on the edge of a neighbourhood or at an infrastructural knot but never seem enabled to go beyond their function as a necessary modal transfer node. To redevelop these peri-urban station areas, this piece of infrastructure called the station has to become included in the social sphere of the neighbourhood.

8. Nilsson, 2013

In Scotland, Alexander & Hamilton[9] researched the 'adopt a station' program by rail service operator ScotRail, where local public and private parties were invited to 'adopt' their local rural railway station into the community in an active way. Depending on their location and community setting, people added functions like a bookshop or a café to their station. Hamilton explains that a sense of ownership by the community is an effective way to achieve a positive station environment and that railway company policy concerning identity, organisation and health/safety standards do not have to be an antithesis to station appropriation by this local community.

9. Alexander & Hamilton, 2015

Starting from all this, in trying to define the activities and the potential surrounding an existing railway station, I asked myself: How do local functions and activities relate to the perception of 'social' public space in a station area? And how do I analyse/define these activities? Jan Gehl[1] is an architect who has devoted his work towards "life between buildings", and towards pedestrianisation of city streets that used to be car-oriented. According to Gehl, a distinction can be made between three kinds of activities within the public realm: necessary activity, optional activity, and resulting (or social) activity. He uses this theory as a foundation in his efforts to create more social public spaces in cities around the world, where the goal is always to make a comfortable and publicly 'owned' space, and to give infrastructural space back from the car to slower traffic like the cyclist and the pedestrian.

Following the theories of Gehl, I relate public activities to either necessary or social public space. Necessary public space strictly inhibits activity related to the specific needs of specific users, while social public space can 'blur' the socio-spatial distinction between users and activities. In my research on this, I develop Gehl's vision into a way to place station functions in three categories: going, passing and staying. Spatially, social public space can provide an opportunity for functional overlap of its physical elements. For example: drinking in a café can be seen as planned 'staying' amongst businessmen, but can also result from 'passing' as a visitor or dweller and running into an old friend. Here, 'staying' and 'passing' are blurred because the social public space of the café allows it. This however works both ways: the social public space is only viable if the context can support it: if the station is only used to rush to a train, the viability of a coffee corner is doubtful. The ratio between going-staying-passing at a station can be an indicator of the viability of proposed functions. Social public space may not be achieved in a station at the edge of a residential area with fewer needs and activities: only necessary public space is needed. If more diverse user groups are added to the area it creates more needs, which demands a better balance between station activities. This in turn will provide a more solid basis for social public space: the more different elements and functions in the space, the more possibility for change and interaction between them.

In my design proposal for Amsterdam Lelylaan, I use this developed system to create a connection between the core functionality of the station (going), and both existing postwar housing and new residential and commercial developments next to the railway station. Where necessary 'go-

ing'-spaces define the larger structure of the station, within it, pockets are created where transitions in activities take place towards passing and staying. The organisation allows passers-by to stop for a coffee and turn it into lunch, the public spaces facilitating this 'blur' in activities.

Because activities change, the station should be able to change, which is facilitated by making its functions appear as stand-alone pavilions within the necessary framework of the station. Thus, the station may in the future for example adapt to be oriented towards staying, offering more restaurants and fewer kiosks, if the context would get an impulse of businesses that seek meeting places or lunch opportunities. If the area develops studios for young urban professionals, they will desire their expensive coffee brand and flexible workspace to be close by and the station will again be able to adapt. This flexible design creates a station that is never finished, as no architecture should ever be, and is constantly adapting to stay relevant.

In areas like this, where a rigid infrastructure has imposed a rigidity in public life, TOD is able, and needs, to offer a different perspective on the development of local qualities and ownership of public space.

Figure 3. At the station, beyond the necessity of transit, there is space for a multitude of different activities.
Image by Jasper Rouwenhorst

Project HUMAM

Mesut Ulkü

Hub for Urban Mobility for Amsterdam Metropolitan area

In today's world, it is unthinkable to imagine a street or neighbourhood without cars or highways without traffic jams. However, the modern negative consequences of our automotive desires do not only stop at traffic jams as an obstacle; the use of non-renewable fuels, a dramatic increase in car accidents, the separation of local communities, the decrease in the economy, an increase in obesity, the emission of air and noise pollution, urban decay, and a decrease in the railway network. It can be said that the car is indefinitely connected with our social lifestyle. The fact remains that a car sitting idle for 96% of its time. On an average of 380 hours per year; conversely, it spends the other 8380 hours of no use. It is known that problems associated with cars, we recurrently focus on visible aspects such as accidents, pollution and traffic jams and that we have grown with the fact that cars can park in any city or village to their favour, not to mention the sheer space cars take up in cities. Can we attach new meaning to the quality of life in cities while still preserving most of its quality and efficiency? This project asks to rethink how Sloterdijk area in Amsterdam city will be dealing with the car up to the year 2040.

The rapid urbanisation in the Netherlands creates an enormous amount of pressure on our urban, peri-urban and rural areas. More and more people are moving from their villages to cities or suburbs, creating a full expanse of city boundaries and less space to accommodate residents. The municipality of Amsterdam is expecting an increase of 70,000 new households over the 30–40 years in the Sloterdijk area. With this scenario in mind, the city wants to get rid of its 'old-fashioned' car-dominated and industry-focused image, as it currently faces major issues. This located area is characterized by its industry and high employment rate but a low number of housings, which results in a monofunctional existence. The industry does not show any social or architectural cohesion with its neighbouring surrounding while being dominated by the tremendous concrete masses. This continuation of monofunctional spaces in Sloterdijk also results in car domination and abandoned parking spaces after work hours. It may be clear that the government recognizes the car as a potential threat in the area of Haven-Stad. However, Amsterdam was not the leading city to plan to vision a car-free city. A specific example of this development can be traced to the works of the Danish architect Jan Gehl. Gehl[10] faced comparable issues in New York, where the car is taking up a significant amount of space, resulting in an infrastructure that did not innovative since the 1950s. To restore balance with society, we have to design the city for the people, not for vehicles. Likewise, the problems in the Netherlands can be seen in a quite similar way. According to

10. Gehl, 2013

Figure 1. Impression of the desired message Amsterdam wants to spread.
Image by Mesut Ulkü

the outcomes of the research done by the CBS (Centraal Bureau voor de Statistieken)[11], there is an annual growth in car ownership, increasing square meter roads and highway congestion. More concerning the car is inextricably linked to our social lifestyle; we take the kids to school, drive to work as well as do groceries. While we keep asking for more and better road infrastructure, we never wonder how we can rethink this situation.

With the understanding of the future car problem, the growth in density and considering Amsterdams' past research, the use of a mobility hub can be seen as the solution, combined with various levels of services, such as transfer, shopping and living. In the current transport system of understanding, mobility hubs are commonly seen as physical places that connect various transport modes. A hub can be anything from a bus stop and a bike-sharing station to the transfer to self-driving vehicles or an inner-city main train station. The impact of a hub in Sloterdijk makes it possible to create a higher density on the same square meters while decreasing road capacity. The flexibility here lies primarily in the function of the building; if car ownerships drop because the city can provide more hubs, the parking garages, therefore, become obsolete. When looking over a greater timespan, the city can be designed as such in a way parking garages are the flexible factor that could be transformed itself into housing, parks, or other opportunities to minimize environmental impact. However, transforming existing parking garages might be just a minor intervention but enables the architect to think beyond the present. Flexibility is therefore an important element of a building. According to the study in flexible design in architecture done by Robert Kronenburg,[12] flexible architecture is a necessary design form that enables the budling to frequently innovate and express based on contemporary design issues. By sowing this flexibility, the value and relevancy show that social and economic

11. CBS, 2015

12. Kronenburg, 2011

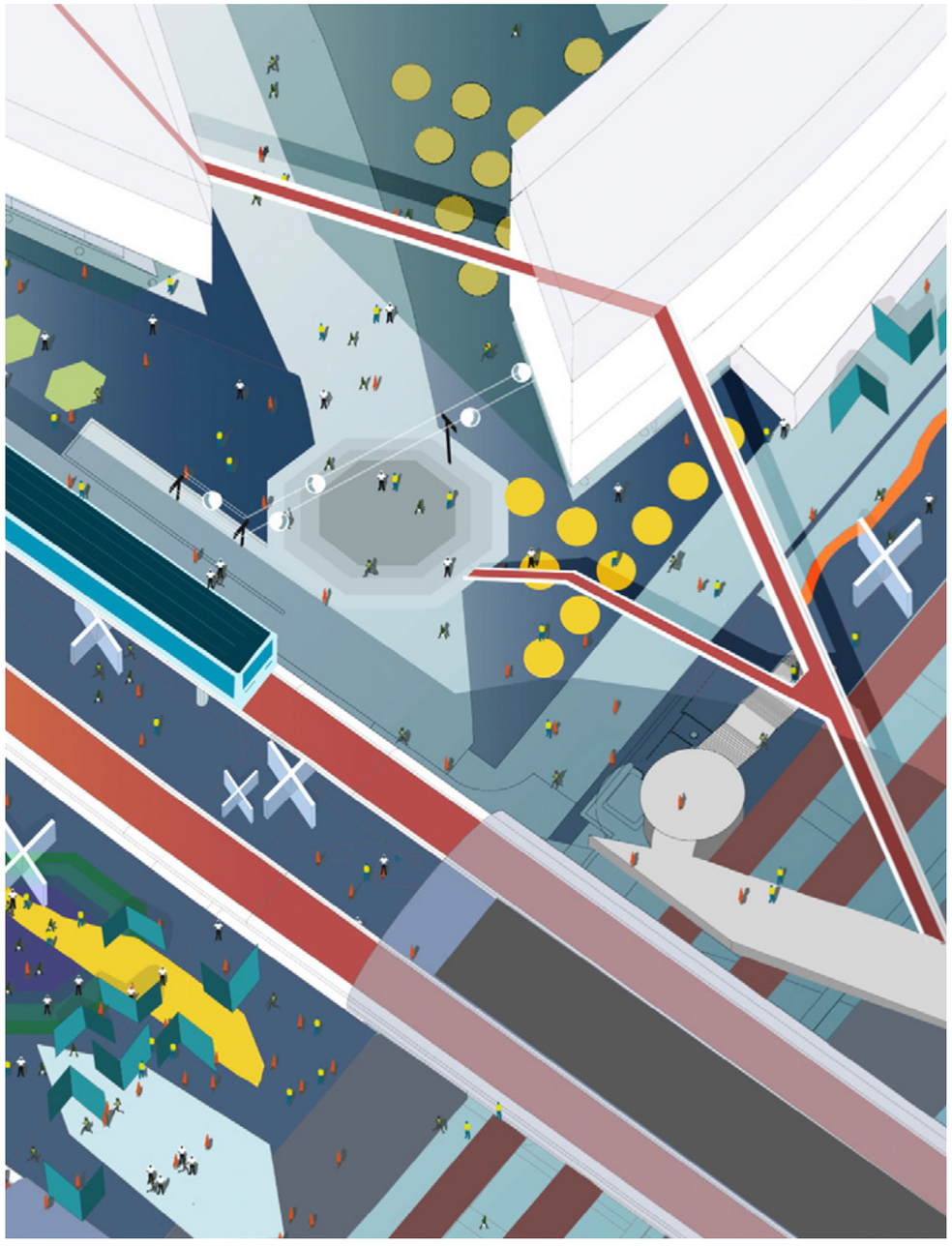
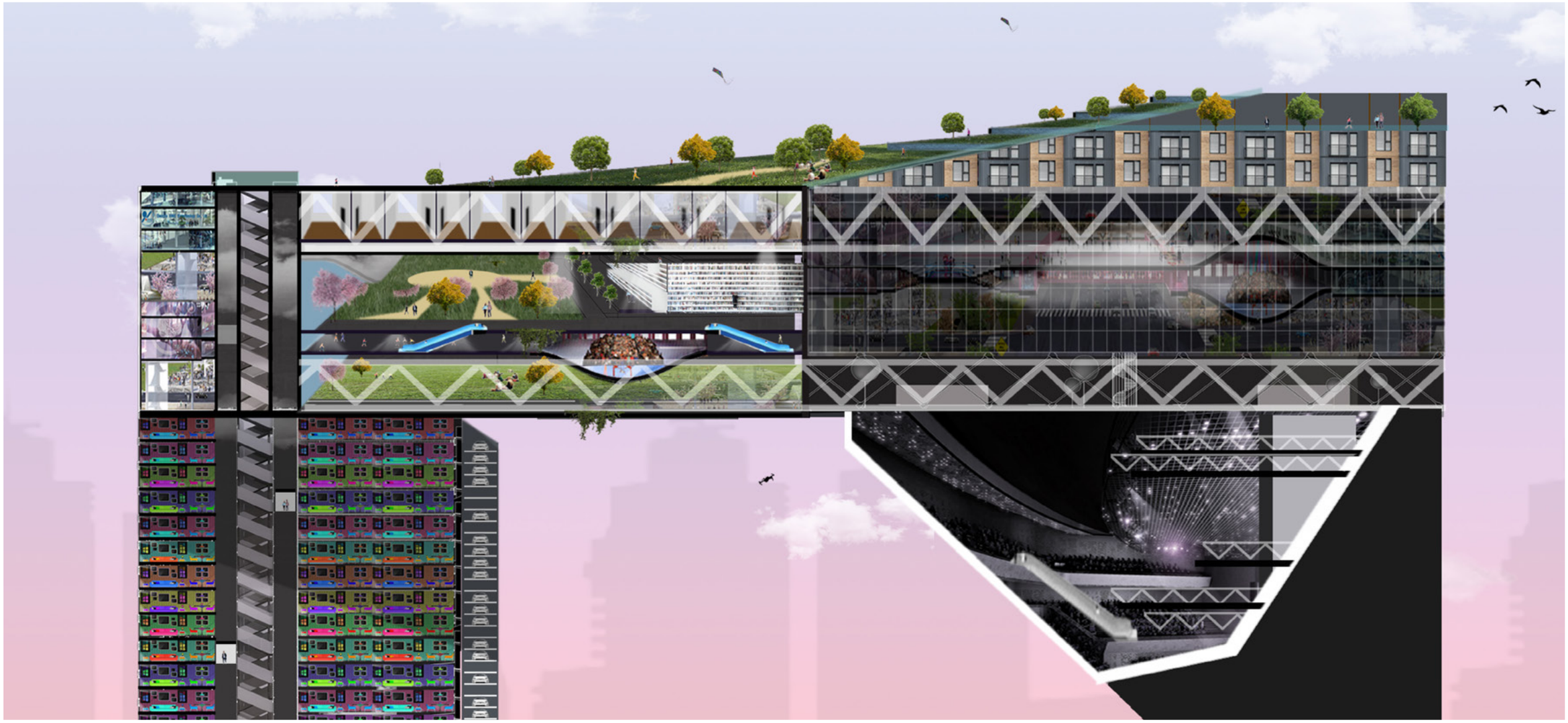


Figure 2. Impression of Amsterdam Sloterdijk without cars?
Image by Mesut Ulkü

change can be revealed. It can be said that architecture should adapt more to human needs, and be more critical yet able to break dogmas and traditional rules. The motivation for evolution is always the will for change.

Project HUMAM is a mobility hub where people can transfer from their original car, by giving the city the space it needs to cultivate and innovate.

Figure 3. Collage concept where the cars will be stored in the building
Image by Mesut Ulkü



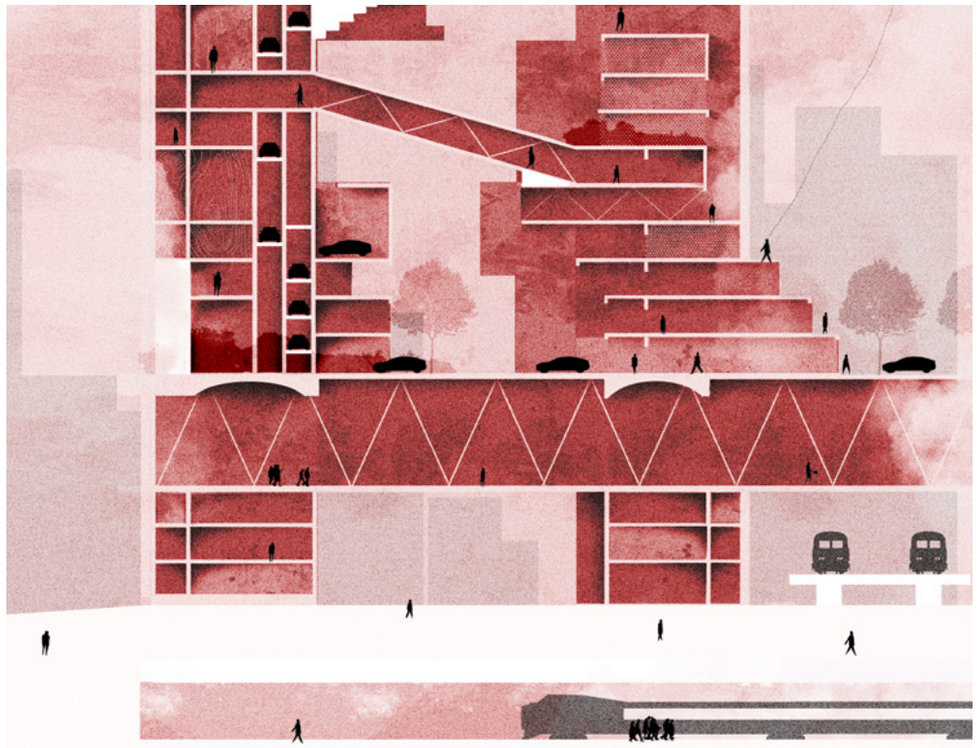


Figure 4. Diagram of building providing parking space, so the inner-city won't need cars
Image by Mesut Ulkü

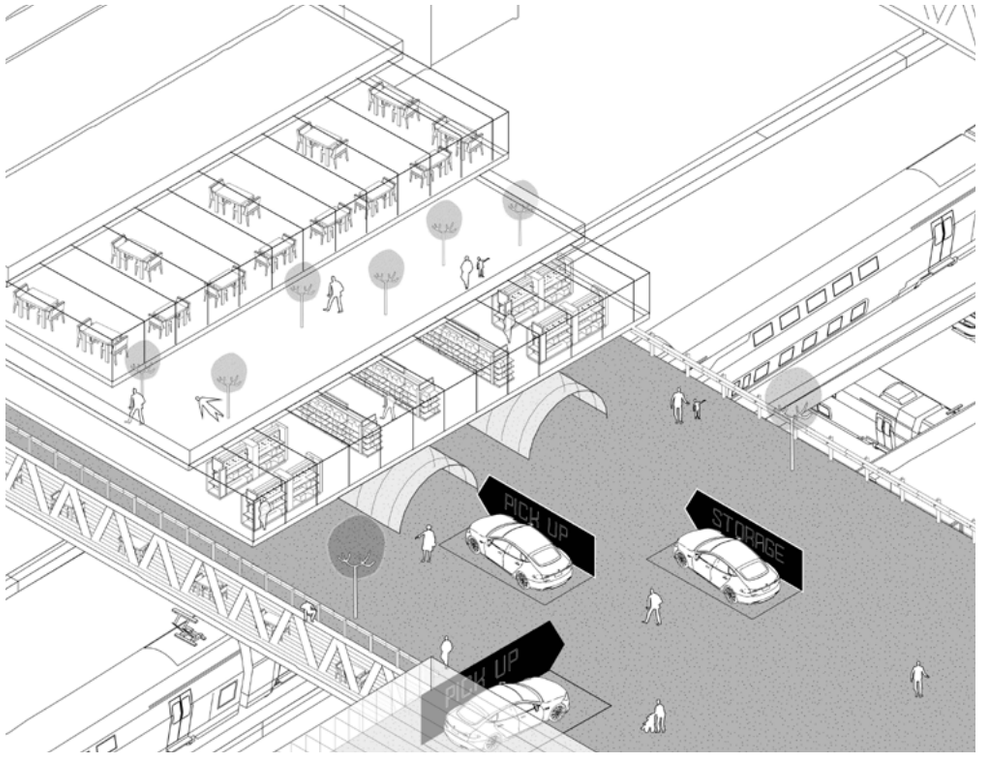


Figure 5. Mobility hub placed over the original station
Image by Mesut Ulkü

Built (Im)permanence

Unlocking transport in a hyper-flexible urban future

Can we say that a city is ***flexible***? Looking at a regular city skyline and its fixed heavy concrete structures, it seems that buildings are rather permanent. This is not incorrect—many buildings have been standing for decades or even centuries —but, as a whole, the built environment is impermanent. Over time, the city evolves, grows, and shrinks; some parts are renovated, others demolished, and others added, responding to the social and economic needs of each historical moment. This feature points to the answer of *yes*, the built environment is flexible to some degree, not exactly on the timespan we usually associate this concept with. Heinrich et al. defines urban flexibility as "the ability to change form and use of existing buildings, urban areas and infrastructure."[13] This takes place slowly, over decades and centuries (figure 1).

Flexibility has been an emerging feature in the last decades with the advances in construction technology such as machinery, modularity and prefabrication,[14] and in recent years pushed by digitisation. These techniques accelerate construction timespan; a usual time frame of construction of a building is 3 to 5 years, while there are recent examples of buildings built in 1 year or less.[15] Flexibility also enables reuse and repurposing of buildings, for example the trendy repurposing of office buildings into residential buildings, which is expected to increase with the pandemic and remote working, and the transformation of industrial sites into neighbourhoods.[16]

Urban flexibility could create opportunities to renovate or modify current cities in search for better urban environments. One example is the tunnelling of transport infrastructure to create urban spaces above.[17] Besides urban quality, urban flexibility could contribute addressing the urgent net-zero race towards 2050 by accelerating the transition to sustainable mobility, land-use change and limiting urban cover growth, of course depending on how it is applied.

Figure 1. The city might seem to be a permanent entity, but it does contain flexibility if observed at longer timespan.
Image by Marcelo Matias

13. Heidrich et al., 2017

14. World Economic Forum, 2016; McKinsey, 2017

15. See ‘Mini Sky City’ in Changsha, China, or education building ‘Pulse’ at TU Delft

16. See Haven-Stad in Amsterdam and Nordhavn in Copenhagen, both redevelopment of port areas.

17. See examples: Hudson Yards, New York; Over de Ring, Antwerp; Gasperdammertunnel, Amsterdam; bypass tunnel, Stockholm.

Urban flexibility and transport planning

Urban flexibility has impacts on many practices and one of those is transport planning. How to plan transport infrastructure under the extra uncertainty associated with flexibility? Imagine that a metro line is built to connect the city centre to an outskirts office location and over the years this office location transitioned into a housing neighbourhood. Now the transport patterns have changed. Should the planning of metro lines 20 years ago have somehow considered this possible adjustment? How is the metro system designed today to take future urban variations into account? Imagine another example, this one reality. A large piece of the Port of Amsterdam will be repurposed into the new *Haven-Stad* neighbourhood.[18] New public transport lines will be designed in combination with the neighbourhood. If we think about the existing public transport spine to which these new lines will branch, were they designed considering that one day a whole neighbourhood would be created from scratch? Uncertainties in urban development are enlarged

18. For a deeper study of the Haven-stad plan, see project *Eco-Inclusive Opportunity* by Thomas Dillon under the theme Natural Systems.

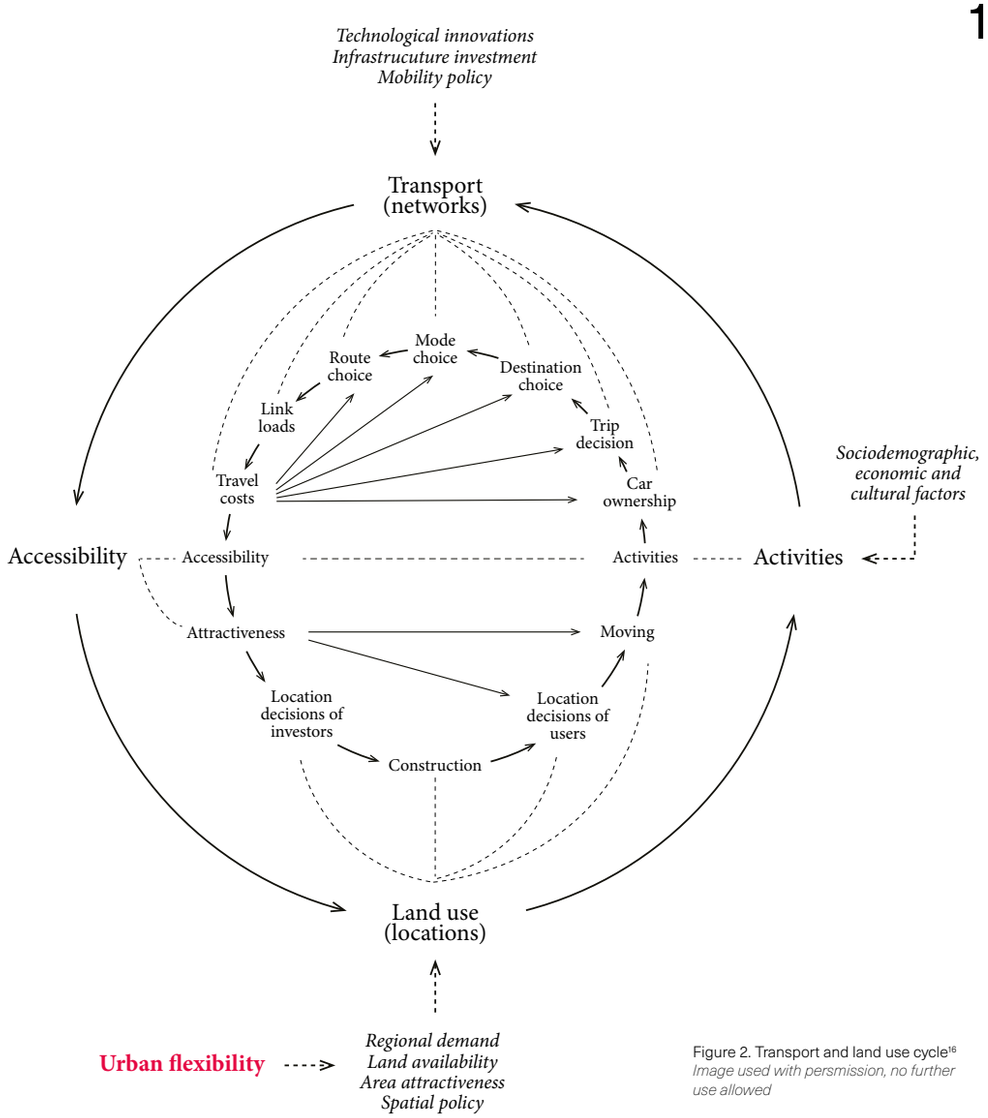


Figure 2. Transport and land use cycle[16]
Image used with persmission, no further use allowed

Figure 3. Mathematical description of the modelling procedure: trip distribution, travel time and accessibility
Image by Marcelo Matias

Factor	Formula	Explanation
Trip distribution	$F_v = \alpha_v \cdot exp(\beta_v \cdot ln^2(c_{ijv} + 1))$	*We tend to choose services that are close. The further, the less atractive.*
Travel time	$T = T_o(1 + \alpha(V/Q)^\beta)$	*The more congested a road is, the more time it will take to cross it.*
Potential accessibility	$PA_{iv} = \sum_{i \neq j} D_j \cdot exp(\beta c_{ijv} + \beta_{ov})$	*The more activities and the easier to reach them, the more accessible is the area.*

with urban flexibility, creating uncertainties in transport planning as well. This project addresses these questions by aiming to answer the question: *what are the implications of urban flexibility for transport planning?*

Transport and Land Use theory is applied as the theoretical framework for this project. This theory is elegantly summarized by the Wegener cycle adapted by Bertolini[19] (figure 2). Land use determines the location and types of housing and services, such as schools, offices, shopping malls etc. These services generate activities, such as studying, working, and leisure. The need for moving in space and time to fulfil these activities creates a demand for transportation. Transport networks and services in return make certain areas more accessible than others. Accessibility creates feedback on land use since usually people and services want to relocate to places that are easily accessible. Then, the location of people and services changes again and the cycle restarts. Various external factors to this cycle take into account the multiplicity of physical, economic, sociodemographic and policy influences. We place urban flexibility as an external factor to the land use system, impacting (1) spatial policies, with possible change of planning regulations; (2) land availability, by enabling construction in new, possibly unconventional locations; and (3) technological innovations.

19. Wegener & Fuerst, 2004; Bertolini, 2012

Methodology: scenario planning and transport modelling

The project's methodology applies scenario planning to explore urban flexibility configurations and transport modelling to investigate impacts on transport. Four scenarios are proposed. The City of Eindhoven was selected as a case study.

0. *Zero scenario:* characterized by expansion in urban edges, or sprawl, which is the current usual form of urban growth.
1. *Organic development:* composed by soft densification, that targets individual home owners or small local real estate developers.
2. *Urban acupuncture:* small and medium developments to renew specific urban locations, such as parking lots, industrial, sociocultural, retail and rail TOD areas.
3. *Powerful bottom-up:* large and random developments. Private-led mixed-use complexes.
4. *Urban strategy:* flexibility becomes an established planning mechanism. Extensive *flexible zones* of public interest are determined, e.g. repurposing of industrial zones.

The designs of each scenario are presented in figure 4. They are based on variations in spatial randomness and development size, while development locations are based on Municipality plans.[20]

The Eindhoven Metropolitan Region transport model (SRE 3.0) was used, which is an aggregate 4-step model that includes car, cycling, public transport and freight transport.[21] The same transport network is present in all four scenarios. Accessibility is measured with potential accessibility (PA), which indicates the number of activities reachable discounted by transport costs and infrastructure-based accessibility (IBA), which captures only transport costs. Mathematical rules of a few of the main steps in the modelling procedure are presented in figure 3.

Results: modal split, traffic flows and accessibility

Results show that urban flexibility reduced congestion levels in comparison to the zero scenario. All forms of development were possible in the inner city without the generation of congestion. This is an unexpected result, as urban intensification policies

20. Eindhoven, 2009

21. Goudappel, 2012

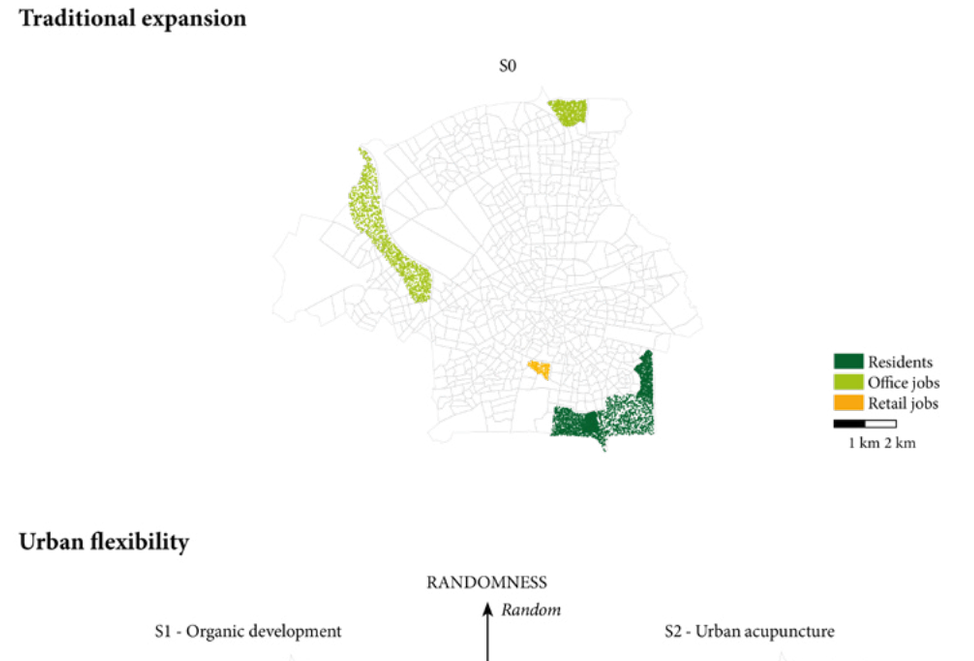


Figure 4. Growth distribution per scenario
Image by Marcelo Matias

usually increase congestion.[22] Shift to bike and available infrastructure capacity were observed as the main factors for this result. In combination with reducing congestion, urban flexibility increased agglomeration of activities, improving accessibility. The more central the activities are placed, the better.

The PT share was relatively constant across all scenarios, which suggests that the analysis limited to urban boundaries might not have been able to capture effects on public transport. We expect that a regional analysis would increase PT share and accessibility, particularly in the inner-city.

We must bear in mind that the ring-radial structure of Eindhoven contributes to magnifying the impact of centrality on accessibility measures, therefore, centrality might not be as desirable in other cities. A second consideration is that the cycling available in Dutch cities gives unique results by allowing intensification of the inner-city area without an increase in congestion, while in most cities this would have a larger impact on the road network. On the other hand, the share of public transport in Eindhoven is low (5%), while other cities might have a more competitive PT system that could partially offset such impacts.

Accessibility outcomes show that, on the contrary of the expected, random developments do not always have lower accessibility than directed, planned developments, however relying mostly on car accessibility, which conflicts with sustainable development goals. Secondly, a substantial increase in bike share was observed for directed scenarios when development occurs in central areas. This result follows the expectation that concentrated land-use can increase the share of active modes.[23] However, a certain level of intensification must be reached so that bike effects can be observed.

22. Melia et al., 2011; Ferreira & Batey, 2011

23. Naess et al., 2011; Duffhues & Bertolini, 2016

24. Nabielek et al., 2012

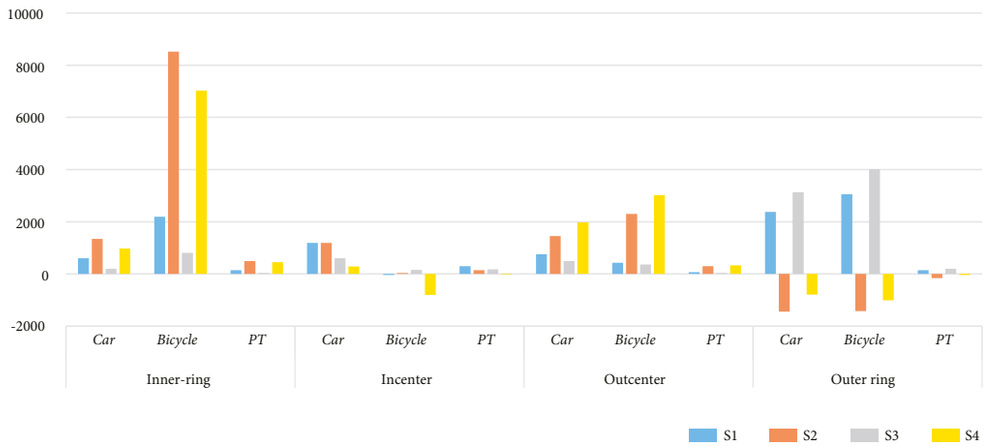
Conclusion

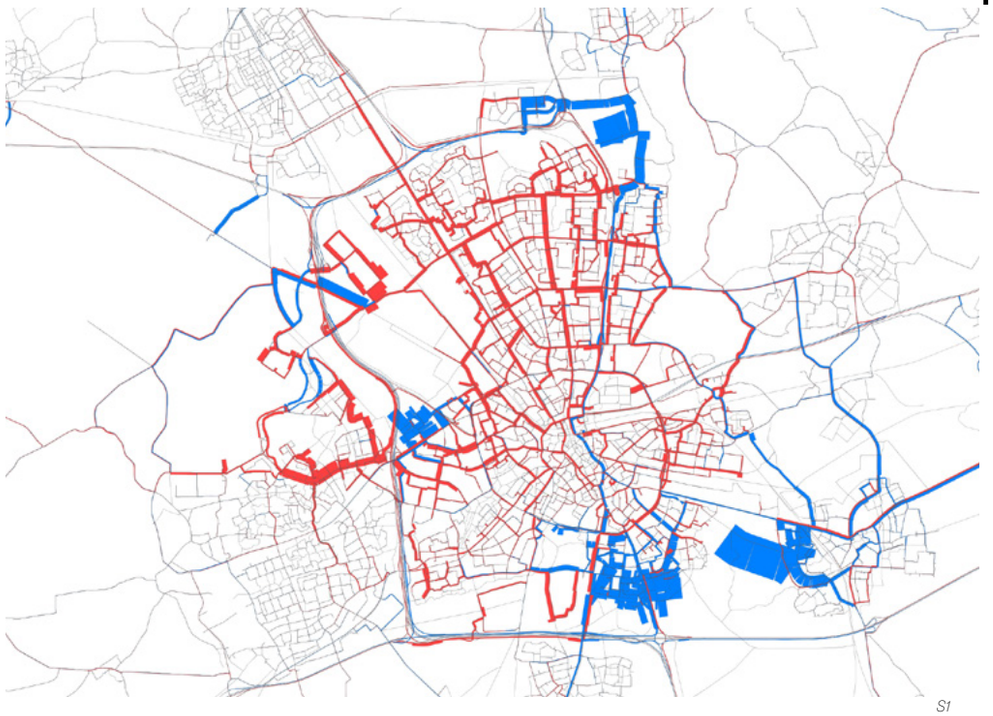
There is potential for applying urban flexibility to achieve intensification of inner-city areas. In other cities in the Netherlands, this is expected to hold true; in fact many municipalities are following this strategy.[24] In other European cities with a similar scale, that is also expected to be true if either cycling or public transport is available. That is one of the reasons why cycling and public transport have become primary strategies for sustainable mobility, as they provide support for densification.

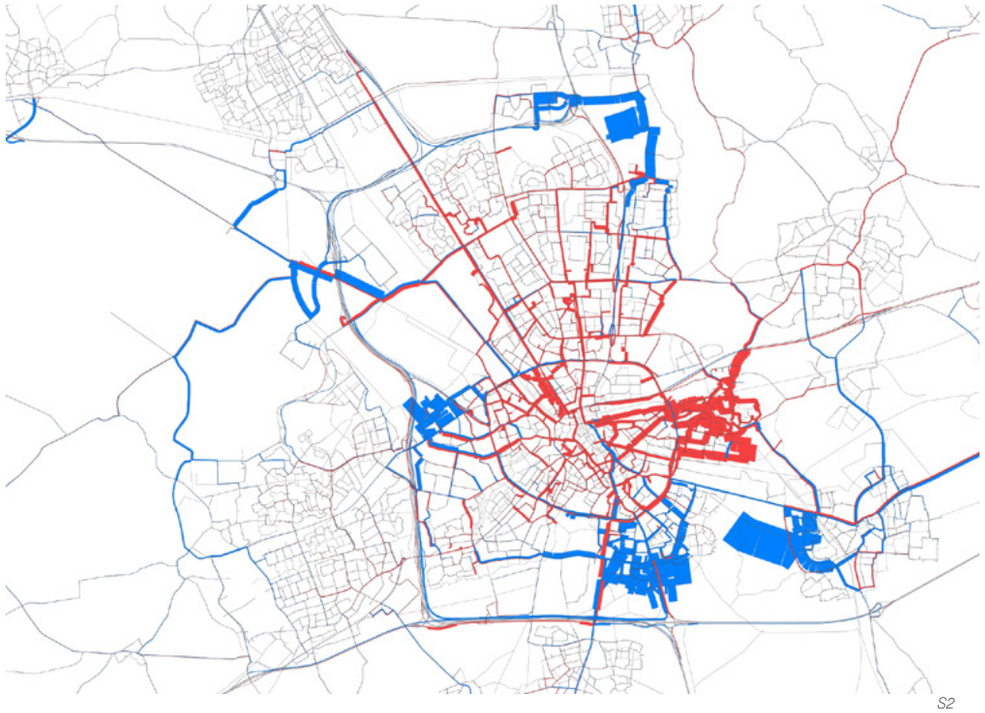
A crucial message from this research is that transport planning should give more attention to innovations in construction technology. This is structurally overlooked in the field in comparison to the large attention given to innovations in transport technology.

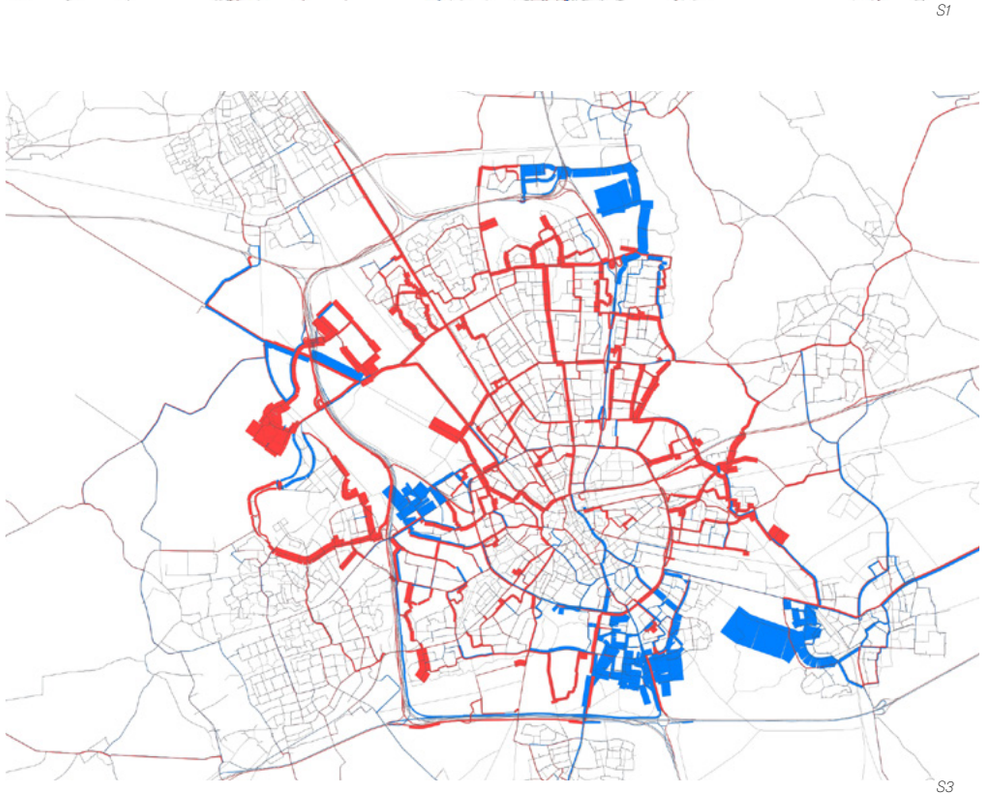
Urban flexibility raises questions on stakeholder behaviour, particularly whether developers and municipalities would see benefits. This is a topic for further investigation. Another consideration, this one methodological, is that urban flexibility could be tested with a very large sample of automated generated scenarios based on predefined spatial rules. This will capture more robustly the inherent variability embedded in flexibility. This draws on usual approaches in the field of transport resilience and transport planning under uncertainty.

Figure 5. Variations of trip patterns for scenarios, according to trip direction and mode. Each bar represents the difference between trips in DLU scenarios and zero scenario
Image by Marcelo Matias









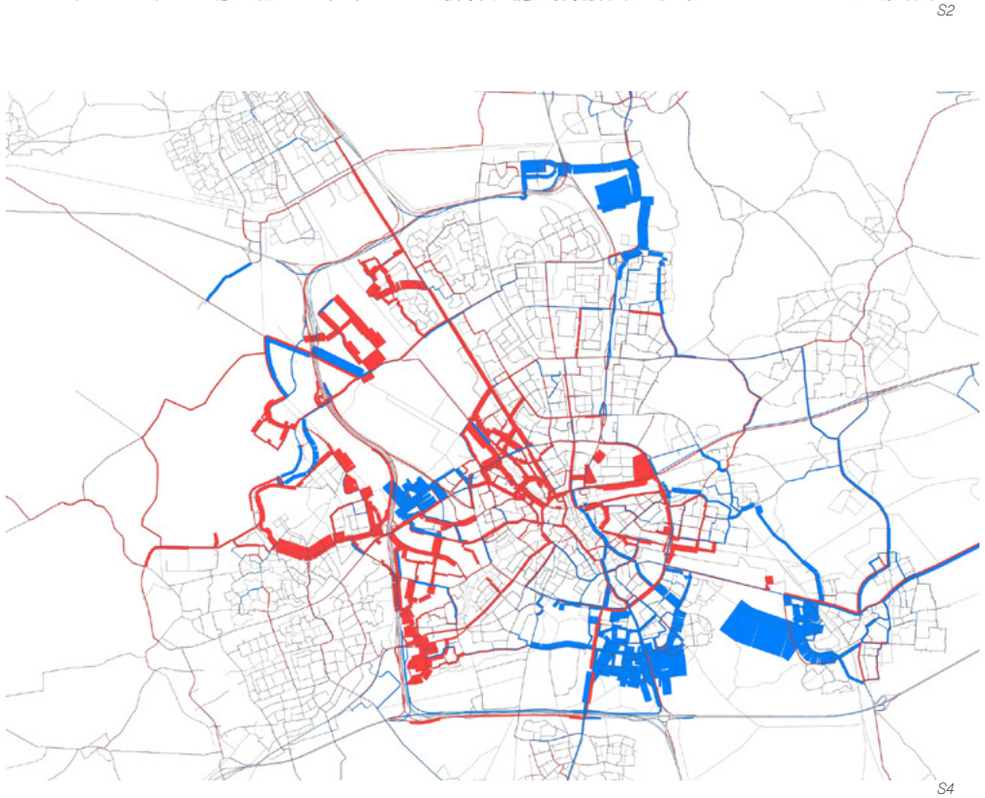


Figure 6. Volume-capacity ratio difference between urban flexibility scenarios and zero scenario
Image by Marcelo Matias

Safe Cycling Infrastructure

Leanne van Bentem

The impact of infrastructure design on cycling safety

As a Transport, Infrastructure & Logistics student, I joined The City of the Future lab to gain more insights into the architectural contribution to urban mobility. What is the effect of the surroundings on mobility? During the course, I was already very interested in cyclists and their behaviour. After finishing the course, I decided to graduate with a bicycle topic related to cycling infrastructure. My thesis project was about the impact of infrastructural characteristics on cycling safety.

Cycling is a popular mode of transport in the Netherlands. In 2019, the bicycle share was equal to 28% of daily mobility trips.[25] In 2019, 65% of road crashes involved cyclists. Cyclists incur a higher risk of getting injured than motor-vehicle occupants, making them more vulnerable.[26] Because of this, there are increasing concerns about their safety. Schepers and Klein Wolt found that about half of all single bicycle crashes were related to infrastructure.[27] The Rijksoverheid estimated that a fully safely equipped cycling infrastructure could prevent approximately 15 fatalities and 3850 serious injuries per year.[28] For these reasons, it is essential to study the infrastructural factors contributing to bicycle crashes to understand how the infrastructure can be improved to increase cycling safety.

Several studies were found in the literature that has been studying risk factors affecting cycling safety. Multiple studies have developed safety performance functions (or crash prediction models) to find contributing factors to road crashes. However, only few studies focused on the prediction of bicycle crash risks. Also, the amount of available data was often very limited. Especially bicycle exposure data was often lacking.[29] As data sources have become richer, more representative models can now be developed. As the bicycle monitor developed by Witteveen+Bos (the so-called FietsMonitor) contains rich exposure data in the form of average daily bicycle loads, it was decided to develop safety performance functions for both road sections and intersections that predict bicycle crash risks.[30] By doing so, the main research question answered in this study was:

"How can cycling infrastructure be improved to contribute to safer cycling?"

To answer this research question, this study was divided into two parts. The first part of the study included a qualitative analysis, which consisted of additional literature research and interviews. In this literature research, state-of-the-art on cycling safety was studied and potential risk factors contributing to bicycle crash risk were identified. These potential risk factors were used to develop a conceptual model, which is shown in figure 2.

Interviews with the municipality of Haarlem and Fietsersbond were conducted to gain insights into the decision-making process when implementing proactive cycling safety measures, in which barriers were identified.

Figure 1. A separate bicycle lane located at the Gedempte Oude Gracht in Haarlem, the Netherlands, where cyclists are elevated from motorised traffic.
Image by Leanne van Bentem

25. De Haas & Hamersma, 2020

26. Reynolds et al., 2009; Guo et al., 2018

27. Rijksoverheid, 2018

28. Merlin et al., 2020;

29. Vanparijs et al., 2015

30. Witteveen+Bos, n.d.

The second part consisted of quantitative data analysis, in which the safety performance functions for both road sections and intersections were developed. The data that was needed to develop safety performance functions can be classified into three categories: crash data, exposure data and data on infrastructure characteristics. This research focuses on the cycling network of the city of Haarlem. These counts were based on data from Onderzoek Verplaatsingen in Nederland (OViN). The bicycle crash data that was used in this study was retrieved from Bestand geRegistreerde Ongevallen Nederland (BRON). The BRON data is however underreported, as not all road crashes have been reported to the police. To be able to model with sufficient crash data crashes from the years 2015 to 2020 were combined so that a larger data set could be used. The infrastructure data was collected from different open data sources, including OpenStreetMap (OSM), Basisregistratie Grootschalige Topografie (BGT) and Basisregistratie Adressen en Gebouwen (BAG).

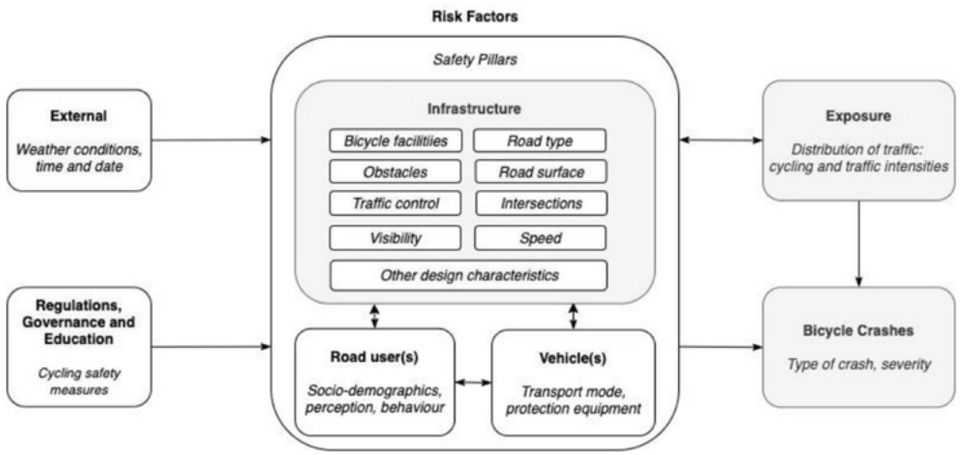


Figure 2. Conceptual model for cycling safety, inspired by Schepers, Twisk, et al. (2017) and Van Weelderen (2020)
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As not all collected data was useful, the data needed to be filtered and prepared for modelling. OSM contains many nodes connected by links. Every single path that can be taken by road users is mapped in this network. The network had to be aggregated to exclude parts of the network which are not (sufficiently) used by cyclists. By doing so, areas that might bias the models because of their low bicycle crash risks were excluded. The main bicycle network established by the Municipality of Haarlem was used for this purpose. This network is part of the Structuurvisie Openbare Ruimte (SOR) network. During the aggregation procedure, intersections and road sections were generated with the following definitions:

- The intersections of the aggregated level only include intersections that connect at least three roads of the SOR network.
- Road sections are the road parts of the SOR network between the defined intersections.

For intersections, a distinction was made between verkeersregelinstallaties (VRIs), roundabouts and uncontrolled intersections. VRIs are traffic light-controlled intersections. For uncontrolled intersections, a distinction was made between equal (or equivalent) and unequal (or priority) intersections.
After the aggregation process, the bicycle crashes were assigned to the locations in the aggregated network. Moreover, the exposure was approximated for each location by estimating the bicycle loads. These are the number of cyclists passing the location on an average day. Subsequently, the explanatory variables were defined for each location. First, an explanatory analysis was performed to determine what variables to include. A selection was made based on findings from the literature and on the availability of data. When all data was prepared

for modelling, the safety performance functions were developed. The safety performance functions were based on the following model formulation:

$$ln(Y) = \beta_0 + \beta_I ln(I) + \sum \beta_j x_j$$

(1)

where;
Y = the expected bicycle crash count or crash density,
I = bicycle intensity,
x_j = risk factors related to the bicycle crash risk,
$\beta_0\ \beta_I\ \beta_j$ = model parameters of the different model variables.

The safety performance functions were developed using generalised linear regression modelling (GLM). Generalised linear models can have different distributions. As the data was over-dispersed, it was chosen to develop negative binomial distributed models. Overdispersion means that the variance is larger than the mean. The level of overdispersion was approximated by calculating the ratio between Pearson's chi-squared and the residual degrees of freedom for the Poisson models. Many negative binomial generalised linear models were explored, including various combinations of variables. The best-fitting models were used to analyse the effects of several variables on bicycle crash risk.

Results

Interviews with the municipality of Haarlem and Fietsersbond revealed some considerations and barriers in decision-making. The first important barrier is that the CROW guidelines leave room for improvisation. Moreover, different political interests also affect the decisions of policymakers. Another important constraint in decision-making is the available budget.

The safety performance functions that were developed in this research are shown below. Equation 2 shows the safety performance function for road sections and Equation 3 for bicycle facilities. Equation 4 shows the safety performance function for an intersection.

$$ln(Y) = Intercept + \sum(\beta_{function} * Function) + \sum(\beta_{pavement} * Pavement) + \beta_{humps} * Humps + \beta_{cyclists} * Cyclists$$

(2)

$$ln(Y) = Intercept + \beta_{width} * Width + \sum(\beta_{pavement} * Pavement) + \beta_{humps} * Humps + \beta_{light} * Light + \beta_{cyclists} * Cyclists$$

(3)

$$ln(Y) = Intercept + \sum(\beta_{type} * Type) + \beta_{light} * Light + \beta_{approaches} * Approaches + \beta_{cyclists} * Cyclists$$

(4)

The safety performance function for road sections showed that separate bicycle facilities were significantly related to lower bicycle crash risks, after which suggested lanes follow. Speed humps were also found to be negatively correlated to bicycle crash risk, which means that the presence of speed humps decreases the bicycle crash risk. Closed pavement would also induce a lower bicycle crash risk compared to (partly) open pavement. Moreover, it was found that increasing the bicycle width significantly decreases the bicycle crash risk. For intersections, the results showed a higher risk for roundabouts compared to the other intersection types. Additionally, the number of traffic flows crossing the intersection was positively related to bicycle crash risk. Finally, the presence of street lights was found to be positively related to bicycle crash risk for both road sections and intersections.

Discussion

The barriers that were found conflict with the fourth Sustainable Safety principle, which says that responsibility should be allocated. Road authorities should acknowledge their contribution to cycling safety. Decision-makers should feel more responsible to satisfy road design guidelines. Moreover, a national approach could provide more continuity in safety evaluation and also encourage road authorities to work together. By doing so, they could be stimulated to implement appropriate safety measures.

The safety performance functions confirmed the influences of several risk factors on cycling safety. Although not all results were statistically satisfactory due to a lack of significance, most of the variables still revealed some clear relationships to bicycle crash risk. The relationships that were found for road sections were as expected. Separate bicycle facilities, the presence of speed humps, closed pavements and an increased bicycle lane width were all found to be related to lower bicycle crash risks. All four confirm the expectations, as they comply with the Sustainable Safety principles. They increase the homogeneity and the forgivingness of the roads.

The safety performance function for intersections gave an unexpected result. It was assumed that roundabouts reduce bicycle crash risk, as they separate cyclists from motorised traffic leading to homogeneity. However, the results of this research showed a higher bicycle crash risk for roundabouts compared to the other intersection types. Different explanations for this high bicycle crash risk have been proposed in this research. However, no clear explanation for this high bicycle crash risk could be found. Lastly, the amount of traffic flows crossing intersections, which is accompanied by increased conflicts, did significantly increase bicycle crash risk.

Moreover, the presence of street lights unexpectedly increased bicycle crash risk for both road sections and intersections. As street light is mostly absent in the outer regions of the city, the lower crash risk could be due to other road characteristics or to compensatory behaviour.

To be able to work with the amount of data, assumptions had to be made. First of all, the crash locations in BRON are appointed to the centres of sections and junctions and not to their exact location. As this research was based on an aggregated level, crashes may have been reallocated to the wrong road section or intersection. As was mentioned earlier, another important limitation is that bicycle crash reports are very limited due to underreporting. Due to this, the crash statistics are underestimated.

Another assumption is the level of overdispersion in the data. The method that was used for generalised linear modelling does not estimate the overdispersion parameter. Instead, a default value is used. Because of this, it is not known whether the level of overdispersion is sufficiently accounted for. Moreover, not all potential explanatory factors could be included. The conceptual model in figure 2 shows that the true model is much more complex than the safety performance functions developed in this research. As an example, not all infrastructural characteristics could be collected. Moreover, different types of cyclists and vehicles could not be distinguished. Road user characteristics could not be included, such as their behaviour. Furthermore, the different types of bicycle crashes were also not distinguished. When interpreting the results, one should have in mind that the safety performance functions are incomplete, as other factors might also explain increases in bicycle crash risks. It is recommended to include more information in future research.

Finally, some appropriate measures were proposed to improve cycling safety in the future. Most of the results that were found agree with the Sustainable Safety principles. Homogeneity can be created by constructing separate bicycle lanes. When this is not possible, suggested bicycle lanes are preferred over sharing the carriageway with other traffic. Moreover, speed humps are recommended to reduce speed differences. Additionally, the cycling infrastructure should be forgiving with closed pavements and sufficiently wide bicycle lanes. The complexity of intersections should be minimised. Finally, road authorities should acknowledge their contribution to cycling safety and need to take responsibility.

Conclusions

Finally, the main research question "How can cycling infrastructure be improved to contribute to safer cycling?" could be answered. The results of the safety performance functions comply with the already existing Sustainable Safety principles. Homogeneity can be created by separating cyclists from other traffic through the construction of separate bicycle lanes. Differences in speeds could also be limited by constructing speed humps. Moreover, the cycling infrastructure should be forgiving with closed pavements and sufficiently wide bicycle lanes. These safety measures are already integrated into the Strategic Road Safety Plan (SPV) and the road design guidelines derived by CROW. However, several barriers were identified as to why these guidelines were not always lived up to. To be concluded, the findings of this research agree with already existing safety measures. This shows that there is no need for new guidelines. However, more research should be done into the barriers and how they can be removed.

One important gap in the literature was the lack of good exposure data in safety performance functions (or crash prediction models). In this research, rich data on average daily bicycle loads were used to develop the safety performance functions. Therefore, the safety performance functions developed in this study contribute to scientific literature. However, one should have in mind that the safety performance functions might be insufficient for predicting actual bicycle crash risks as the safety performance functions are incomplete.

Recommendations

Bicycle facilities show a decrease in bicycle crash risk. Especially separate bicycle lanes seem to reduce the risk of having a bicycle crash. Also closed pavements, speed humps and increased lane widths show a decrease. It is recommended to focus on these characteristics in future road designs.

As the results showed unexpected high bicycle crash risks for roundabouts, it is advised to further investigate these. More research could also be done on the effect of street lights on the behaviour of cyclists and how this contributes to cycling safety. It is expected that compensatory behaviour might affect bicycle crash risk negatively. As only limited research has been done in the decision-making process of cycling safety policies, it is also recommended to do more extensive research on the barriers to implementing measures to improve cycling safety.

Furthermore, it is recommended to extend the data for further research. Because of the limited amount of locations, all locations were used to develop the safety performance functions. Due to this, no validation could be done on the results. It is however still advised to validate the results with another data set. Moreover, as was previously discussed, the safety performance functions that were developed are incomplete. Including more characteristics could lead to better representative models.

Finally, it is desired to have measures of safety for the cycling network of Haarlem that can be applied to the FietsMonitor. For this, it is also advised to score the safety performance of road sections and intersections based on scores other than bicycle crash risks derived from the safety performance functions. An example of an alternative scoring method could be a more qualitative approach, where road characteristics are compared to design guidelines which comply with the Sustainable Safety principles and the Strategic Road Safety Plan. Scores could be based on characteristics that were collected in this research. However, to be able to develop complete safety scores, more information about the infrastructure is needed. This for example would include the presence of forgiving roadsides, obstacles, speed limits, road markings and the condition of the road surface.

Figure 3. A so-called “fietsstraat”, where motorised vehicles are seen as guests
Image by Leanne van Bentem

Interview

Davide Massa
TIL graduate

Introduction

I'm Davide Massa. My background is in architecture, especially at the urban scale, and I'm currently finishing my master in Transport, Infrastructure and Logistics. I'm very interested in transport and mobility, which was my reason to join this studio. Now I'm doing my thesis at a company in Stockholm.

Motivation [pre-phase]

What motivated you to choose the studio?

First of all, the studio was an opportunity to bridge my two main study backgrounds, architecture and transport. I'm very interested in transport and mobility and the studio was one of the few opportunities inside the curriculum at TU Delft to deal with the two things together.

What underlies this choice is that it's very common now that people focus on something but know very little about things around it. I think it can be a risk when you don't have an awareness of the bigger picture. If you only think about the city of the future from an architectural perspective, you are not familiar with the flow of people and goods that are an important part of the city. This is just an example to say that the more you know about the topics around your focus topic, the better solutions you produce. I think this holds in basically any field. And I felt that in TU Delft most people are quite centred on their specific faculty and they don't know much about other faculties, other projects, or other research fields.

Experience [process phase]

How was your experience with the educational setup of the studio?

I think my experience has been great because I felt at home with the architectural approach. I enjoyed the studio approach much more than the other things I did for TIL because it was based on a group with different ideas and cooperation. The professors were very open to work with different topics and they were open to give feedback. In general, the studio was probably some of the best parts of my education at TU Delft.

I even wish that TIL would have this same structure based on sessions with groups of students divided into different topics according to their preferences and being able to discuss and build a shared knowledge base while each group develops in a different direction. This is exactly what we did in the studio.

How did you find the studio educational structure, including the graduation process and the weekly studio sessions?

As a TIL student, we don't follow this process from architecture. Our thesis does have a similar process with progress presentations, but within the studio, I was following the seminar, not my thesis, which ends with a summary or a paper on your topic. So I had more freedom to find my process. About schedules, I didn't have any issues. The time that we were supposed to meet was always or almost always on a Friday afternoon, which is usually the free time for TIL. I didn't have any overlap or issue with the rest of TIL, except for the Milan excursion which was just the week before the exams.

Project [post-design phase]

In what ways does your project answer to the studio's theme?

My theme was Transit-Oriented Development. I think this is very much connected to the studio because, in my opinion, it is the foundation of the city of the future, both in developed and developing countries. You can build sustainable cities by following the TOD principles and the five D's.

How did you experience developing your research within the studio?

The studio did influence the decision of my topic because I was able to learn about other urban topics from the other students. At the same time, I brought the TIL perspective to the table. Let me give some examples. At some point, we were talking about networks. I brought some knowledge on the differences between a point-to-point network and a hub and spoke network, which is something that should be taken into account by architecture students when they develop a project. Another example is the different planning levels, strategic, tactical and operational, which is a useful framework also in urban planning and basically in all the disciplines to be able to distinguish the hierarchy between the different processes.

Why did you choose to do your full thesis at a company?

I found the TIL master not to be as interactive as I would expect before, because it was relatively theory-based. So I wanted to do something outside the university. On top of that I probably wouldn't be able to find a company that worked on the same topic I did in the studio.

Added question—bridging the gap with TIL

Why do you think the majority of TIL students prefer to do their thesis at a company?

There are many reasons. First of all, in engineering faculties, students are very focused on a specific path. And there's a general reason for this. Nowadays society seems to value more this kind of people. The job environment is so deeply divided into fields that most companies and recruiters are interested in having experts, people keen on doing a spe-

cific task. Being Cross-Domain is not something well appreciated because I think it's a bit more difficult to label this person and by putting them in a specific box. But easier doesn't mean better. I see that engineering students more or less consciously follow this 'specialization' attitude. They know that they need to go deeply into one topic and then they know that they will find opportunities in that topic.

The second reason is communication. There are plenty of electives in TIL that people don't even know about. It's such a broad and diverse program. So it's also very possible that people might be interested in something like City of the future but they just don't know about it. I know there are presentations of the studio at TIL, but we get so many announcements that you cannot always be aware of all the possibilities.

You mentioned the difficulty to label a cross-domain person. Do you think it's better if a person is specialized or cross-domain?

I think both types of people are needed. I think any organization needs vertical people that go deeply into a single topic and horizontal people that cover many topics. When you are a starter, it is more common to be vertical while managers usually go more horizontal because you need to take care of many people doing different things. So there is a contradiction for juniors that have a horizontal profile. They are always assigned some specific task and they are not able to apply their cross-domain knowledge.

How can we bridge these difficulties related to cross-disciplinarity in education and in practice?

From an education perspective, cross-disciplinarity is something that can be taught. However, I see a different trend in the Technical University where in most courses teachers want or maybe have to teach something very specific. If you are a cross-domain person, you probably even suffer a bit more because you can't fully express your potential.

From a company perspective, it's hard for me to answer because first I'm not an expert in organizations, and second it's up to how the company wants to be structured. But I can imagine that many benefits arise if the company can combine different people with different attitudes. I don't know if that's what companies do; they probably try to. But it's also a bit up to the person to find a sort of more personalized path within the company to do what they want. For example, in the company I am now, I'm in the Rail advisory group, but I've seen that they also work on TOD which is a topic of my interest so I want to find a way within the company to work on this topic.

Interview

Marcelo Carreiro Matias 188
TIL graduate

Introduction

Hi, I'm Marcelo Matias. I joined the City of the Future studio in its first year, 2018–2019. I'm Brazilian and I have a background in Civil Engineering. I studied the Master in Transport, Infrastructure and Logistics—TIL, which is a very diverse and multidisciplinary program. I followed the specialization in Transport Policy. Now I work at Arup, an engineering consultancy firm, as a transport engineer. I'm also lately on a more social vibe, developing some understanding in urban geography. We never stop learning!

Motivation [pre-phase]

What motivated you to choose the studio?

In the Transport policy specialization we follow a few courses in Architecture. From this experience, I became interested in the education method in Architecture: the freedom for choosing your fascinations, the teamwork, the critical debates, and the creative process. I found it essential that sometimes the problem was not clearly defined, as we are used to in engineering, because this is how problems are in reality. I remember that famous Einstein quote: "If I were given one hour to save the planet, I would spend 59 minutes defining the problem and one minute resolving it". So the studio provided me with all these benefits.

Talking now about content, since I started in civil engineering I've always had this position that the city must be observed with a territorial lens. What I mean by territory is a space subjected to relations of power, politics, and social relations. In engineering, there is a strong focus on transport systems networks, performance, and modelling, but many times the context and its underlying forces are not looked at. So the studio attracted me by offering this multidisciplinary setting where I would be able to integrate this territorial lens into my project.

Experience [process phase]

How was your experience with the educational setup of the studio? Did the different techniques from Architecture, urbanism and MBE helped you in your thesis?

Not precisely urbanism approaches but I used scenario planning to test what I called 'hyperflexible urban futures'. In this, I had support from Maurice, a professor of Urbanism. I designed these scenarios myself so a lot of urbanism-related thinking came by. I also slightly touched on the stakeholder layer, explaining why and how stakeholders would engage in urban flexibility. But I didn't go that far on it, so I didn't connect much with MBE, also because we had only one MBE student in our year. Now looking back I see that I could have explored this side a bit more, and certainly, I would have done it if there were more MBE students around me.

Did you find that helpful atmosphere to work in this crossdisciplinary environment, including the tutors, lecturers and students?

Yes, definitely. Because the whole idea of my project came from the studio. In the Venice Biennale and after during the P1s I've noticed that the majority of Architecture projects touched on refurbishment, repurposing or redevelopment of a building. From there I came up with the topic of urban flexibility. For sure the beginning was perhaps the most essential interchange.

Concerning the education process, there was some mismatch between the thesis process in BK and TIL. In TIL we have a thesis of six months while in BK the thesis is one year. So in the first two quarters, Architecture students were working very intensively full time on their projects while I had only 6 ECTS for this work while simultaneously taking other theoretical and practical courses. I couldn't dedicate as much time and then at some point they were so advanced that it was difficult to continue exchanging ideas.

Were the lectures given at the beginning helpful for your project?

They were inspiring for me. The beginning of the studio was overwhelming with all the different people, approaches, ways of talking, new social environment etc, so it took some time for me to adapt especially because I was the only TIL student in my year. The experience at the Venice Biennale was essential for my thesis and some other lectures inspired me to think beyond without necessarily landing in my thesis, which is not a problem I guess. But I enjoyed the lectures to have a glance at the different approaches, to kind of create your toolbox.

The project [post-design phase]

In what ways does your project answer to the studio's theme?

As I mentioned my project was about hyperflexible urban futures and it touched on the urgency of redeveloping established urban areas. I think my project was by nature multidisciplinary because I had an urban design and a transport step. In the urban design part, I had this whole process to think about how flexibility would take place in cities and I ended up with four scenarios according to the size and pattern of redevelopments.

On the transport side, I applied strategic transport modelling to assess impacts on the transport system. Strategic transport models contain a lot of information about the city—networks, population, and employment, in a very fine level of detail.

Did you face any challenges in combining these two approaches?

Yes, the main challenge was bridging scales. I defined the question of flexibility as changes in form, function and speed of buildings. I had to translate these building-level factors into the urban scale to be able to make the connection with transport infrastructure. It required a lot of research and creativity to make scenarios that were plausible and useful but also a bit imaginative. In my case, I had to think a bit pragmatically about how these scenarios would interact with the transport model because some great scenario ideas cannot be well captured by the model. I did see some interesting approaches in urbanism, on how to design touching various scales, that now looking back could have been useful.

Was there enough integration from TIL tutors and experts with Architecture, urbanism and MBE? Did they also assimilate useful things from your discipline?

I noticed that the exchange from the direction of Architecture to TIL was easier than from TIL to Architecture. This is because in Architecture things are naturally more general so you can grasp them more easily, while in transport there is more precision and at some point perhaps too much detail for people from other disciplines. But I do think designers could be more interested in the pragmatic approaches from engineering. For instance, there are frameworks in TIL about how pedestrians perceive space in choosing their trajectories. I'm sure this can be very useful for designers.

Cities of the Future: A Mobile and Sustainable Society

Jaap Vleugel
Researcher and Lecturer, CEG and TIL, TU Delft

My research career started with a publication about externalities of mass motorization. Academic researchers are producing an endless stream of paper. Unfortunately, only a few of these publications have practical relevance. Even if they do, their recommendations are frequently butchered, mitigated or ignored in the political arena. Such experience can even turn a born optimist into a pessimist.

It was time for a career change. Lecturing, in particular in design courses, turned out to be an effective means of translating research results into implementable solutions for businesses and government agencies. It is interesting to explore some examples where this applies. This can also provide input for new research projects and education courses.

A modal shift policy in passenger transport means motivating individuals to use public transport or active modes like cycling or walking instead of a car. This motivation may come from congestion reduction, climate change mitigation, air pollution control or reducing space needed for roads and parking. Such a policy frequently fails due to factors such as like fixed behavioural patterns, household characteristics, trip length-motive-price, income level and equity, car ownership, and available public transport alternatives. It may succeed in special cases, in particular in high-density areas with sufficient transport alternatives, limited and high-cost parking space, short trips, low speed limits and widespread congestion.

A modal shift policy has also been a goal for freight transport. Road transport has again a dominant and growing market share. Some policymakers regard freight trains as a viable alternative; yet, a modal shift is rare. This can be explained by many factors: trucks and trains serve diferent markets; they provide very diferent transport capacities; rail infrastructure is less dense, hence less time and cost-eficient; and transhipping goods between rail and truck in terminals has extra cost. Still, there are examples where such a policy succeeds. This is because the initiators offer transport conditions that match the logistic requirements of the main players in the supply chain. The latter is usually the weak spot of generic modal shift policies.

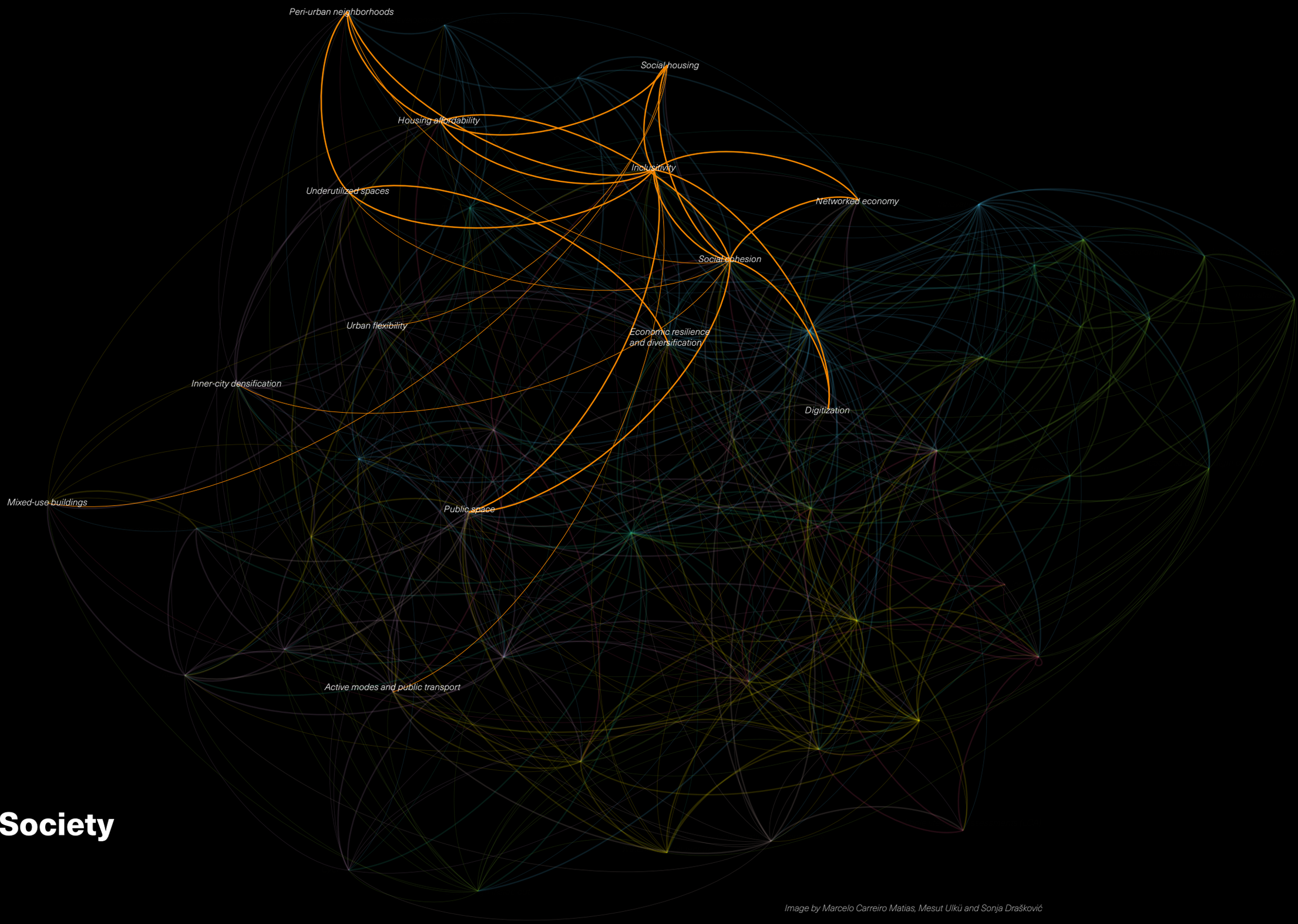
Frequently, policymakers reasons suffer from tunnel vision, each seeing just a small part of reality, usually through blurred lenses. If a policymaker intends to change individual mobility or freight transport structurally, then, a holistic system approach is needed. Such an approach involves an interdisciplinary study of the social, economic, spatial, technical and other key parameters that condition and determine the decision-making of individual consumers, producers and other stakeholders.

Urban designers should treat infrastructure as a key ingredient in plans for area (re)development. Infrastructure is not something to be added after an area was designed. Any infrastructure link serves a certain purpose. Infrastructure cannot be easily adapted after construction. Therefore, the ‘language’ of infrastructure should be simplified. There are many examples of failures in this area:

- Spatial layout and route choice. Finding your way in the suburbs is frequently a drama without navigation software, leading to many unnecessary kilometres and emissions;
- When planning green areas in newly built areas make them twice as big, because parking norms tend to have a short life span;
- When designing road space geometry, take care of the dimensions of public transport. If a bus cannot use a roundabout, then the bus service may be diverted, making it necessary to use a car;
- Do not leave out freight transport in spatial designs. Freight transport is frequently treated as a nuisance, yet it offers essential services. Make its use more efficient.

Architects are designers of objects and their surrounding space. There is a tendency in urban areas to increase spatial density and to build higher. Open areas are regarded as waste. Yet, open areas serve a purpose in the social arena. They allow social activities, green and animal life. High buildings influence wind patterns and temperature. Higher densities go along with overheating. Overheating is also a problem in low-energy buildings. Architects should take care of these problems in their designs, if necessary on their own initiative.

A change in the way we think about mobility and infrastructure and the built environment, is not only necessary but also inevitable. Fortunately, there are (younger) people interested in this issue. They can provide the necessary changes in urban design and architecture.



Society

Image by Marcelo Carreiro Matias, Mesut Ulkü and Sonja Drašković

Introduction

Sylvan Muijlwijk

The global ongoing trend of urbanisation makes cities grow substantially. There will be more people living in increasingly dense cities in the coming decades. The population in those cities becomes more diverse due to globalisation and migration. Those people of different backgrounds and beliefs will have to coexist. Will the design of our built environment facilitate this in an inclusive way so that there are suitable public spaces and housing for everyone, community ties can be formed, and segregation can be countered? This aligns with the Sustainable Development Goals (SDGs) adopted by the United Nations in 2015. Particularly relevant here is the goal of making cities and human settlements inclusive, safe, resilient and sustainable. For planners and designers, a responsibility exists to translate this goal into policy and design principles.

Social inclusivity and inequality

The essence of city life in the coexistence of a certain density of people. However, those people too often don't have equal opportunities regarding their livelihood, perspective or the places where they are able to reside. Striving for inclusivity means making efforts to ensure equal opportunities—that everyone, regardless of their background, can achieve their full potential in life.

The built environment reflects the existing inequality in our societies. This is visible in the quality, layout, location and type of city neighbourhoods, dwellings and public spaces. Population groups can be separated by obstacles like infrastructure barriers, different entrances or even gated areas within a city. Some areas in the city can be stigmatised due to the perspectives of the residents that reside there, the location or the physical urban form. To overcome our differences and connect with one another, it is essential that people of difference find places to meet one another. The built environment should facilitate this by countering segregation.

Individualisation

Individualisation of society results in the decline of mutual ties between people, articulated in less physical contact and interactions and a reduced community sense in neighbourhoods. Challenges like loneliness, crime and social exclusion follow. Improving social cohesion might help to tackle these challenges. However, in achieving social cohesion the diversity of people should be embraced.

Striving for a City of the Future that aligns with the social goals related to the SDGs of the United Nations, the role of the built environment should not be underestimated. However, an academic discussion exists on the impact the built environment has on the social mechanics of city life. It is not certain to what extent this impact exists, however, the physical layout of our cities could enlarge social challenges or help counter those.

Student projects

In the following chapter, the topic and challenges of inclusivity, safety, resiliency and sustainability will be addressed in the student topics. The topic of affordable social housing in Amsterdam is addressed by Jeff Hill's *Linking Quality & Affordability* project. Through social investigations and interviews with social housing agencies, his project addresses the future of social housing through the lens of an architect. The topic of inclusivity in post-war neighbourhoods is tackled by Ilse de Jong in her project *Inclusive Station Development* which offers an opportunity to create sustainable and highly dense neighbourhoods. Furthermore, Floor van Dedem's *Mind the Gap* approaches the problem of integration and lack of social connection by designing a strategically placed building that brings people together. Finally, Sylvan Muijlwijk's *Vertical Social Connectivity* addresses inclusivity on a vertical level in a high-rise building in Den Haag, as the Municipality proceeds to encourage higher density as a solution for the housing shortage.

Linking Quality & Affordability

Jeff Hill

Investigating the future of social housing in Amsterdam

Social housing in the Netherlands continues to become increasingly more stigmatized, more difficult to access and reserved for lower income brackets.[1] Housing associations—alongside municipalities and other stakeholders—face the daunting task of meeting mandates to deliver thousands of new social rental homes while maintaining their existing properties and facing high rates of taxation from the national government.[2] To meet the growing demand for affordable housing, housing associations in Amsterdam are building larger buildings, with smaller units and inadequate consideration is being paid to resident needs and how these buildings will function decades from now.

More broadly, housing affordability and housing quality are often pitted in opposition to one another, where a perceived increase in one aspect correlates to the diminishment of the other.[3] When considering housing design, this way of thinking can be an unhelpful oversimplification because more quality is seen as a threat to affordability and vice versa. When designing with this narrative in mind, buildings must be of a lesser quality to be realized, the results are cheaper-made buildings that do not age well, feature unhappy residents and many face early demolition. When little attention is paid to housing quality, in a broader sense of the term, there are environmental, social and economic consequences.

This thesis demonstrates how affordability and quality can be mutually reinforcing and guide the design process. This concept is explored through the design of social housing development in Amsterdam North. This is not done by creating a balance between cost and a superficial definition of quality but rather by investigating the concepts

1. Boelhouwer & Priemus, 2013

2. Gemeente Amsterdam. 2019; Elsinga & Haffner, 2020

3. Sultan Sidi, 2010

Figure 1. View from southwest at Klaprozenweg.
Image by Jeff Hill

of affordability and quality to discover how they can reinforce each other over a project's lifetime.

This project sought to address the following question: *How can affordability and quality be complementary when realizing social housing projects in Amsterdam?* Rather than following the point of view that quality and affordability are in opposition, the intent was to first understand what affordability and quality mean and to whom. Affordability and quality were considered from the perspective of the resident, the housing association and eventually, the designer as each of these perspectives differs greatly. For residents, quality refers to a host of factors including housing security and how the building meets their needs. Housing associations, aim to develop housing that meets residents' needs, is durable and adaptable. By trying to understand the point of view of residents and housing associations and overlaying the factors that can bring quality and affordability for both, a set of key design considerations were created.

Key design considerations, principles that would guide the design process, were created to better link these perspectives. Throughout the design process, these guiding principles were refined

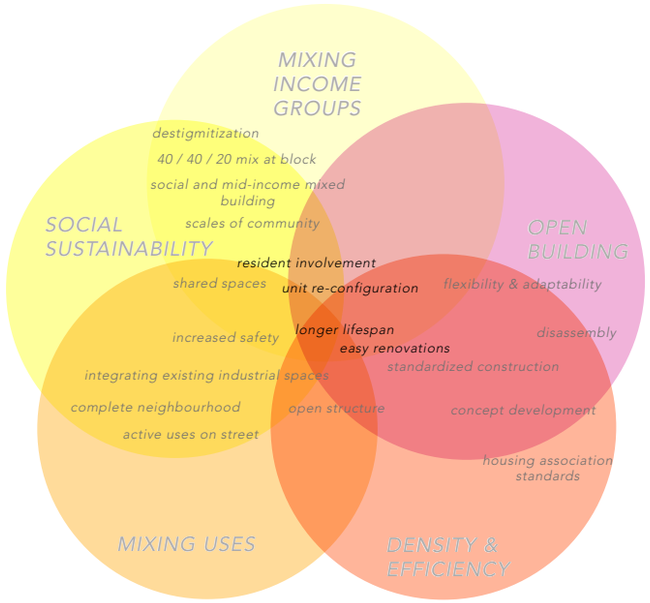


Figure 2. Key design consideration diagram demonstrating how guiding principles should be interconnected. *Image by Jeff Hill*

as the design developed based on further research and site requirements. The final five design considerations are:

1. Mixing income groups
2. Following Open Building principles
3. Ensuring social sustainability
4. Design dense and efficient buildings based on housing association standards
5. Mixing uses and integrating existing economic activities

These five were chosen because:

1. Mixing income groups (social and mid-income) has the potential to lead to the de-stigmatization of social housing, encourage upward mobility of social housing residents and broaden of social networks.[4]
2. Designing based on Open Building principles can result in a building that is easier to adapt over time to residents' needs, provide opportunities for resident input and limit unwanted resident displacement.
3. When social sustainability is prioritized in the design, resident networks and well-being can be improved, and there is an increase in resident pride which is ultimately beneficial for the housing association.
4. The design is dense, efficient and based on the norms of housing association design to ensure their programmatic requirements are met, more standardization can be created which improves opportunities for future adaptability.
5. Integrating existing economic activities and creating a mixed program improves the relationship with the surrounding community and creates a neighbourhood with a wide range of activities at the street level.

The selection of these main considerations was also determined by their relation to one another so they can reinforce each other. An example of this is how the Open Building design allows for residents to reconfigure their dwellings to match their needs over time thus improving social sustainability.

Following an analysis of the site and the municipalities masterplan, a new masterplan was created for the selected block. This master plan aims to integrate existing economic activities at grade, follow the municipality's 40/40/20 guideline and host several buildings that all share a communal courtyard on the first level.[5] The plot in the southwest corner was developed in more detail due to its relationship with the Klaprozenweg and the new public square that will be introduced to the west of it. Here, a 46-unit mixed social and mid-income building becomes a testing ground to see how the key design considerations can work together to ensure the project remains affordable and of high quality both for residents and the housing association over its lifetime. Aspects of these key design considerations are touched upon below:

The building is designed around Open Building principles with a disassemblable prefabricated concrete structure. The prefabricated brick and concrete facade elements are designed to last a long time with the internal layers and insulation

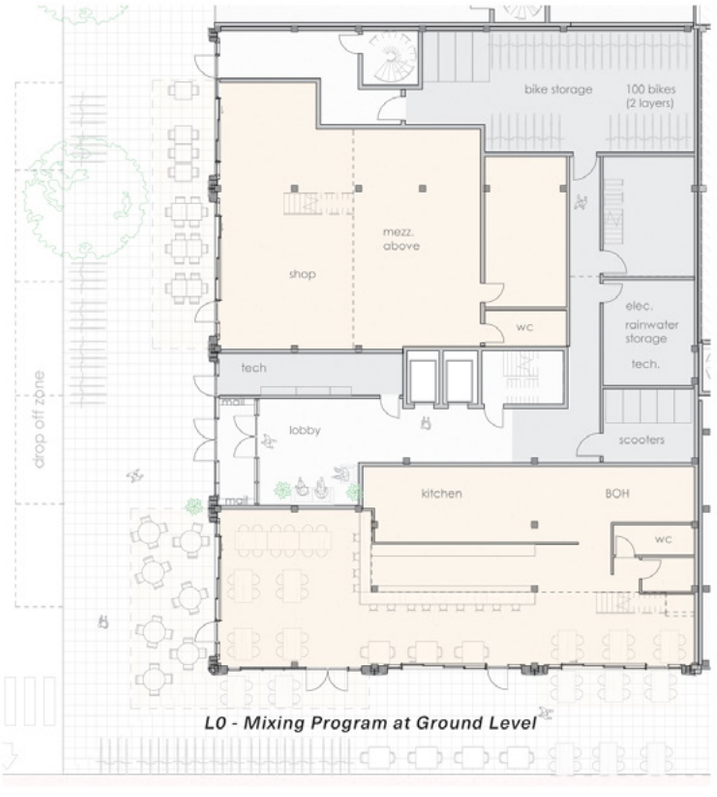
4. Galster, 2013

5. Gem. Amsterdam. n.d.

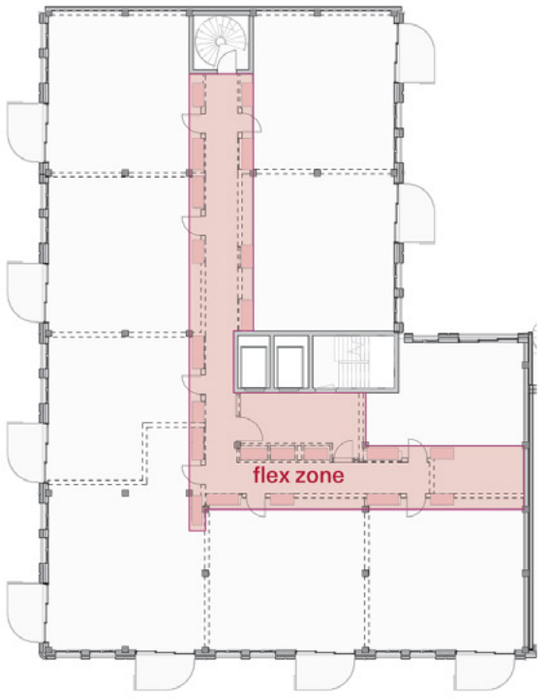
easy to access and replace while the outer shell remains. The dwellings and the installation systems are designed to be easily re-configured over time. Open Building principles are instrumental at grade to allow the integration of several types of businesses, particularly for existing businesses to return. To strengthen the social sustainability of the development, each building on the block has less than 50 units and features shared spaces that connect to the communal courtyard. Each level has half social housing tenants and half middle rent tenants. Social tenants are on one side and mid-income on the other, to allow for easier unit expansion over time. The building is arranged around an efficient layout that features a limited number of unit types and offers ample opportunity for prefabrication.

The final design demonstrates several practical areas of innovation that housing associations should introduce to better meet resident needs over an extended period. By extending a project's lifespan and considering future renovation strategies, housing associations have the opportunity to save costs over the generations they will be managing these projects. Further investigation should be done into what residents and housing associations want in terms of quality and affordability so more synergies can be achieved.

Figure 3. View of west facade shows the repetition in the prefabricated elements.
Image by Jeff Hill

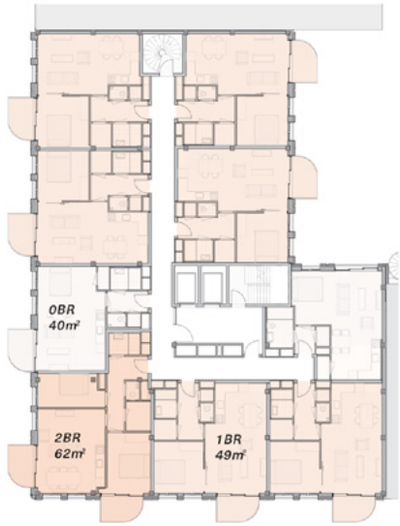


L0 - Mixing Program at Ground Level



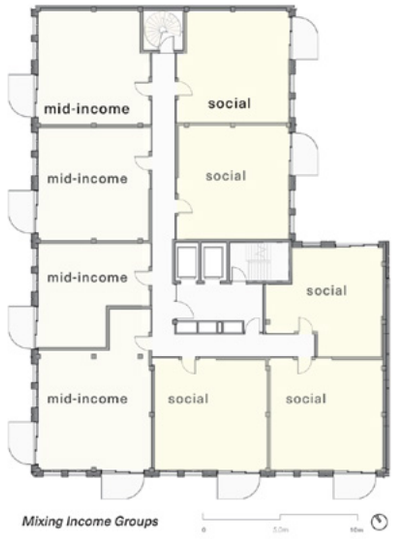
Open Building Principles to Create Future Flexibility

L1 - Social Space Connecting Residents to Shared Courtyard



L2-L4 - Plan Designed Around Efficient Unit Layout

Simple Unit Re-Configuration Potential



Mixing Income Groups

Figure 4. Floorplans.
Image by Jeff Hill

Inclusive Station Development

Achieving post-war neighbourhood renewal by creating station areas of the future

In recent years, the redevelopment of railway station areas has had an important role in urban planning and governmental politics.[6] As most of the central stations have been improved focus of municipalities and the Dutch national government have shifted to the smaller, peri-urban stations.[7] When researching these peri-urban stations it became clear that some of those stations are located in disadvantaged neighbourhoods. The development of the station areas clashes with the deterioration of the existing neighbourhoods.

The densification of cities results in a new focus on peri-urban stations. The peri-urban station offers opportunities to create sustainable and highly dense neighbourhoods. But these neighbourhoods are often located in post-war neighbourhoods.[8] The Development of these station areas creates an emphasis on the inequality between the residents of the disadvantaged post-war neighbourhoods neighbourhood and the residents of the new station area development.

The research aims to find a connection between the development of the station and the improvement of the post-war neighbourhood Voorhof. The main question is as follows:

'How can spatial redevelopment of peri-urban station areas improve the quality of life in adjacent post-war neighbourhoods?'

The research for this thesis report is done by a combination of three methods. A literature review has been undertaken to understand the history of post-war neighbourhoods, research inequality and formulate a theoretical framework on which the answer to the questions *'what is a good neighbourhood?'* and *'how can we improve post-war neighbourhoods?'* can be based. The theoretical framework was used to set a base for a spatial analysis, which will include multiple field trips. The conclusions of the spatial analysis will be validated by short street interviews with the current residents of the neighbourhood.

6. Dijkstra & Emmerik, 2015

7. Stedenbaan, 2016

8. Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2016

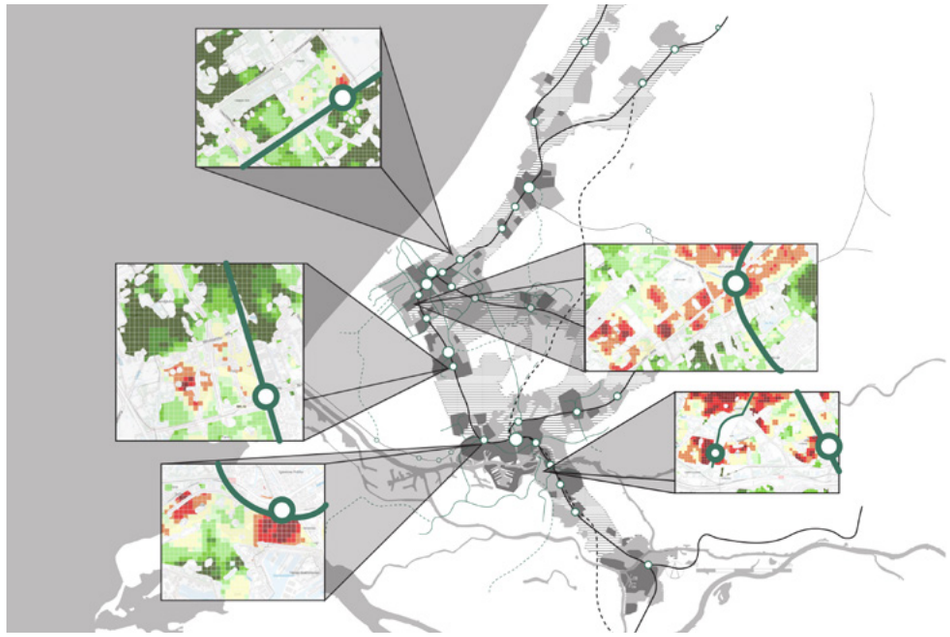


Figure 1. Disadvantaged neighbourhoods along the Stedenbaan project. (Self illustration) Leefbaarometer Kaart.
Image by Ilse de Jong

Based on the research two conclusion statements were made:

1. Monofunctional design of post-war-neighbourhoods creates a low-affordance neighbourhood
2. Design of public space and buildings does not promote social activities

These statements were validated by the short street interviews.

Strategy

At the core of the strategy was my perception of what I think is the role of the architect: There are always areas which are being neglected because they are of lower quality, or their redevelopment won't make anybody any money, or they don't fit in the image of the city of the future. I think an archi-

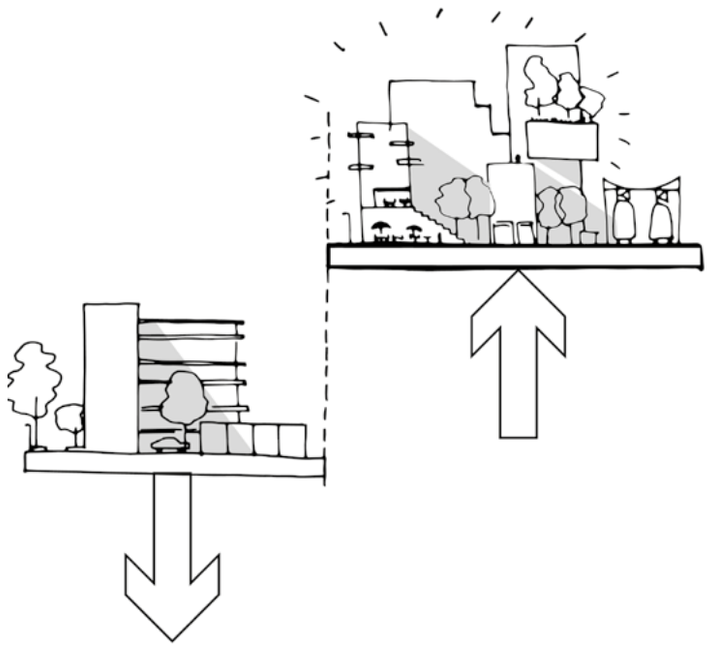


Figure 2. Part I of the strategy: Raise new development to higher levels, to make place for program that creates mutual benefit.
Image by Ilse de Jong

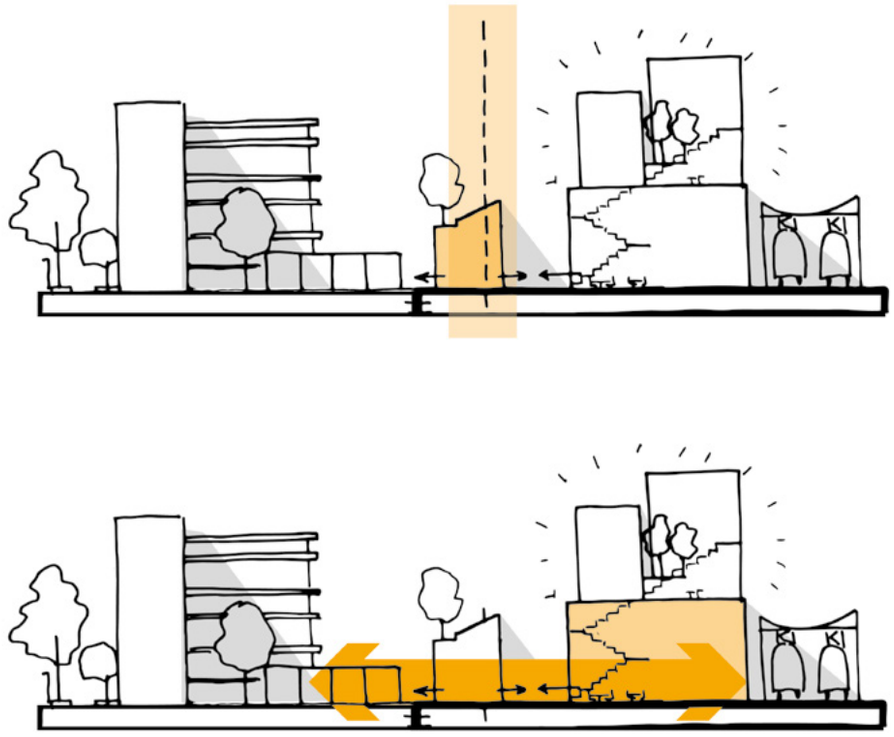


Figure 3. Create a transition from highly urbanised to local community scale.
Image by Ilse de Jong

tect should always have a wider scoop and look for opportunities and creative designs to connect the interest of different stakeholders and create architecture that is holistic in addressing societal issues. Based on this statement, a theoretical framework based on the theory of affordances, spatial analysis and resident interviews strategy was developed which had three parts

Part I
Raise new development to higher levels, to make place for a program that creates mutual benefit.

1. Raise the new high-quality neighbourhood to create space on the ground floor.
2. Create a program that enlarges the affordances of the current residents.
3. Connect the new program to the economy and activities in the region, on a local and regional scale, to secure a stable economic position. By connecting to local and regional economies the new program does not depend on municipal or governmental funding. Creating opportunities for residents to work also means creating opportunities for them to become part of society.

Part II
Create a transition from highly urbanised to a local community scale to protect the current qualities of the neighbourhood.

1. Preserve the existing street and structure;
   By respecting the current boundaries of the neighbourhood the current neighbourhood is shown respect, which is something post-war neighbourhoods don't receive often.

2. Green and Blue elements create barriers; The green and blue barriers create additional benefits; maintain the current character of the neighbourhoods, improve biodiversity, prevent flooding and counter urban heat islands.
3. Create a transition in volumes.; The gradual increase in volumes facilitates the transition from the old neighbourhood to the new development. In the existing neighbourhood, your view of the new high-rise buildings is blocked by small buildings that are in between the new and the old. This way the influence of the new building on the existing streets is less.

Part III
Connect the new dwellings to the surrounding area to prevent segregation:

1. Create routes and sightliness. To connect the new development to the existing neighbourhood the possibility for the current residents to adopt the new development into their daily lifestyles has to be created. This can be done by creating sightlines and routes.
2. Use local materialisation. The production of the post-war neighbourhood has been characterised by technical innovation. Technical innovation in prefab construction and concrete casting created an unprecedented production speed. This resulted in neighbourhoods with very characteristic neighbourhoods, to blend the new development into the existing neighbourhood the materialisation of the existing buildings is used.
3. Create public space at higher levels. To create public spaces on higher levels the transition from public streets to private areas is taken into account. Multiple routes lead to a public square on which front doors are located. Public functions can be located along these routes and on the square.

The program
The relationship between Delft and Technology is strong but is missing a vital link. a Vocational education facility will improve the connection between knowledge and innovation. The location Delft Zuid provides the vocational school to create an east-west location.

A circular economy creates neighbourhood benefits
A circular economy seeks to rebuild capital, whether this is financial, manufactured, human, social or natural. The goal is to optimize resource yields by circulating products and materials in use at the highest material utility at all times in both the technical and biological cycles. This means that during a life cycle, you invest in maintaining the quality of a product. When a product is no longer used, you try to find a new use or you redistribute. When a product is broken you try to refurbish it. Only when a product is beyond repair do you recycle the materials.

Vocational education will have to include education in the maintenance, refurbishment and recycling of materials. As students need to practice maintaining and repairing products the residents can benefit from the school by having their products repaired for free or at a low price. At the moment, repairing a product is almost always more expensive than buying a new product. The vocational school will provide residents with the opportunity of making their life more circular.

Besides repairing products, vocational education will house an informatics and robotics department. These departments can provide the neighbourhood with an IT help desk. This will diminish the divide of unequal excess to information and communication technologies between the elderly and other disadvantaged groups.

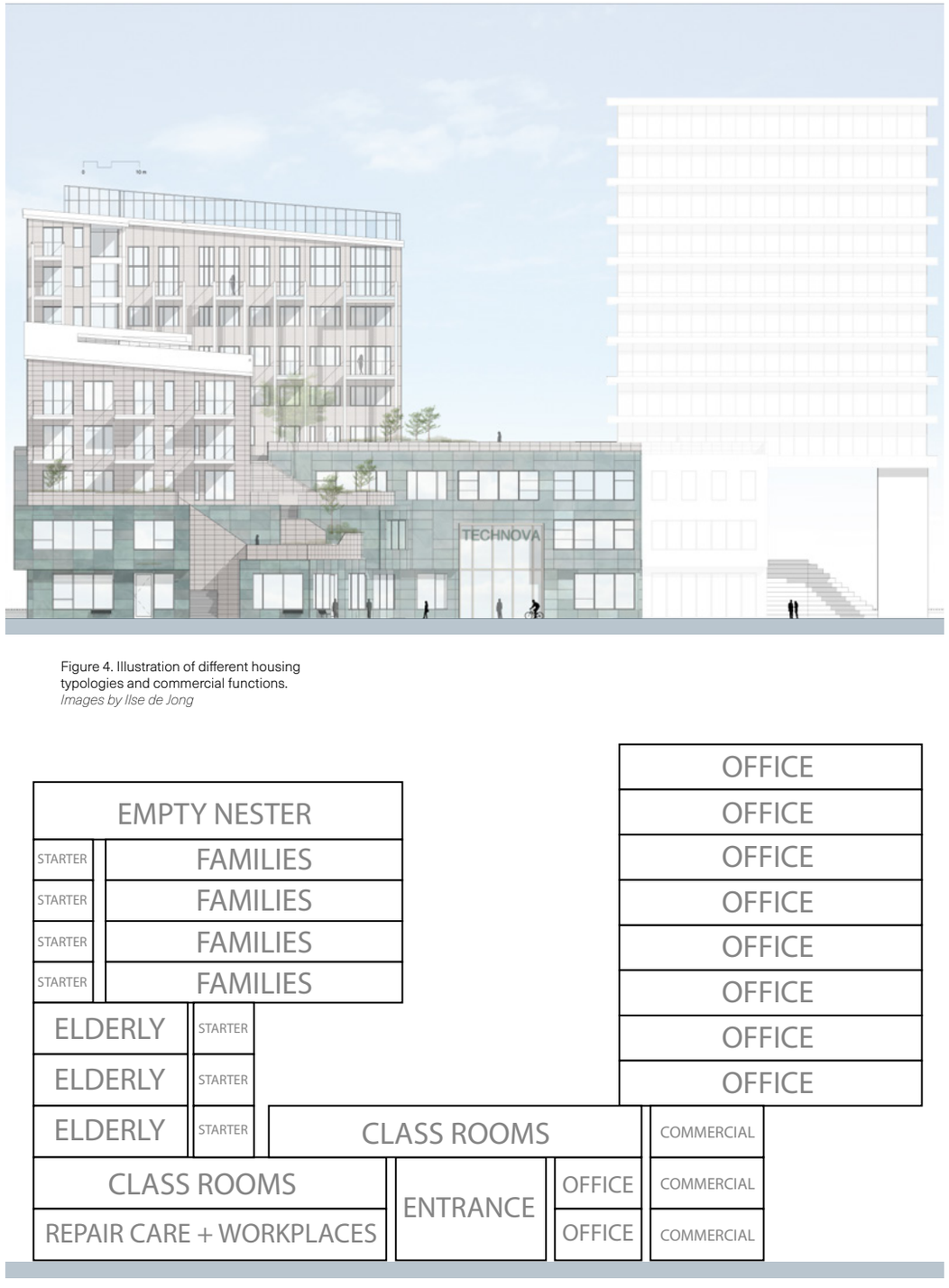


Figure 4. Illustration of different housing typologies and commercial functions.
Images by Ilse de Jong

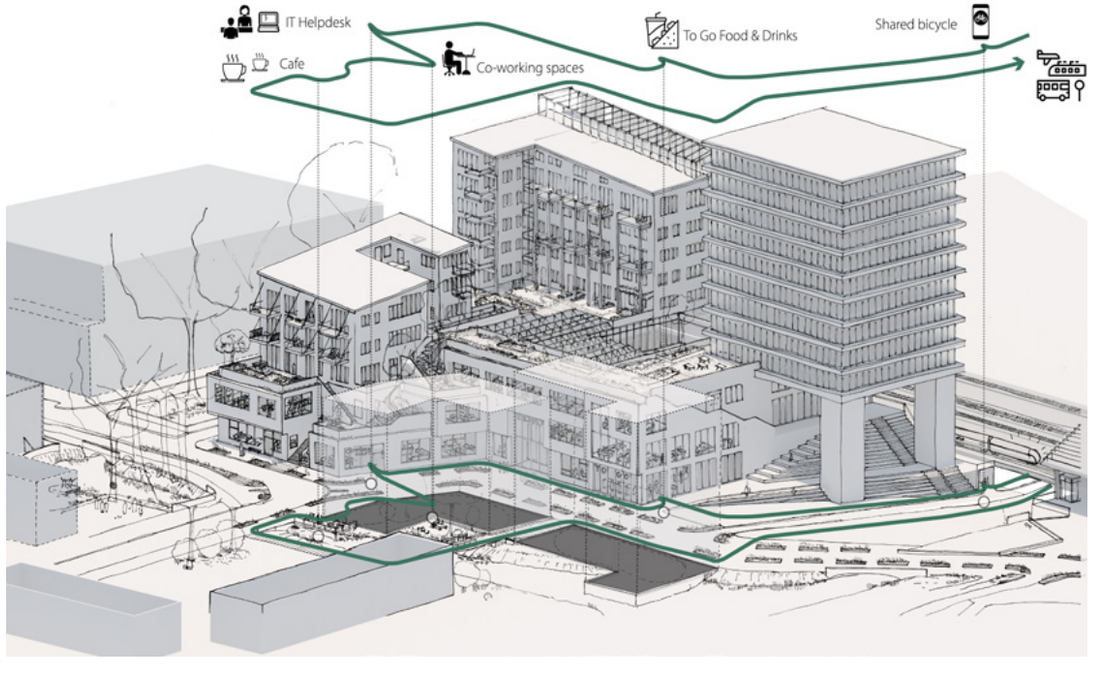


Figure 5. Network of daily activities.
Image by Ilse de Jong

Improving social cohesion through redesigning the underutilised space

For the past twenty years, social cohesion has been an important part of the political agenda and policymakers. Due to, among others, modernisation, globalisation and the individualisation of society, mutual ties are declining.[9] The individualisation of society leads to fewer physical contacts and interactions and a reduced community sense in neighbourhoods.[10] Social cohesion has a major influence on the perception of the neighbourhood. Poor social cohesion leads to multiple problems, including crime, feelings of insecurity and poor quality of life[11]. Improving social cohesion, also referred to as internal cohesion in society, has been an essential political starting point for years. This is an important topic in almost every vision of the future of a city in the Netherlands. Yet, each program is also quite global and it is not clear how this social cohesion can be improved. The importance of social cohesion has also been noted in Rotterdam; part of its budget has been released to improve society's social aspects. An inclusive city is an important starting point for the city. This means that there is room for everyone, regardless of background, education, age or culture.[12] In Rotterdam's environmental vision, the inclusive city is defined based on five concepts: social resilience, accessibility, space for meetings, mixed neighbourhoods and bonding with the neighbourhood. Of these five concepts, four are related to the social aspects of society. These are all important goals that cities must achieve, but nowhere is exactly described how a city could best do this. In addition, the definition of social cohesion is ambiguous. Various definitions can be found in the existing literature.

9. Schiefer & van der Noll, 2016

10. Hoogerbrugge & Burger, 2018

11. Knol et al., 2002

12. Gemeente Rotterdam, n.d.

Figure 1. View from the covered square, where the facade, which can be opened, encourages connection between different users of the building.
Image by Floor van Dedem

Social cohesion and the physical environment strongly influence each other. The satisfaction of residents is strongly related to the perception of social cohesion in the physical (and social) environment.[13] Architecture can make a major contribution to the improvement of the current situation of the environment and thus, the improvement of social cohesion. One of the available types of spaces that is suitable for this is the underutilised space. Underutilised spaces are often linked to activities that are not perceived positively, such as loitering youth and other nuisance forms. Little or no social cohesion is usually found in these underutilised places in the city. These places also score poorly on the quality of life. Reviving these places could lead to more interactions and more encounters between residents. This could lead to better social cohesion. The revival of these places could be achieved by, for example, architectural redevelopment.

In the search for the right means to make cities resilient, social cohesion is often mentioned as a possible solution. Besides the fact that social cohesion has been the subject of many political programs and policies at both local and national levels for many years, it is a classic sociological theme. Partly because of this, the definition of the

13. CBS, 2015

term and the method of measuring the degree of social cohesion is not unambiguous. Firstly, the concept of social cohesion was defined. Then, the effects of social cohesion on society, positive as well as negative, are examined. Improving social cohesion is not only a goal but also a mechanism to achieve other goals.[14]

Social cohesion is an ambiguous term. As a result, this research started with an overview of the different definitions mentioned in the literature, to arrive at a description that is the most comprehensive for this research. Émile Durkheim (1897) is considered as one of the first sociologists in Europe. In 1897 he wrote Le suicide, étude de sociologie. In this book, he describes social cohesion as the absence of conflict, crime or unsafe situations.[15] Maxwell (1996) describes it as follows; “Social cohesion includes having shared values, reducing inequalities in wealth and income, and generally making people feel involved in a society, facing shared challenges and that they are members of the same community.”[16] Gross and Martin (1952) suggested that cohesion is the ”sticking-togetherness” of the group, social cohesion is the strength of collaboration between primary and secondary social networks. It also refers to participation in social activities, shared norms and values and the degree of social contact that people maintain. Parsons is relating social cohesion to a degree of stability and harmony experienced.[17] And the Council of Europe speak about four driving elements that influence social cohesion.

Social cohesion;

1. Is created by strong social bonds and acceptance by members of the society and their joint responsibilities;
2. Requires all individuals to be able to participate in economic life and enjoy their community;
3. Necessitates processes challenging power structures and the distribution of resources in society;
4. Requires tolerance and recognition of persons from different cultures and identities.[18]

14. de Meere & Huygen, 2008

15. Durkheim, 1897

16. Maxwell, 1996

17. Parsons, 2005

18. Council of Europe, 2008

From all these different definitions of social cohesion, it can be inferred that not one description is correct. In short, social cohesion can be described as the coherence of society. In this essay the following definition of the term social cohesion is used;
“Social cohesion is the internal cohesion of a social system, based on mutual connections, shared challenges, trust, equal rights and shared norms and values, in which the solidarity of society is central.”
Besides the fact that social cohesion is a concept that is difficult to define, it is also a concept that is meaningful on several scale levels. The scale levels of the neighbourhood and the city are essential for this study. In both scales, both the individual and the group are crucial factors that influence social cohesion. The individual must want to be part of the group, and the group must function well to add value to social cohesion on a larger scale. To act as a group, the individuals will have to develop shared ideas, norms and values.

Social cohesion is defined as the ”glue” or the “bonds” that keep societies integrated by ordinary citizens, policymakers and social scientists.[19] But what are the ingredients that form the glue? With these assets, a strategy for improving cohesion can be developed and practically applied.

To improve social cohesion in cities through architecture, municipalities must seek suitable spaces. These spaces are where interventions are possible from the perspective that problems within the current city must be solved. There is sufficient space available that can contribute to improving social cohesion in the neighbourhood. A suitable public space is defined by activities, the mix of people and cultures, and different programming types. Physically seen, a well-functioning public space needs a connection with its surrounding. It should be easily accessible, bring people together and serve the community. It should also feel comfortable in terms of climate, so the temperature, sun, daylight, and wind.[20]

An underutilised space is a (public) space that is

19. Larsen, 2014

hardly used or is not used as it is designed. There is an essential difference between a deliberately unused space and a space that has been occupied but has been abandoned since. The underused space is often uninviting and uninspiring, and for many people, it is a place they walk by without forming an opinion. When there is no more activity, and the space is therefore underused, this can lead to multiple problems for the entire neighbourhood. Two examples are loneliness and mental health issues. Underutilised public space increases loneliness among the vulnerable and the elderly. Casual social contact is important for a sense of togetherness and feeling at home in a public space, according to Bas Spierings.[21] Impoverishment is another reason that leads to problems. Logically, a deserted place results in the avoidance of encounters, leading to a worse sense of security. Research shows that crime rates drop when there is a healthy and vibrant public space. When the crime figures are alarming, public space perception may not be good.

By reviving the underused spaces, the involvement of the residents can be increased. By stimulating more interactions and encounters and creating more liveliness on the street, impoverishment is counteracted, and social control improves. This contributes to strengthening social cohesion. The experience and interpretation of the public space, which includes these underused locations, is essential for the entire neighbourhood. Besides, sufficient and good public space contributes to improving the economic situation, and people experience better physical health. The improvement of the underused spaces has a positive impact on many aspects that are essential for improving social cohesion.

20. McKinsey & Co, 2016

21. Baggerman, 2020

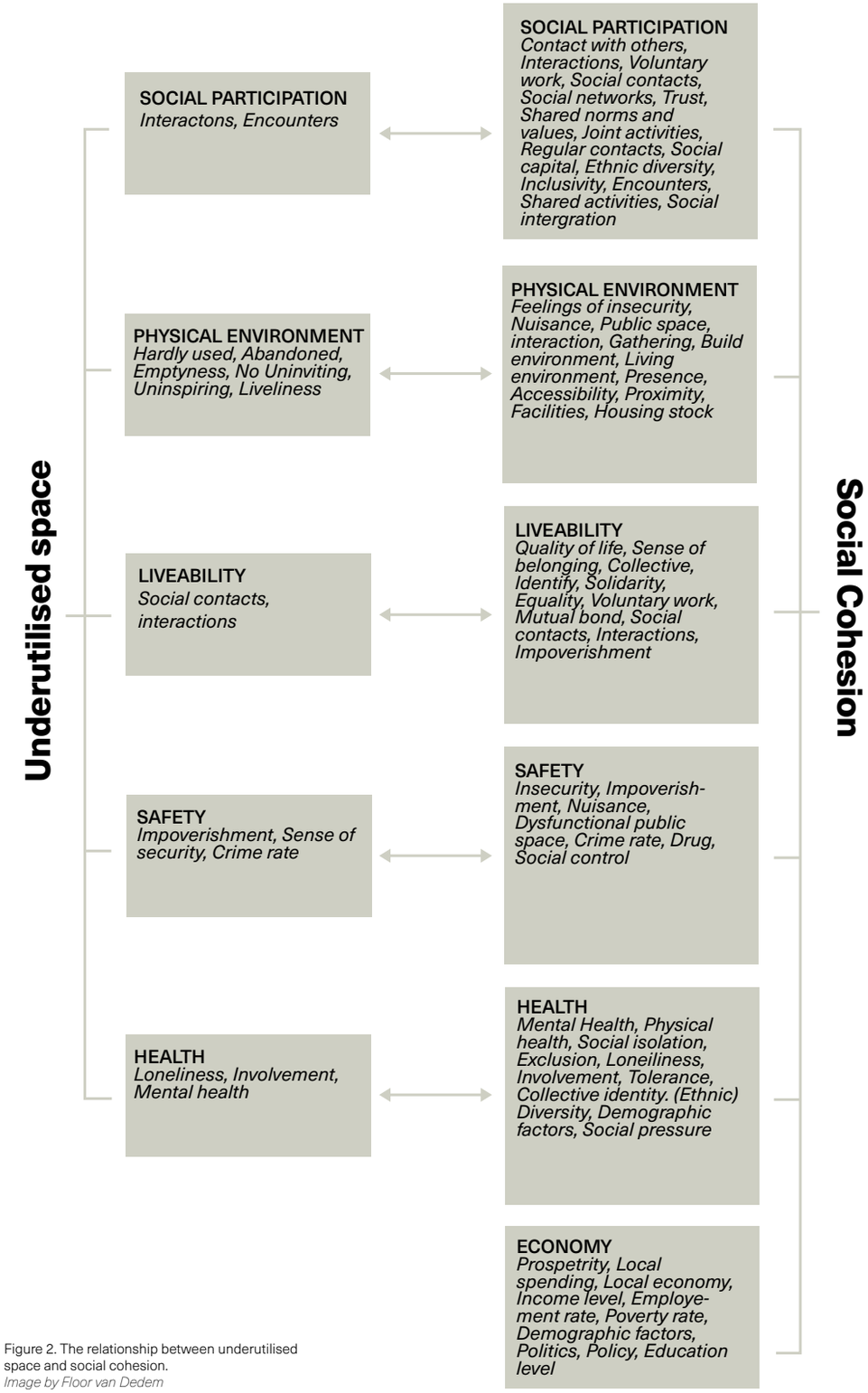


Figure 2. The relationship between underutilised space and social cohesion.
Image by Floor van Dedem

With a view to the future, when urbanisation will most likely increase further, the available space in the city will decrease.[18] It is predicted that nearly two–thirds of the world's population will live in cities by 2050. As cities become denser, people have less space at home, so the city and its public spaces must function as extra living rooms for the residents.[20] Healthy public spaces help revitalise the neighbourhood and community. Crime rates are falling, the economic situation is improving, and people experience better physical health.[22] Given all these positive effects, you could say that social cohesion will improve when an underused space is revived. Well-used public space can be of value to society.

When there are more interactions, more inclusivity and more joint activities, social participation will improve. The public space in the physical environment is an important facilitator for interaction and gathering. When the underperforming public space is improved, impoverishment and nuisance will decrease. Therefore, the sense of security will improve. With more interactions and liveliness in the public space, the area's social control will increase as well. The liveability will improve by developing a local identity and creating a corresponding sense of belonging. By stimulating social interactions, loneliness can decrease, which contributes to better mental health. Physical health improves when the space is organised with, for example, sports functions. From an economic point of view, the situation can improve when the new development's function is focused on improving the economic situation. For example, when there is space for (local) economic activity.

The underutilised space is often uninviting and uninspiring, and for many people, it is a place that people walk past without noticing or forming any opinion about. When underutilised spaces are revitalised, people will start seeing and using the location again.[23] Therefore, restoring the underused spaces will be necessary for improving the engagement with the inhabitants. Healthy public spaces help to revitalise the neighbourhood and community. Also, the crime rate will go down, the economic situation improves, and people experience better physical health.

Since underused spaces have an influence on social cohesion, filling in an underused space can contribute to the improvement of social cohesion. This can be done in several ways. Firstly, by filling in better, defining and making use of the available space. This prevents impoverishment and will improve the physical environment. Secondly, people will experience fewer nuisances because nuisance occurs more often in an undefined space. By reducing nuisance, the feeling of safety in the neighbourhood also improves. By stimulating interactions in these spaces, not only will social participation increase but also the mental health of the inhabitants will improve. Finally, with a better filled-in area with a clear program, people will feel more connected to their immediate environment, enhancing the neighbourhood's social cohesion. But designers still must continue to maintain a critical balance between the ideal picture and the feasibility at all times to create better living conditions.

22. Hub+Weber Architects, 2016

23. The Globe, 2019

Figure 3. View of the design from the north, with emphasis on the public square. An important meeting point in the design.
Image by Floor van Dedem

Vertical Social Connectivity

Sylvan Muijlwijk

Inclusive high-rise design

Due to globalisation and migration cities have become more diverse. An international city like The Hague exemplifies this. The residents are originating from 176 different nationalities, the linguistic profile is made up of 89 different languages, and they are connected to various religions. However, this understanding of diversity that is often used in social sciences or wider public spheres could be seen as a misleading and one-dimensional appreciation of contemporary diversity. Urban diversity should be understood in a more open and complex way. Tasan-Kok et al.[24] use the term hyper-diversity:

"...an intense diversification of the population in socio-economic, social and ethnic terms, but also concerning lifestyles, attitudes and activities."

Groups that are considered homogeneous through various variables like socio-economic status can turn out to be very heterogeneous in terms of their lifestyles, attitudes, and activities.

The Hague is one of the most socio-economically segregated cities in the Netherlands, parallel to this there are social challenges like loneliness and social exclusion. While these challenges exist, The Hague is predicted to grow substantially in the following decades. To house this predicted population growth in The Hague, the municipality has chosen a central high-rise development strategy as a means to density and achieve urban qualities. The new residential neighbourhood, The Binckhorst, is one of the central areas appointed for high-rise development.

This high-rise strategy fits in a broader trend, since the turn of the millennium the amount of residential high-rises constructed in Europe has exceeded the post-war peak period.[25] One of the reasons for this trend is the globalisation and

24. Tasan-Kok et al., 2014

25. Drozdz et al., 2018

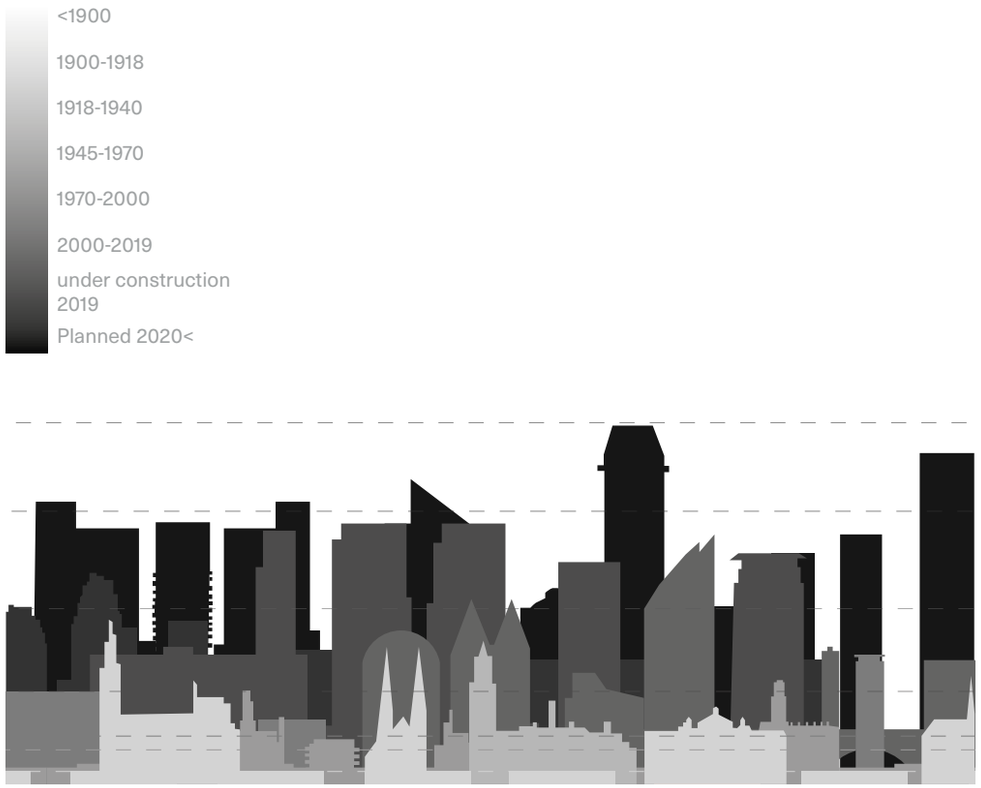


Figure 1. The Hague skyline-timeline.
Image by Sylvan Muijlwijk

financialisation of real estate, this neoliberal system results in housing being treated as a commodity instead of a social good. Potentially increasing segregation in the city.

Segregation can be defined as a spatial result of differences or inequality in society.[26] Apart from the horizontal dimension, segregation can be witnessed in the vertical dimension. Vertical segregation can be seen as a contrast between high- and low-rise dwellings or between residents of a single building. The contrast between high- and low-rise dwellings is depending on contextual factors and shows different variations. Segregation in a single building is often articulated by the wealthy living on the highest floors. The example of the Haagse Toren illustrates this, two different socio-economic groups live in the building. However, the design completely separates the groups. Separate entrances and a lack of social collective spaces eliminate any interaction between the two groups. The fact the wealthy occupy the top floors occurs partly because of individual preferences and a desire for exclusivity.[27] On the other hand the investment costs of building above a certain height play a role in making top floors for the wealthy.

In the debate about the Sluisbuurt in Amsterdam, Soeters ventilates a critique on the expat community of the super-rich, neighbors are completely invisible to each other, something he labels ghost behaviour.[28] While in history the upper floors have belonged to the poor and the lower floors to the wealthy (e.g. Roman Insulae, Hausmann's Paris, 19th century),[29] the tables have turned and Walker's theorem of stacked independent private domains[30] seems materialized. The privileged live fenced off by height in what Graham et al.[31] call vertical gated communities.

Due to the scale of high-rise buildings, they have been understood as a city within a city. This dates back to the early skyscrapers of Manhattan, modernist designs like Unite d'Habitation and more recently the Binckhorst B-Proud. B-Proud is claimed by OZ-Architect to become a vertical city. With 870 households and 800 workspaces, with an estimated 1,740 residents, the building will exceed the population of 20 individual neighbourhoods of The Hague. Derived from the study of the implicit philosophy of Manhattan, the theorem of Bigness describes architecture defined by its size beyond a certain scale. Bigness as defined is in itself urban; independent of context; its internal parts act independently committed to the whole, and it separates interior and exterior spaces.[32] In short: *"Bigness ... is the city"*. As Koolhaas describes it, buildings beyond

26. Ponds et al., 2015

27. Gifford, 2007

28. Milikowski, 2018

29. Sennett, 2018

30. Koolhaas, 1994

31. Graham et al., 2012

32. Koolhaas et al., 1995

Figure 2. Vertical public space, pockets.
Image by Sylvan Muijlwijk

a certain scale should be understood as a piece of the city which acts independently of the rest of the city. The notion of *"Fuck the Context"* is in every way contradicting the field of urban design, where context should be everything. Harteveld[33] argues that the role of Interior Urbanism, on the basis of cases in the United States and the Netherlands, related to the increase of scale, has the opposite effect. The scale invites internal public spaces to be nestled inside and the increased amount of users using in- and outdoor spaces creates stronger connections with the building's surroundings.

Accepting the notion of a building being a city within a city comes with the responsibility of its integration within the urban fabric and consideration for the design of the interior spaces from a humanistic point of view. Challenges for this are regarding the interaction between indoors and outdoors, the relation between public and private, and the vertical design of the interior becoming relevant. For the latter, a vertical urban design strategy is needed. Urban design strategies and principles should therefore be applied integral to the interior architecture and spatial configurations extending into the verticality of the building. This urge is described by Yeang[34] as Vertical Urbanism.

Environmental psychology and geography scholars have attempted to demonstrate the social effects of high-rises on their residents.[35] A lot of the research conducted on social outcomes of living in high-rise structures followed the post-war modernist housing estates built between 1950–1970. The structures were often in poor conditions, located in low socio-economic neighbourhoods, and housed disadvantaged communities. Researchers neglected the socio-economic circumstances that resulted in the stigmatization of high-rise living. The negative social effects of high-rise living are therefore the most elaborated on.[27,35] In the discussion about the possible social outcomes, it is therefore important to realize the limited influence of the height or the building type and to take into account the moderating factors (non-architectural factors) that contribute to certain social outcomes.[26,35]
The research is not always conclusive and the dependence on moderating factors creates different outcomes, however, it should inform the design process to understand what possible social effects living in high-rise buildings may have. The layout of many residential high-rises contains a high degree of privacy and anonymity. Gifford[26] compares this to characteristics of inner city life with advantages like privacy and less unwanted social interaction and disadvantages like less intimate social interactions and less care for one's neighbours. The amount of people living in one building essentially provides the opportunity for many social interactions.[26] While the population within one building can be hyper-diverse and too many people can create a feeling of anonymity, it is not given that when people are placed in proximity they will interact. A well-designed network of collective and semi-public social or circulation spaces should provide the opportunity for residents to use the space, facilitate shared use of space and possibility social interaction will take place.

Answering the given challenges in a social context of The Hague and of high-rise buildings in general the main design value of this project is inclusivity. Included as one of the Sustainable Development Goals of the United Nations,[36] answers to the most fundamental ethical consideration for the development of our cities. Spatial inclusivity forms a challenge for our cities of the future. Related to the theories of Just Diversity[37] and the Open-City, the sub-design values that contribute to a more inclusive city and answer to the social context of The Hague are formulated. The design values taken from these theories are recognition, encounter and adaptability. Recognition addresses the different needs and values of people, adaptability responds to the changing needs and values and encounter is aimed at facilitating interaction between like and unlike individuals.

33. Harteveld, 2006

34. Yeang, 2006

35. Baxter, 2017; Larcombe et al., 2019

36. United Nations, 2015

37. Fincher & Iveson, 2008

High-rise design is in practice principally approached from an architectural perspective. The lack of a humanistic approach and the high amount of residents per building from the need to approach the design of high-rise buildings from an urban design perspective. Urban design is predominantly understood in a two-dimensional manner and is often exclusively focused on outdoor areas. This approach is challenged in this project. The outcome could inform the interpretation of the concept's interior- and vertical urbanism. Principles taken from planning and urban design are applied on the scale of the building (interior and exterior), which could provide an example of the application of those principles in high-rises. Furthermore, the design could serve as an example of a more socially informed way of designing high-rise buildings. Continuing on the design values a set of urban design principles and related elements guide the projects towards a more concrete form. These principles are tested by observations in and around existing high-rise buildings in The Hague and interviews with residents. This is captured by the main research question:

In which manner could the design of a high-rise building in the context of the Binckhorst The Hague, from the perspective of urban design, contribute to the development of a more inclusive city?

The project concludes with the design of a high-rise building in the Binckhorst The Hague. The design consists of urban design elements like a vertical living street, public spaces (pockets) along the route and a configuration of volumes and programs. Around the crossing of the Binckhorstlaan and the Mercuriusweg, an inclusive centre is formed which is accessible to all and answers to various needs and values. The layout of dwellings and functions is made horizontally to ensure encounters between different users and residents. The functions and dwellings are connected horizontally and vertically by a vertical living street. Adjacent to this public spaces are created. Those spaces, functions and dwellings correspond to a variation in the neighbourhood or urban atmospheres. To ensure the spaces and functions are adaptable they are designed to cope with changing needs and values over time.

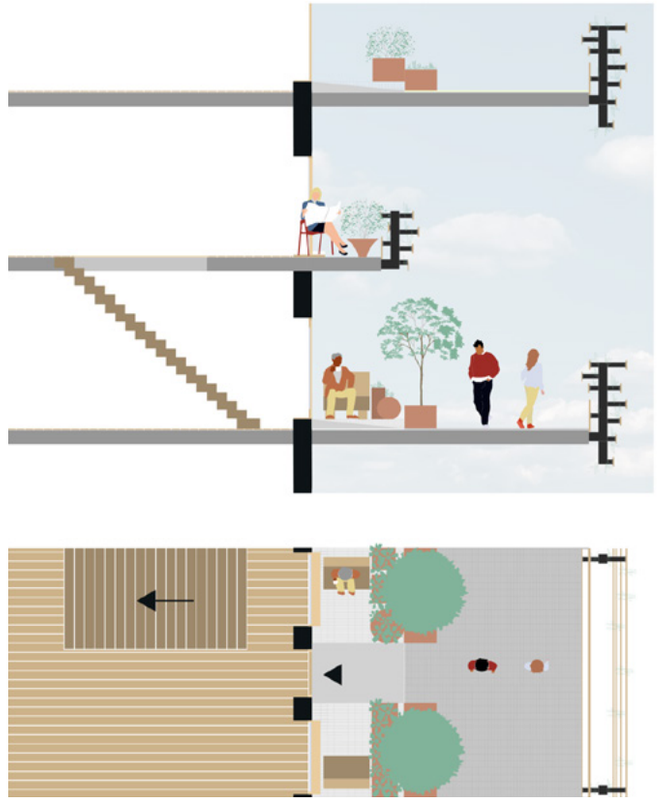


Figure 3. Vertical streets.
Image by Sylvan Muijlwijk

Interview

Sylvan Muilwijk
Urbanism graduate

Introduction

Hi, I'm Sylvan Muijlwijk, I completed my bachelor studies in Groningen in technical Urban Planning and from there I started the masters in Urbanism in Delft. In my studies, I moved through different disciplines and experienced different approaches to urban themes. After my master, I started working at the Municipality of The Hague. I've noticed the importance of multidisciplinary work there. Right now I'm working on spatial planning and spatial regulations, which involves thinking about how to design the city and making rules to make this way of designing possible for instance thinking about volumes, building heights and parcelling.

Motivation [pre-phase]

What motivated you to choose the studio?

I participated in the Architecture & Urban Design MSc2 studio in Boston and I immediately I felt a connection with the mentors and the tutoring style. There was a lot of freedom in choosing your topic. Content-wise, I wanted to learn more about design and explore this boundary between disciplines, especially using architecture as a way to enhance the urban design.

How was the City of the Future studio different from urbanism studios?

Usually, in urbanism studios, you can define your topic but it's still more guided as if your project springs out of the main studio topic. In the City of the Future, you can choose your location and your topic without constraints. There are almost no boundaries.

Experience [process phase]

How was your experience with the educational setup of the studio?

COVID started in the last part of the studio so things came out different than expected. We didn't see the rest of the studio as much anymore. But in general, it was a good experience. I learned a lot from my mentors and I enjoyed the freedom. This can be a challenge though, trying to find your way in these multiple possibilities and multiple kinds of literatures.

And what about the trips and activities?

The trip to Milan was interesting to see the city together with different disciplines.

Did you see a dialogue with other disciplines in your project?

In some cases responding to presentations from people from different disciplines was more difficult. I engaged in discussions with students from other disciplines. But that doesn't mean working together on a topic. In the future, perhaps the studio could have a more structured way of engaging the different disciplines in an individual project by allowing cross-evaluations.

The project [post-design phase]

In what ways does your project answer the studio's theme?

In my project, I explored how the principles of the city could be projected onto a building. How can a building be designed as a neighbourhood, combining the diversity of tenants, public inner-spaces, hybrid spaces, and interaction between indoors and outdoors? It's interesting to think about the indoor spaces of buildings using some levels that are public and how this can be part of the fabric of the city. It was a very experimental project. I don't know if I found the answer to it, but it's something to be explored to tackle the segregation that we see in big cities with these enclaves of high buildings with guards in front. The challenge is how to densify urban areas while making sure people still interact with each other.

Cities of the Future: Societal by Nature

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Cities and their challenges are societal by nature because cities are creations of humanity, and thus when faced with the question of what will be the future of our cities, this implies three aspects:

First, there will be no single mind able to produce and envision answers alone. At least not in isolation, nor behind the desk. Aware of this, when designing for the city of the future today, we are informing ourselves in multiple ways and on different levels. Thanks to digitalisation, we have not only the availability of a million sources on a topic or place online, but we also have spatially near real-time insight. We can trace and track virtually every person, represented by those people sharing their activity patterns and likes, we can experience situations in simulated models, and we can easily reach out to local experts and street-wise citizens to know more. We have to keep in touch with the world around us. Most directly, sensing changes in public life within the urban fabric *ut ubi est* forecasts what will be next best. That is to say, the ongoing change is best recognisable through public space, and often in greater detail... if conditions remain the same.

Second, from a multidisciplinary–even interdisciplinary–point of perspective, we see more at all levels of detail. Professionals represent different views on societal challenges and interrelating this viewpoint help to find better and more accurate answers. This may have a bigger societal impact, as we can coordinate socio-spatial intervention strategies in constellation with others. We see, for instance, where people continue to rely on car transit out of socio-spatial necessity generated by the urban condition, architectural programme, infrastructural design, and logistic systems. It contrasts urban areas where people are able to use public transport or shift to sharing vehicles and making use of other mobility services. A different multidisciplinary perspective may help to recognise and locate where for example particulate matter by e.g. urban and architectural design is reduced in contrast to areas where heavy traffic and industry affect community health issues through pollution. We also would challenge the lack of public space quality in dense areas or social potentials in developing areas.

Thus, from these well-informed multiple disciplinary angles, thirdly, we want to design for better futures. In the cases like the examples given, unjust differences may desire an alteration of the forecasts. While designing for the mobility transition, the health transition, or e.g. the material, energy, or demographic transitions, the aim for better liveability for all people and sustainability of urban life comes along. Thus, city-making in times of big transitions is societal by nature. We design for society. Hence, by means of design, we aim for a better future for the urban population, interconnected to the peri-urban, *urbinum*, rural, and all *orbi*. We keep everything together and give everyone a place. Inclusivity, facing diversity, inequality, and equity, is thus both a premise as well as given.

Our perspective on what may be the *città ideale* on a misty ever-changing time-horizon has become multi-perspective *everyday urbanism*,[1] in which the ugly and ordinary at "the meeting of interior and exterior forces"[2] bring professionals and people together with respect to differences. Still, whereas, we still aim for better societies in a kind of Corbusian premise of designing *the city of to-morrow and its planning* (1929)[3] on the base of the *ville contemporaine* (1922),[4] the professional mind shift is enormous. Societal reasoning on future cities has become the inverse of what it once was. It is not so much different in the intent. This hardly changed. Clearly, for instance, the objectives of the ground-breaking Dutch design research *Stad van de Toekomst, De Toekomst der Stad* led by Alexander Bos (1946)[5] are not so contrasting in comparison to our own contemporary *Stad van de Toekomst / City of the Future* design research study (since 2016).[6] The past guiding paradigm, the neighbourhood model or so-called *wijk-gedachte*, has merely evolved into a new paradigm based upon hybridity, dynamic social networks, and day-to-day experience and perception of public space.[7] To a much greater extent, its seminal contrast lies in the mirroring image of the Modern *starchitect*, pretending to have all the answers and glamorously guiding society to the next level. This does not give any effective design results anymore at the present. Even so, this professional positioning, which is still alive in some minds, appears to be misleading and falsifying the complexity of reality today. In current times when growth, globalisation and universality are facing its limits, we better investigate the local conditions, without losing the bigger picture. Simply following complexity theory, we navigate in a dynamic, sometimes maybe chaotic, society and recognise the potential of (re)design of specific areas in the city. As a consequence, designers and engineers operate each time in different but place-related social networks and their projects are approached multidisciplinary, while other professionals and locals co-create along. Together we can know and do more in the city of the future.

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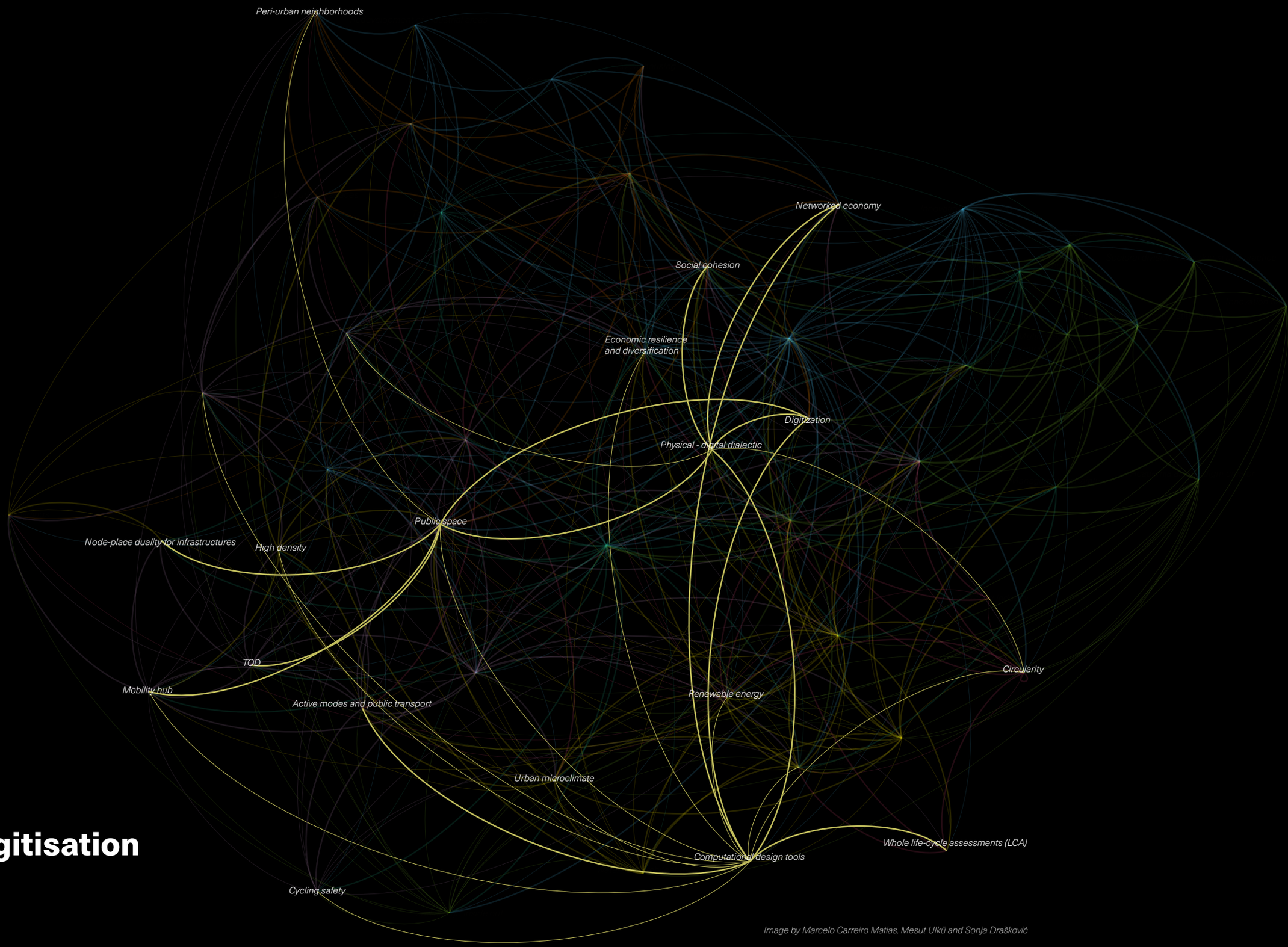
1. Chase; Crawford; Kaliski, 1999
2. Venturi, 1966
3. Corbusier, 1929
4. Corbusier, 1922
5. Bos et al., 1946
6. Berkers; de Boer; Hinterleitner, et al., 2019
7. Graham & McFarlane, 2014



Digitisation

Image by Marcelo Carreiro Matias, Mesut Ulkü and Sonja Drašković

Connection and disconnection

One could say that the phenomenon of digitalisation, also known as the digital revolution or the information age, has connected us as much as it has disconnected us.

Since the emergence of digital computing and internet communication technologies, we have seen an unprecedented acceleration in traditional processes, the ever-increasing efficiency of systems, groundbreaking innovations and connectivity possibilities that we never anticipated. But, on the contrary, also an increasingly anonymous, impersonal and individual society is arising. Nowadays, a great part of societal settings is lived from behind the screens as to think of social media. The latter is providing worldwide interconnected platforms, offering us new ways of expressing our societal, political, emotional, and so on, values. All this has extended our reach in terms of connectivity to a whole new level and therefore we seem to have access to whoever or whatever we want within a few clicks away. We sometimes even tend to forget that we don't need to dive into our screens to connect with people. In the contemporary, a kind of situation has appeared where social interaction and engagement can exist in either virtual or physical environments, in which they do not complement, but rather exclude each other. The more active on social media, the more isolated from the physical environment and vice versa. Is this the desired relationship between both worlds or should there be another way? Should we not look into ways of enhancing the integration of both worlds?

In this chapter of the book, two different approaches to these questions will be suggested through two different graduation projects.

Digitisation

But first: what does digitisation mean? Digitising can be described as "changing something such as a document to a digital form (a form that can be stored and read by computers)" or "to start to use digital technology such as computers and the internet to do something", according to the Cambridge dictionary.[1] Based on these definitions, a division can be made in which digitising can refer to the digitisation of analogue information, such as documents, statistics or video fragments into a digital format so that it is processable by computers. In this manner, the traditional ways of processing information can be fully optimized, data becomes more interactive and *smart* and the timespan between input and output becomes shorter. This subdivision is referred to as integrating digital technologies into the design process. Or digitalisation can refer to a broader concept in which digital technologies get implemented in not only systems and processes, but also in buildings, roads, lights and any form of structures from which cities are built. Digitisation is a means of integrating digital technologies with our daily lives.

In both ways, information technology becomes not only inevitable but also very dominant in contemporary societies and cities. As a result, there is a changing interaction between citizens and physical urban spaces in which the role of the material city in presenting the public and the collective experience of urban space is being questioned in future scenarios.[2] Therefore, a re-consideration of physical public space is needed, at which point spatial designers, such as architects or urban planners, are given new challenges as well as possibilities in integrating digital technologies into their designs or design processes.

1. Cambridge University Press, n.d.

2. Signore & Riether, 2018

Student projects
Designers of physical environments are tasked with these sorts of questions when thinking of future scenarios. How can digitalisation be integrated within the design process? Gabriel Gonzalez's project *An Interactive Design Tool for Urban Planning,* suggests a method in which the design process is integrated with digital technologies to develop new design tools which contribute to the optimisation of the design outcomes. Cem Ada's project *The Schiekadeblok as an Urban Machine* suggests a way in which digital technologies can be integrated within the physical design itself, making the design interactive and responsive to people and its environment. It stands for considering a new urban paradigm of public space that serves the public realm at the intersection of physical and virtual space.

An Interactive Design Tool for Urban Planning

Gabriel Garcia Gonzalez

Using the size of the living space as unit of measurement

The city of the future needs futuristic design tools. These tools, like many other futuristic applications, need the most up-to-date data from our current way of living as input for the user to make data-driven decisions and generate future-proof cities. Yes, these futuristic design tools have a user, a human, an urban designer, and a person with cognitive skills. Thinking that in the future design, processes will be made purely by computers is a common mistake. These can get close to an optimal solution but are far away from making a creative process.

This graduation project explored the possibility of creating the city of the future with a computational design toolkit, using as a reference the city (data) of today. For urban planners, one of the most common units of measurement for population density is the number of households per hectare.[3] However, the real size of the household is seldom considered, neither in 2D nor in 3D. In this project, the overall idea is to calculate the size of average households, or living space, and use it as a unit of measurement to design new urban scenarios. For this project, the concept of living space is comprehensive of indoor, outdoor, residential and non-residential spaces, and considers all the spatial elements inside of a neighbourhood, such as buildings, roads, parking, green areas, pedestrian areas, bicycle lanes and water bodies.

The Haven-Stad project in Amsterdam was chosen as a test case because of its envisioned development plans: 70,000 new homes are expected to be built by 2040. Specifically, “Sloterdijk One”, is the second stage of the project, which is envisioned to host 11,220 new households within an area of 58 hectares.

3. Torrens & Alberti, 2000

Figure 1. Existing spatial configuration of four ‘successful’ Amsterdam neighbourhoods. Colored volumes: non-residential functions. White volumes: residential functions.
Image by Gabriel Garcia Gonzalez

Two are the main objectives of this project. The first one is to analyze the current situation of our cities through open data. The second one is to define a methodology to make research by design, allowing the user to create, several design scenarios based on the previously generated knowledge quickly.

This work aims to tackle a well-known problem in urban design: the excessive time of decision-making during the design process, sometimes, up to 10 years. During this time, the guidelines of a project may change. Therefore, this process could be used during the following stages of the design process:

- Before: To help establish the minimum parameters of a new project.
- During: To review the guidelines and check whether the parameters are up to date.
- After: To adjust the parameters or add extra information to the analysis over time.

The tool is also intended to facilitate participatory processes with stakeholders from different fields of expertise, as it allows the digitisation and visualization of design proposals in a quick way. A procedure that nowadays is rather expensive and time-consuming.

The methodology of this research consists of three successive steps. A graphical representation of the methodology can be found in figure 2. In the first one, the major goal was to describe and characterize quantitatively the current spatial situation of the city, and its neighbourhoods, by computing a series of KPIs (Key Performance Indicators). Such KPIs, combined with urban design expertise, can help the user in reading and understand the city, and eventually improve the quality of future built environments. This is indeed a rather innovative approach because quantitative design parameters and knowledge from existing "successful" urban contexts are extracted and used to generate new urban interventions. A reference to four of these successful neighbourhoods is depicted in figure 1.

Different spatial and non-spatial datasets were retrieved and harmonized to compute the KPIs related to the average price of households, housing density, land use, year of construction of the buildings, quality of life, etc. These KPIs helped to select 6 similar existing neighbourhoods in Amsterdam having in mind the overall target goals and the regulations given by the Municipality for Sloterdijk One (e.g. high quality of life, 192 households/ha, 80% of residential use, 30% of the residential use should be social housing, etc.).[4]

In the second step, several additional parameters were used to calculate the average size of the living space in each of the selected neighbourhoods. Such parameters consist of the average values for outdoor spaces (calculated as surfaces in 2D) and indoor spaces (calculated as volumes in 3D). Indoor spaces were subdivided into residential and non-residential. Simplified building geometries (LoD1)[5] were used for this purpose. In the beginning, non-residential volumes were calculated, and then gross residential spaces were obtained by subtracting non-residential spaces from the whole building volumes. Conceptually, a similar approach was used to calculate the outdoor areas in 2D.

To facilitate a comparison among the results, all living-space values were visualized and normalized into one prototypic average building, in this case, composed of three households (apartments), with additional non-residential and outdoor spaces. The comparison can be seen in figure 3.

In the third step, the sizes of the living spaces of each neighbourhood were used as input parameters in the urban design studies. A prototype of a semi-automatic design tool was developed. Acceleration of the design process was the main purpose, followed by the creation of many proposals for the same study area in a quick and interactive way. By modifying the design parameters, the toolkit generates a new design proposal on the fly. At the same time, real-time feedback is given to the user when design criteria follow the required standards or not. Some parameters and constraints are based on the "Sloterdijk I Strategie nota", a document including the guidelines for Sloterdijk One, published by the Municipality of Amsterdam in 2016.[6]

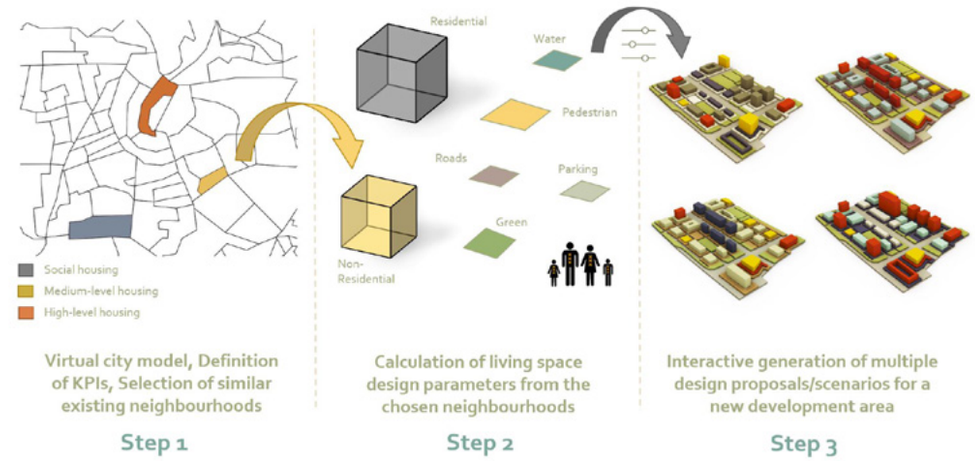


Figure 2. Graphical representation of the methodology.
Image by Gabriel Garcia Gonzalez

4. Gem. Amsterdam., 2017

5. Biljecki et al., 2014

6. Gem. Amsterdam, 2016

This project was widely inspired by one of the ambitions of the Municipality of Amsterdam: study areas of 'urban success' within the city centre and reproduce them in future expansion areas outside of the city centre.

A real-world case study located in Amsterdam was chosen to test the prototype tool. Interactive and semi-automatic design scenarios were created and compared to find the most suitable solution to the problem. Despite its initial and prototypic nature, the tool already allows to define the design parameters and constraints based on GIS-analyses. Furthermore, the possibility to store the generated design scenarios in a database allows making the design process more transparent and public.

Despite the need to use some simplifications and assumptions during the data analysis process, the tool has demonstrated that the size of the living space, in particular the size of an average household, plays a major role in how our new urban environments are created.

In this methodology, the size of the living space as a unit of measurement plays the major role and contrary to what was personally expected, the results of the first analysis demonstrate that the size of the households and open spaces in Amsterdam has no relation with the socio-economic status of the neighbourhood. My thought was: more expensive the households, the bigger the spaces related to it. However, in Amsterdam, it seems to be the opposite.

Nowadays, most of our design proposals often end up 'forgotten' or stored on local computers, sometimes inaccessible, or lost. For this reason, we propose the CityGML format to store the generated design proposals in a (preferably cloud) database and make them available as background information for future design scenarios.[7] Definitely, a beneficial "side effect" for further valorizing the use of (open) datasets for design purposes, not to forget, the chance to use each generated scenario as input for further domain-specific analyses (e.g. solar irradiance, 3D noise and micro-climate simulations, urban heat island assessment, etc.).

Every second, we collect data from our cities and this is the main ingredient to build the city of the future. Toolkits like the one proposed in this research, facilitate the use and spread of this information to create future-proof cities.

Giving shape to the city of the future requires a multidisciplinary team involving academia and professionals from different fields of expertise: architecture, urbanism, building management, environmental experts, transportation and geomatic engineering among others; and this project is a first step towards shaping the future of cities by facilitating collaboration and data-driven knowledge for city makers.

Figure 3. Comparison of prototypic average buildings generated for the 6 selected neighbourhoods.
Image by Gabriel Garcia Gonzalez

7. Kolbe, 2009

Urban Machines in a Digital Era

Cem Ada

The Schiekadeblok as an Architectural Apparatus

Why are Architecture and the built environment still so permanent, in a time which is characterized by temporality? Especially in a time where certain types of urban spaces or buildings get more and more neglected due to their outdated functioning and changing demands of society.

Since the emergence of the digital era and Internet Communication Technologies (ICTs), changeability is becoming at least equally valuable as permanence. Virtual environments like social media and smart mobile devices have proven their value mostly through their high capacity of connectivity, accessibility and adaptability. The speed at which these virtual environments can change and react to instant events or changing needs illustrates a parallel between the current situation and the demands of our society. Trends and societal values change in a much shorter time and everything around us becomes more adaptive, 'smart' and responsive. We as human beings have been extremely adaptive to these changes that digitalisation has brought to our way of life; so why not the built environment? Especially considering how the physical built environment is strongly affecting the way we live, work and move. How we use space is influenced by how this space is physically designed. After all, the ability to adapt to the ever-changing times and society is also a form of sustainability and future-proofing. So how can the design of a physical space answer to this phenomenon? And how can the design of physical spaces be integrated with digital technologies?

These are questions that triggered this graduation work and resulted in a design that elaborates through multiple scales on the theme of responsive architecture and the collaboration

Figure 1. Exterior view of the Urban Theatre, giving an impression of one out of many possible atmospheres and configurations that can be created by this building.
Image by Cem Ada

with digital environments; the Urban Theatre as an urban device, a system of systems and as a hybrid space that mediates between the people, the physical urban fabric and digital environments.

Relevance

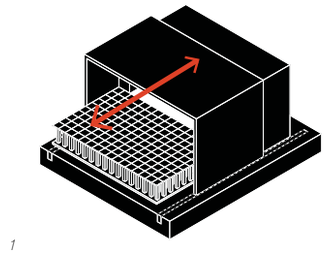
In a broader sense, this graduation work suggests a possible direction in considering a new urban paradigm of public space that serves the public realm at the intersection of physical and virtual environments. The crossdisciplinary nature of this theme generates a relevance which is touching upon more aspects of society than just spatial design since digitisation and virtual publicness like social media platforms are heavily influencing our social behaviour within both the society and the urban fabric.

Since the introduction of ICTs, a lot has changed in how we live nowadays, affecting almost every discipline and the way they contribute to society. New developments come and go in much shorter periods and so newly created structures have to be able to adapt even faster to grow along with these developments. Therefore, the theme is very topical and the ever-growing technological

developments make thinking about such future scenarios not only inevitable but also necessary. Accordingly, spatial designers can no longer ignore the digital layer of society and should rather explore ways to integrate the digital into physical designs.

From a larger perspective, it can be said that this project is trying to undermine the negative influences of digitisation: an increasingly anonymous, impersonal and individual society. The very widespread opportunities that digitisation offered us and the extensive innovations on grounds of connectivity, accessibility and adaptability through digital services might have blurred the quality of being, engaging and meeting in physical places. But we must not forget that, despite the many possibilities of the digital world, in the end, we will always need physical space. Although the virtual world seems to be very conducive to social engagement, on the contrary, it can also be said that social engagement in physical form is declining. As a result of such extensive and active participation in society on social media platforms, there seems to be less and less social contact taking place in physical form, because people are becoming isolated by the use of mobile phones. Also, on one side of the argument social media is very much dominated by profiling and positioning oneself within society, but on the other side it creates an enormous amount of impersonality and anonymity when the public is dominantly lived from behind the screens.

In the end, the discussion is not about whether the public space should be in physical or digital spaces, but it is about considering a new urban paradigm of public space that serves the public realm in both ways. Therefore, a re-consideration of public space as just physical and material space is needed and we, as designers of physical space, are now and certainly in the future tasked with this multidisciplinary challenge.



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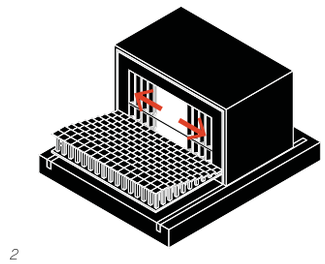

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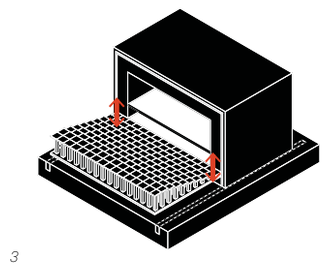

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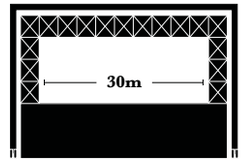

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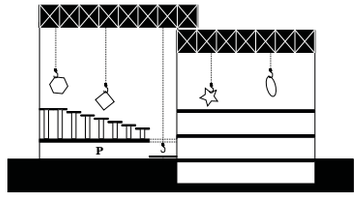

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Figure 2.
1. Telescopic second roof structure
2. Openable facade
3. Lowerable deck
4. 30m column-free span
5. Integrated industrial & AI systems

Image by Cem Ada

Methodology

This narrative was the foundation for the theoretical framework and the creation of guidelines and design principles. From a methodological point of view, this process was based on research-based and experimental design, in which theory and design practice are continually complementary to each other. The theoretical framework is mostly ontologically and is carried out through a qualitative dialectical literature review, where initially was looked at the general perception of public space and how it serves the public realm. In general, one can conclude that the idealized notion of public space is like an open and inclusive stage for social interaction, political action and cultural exchange.[8] Since the digital revolution, a lot of these activities have shifted from physical public spaces to virtual public spaces like social media platforms, being one of the reasons why public spaces in cities get neglected and abandoned. Based on these outcomes it was concluded that public urban space could no longer be seen as just physical, material space and that we should rather find ways of intersecting the physical and digital public spaces by elaborating on the qualities and advantages of both worlds. This way a more balanced interrelation will arise to serve the public realm at its best. During the early interpretations of this concept the term 'phygital' was introduced to hint in the direction of a synergy of physical and digital space. In a further developed stage, phygital space became more of a metaphor than a guideline for the design process. At this point, the research shifted more towards a notion in which the statement was made that physical and virtual space should be more complementary to each other, instead of being merged in a very literal way. As a result, the following theoretical interpretation formed a guiding principle in the later stages of the design process: 'from a conceptual context, Urban Machines are interventions in the physical urban public space that function as a system or set of devices and through information technology, mediate the relationship between the urban environment and the user.'[9] 'In this framework the spatial practitioner is designing and programming these machines to promote, test and prototype the relation between city, technology and the human scale.' This approach was used as a design paradigm for The Urban Theatre. By creating a physical public space that can adapt to a variety of different activities, events and configurations, this public space becomes more future-proof and is more likely to evolve into the future in parallel with digitisation.

8. Carmona, 2013

9. Signore & Riether, 2018

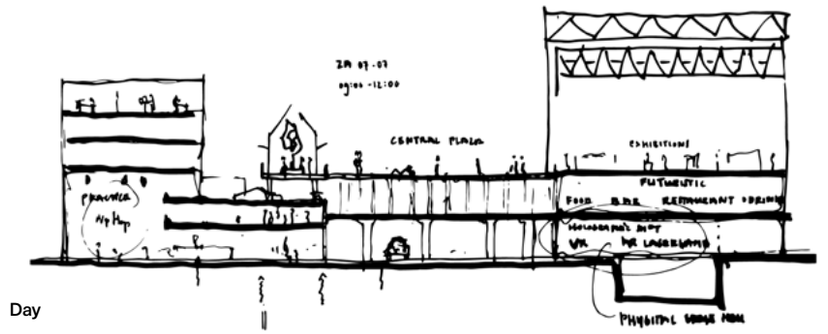
Design

So, what is the Urban Theatre (UT)? The UT is a multi-purposed public culture building with a high capacity of responsiveness to its users and environment. Depending on the type of event that might take place, the spatial layout of this building can physically change because the structure consists of kinetic elements. The building is smart and autonomous in its functioning because the digital brain can receive and process real-time data through artificial intelligence. Based on this input, the building transforms and adjusts its spatial setting. Not only based on pre-scheduled events, but also as a reaction to more instant events like changing weather conditions. Therefore, it informs, performs and transforms continuously throughout the day, month and year. It is an architectural apparatus designed for the creation of multiple and multi-layered experiences due to the sophisticated integration of kinetic architecture and digital technologies. Although it is designed as a theatre building, in a broader sense it can also be described as a flexible and smart structure that houses multi-purposed public space for all sorts of public events under one (expandable) roof. One can think of events like art or theatrical performances, concerts, exhibitions, festivals, nightlife, product launches, talks, (cinematic) screenings,

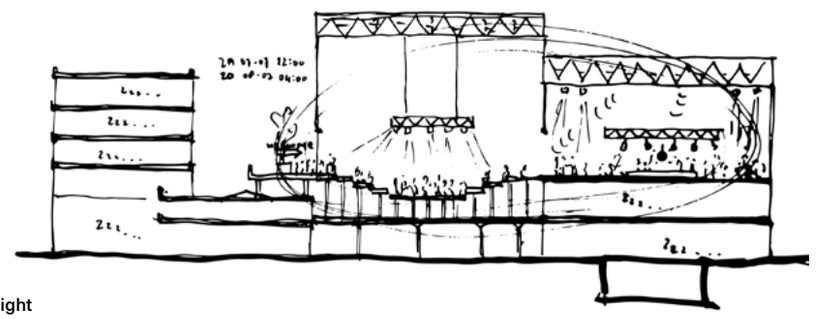
presentations and lectures. But also political activities like protests, (municipal) election days and other events organized by municipal or civil organizations, and so on. It is designed as a public urban structure without specifying a single use, which makes it suitable for contemporary times, but also prepared for future scenarios in which the demands of society and thus the type of urban spaces may change. The Urban Theatre can adapt to these changing needs by adjusting its spatial setting.

So, more specifically, what exactly is changeable about the spatial layout of this building? The building consists of a permanent main volume which is covered by a second, extendable, roof and a raised deck adjacent to the building. The second roof structure is able to extend over this deck because it has train wheels with flanges at the base that can ride out over a track. This roof structure is cladded with ETFE-foil integrated with PV-cells, which supply the electric power engine that initiates the movements. The raised deck is movable and consists of multiple vertically moveable platforms. The platforms are supported by telescopic columns and therefore each of them is individually adjustable in height. This way the deck can serve for instance as a traditional flat square, an ascended grandstand with seats and steps for concerts or it can be transformed into a stepped terrace that connects to the restaurant facility of the building when the deck is lowered. Further spatial flexibility is facilitated by foldable curtain wall systems in the front facade. By opening these façades the size and organization of the main event space can be adjusted to the specific requirements of any given event. The collaboration between these openable facades, the adjacent lowerable deck-area and the telescopic roof creates an interesting coherence in spatial quality between interior and exterior space. The organizational freedom is then additionally supported because both the permanent and extendable roof are integrated with industrial hoisting systems, light and sound grids, technical installations and smart technologies. This is where the so-called ‘digital brains’ of the building are to be found. These systems and technologies are located between the truss structures that run from the roofs into the facades. Within these structures, there are also aisles for technical staff, but in essence, the building is self-directed and so rarely assistance from people will be needed. Furthermore, the trusses in the facades also house sanitary facilities, stairs and elevators and galleries looking out on the main event space. In addition to the fact that the trusses are integrated with all these functionalities, it also serves a constructive purpose. The choice for this constructive principle also provides an extra flexibility aspect because it creates a column-free space of 30 meters wide and 25 meters deep. And when the second roof structure extends, this space even doubles in size.

Figure 3. Possible dayshifts for the Urban Theatre
Image by Cem Ada



Day



Night

The degree of adaptiveness and the integration with digital technologies makes this building in its functioning a kind of digital device that is connected to the internet and responds to real-time data. This can be very basic data like the weather forecast so that the building ''knows'' that it will need to cover up the deck-area before it starts raining. Or the data can be more sophisticated. For example, through AI the building could generate a kind of survey in the form of a poll and lay it out on social media. When the data comes back, the UT will know that the visitors would for example like a Latin dance event to take place this coming Friday and so the spatial organization will be adjusted to this event's specific requirements. Also, aspects like music, sound and lighting are accordingly pre-programmed for this night by the digital brains. In this manner, the UT can match supply and demand in a very short time frame and this makes the building responsive to its environment and users.

Therefore, like any smart device, the urban theatre can receive (INPUT) data and respond in ways that generate a suitable spatial configuration (OUTPUT) for the public according to the desired needs. In this manner urban public space is created that adapts to the demands of the people: a Responsive Urban Machine.

Conclusion

The structure is permanent but yet temporary at the same time. It is traditional in its (architectural spatial) functioning, yet futuristic in its performance. It is raw and industrial, yet very detailed and sophisticated. It is an assemblage of elements, but yet a holistic uniformity. And it addresses both the individual and the collective. The unified notion of these contrasting features illustrates the kind of space this Urban Theatre creates: a hybrid space that triggers the relation between physical material space, virtual immaterial space, the users and the urban fabric(city). But most of all, the Urban Theatre suggests a way in which architectural design and digitalisation can be forged into a new urban paradigm in future perspectives.

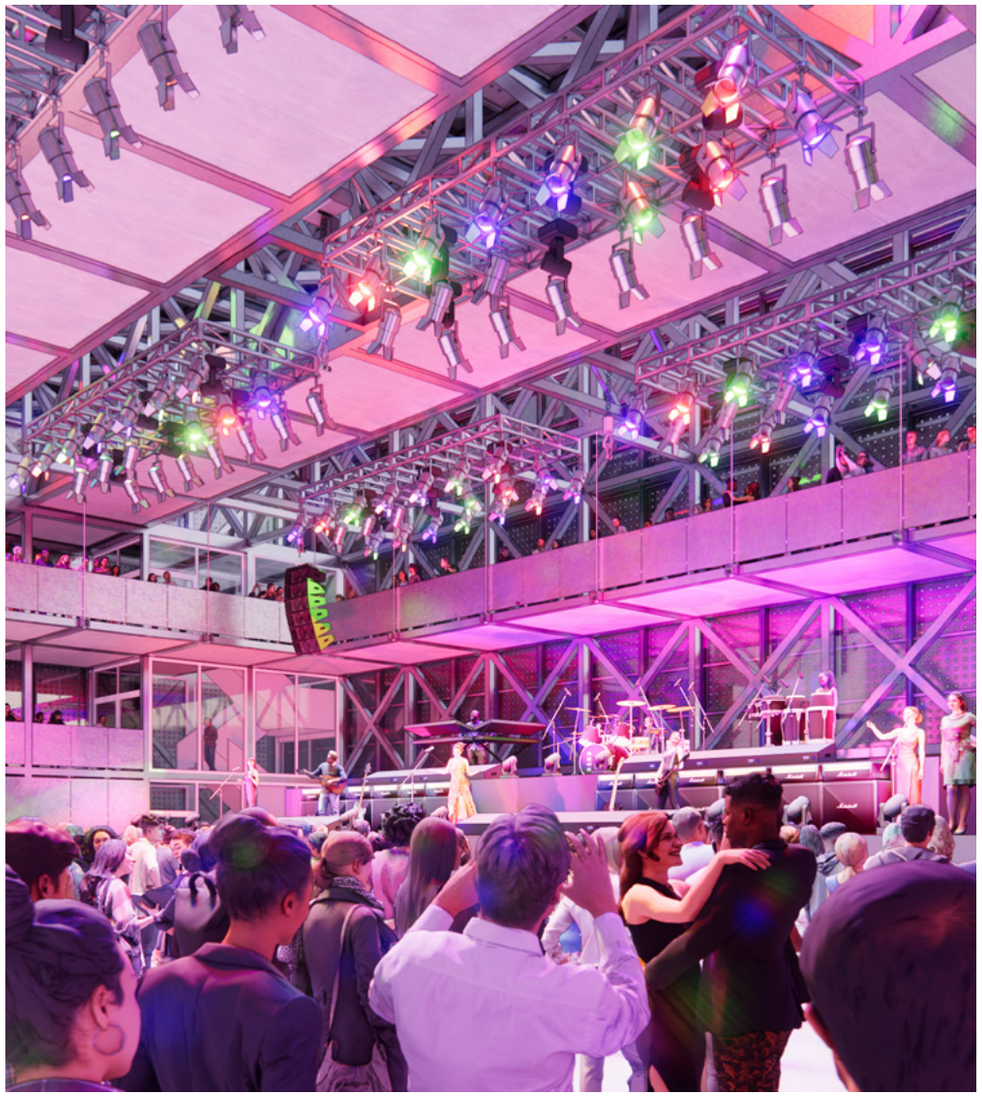


Figure 4. Interior view of the Urban Theatre, giving an impression of one out of many possible atmospheres and configurations that can be created by this building.
Image by Cem Ada

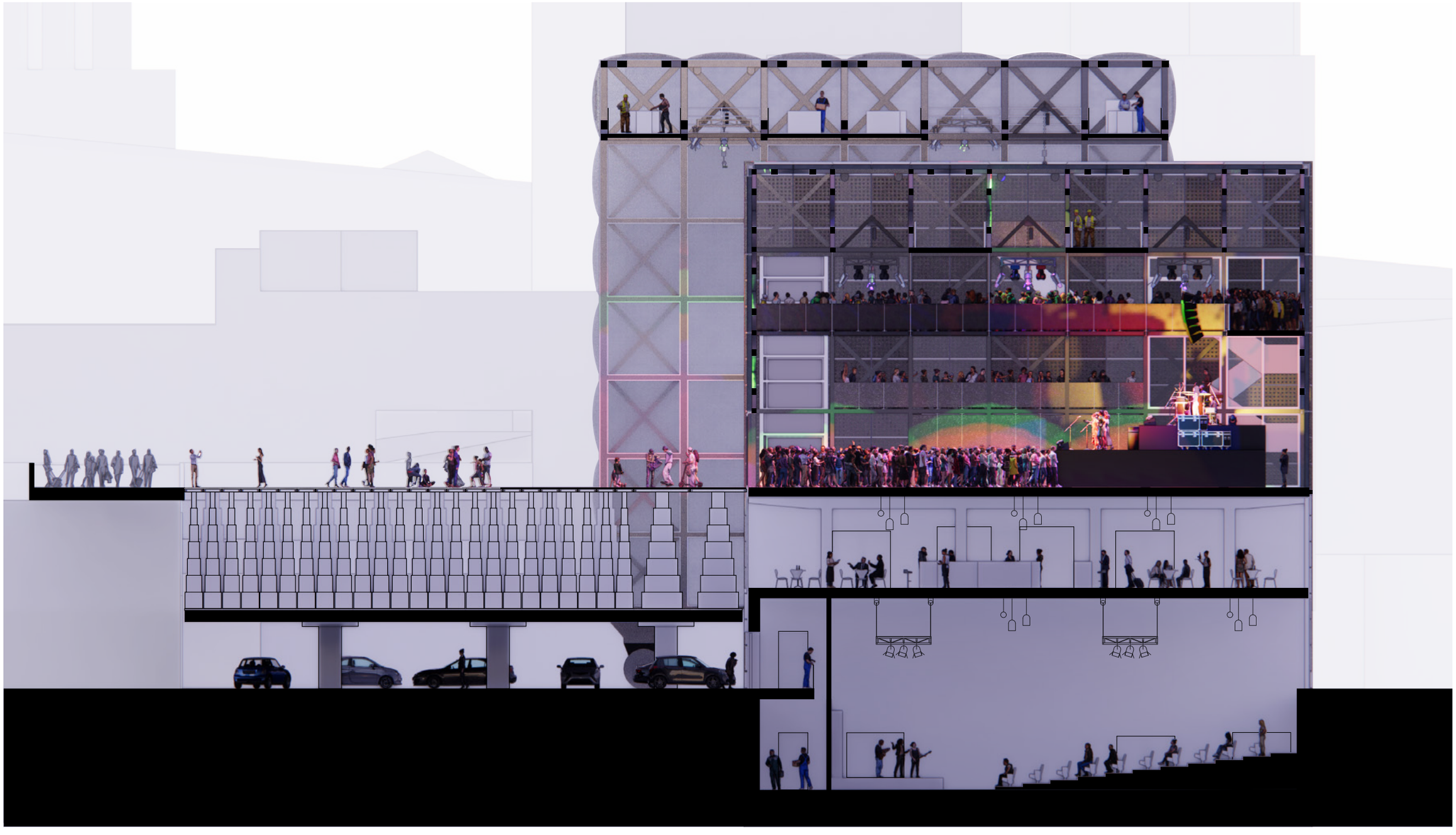


Figure 5. Section view of the Urban Theatre, giving an impression of one out of many possible atmospheres and configurations that can be created by this building.
Image by Cem Ada

Interview

Floor van Dedem
Architecture graduate

Introduction

Hi, I'm Floor. I have an architecture background and I joined the third generation of the City of the Future studio. Right after graduation, I started working as a project manager at Drees & Sommer, an International Company for project management and real estate. Now I am doing consulting.

Motivation [pre-phase]

What motivated you to choose the studio?

What interested me in the studio was the freedom for choosing my topic combined with the possibility to work between architecture and urbanism. During my entire master, I was doubting between architecture and urbanism and the studio allowed me to combine both.

Were you satisfied with the way you combined urban and architectural approaches in your thesis?

Yes, definitely. The topic I chose was social cohesion, which is even more interesting on an urban scale than on an architectural scale. Since I did an architecture intervention, I was able to combine both fields.

Experience [process phase]

How was your experience with the educational setup of the studio?

In the beginning, it was quite distracting to have all the students from TIL, MBE and Urbanism. In the first three months, I didn't know what I was doing and where it was going. It was both good and distracting. From the moment I defined my research topic, then it turned around. It was great to be able to communicate with the people that had an interest in related fields to my topic. Students from other fields had opinions about what I was doing and I could use that in my project.

But it was a pity to have the studio during COVID-19. At first, we were allowed to go to the faculty and then for a large period of time we couldn't go. When we were together in the faculty with the entire group, it inspired me to think a bit further. During COVID-19, we had weekly sessions by Zoom of a maximum of an hour; you had to figure out your questions beforehand to be able to continue for another whole week.

How did you experience the workshops?

They were great. Not only for my thesis but also to get my mind a bit off the things I was entirely focused on. Because at the point of the workshops, we are already quite far into our projects.

The project [post-design phase]

In what ways does your project answer the studio's theme?

My project dealt with improving social cohesion. The diversity of inhabitants is growing and population numbers are in stable growth. Inhabitants are one of the main characters of a city so the synergy between them is crucial for any city life.

What impact did the studio have on your future work and your choice to go into project management?

During the project, I came to realize more and more that the larger scale had my interest. Both the urban planning assignment and the drafting of a vision were for me interesting elements. I came to the conclusion that larger projects got me more excited. Plus, I've always had an interest in organizational matters.

How was the presentation of the urban and the architecture parts of your projects? How did you carry out research, scale and type of drawings?

My research started on a larger scale, creating a master plan and coming up with a strategy. I created a master plan with all kinds of paths and crossings where people could come together. My architecture proposal then aligned with this urbanism strategy.

If you only looked at the architecture and not the urban part, do you think your project would be different?

Without the urbanism plan, the project would be entirely different because the strategy focused on combining and connecting different neighbourhoods in that location. For instance, the publicness of the building with squares on the inside and outside are clear features that originated from this urban vision.

Cities of the Future: Control in Times of Acceleration

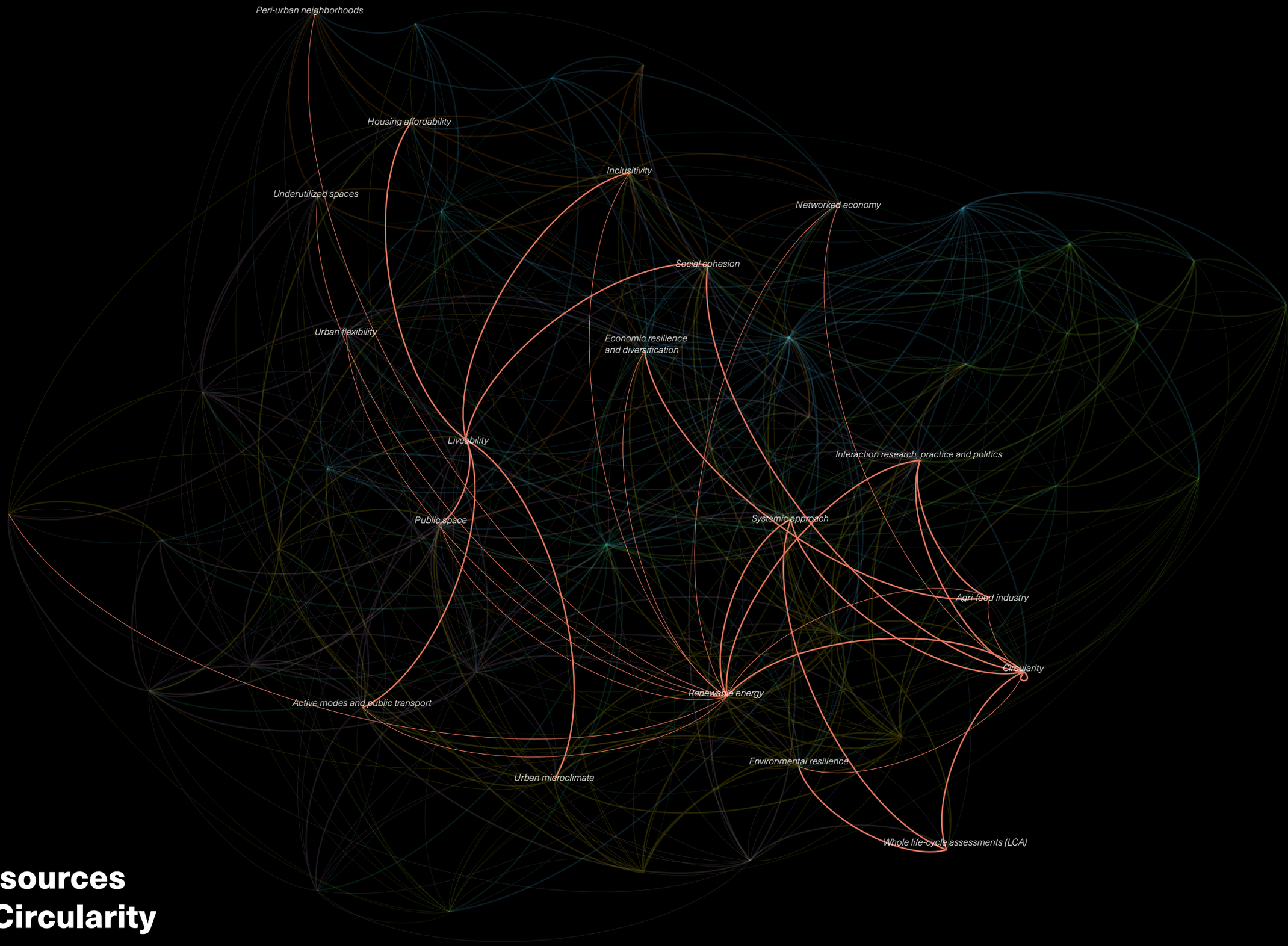
Víctor Muñoz Sanz
Assistant Professor of Urban Design, TU Delft

The architect who proposes to run with technology knows now that he [sic] will be in fast company, and that, in order to keep up, he may have to emulate the Futurists and discard his whole cultural load, including the professional garments by which he is recognized as an architect. If, on the other hand, he decides not to do this, he may find that a technological culture has decided to go on without him.

These cautionary, and still relevant, words by Rayner Banham in his book *Theory and Design in the First Machine Age*[10] are very telling of the key challenge of dealing with the implications of technology in our cities. Simply, it goes too fast, while architecture and allied design disciplines are, almost by definition, slow. In just a very few years (I got my first iPhone in 2007) and perhaps accelerated by the pandemic, we have included in our vocabulary and internalised in our everyday practices a whole new set of terms, related to professions (mechanical turks, flash delivery riders, YouTubers, influencers, content creators), psychological states (Zoom fatigue), forms of violence and manipulation (fake news, Zoom bombing, ransomware, DDoS attacks), forms of access (FaceID and other biometric data), economic exchange (Tikkie, cryptocurrency) and even opening embracing the possibility of life in some sort of multiverse in the Cloud—a Metaverse populated by avatars, digital twins, and other *architectures*. Yet it also leaves us physical remains, new architectural typologies like fulfilment centres, dark stores and dark kitchens, data centres, or crypto coin mines. These terms, and buildings, change and evolve, some succeed, and some are abandoned and superseded (who remembers Second Life?), making it difficult, even for those working on technology, to keep the pace.

The urbanised landscape faces an uncanny condition. The traditional understanding of the layers of urbanisation and the longue durée is today challenged by technology and the planetary climate crisis. Both layers at the bottom (landscape) and the top (cloud) are changing faster than the middle layers our cities, buildings and infrastructures can cope with. In a way, it seems futile to try to anticipate what is on the way. Anticipation distils some sort of sense of control, that we know what comes next and we are prepared. That the disciplinary tools and knowledge we have now are enough to confront a challenge. Agility, innovation, and critical thinking concerning digitisation and technology are a way forward. To deal with the spatialities and wicked problems technology brings, as architect Rahul Mehrotra would say, the profession needs to go from being thermostats—just reading the temperature—to becoming thermometers—controlling the temperature.[11] What does that mean in practical terms? Perhaps, following Banham, it requires that the discipline rethinks what the architectural project is. As shown in the projects in this section on Digitisation, technology can offer tools to support the work of the architect and urbanist, facilitating the testing of options and decision-making. What is important is that the designer keeps hold of the steering wheel, and the discipline does not fall into the trap of *Data Driven Design* and pushes forward *Design Driven Data Practices*. Data does not necessarily mean knowledge. Asking the right design questions to it (Cedric Price Dixit) is key to bring the city of the future our planet needs.

10. Banham, 1960
11. Mehrotra, 2018



Resources & Circularity

Image by Marcelo Carreiro Matias, Mesut Ulkü and Sonja Drašković

Today's linear cities

The economies of our current cities are based on the extraction of resources from the natural environment. They are linear economies based on a 'take-make-waste' model, where raw non-renewable resources are extracted from the Earth to make products that are sold, used, and then disposed of as waste.[1] This type of economy has many negative impacts because higher demand for products means that finite resources will be depleted faster and waste production will increase.

1. Ellen MacArthur Foundation, 2021

According to the *Global Footprint Network*, as of 2017 humanity is using the Earth's resources 1.7 times faster than the planet's biocapacity can regenerate.[2] This means that the natural resources of 1.7 Earths would be required to meet the demand of the global population, and this number is continuously rising.

2. Earth Overshoot Day, 2022

Just like the current economies of cities, the built environment operates in a linear way. Large amounts of energy and non-renewable resources are used in the construction, operation, maintenance, and demolition of buildings, especially in urban areas. According to the UN Environment Programme, the amount of CO_2 emissions from the global building construction sector in 2019 was 9.95 Gt CO_2, accounting for 38% of all energy-related CO_2 emissions.[3] By 2050, the World's population is expected to increase by 2 billion people, 68% of which will be living in urban areas.[4] This means that the material, energy, and spatial demands of our cities will continue to grow.

3. UNEP, 2020

4. United Nations, 2019

The Circular Economy

In response to the global climate crisis and ever-increasing depletion of natural resources that are in large part due to the Linear Economic model, the concept of the Circular Economy (CE) has been gaining popularity. According to the European Parliament, the Circular Economy is "a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling materials and products as long as possible."[5] CE minimizes waste by closing the loop and reintroducing waste products as resources for new products, applications, and services. By doing so, CE adds value to waste and extends the lifecycle of materials and products.

5. European Parliament, 2022

There is no obvious origin or originator of the CE concept, however, the main ideas of CE are not new and date back to the last century. The idea of circular material and energy flows date back to 1965 when Abel Wolman published "The Metabolism of Cities"[6] and one of the first notions of CE was published in 1966 by Kenneth Boulding in his book "The Economics of the Coming Spaceship Earth."[7] The increase in popularity of CE in the last few decades led to one of the most influential publications within the development of CE, *Towards the Circular Economy Vol. 1: An Economic and Business Rationale for an Accelerated Transition*, by the Ellen MacArthur Foundation in 2013.[8] The development of CE is still in its early days; only in 2017 did the British Standards Institution (BSI) publish the first circular economy standard framework.[9]

6. Wolman, 1965

7. Markandya & Richardson, 2017

8. Ellen MacArthur Foundation, 2013

9. BSI Group, 2023

The adoption of circularity is still in its early phases. Designers can help facilitate and accelerate this adoption by visualising a city of the future that is circular, sustainable and resilient. By doing so, designers can help start conversations and collaborations with different stakeholders that bring new circular projects one step closer to reality.

Student projects

In this chapter, we attempted to highlight the importance and relevance of circularity in the built environment, taking the discussion beyond materials at the building scale, and visualising a city of the future that integrates different aspects of circularity through three visionary student research and design projects.

The student projects envision a city of the future that adopts circularity principles to replace the linear systems of current cities. Each student project in this section has focused on different areas of the circular economy. *House of Circularity* by Fikri Yalvaç approaches circularity through a social lens by promoting the importance of circular behaviour with the integration of spaces for education and initiatives related to circularity in a mixed-use and adaptable building. *Synergising Architecture* by Daniel Sobieraj applies circularity as a tool on both the urban and architectural scales to create value-adding synergies between three land-uses that are currently competing for space, and to mend a fragmented area that is experiencing issues of liveability and sustainability. *Planning the Power Plant* by Gerjan Agterhuis provides a different perspective on circularity by focusing on a reimagined energy system that intertwines social and energy networks in a hybrid building that integrates public functions with sustainable decentralised energy production.

Planning the Power Plant

Gerjan Agterhuis

Integration of energy production in urban environments through Architecture

As of 2007, the balance of urban residents versus rural residents has hit a historic equilibrium. For the first time in modern civilization, more people started living within cities than outside of them. The cities of today are generally not well suited to house this ever-increasing urban population which is pushing the equilibrium in favour of urban residents up to the point where roughly two-thirds of the population is expected to live in urban areas in 2050. The pressure on existing infrastructures emerging from this influx has the potential to destabilize urban infrastructures. This is found to be especially true for Urban energy systems.[10] The relevance of this energy infrastructure is highlighted with the following statement:

"The world's cities occupy just 3 per cent of the Earth's land, but account for 60–80 per cent of energy consumption and 75 per cent of carbon emissions."[11]

This development has its roots deeply embedded within the history of the city, which has occurred at the cost of significant amounts of energy and material. Simultaneously the intensification of the fabric has not prevented the city's networks from becoming jam-packed and the city is now only able to sustain itself by consuming vast amounts of resources from rural areas around the globe without creating a reverse flow of valuable resources.[12] For cities to now become sustainable in common sense, or at least in the sense of their resource consumption and agglomeration, they will have to find low-carbon alternatives for their current processes. This is not merely a technical issue concerned with innovation, but it also requires durability and resilience to be able to become sustainable in the full sense of the word. This all

10. Kammen & Sunter, 2016

11. United Nations, n.d.

12. Ferrão & Fernández, 2013

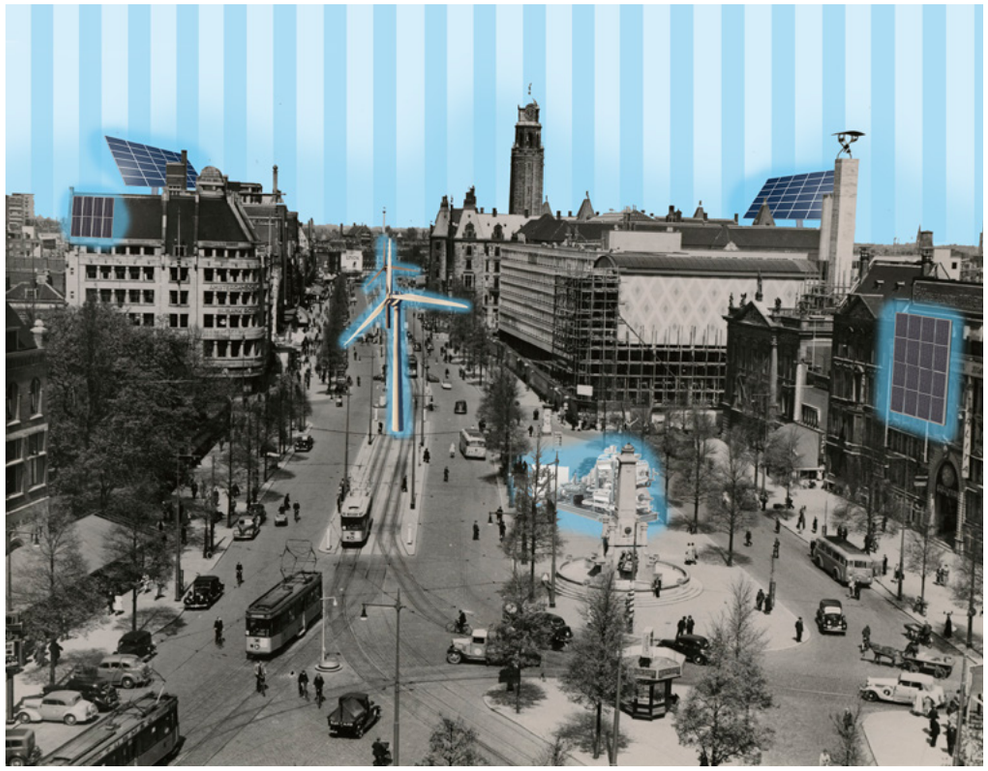


Figure 1. Dystopia of green 'finery'

Original image: "Gezicht op het Van Hogendorpsplein en de Coolsingel in noordelijke richting, 1939 " (City Archive, Rotterdam) .
Image by Gerjan Agterhuis

13. Weinstein & Turner, 2012

starts with the source of our shared consumption: the global urban population. The amount of consumption society demands proportional to the capability of an ecosystem to produce said goods is a fundamental balance in creating a global sustainable society.[13] Since the global population is still increasing drastically, the demand for consumption is not likely to reduce in the foreseeable future. Ergo, the opportunity for a sustainable future heavily relies on creating sustainable infrastructures and consumption patterns that can support the growing population, with an uneven emphasis on the nuclei of consumption: the global urban area. The city however cannot be seen as a homogenous construct, which increases its complexity. There is a vast number of artefacts, processes, infrastructures, social patterns, etc., which make up the city. These actors of the play of the city all play a part in tran-

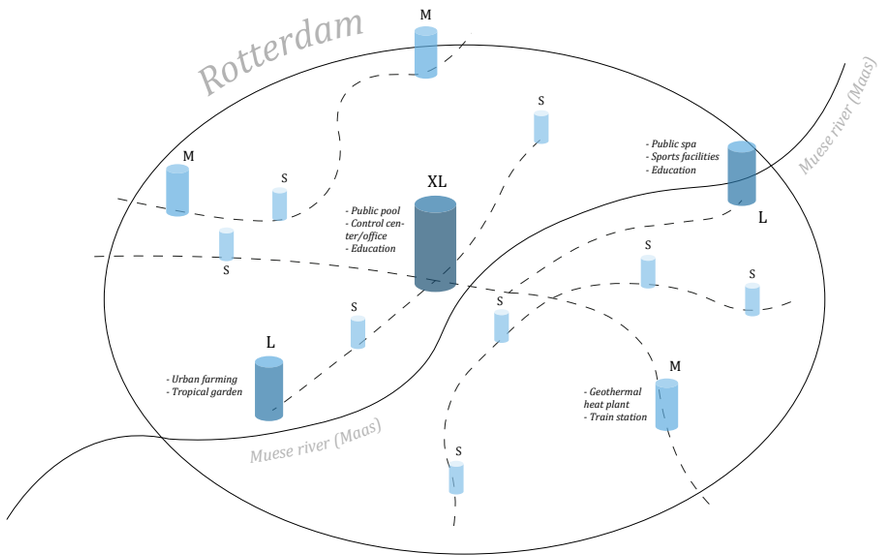


Figure 2. Energy hub system (Integration of S, M, L, XL energy installations)
Image by Gerjan Agterhuis

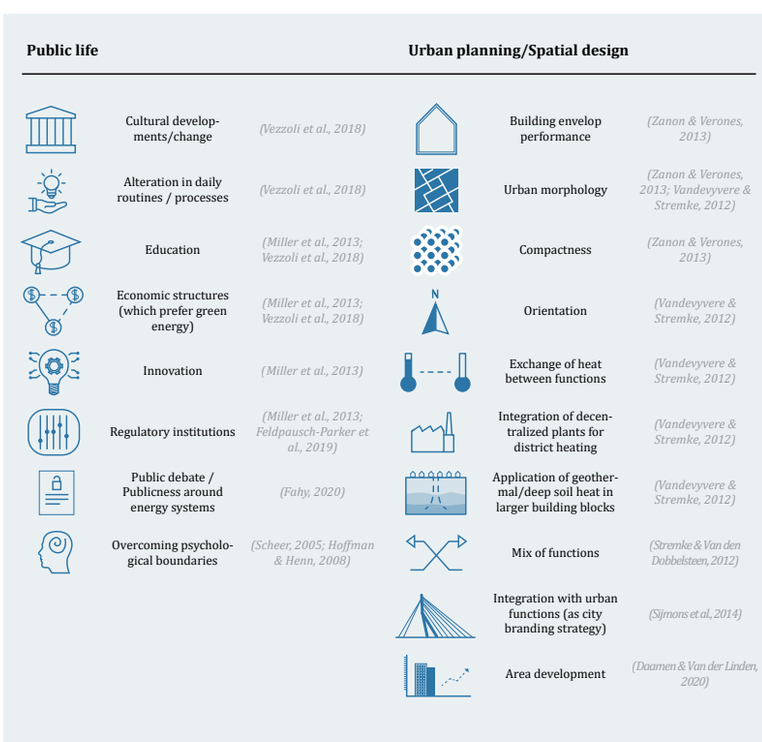


Figure 3. Fields of intervention to integrate or improve energy production
Image by Gerjan Agterhuis

sition strategies. Because of the expected growth of the city's population, accelerated by a global trend of urbanisation, more of these components will either voluntarily or forcibly intertwine because of increasing pressure on land use.[14] Urban energy systems will therefore require a broad understanding of how these actors together create the demand, and how they can moreover create their potential to satisfy this demand.

During the 20th century, the production of energy was moved outside of urban regions because of pollution problems in the city. Now, the increasing demand for energy and a desire to fulfil this need with renewable energy even more so has the potential of occupying vast amounts of land in rural areas.[15] This sparks the debate whether the urban region itself should instead be able to fulfil its energy demands, rather than sacrificing large amounts of the ecologically important hinterland.

Embedding a renewable, resilient and sustainable energy production network within the city limits is not simply a matter of feasibility and practicability, but rather one of integration and is therefore one of the crucial tasks at hand for planners, politicians and architects. Therefore, this thesis is relevant in the context of The City of the Future lab. Currently, the production of renewable energy often occurs on a micro-scale portrayed in figure 1. Photovoltaic cells, wind turbines, and even small-scale heat exchange systems have become popular under regional and national energy policies. Even on the local scale, these have been adopted by private house owners in the case of PV cells and heat pumps. However, through these developments at no point do these policies reach a point where they are durably integrated into the built environment and remain to be 'green finery'.

The position of architecture in the context of energy infrastructures was therefore researched in the first leg of the research. It was found that there unequivocally is a place for architecture in

14. IABR, 2014; Frijters et al., 2018

15. Stremke & van den Dobbelsteen, 2012; Zanon & Verones, 2013

the context of energy systems, due to the inherent nature of energy systems as being socio-economic systems. The research dove into the specifics of this nature, in so doing trying to find specific areas of intersection between spatial design/public life and energy systems. It was believed that the results of this inquiry could positively imply leads for the architectural elaboration and the urban planning phase which would act as an intermezzo in the research.

It was believed that an elaboration of the research towards the field of Urban planning was required to underpin the broader relevance of architectural design. This was since the majority of the available policies and design strategies dwell in regional and neighbourhood scales as can be seen in the figure on 'Fields of intervention'. The approach here was inspired by the works of the urban metabolism study within the municipality of Rotterdam.[13] In this study, the concept of the Energy Hub was proposed on a schematic level. Furthermore, the potential positive effects of this district heating system were measured, claiming that the equivalent of 1276 ha. of forest could be spared if the approach of the Energy Hub became widely adopted throughout the municipality. The architectural vision for this energy system together with the groundwork of the metabolism study led to the envisioning of the 'Energy Hub system' as shown in figure 2. In this system, the potential for the 'Fields of intervention' was incorporated to secure the long-term potential of both concepts.

The strategy proposes S, M, L & XL versions of the Energy Hub with different levels of Programmatic overlap. Furthermore, the number of disciplinary overlaps indicates the scale of the intervention implying the conceivable contexts in the hubs can exist. For example, the S could potentially be small enough to fit within the housing block, whereas the XL aims to be a landmark project housing more overarching functions like education and control systems. M and L versions of the Energy Hub have the option to incorporate secondary programs based on local opportunities, for example, Urban farming, Public spa, Heating large entertainment buildings, and other public programs. Crucial here is to mention that in an ideal scenario, the hub will operate in a context that boasts the potential for mutually beneficial relationships. This means that there will have to be an exchange of resources between the Energy Hub and its direct context. This can take shape in the form of an exchange of electricity, but also heat, labour, ideas, and culture, are among the probable possibilities. A wide variety of prospects can be conceived through which this exchange can exist. This means that a plethora of architectural artefacts will have to be designed which will increase the creative development of this system and philosophy, further improving the integration and implementation in densely populated areas like Rotterdam.

For the architectural elaboration of the research, the XL version of the Energy Hub was chosen to take centre stage. Being the biggest challenge in the sense of the programmatic intersections, it was believed that it would pave the way for further research and design in this field. The XL in this case takes on the biggest challenge when it comes to energy production to create a hypothetical 'worst-case scenario' for the architectural design, to stimulate further investigation of the Energy Hub typology. It was found that the subsoil of the The Hague-Rotterdam area was uniquely suitable for deep geothermal energy as a way to sustainably produce heat for district heating systems. However, the image of geothermal heat as being a nuisance with potential negative effects on the near subsoil has made it a topic of debate whilst sparking significant 'not-in-my-backyard' sentiments. For this reason, the site of the Schiehaven was selected to experiment with this ambitious technology that could secure a sustainable heating system for Rotterdam.

To overcome 'Not-in-my-backyard' sentiments, the goal became to provide a valuable reimbursement for the neighbourhood by offering a unique public program. As mentioned before, this public program will need to have the benefit of being able to interact with the energy system offering unique technical opportunities. In the simplest case, this means that the return heat of a district heating system can still heat a small greenhouse for urban farming. Furthermore, there will be a public experience centre through which the installations can be explored. All the while seeking new modes of interaction with energy infrastructures in so doing seeking a new and more sustainable way of Energy practice.

The XL version was envisioned to be the heart of Rotterdam's Energy Hub system. Whilst in its current state being a heat hub, this can in the future expand to become a hub in the electricity system as well. This could overcome the intermittency issues on the electricity network amongst other problems. The XL Hub, being a multi-modal platform for Rotterdam, is conceived to house not only heating systems (production, recovery & transport), but also an office, school, auditorium, exposition hall, research hall (lab practicals, guided tours, R&D, etc.), start-up offices, and restaurant. Additionally, the building offers a unique opportunity for public programs manifesting in a public pool able of being supplied with the return temperature of the district heating system at roughly 30 C. Additionally the low- temperature system is designed to be able to expand into the Schiehaven's water basin for a floating seasonal pool. This pool can again be heated to extend opening hours.

The program is organized along two philosophies. In the longitudinal progression, the program and systems are organized from 'cold' to 'hot', which translates to return pipes from the district heating system entering the building on the East side where they exchange heat with the public pool. Furthermore, on the west side, the heat production systems are located including the outgoing pipes feeding the district heating system for the Delfshaven block. The design aims to make this development visible by taking the visitor along the main transportation lines so he can see the potential manifestations of the heating system. By crossing the main lines he can make his way through the exposition halls to the atrium where he can ascend the building and continue the storyline towards the educational facilities of the building. Along his way, the continuing factor is the constant presence of installations, whether it be for the industrial heating system or indoor climate systems like HVAC. This is a deliberate choice to put the visitor in a constant awareness of the industrial nature of the building.

In the cross-section, one can see how the main line is strategically hidden in the second ring (seen from outside) around the building's inner sanctum. This is done for safety reasons, resulting in the fact that no vehicle can damage the crucial pipelines directly. This is important when ensuring the long-term operational safety of the building. To retain the option for large maintenance operations, the front facade is designed to have large openable panel doors. The visitor quite literally starts on the outer ring of the system where he merely is a spectator of the system taking in the first glances of the industrial scale. Moving further up the building he can become more acquainted with the full extent of the system and the operational apparatus required to maintain and improve the heat systems.

Not overlooking the future-proofness of the design strategic decisions were made at the expense of aesthetic arguments to force the design to become more transformable. This means that the volumes were decoupled to ensure not only a readable architecture with attention to every aspect of the system but also to ensure a degree of freedom so that the architecture can expand over time housing ever-advancing heat systems. For example,

the installation of state-of-the-art heat recovery systems prolongs the life span of the geothermal well. The future of the design is secured through the parametric shape of the industrial volumes executed in a traditional triangular warehouse-shaped roofline. In due time, the system can therefore expand outward without sacrificing the specific architectural character of the design.

The City of the Future will involve local governments and inhabitants to take significant responsibility in securing the long-term sustainability of their neighbourhoods and city districts. Without this, the city will not succeed in becoming independent and will continue to consume large amounts of external resources, until the ecosystem can no longer do so.

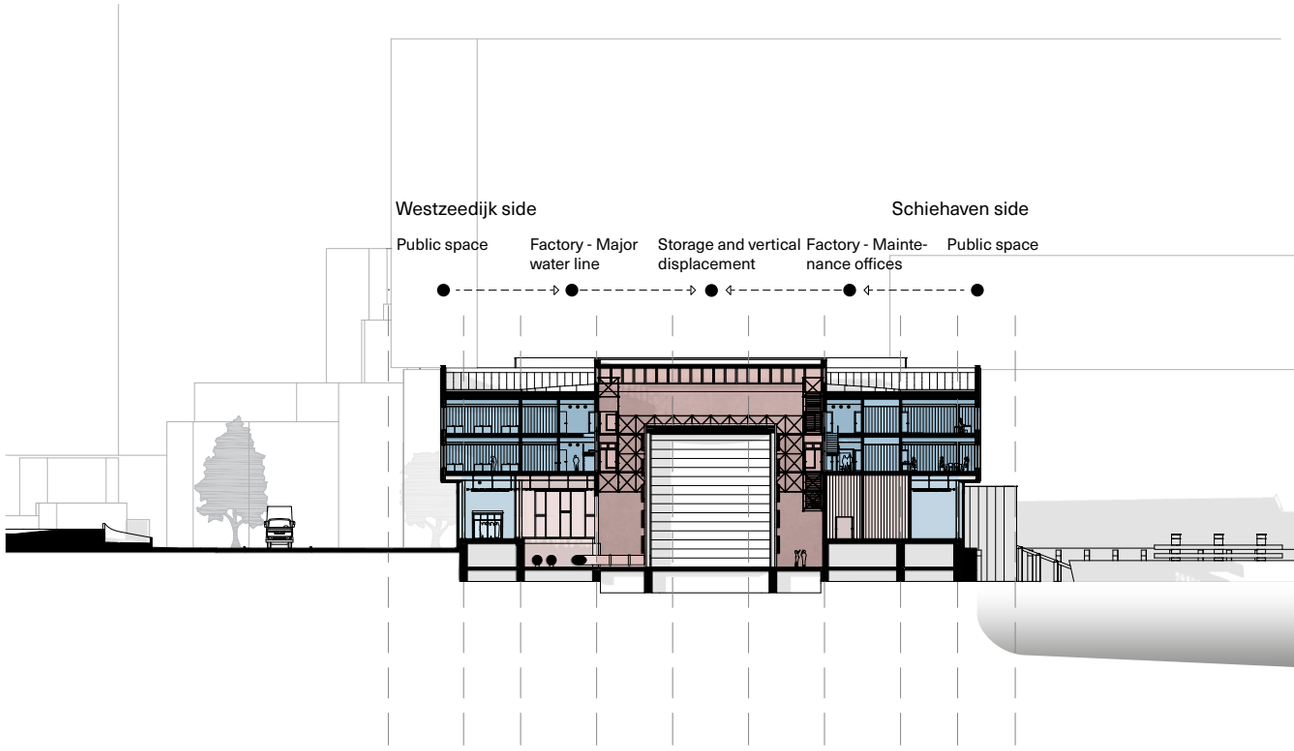


Figure 4. The sections show the integration of the overal energy concept, the architecture and the building technology. The integration of these three themes is crucial for the overal success of the Energy Hub.
Image by Gerjan Agterhuis

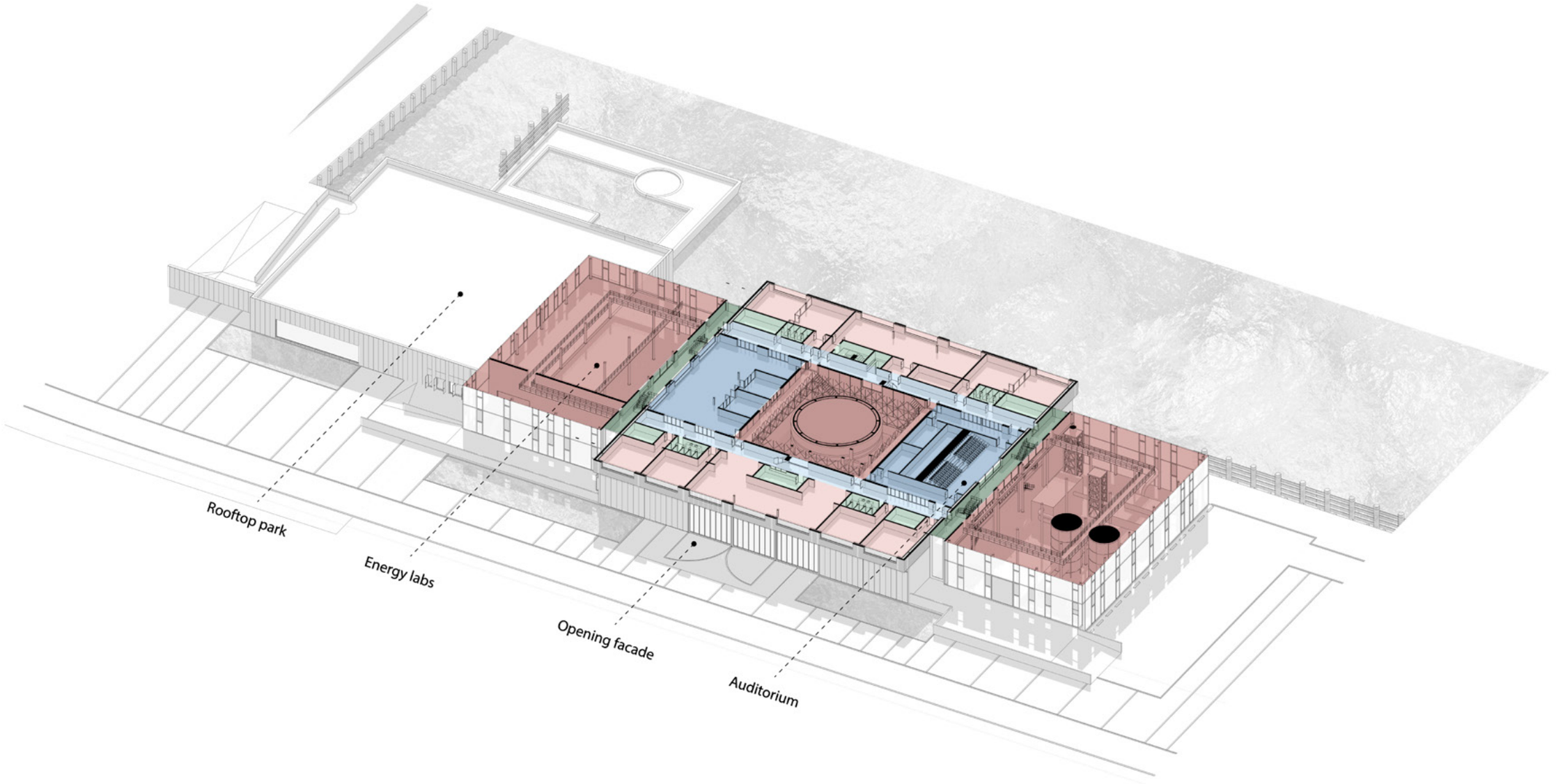


Figure 5. The visitors, students and employees are invited to walk through the different cycles and processes involved in the Energy Hub. The isometric view shows that the paths and spaces are oriented in such a way to stimulate cross-pollination.
Image by Gerjan Agterhuis

House of Circularity

Fikri Yalvaç

A proposal for a hybrid building that stimulates circular interaction

Within architecture, circularity is mainly measured through performance-related aspects, such as recyclability, reusability, and demountability. However, in this thesis circularity is placed in a different context. The year 2050 is relatively short to transition an existing city and economy to one that is circular, but it is long enough to influence and teach the next generation to accept and adopt circularity as their standard.

On the one hand, many people are still unfamiliar with the concept of circularity or are unsure of how they might contribute to the economy. On the other hand, some people (including students) have brilliant circular ideas but lack the resources to put them into action.

Instead of taking a traditional approach to circularity, this thesis distinguishes hard and soft characteristics of circularity, classifying them as short-term and long-term accomplishments. The soft characteristics are circular interventions with a primary focus on education, interaction, and spreading awareness. Promoting circular projects and initiatives, facilitating interaction between users and actors, and providing space for those who want to participate in circularity is an important and necessary endeavour for our planet's future.

Accessibility and location are critical variables in fostering circular interaction. As a result, avoiding or resolving physical barriers and obstructions was critical. After extensive research and careful observation Park Pompenburg, which is located in the heart of Rotterdam and may be transformed into a key hub for the city's infrastructure, emerged as the most suited place for promoting circularity and activating interaction. Park Pompenburg covers three separate areas that are difficult to approach due to the subterranean railway that rises above the ground and forms a barrier in the park. By extending and connecting the railway tunnel with the Hofbogen and the Luchtsingel, a plateau has been created that becomes a public square where traffic from various directions meet.

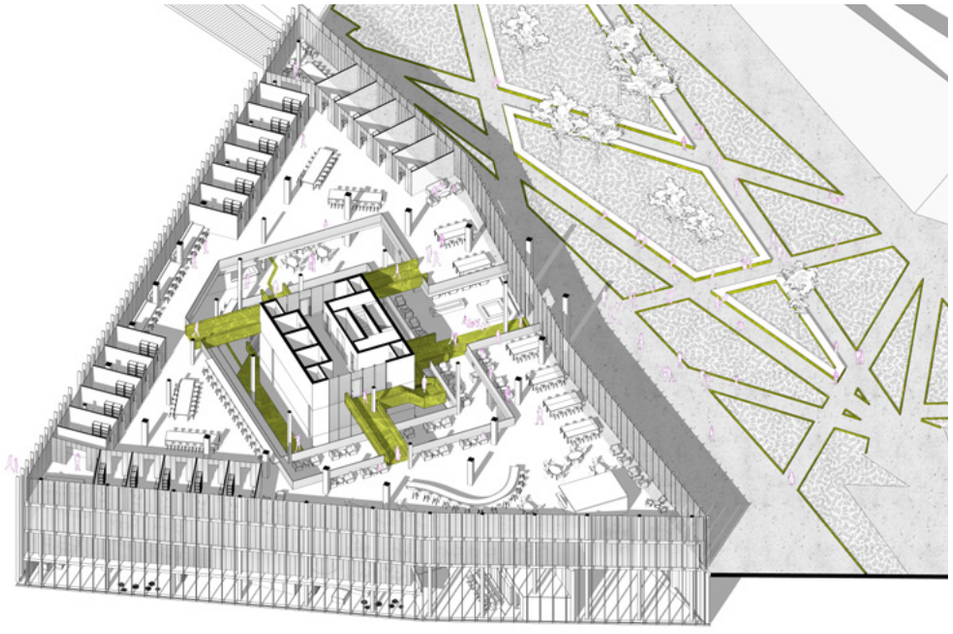


Figure 1. An open and accessible structure with the yellow stairs as a multi-level connector and guide through the plinth.
Image by Fikri Yalvaç

The 'House of Circularity' concept produced a hybrid structure that houses educational programs, dedicated workspaces for circular initiatives, commercial facilities, flexible office spaces, a (short-stay) hotel, and apartments. The project consists of two plinths and towers on either side of the railway, as well as a public plateau that unites both structures and the two districts. The complex pays homage to the area's heritage and the historic Hofpoort (city gate). In the skyline, the two towers mark the crossover between the Central District and Rotterdam North.

The project investigates how architecture might help to increase circular awareness in order to influence behaviour and stimulate interaction. This project is a critique towards standard and con-

ventional circularity methodologies. It is an attempt to make circularity transparent and accessible to the general public to convey a message: *The future of our cities affects us all, therefore a healthy planet can only be a waste-free planet.*

The challenge

The House of Circularity in Pompenburg, Rotterdam, required a fresh take on circularity and hybrid architecture. In a world where resource depletion is so rapid that our planet cannot regenerate itself, and where the climate crisis constitutes a threat to us and future generations, circularity must be prioritized at the top of the list of important issues. Circularity is a collective responsibility that should not be left to a small group of activists, visionaries or politics. To ensure a liveable planet for future generations, everyone bears equal responsibility.

Circularity is currently measured in terms of individual performances or accomplishments. Mainly focused on using recycled materials or designed in a way that allows for immediate reuse. Because recycling is a delayed process of downcycling, the latter is far more effective. If we want to become a circular city, we can't let circularity rely on industrial developments. So far, research has proven that the climate goals are still unattainable and that (virtually) no progress in the field of circularity has been made in a year between 2018 and 2019.[16] However, circularity has become more well-known in recent years. In the Netherlands, Rotterdam has emerged as the frontrunner, intending to become a fully circular city by 2050.[17] Although this is a big statement, Rotterdam has already established itself as a bold city.

The design

The project is focused on the city of the future which allows the designer to create a specific context for his project by defining a scenario.

16. Circle Economy, 2019

17. Rotterdam Circulair, 2019

Figure 2. The Intermezzo as a community platform with a local marketplace, urban farming (school), and material collection point.
Image by Fikri Yalvaç

18. Fenton, 1985

The Netherlands' biggest cities are dealing with population increase at an exponential rate. Rotterdam's population will increase by 50.000 people by 2030. Because most cities, particularly in the Randstad, are bounded by surrounding cities, unlimited expansion is impossible. Therefore, hybrid buildings offer a practical solution to densify and diversify the existing urban fabric.[18] Hybrid buildings also open up new possibilities in terms of circularity. Sharing space with others reduces the need for additional space. Furthermore, it stimulates interaction between different users, which might lead to new ideas and initiatives.

In this project, circularity is viewed as a necessary condition for future hybrids. Circularity, as previously stated, is a collective responsibility. Meaning that contributions to resource conservation and waste reduction should be made on a variety of scales. However, the lack of knowledge is what is delaying circular developments, such as people who are still unfamiliar with the Circular Economy or those who are unsure how they may contribute. In this project, circularity has a specific polarity which is defined as hard and soft character-

istics. Hard are measurable performances that are normally self-evident with circularity; reuse, reduce, recycle. Soft are difficult to measure and have a long-term objective, such as education, raising awareness, creating job opportunities, and sharing products.

For circular organizations and businesses, raising awareness is vital. Currently, Rotterdam has more than 60 circular initiatives, all of which are equally important to the economy. However, their input, but also their impact, is dependent on or determined by the people's input. This became a turning point that defined the meaning of the House of Circularity. For people to get actively involved in the circular economy, we must educate, raise awareness, change people's perspectives, and ultimately influence their behaviour. However, activating circularity is dependent on many factors. Aside from changing one's behaviour and attitude, the process of contributing should be made simple, that is, people should be able to contribute quickly and easily without putting in too much work.

Park Pompenburg is one of Rotterdam's neglected or underutilized areas, with a variety of opportunities and the potential to become a node for circular interaction. The plateau connects different areas and stimulates reciprocity in the surrounding. In the plinth, circular initiatives, start-ups, and the public share the same space. The structure's open character allows knowledge and information to cross-pollinate, creating an implicit spread of awareness. The plinth is a shared space that opposes isolation by emphasizing continuity, openness, and accessibility. It also allows for a cross-connection between the two districts, encouraging people to interact with the activities in the building. The House of Circularity is mainly a meeting place for the public and circular stakeholders to interact and share knowledge.

Apartments, workspaces, and hotel rooms are all housed in the towers. In each tower, an intermezzo layer separates the last two from the apartments. The intermezzo is an intermediate floor that holds a community platform, hydroponic farming, a resource collection point, and material storage displays. The intermezzo is a platform that brings residents and other circular actors together. It provides space to create a local marketplace where people can share materials, knowledge and skills. The intermezzo is an interactive layer that can be seen from the outside to show the circular activities that take place inside the towers. Curiosity is required to elicit a certain functional impact. Nudging is a creative way to persuade people to take a specific action without limiting other possible options.[19] Various creative and playful installations and art objects on the plateau encourage circular engagement. The colour yellow is used to indicate specific paths and directions within the plinths and on the plateau, which, according to psychological studies, evokes feelings of happiness and competence. Moreover, it also establishes a link with the Luchtsingel and its extension to Rotterdam Blaak.

Ultimately, imagining a building with a specific program that aims to alter people's behaviour and perspective on circularity is not necessarily a building of the future. It is the building of today. The project aimed to propose a feasible strategy for a building with a specific program that makes circular activities visible to the public, teaches people about circularity, and at the same time attempts to influence their behaviour to contribute to circularity. This project, however, revealed that this could be closer to a psychological approach than a strictly architectural one. Understanding how the human mind's cognitive capacity works may enable us to create surroundings that better anticipate our actions. Our attitude appears to be a major deter-

19. Thaler & Sunstein, 2008; Didenko, 2016

minant of our actions. The primary components that shape the attitude are education, experience, and the environment.[20] Exactly the three elements that usually separate good architecture from poor architecture.

The city of the future, as imagined in this project, is a world in which people are aware of circularity. A world in which everyone feels equally responsible for the environment. A world in which circular interaction and engagement are facilitated for the public. A world where buildings collect and send resources to initiatives and companies that can put them to good use. A world in which hybrid buildings represent and symbolize circularity.

20. Surbhi, 2017

Figure 3. The plateau as an urban connector and platform for public interaction.
Image by Fikri Yalvaç

Synergising Architecture

Daniel Sobieraj

Integrating Food System Processes with Urban Functions Towards Liveable and Sustainable Agri-Food Business Parks in Westland

Circularity was not the initial theme of my project, yet it quickly became the driver of my graduate work and proved to be a necessity in the development of the City of the Future lab. I began by investigating how food has played an important role in shaping our metropolitan regions, such as Westland in South Holland, the Netherlands.

The industrialisation and globalisation of agriculture in Westland have prioritised economy and efficiency over liveability and sustainability. The market-driven expansion of the agri-food industry has contributed to spatial competition in Westland resulting in numerous spatial consequences, one of the most serious being that according to surveys, areas around agri-food business parks have the lowest liveability scores in the region.[21]

These food-related issues are multi-faceted spatial matters that architects can address. I noticed from my initial analysis of Westland that low liveability was being caused by a fragmenting and rigid urban development. Systems, flows, networks, people, properties, buildings, and nature were disconnected, isolated, and unable to change.

Connectivity and adaptability strategies can mend this urban fabric to bring back liveability, and ensure it in the uncertain future. In other words, what is needed for liveability is circularity; connecting the output of one system to the input for another in an adaptable way adds more value than if the systems were separate.

Through circular thinking, current fragmenting and rigid urban development can be disrupted by focusing on value-adding synergies that connect different systems, networks, spaces, and people, while allowing future adaptability. This research project aims to better understand how the synergistic integration of food system processes with urban functions through architecture can create a more liveable and sustainable development of agri-food business parks in Westland.

21. Leidelmeijer et al., 2014

Figure1. Aerial perspective of the design intervention that aims to create synergies that improve liveability in Westland.
Image by Daniel Sobieraj

Methodology

Firstly, key strategies were identified through a theoretical exploration of case-study projects that focused on integrating food processes with urban areas: *Garden City* (1898),[22,23] *Broadacre City* (1935) ,[24,25] *New Regional Pattern* (1949),[26] *Agronica* (1994),[27,28] and *Southlands* (2007).[29,30] Strategies include (1) regional connectivity, (2) networks and infrastructure thinking, (3) urban metabolism, (4) self-sufficiency, (5) hybridisation and clusterisation, and (6) catalytic design. The architect's role in the food system was determined in a position paper.

Next, a spatial analysis of the selected agri-food business park determined spatial factors contributing to low liveability: (1) fragmenting mono-functional zoning that makes areas inaccessible, (2) isolated and disconnected communities with inadequate public spaces and amenities, (3) limited and disconnected fragments of greenspace, (4) disproportionate jump in scales between small single-family homes directly adjacent to massive greenhouses and warehouses with no transition space, (5) rigid island urbanism made of disconnected developments designed to a final stage with no interaction between adjacent properties, (6) lack of sense of place caused by the homogenous, private, and inaccessible infrastructure that covers Westland and disconnects identity from the place, and (7) repulsive utilitarian urban fabric that lacks attractiveness, housing, amenities, atmosphere, and creates a low quality of life that promotes further disconnectedness.

22. Howard, 1898
23. Howard, 1946
24. Wright, 1932
25. Frank Lloyd Wright Foundation, 2017
26. Hilberseimer, 1949
27. Branzi, 1986
28. Branzi, 2002
29. Duany Plater-Zyberk, 2009
30. Duany, 2011

Missing spatial qualities to restore liveability were then identified and compared against current design interventions in Westland addressing similar issues: (1) interconnected and accessible hybrid areas, (2) connected communities with public spaces and amenities, (3) intertwined blue-green networks, (4) introduction of a human and interstitial mid-scale to connect small and large scales, (5) an adaptable and phaseable urbanism that interacts and connects to neighbouring properties, (6) connection of identity to place, and (7) creation of an attractive urban node that creates a liveable area and promotes the further connection of different spaces, networks, and users.

Based on the result of the theoretical exploration and spatial analysis, a design framework was devised and synthesised into a set of spatial design tools that can be used by designers to create an architectural intervention and catalyst to disrupt the problematic urban development around agri-food

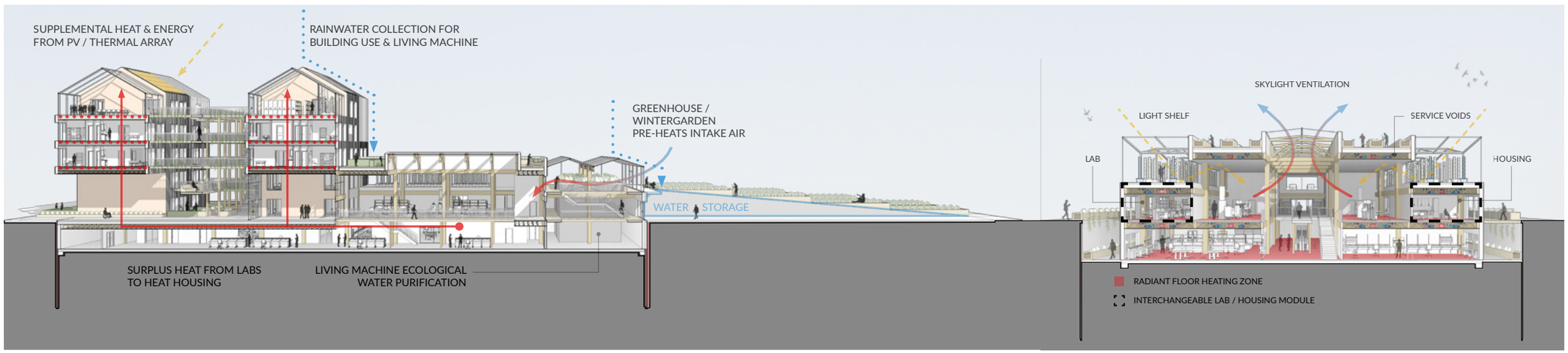


Figure 2. Longitudinal and transversal sections showing synergies between housing and food research labs.
Image by Daniel Sobieraj

business parks. The design framework consists of urban- and building-scale objectives, that can be reduced to connectivity and adaptability. Connectivity objectives join: (1) communities and public spaces, (2) small residential to large agri-food scales, (3) identity to place, (4) nature to urban design, and (5) cycles and waste flows. Adaptability objectives are: (6) hybridisation and clusterisation, (7) phaseability and temporary use, and (8) modularity. The design tools were then interpreted in a design of a master plan and architectural proposal that reimagines a more liveable and sustainable future of Westland's Honderdland agri-food business park in the town of Maasdijk.

Design

The presented urban and architectural design is my interpretation of applying the design tools from the design framework while incorporating the results of the site analysis into the selected site. My project's viability lies in the ability to restore Westland by addressing multiple issues at once, integrating different systems and spaces synergistically, connecting the currently fragmented urbanism, giving it flexibility, and uniting the predominant agri-food industry to improve the area's quality of life and sustainability. Rather than optimising one function, the three most demanded land uses are synergised to reduce spatial competition and improve liveability in Westland: agri-food business parks,[31] housing,[32,33,34] and public greenspace.[35] The result is a mixed-use neighbourhood integrating food research with intergenerational housing in a district built on an ecological network.

31. Batenburg, 2018
32. Capital Value, 2019
33. Janssen, 2020
34. De Jonge, 2020
35. De Zeeuw, 2017

Connecting Communities with Public Spaces

Communities are connected through a blue-green axis that is an ecological corridor, district water manager, recreational public space, and slow traffic passage. The architectural intervention features public and semi-public elements that connect residents to the public realm; an atrium along the building connecting labs to outdoor amenities, common areas, sloped gardens, and indoor winter gardens.

Connecting Small Residential to Large Agri-Food Scales

Mid-scale synergistic spaces between agri-food research and housing include (1) greenhouses that serve as winter gardens for residents and testing facilities for labs, (2) outdoor gardens with various growing conditions for labs while providing recreation for residents, (3) communal kitchens where residents cook meals together or where lab students have cooking classes, (4) a restaurant where residents share meals and where culinary students intern, (5) a food market near the residents where lab-developed products can be sold, and (6) event spaces for residents' entertainment or researchers' lectures. Food research labs provide a human-scale programme that makes agri-food infrastructure visible and interactive for the public. Setbacks, stepbacks, and courtyards make the mid-rise buildings inviting.

Connecting Identity to Place

Reintroduction and reinterpretation of vernacular elements strengthen the site's local identity. The design's use of traditional building forms, like gabled roofs, and the re-imagination of watercourses give new meaning to historical elements. The materiality of the buildings has a strong identity to place; clad in reclaimed wood from wooden pallets, spools, and crates from nearby warehouses. The orientation of terraces, roofs, and greenhouses are unique to the buildings' location, improving wayfinding as every building is different.

Connecting Nature to Urban Design
Industrial areas are reconnected to nature through constructed wetlands, retention ponds, parks, gardens, and water squares. The blue-green axis connects and activates fragments of green areas scattered between industrial infrastructure. The building appears to be growing from the ground; a sloped landscape leads up to the greenhouse, an all-season green oasis with a living machine, and a plant-based water filtration system. Other green spaces include terrace gardens, a lush gallery, and winter gardens.

Connecting Cycles and Waste Flows
The blue-green axis cleanses district water runoff through bio-swales, constructed wetlands, and infiltration ponds. Blackwater, from organic outputs of kitchens, toilets, and neighbouring food processes is converted to biogas through anaerobic digesters integrated into the landscape. A heat-and-power plant generates energy from biogas. Its by-products (CO_2, fertiliser, compost) are valuable to neighbouring agri-food processes. Building greywater, and liquid effluent from biodigesters are purified through a living machine and reused. Rainwater from the roofs is collected in underground tanks. Regarding material circularity, bio-based and reused elements that reduce embodied energy and ecological impact are visible in the construction.

Adaptability through Hybridisation and Clusterisation
The proposal is a mixed-use neighbourhood with building clusters that can hybridise and change functions. This flexibility ensures future walkability as amenities and functions can adapt to resident needs. The buildings mix public and private functions. Building services running through the timber truss structure are designed to include systems suitable for both residential units, laboratories, or other functions if site or market conditions change.

Phaseability and Temporary Use
A bottom-up phasing strategy allows the site to grow or shrink, ultimately resulting in two future scenarios: densification or disassembly. Phases include (1) existing situation, (2) establishment of blue-green axis, (3) introduction of temporary uses, (4) completion of mid-scale development, (5) integration of existing and future developments, (6a) future densification, (6b) future deconstruction. Elements are prefabricated and standardised for reuse in other projects, such as removable sheet pilings.

Adaptable Modularity
Modular construction allows buildings to expand, shrink, or interconnect. Building massings can be adapted to different orientations and site conditions. The modular post-and-beam structure of the labs provides flexibility with changeable partition layouts for different functions. CLT modules can be interlinked for different housing layouts: studio, 1-, 2-, or 3-bedroom apartments.

Conclusion
As low liveability scores seldom originate from one urban issue, but rather from many issues that are also food-related, architectural projects must take a multi-faceted approach to simultaneously address the needs of various stakeholders affiliated with an area at multiple scales. In Westland, areas near agri-food parks have faced liveability problems because of fragmenting and rigid urbanism. A synergistic approach focusing on connection and adaptability must be taken to better integrate food system processes with areas around agri-food business parks and contribute to a more liveable and sustainable urban development in Westland. The outcomes of this project show that the city of the future should go beyond sustainability, and add value at multiple scales and sectors of urban areas by implementing a circular approach. This is possible through con-

nection, by creating synergies that merge systems, uniting people, closing cycles or giving waste value. Along with the flexible design, allowing functions and spaces to change and create new synergies between different elements that can adapt to fit the uncertain needs of the city of the future.

Figure 3. View of integrated housing and food research labs from blue-green corridor.
Image by Daniel Sobieraj

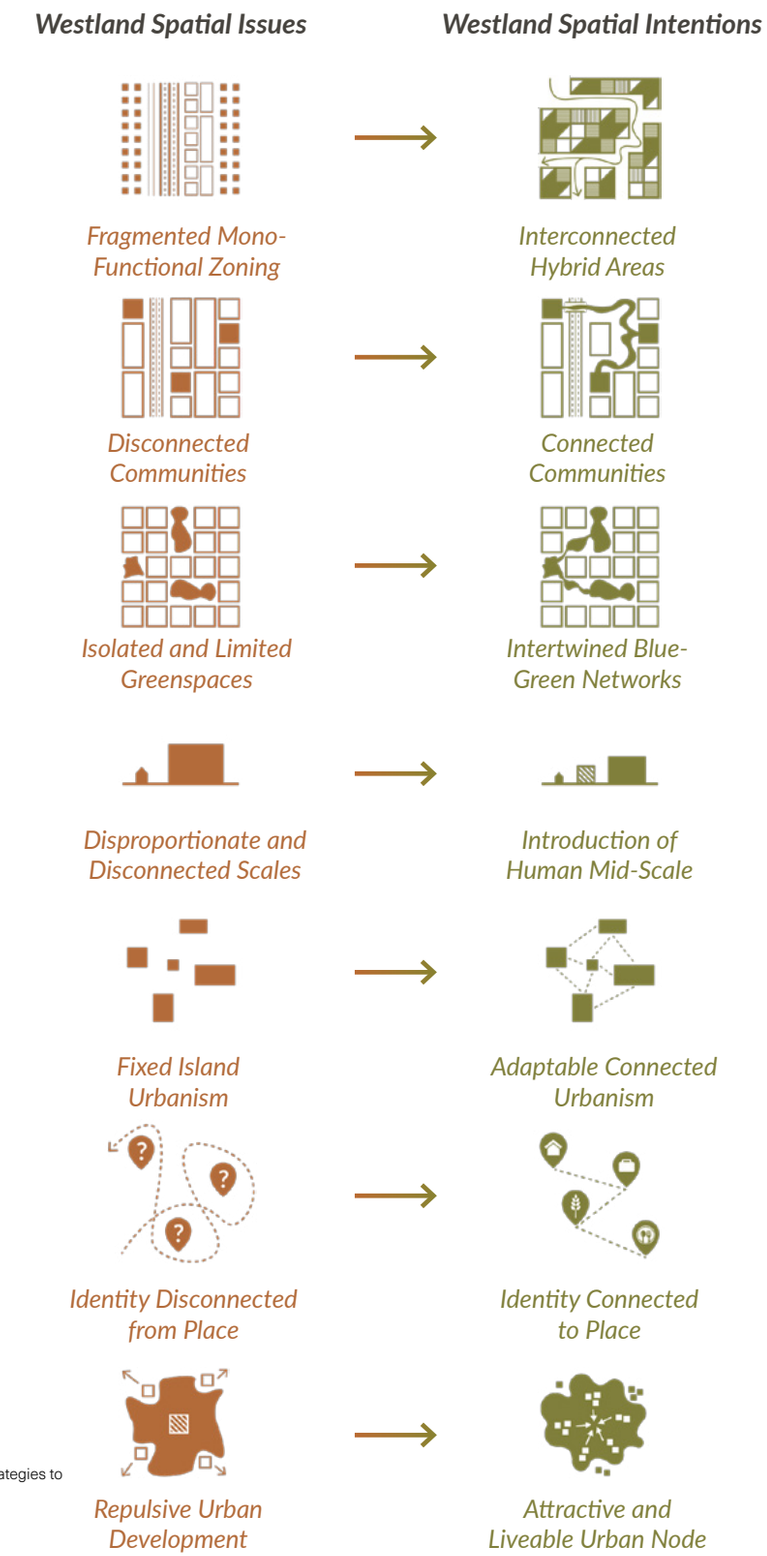
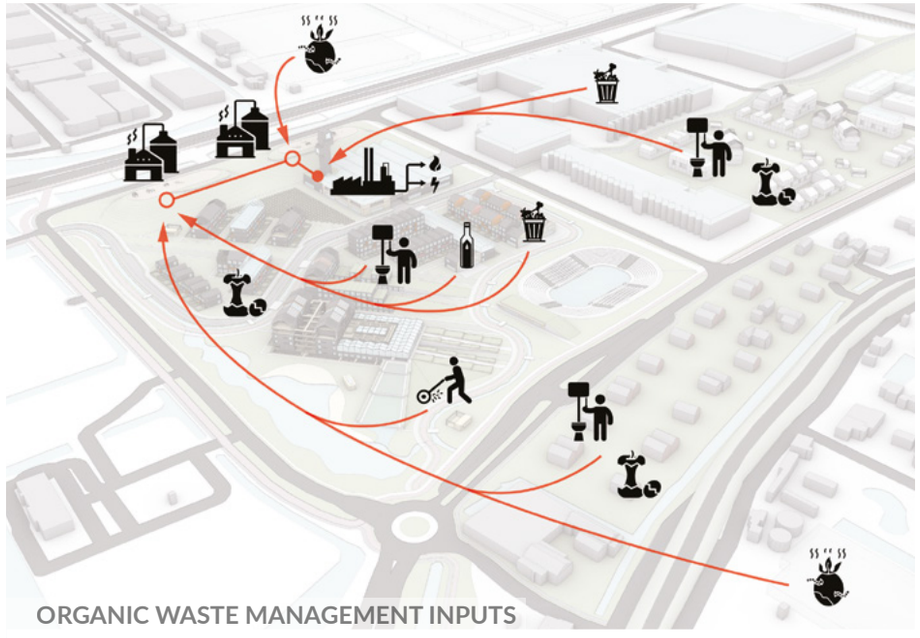
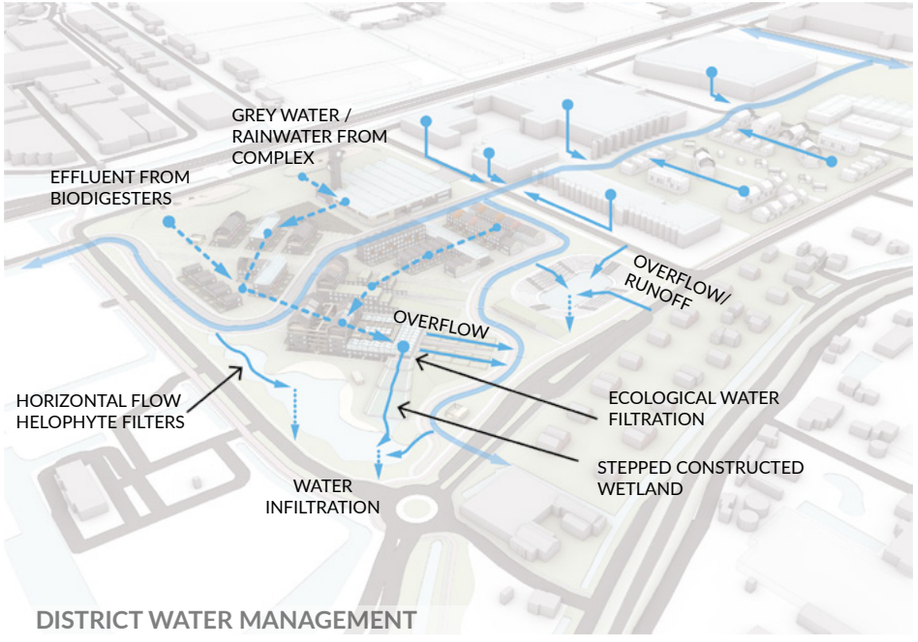
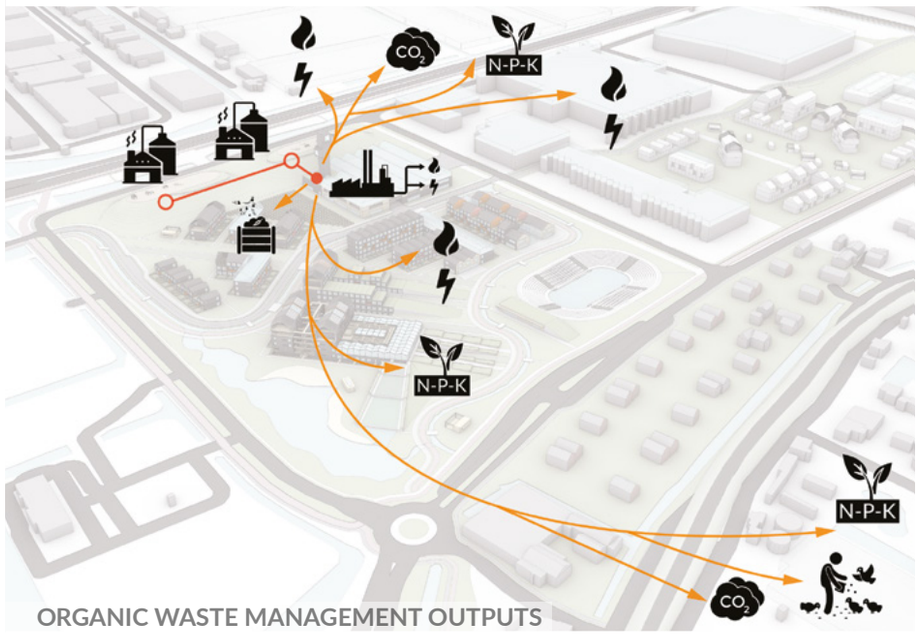


Figure 4. Spatial design strategies to remedy spatial site issues.
Image by Daniel Sobieraj







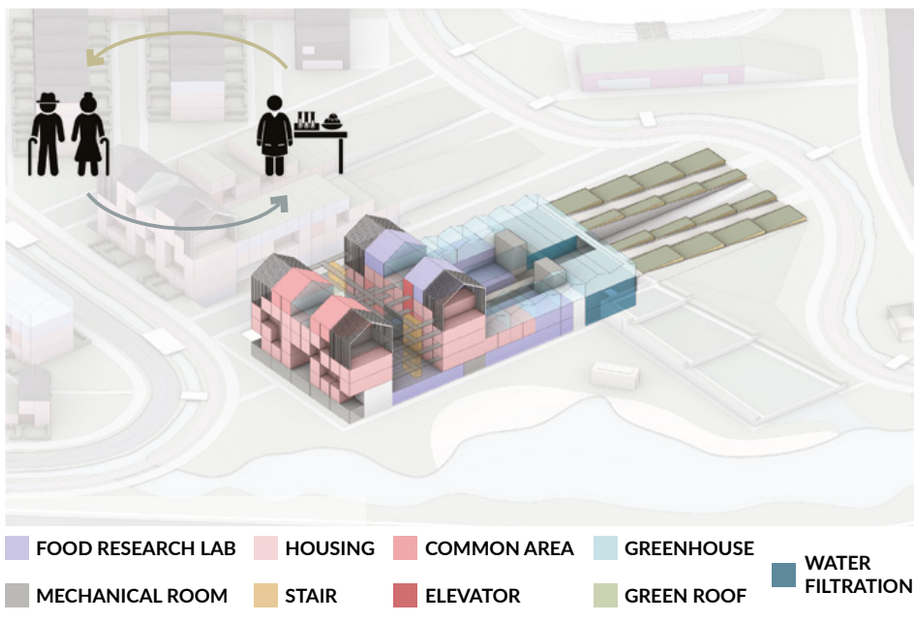


Figure 5. Diagrams showing the design's circular aspects that close loops of various systems.
Image by Daniel Sobieraj

Interview

Fikri Yalvaç
Architecture graduate

Introduction

I'm Fikri, I'm from the first generation of the City of the Future studio. I graduated in the Summer of 2019 and then started working at Barcode Architects for a year. Now I am working for the municipality of Rotterdam on the energy transition. We try to combine climate adaptation with strategies to improve urban quality.

Motivation [pre-phase]

What motivated you to choose the studio?

Before graduation, I was trying to figure out what I wanted to do. I wanted to work with something involving circularity, climate adaptation and sustainability. The studio sounded like an ideal mix of Explore Lab and Complex Projects. You can think of things that don't exist right now and you could pick your location and topic. It was the perfect combination for me.

The cross-domain nature was also a factor. Students from different backgrounds join the studio so you can have a dialogue with each other throughout your project.

Experience [process phase]

How was your experience with the educational setup of the studio?

I liked the master classes and seminars. I didn't have my topic yet at the time so those sessions helped me to define my topic. The tutoring was helpful as well because the tutors were supportive from the beginning. Plus, the structure of the studio was formed along the way and that worked for me.

Concerning the cross-domain input of the studio, it was left to our initiative to cooperate. In the beginning, everybody was looking for their topic and location and you could see that quite some people were a bit isolated because they were too occupied with their own thing. On the other hand, a nice aspect was that we were always sitting in our studio so you could always have a dialogue with each other. It was more of a collaboration on knowledge exchange than on the project level.

How did the approach of the studio have shaped your thesis and how would it be different if you choose another studio?

The multidisciplinarity was helpful for me because there were groups of people with all kinds of different knowledge and experience. So when I came up with ideas, there was always someone with a new perspective or approach. In the end, my ideas truly evolved. I wanted to focus on the social side of circularity in my project and thanks to this environment I was able to combine the architectural level with the social and human levels.

The project [post-design phase]

In what ways does your project answer the studio's theme?

I was searching if my topic was suited for this studio because, when we think about the city of the future we automatically think about a technical city. My idea was more like imagining how circularity can be integrated into the way we live. How can we build towers where circularity is integrated into the system? Buildings that minimize waste or even that don't produce any waste.

My proposal was a building that functions as a node of a circular economy in between three major neighbourhoods. The building would house all kinds of circular initiatives in Rotterdam. Nowadays, there are almost 100 circular initiatives in Rotterdam but they are all dispersed in the city.

Behaviour is an important part of this project. I came up with the idea of creating incentives, so you can deliver your garbage or your resources and you would collect points. And when you have enough points, you can get a coffee from a local coffee shop or something else. Here, I merged the architectural aspect with the social behaviour aspect of circularity.

Cities of the Future: Keeping Resources Local

Mauro Parravicini
Architect and lecturer Building Technology, TU Delft

The crescent of global urbanisation is asking for smart solutions and cannot anymore restrain from integrating technology and nature in cities. The current role of the architectural and urban designer sits at the core of the current global transitions which, in reason of their complexity and interconnection, cannot be addressed separately, but rather integrally.
In this world in transition, technology is not just an answer to a design question, but it configures itself as a reason to even reconsider the role of the designer. Technology and materialisation and, in a way, also digitisation of processes, determine the intellectual position of a contemporary designer ahead of the design itself.

Since the Meadows report of 1972 *The limits to growth*, we have been made aware about the finiteness of natural resources. But only in more recent years have we been capable to state the importance of a circular economy and a circular design assessing the whole life cycle (LCA) of buildings and products. Essays such as Braungart and Mc Donough's *Cradle to cradle*, In which a plea is made to design and produce in circular flows by celebrating nature, as well as the concepts of shearing layers in the theory of Stewart Brand, or the butterfly diagram of the Ellen Macarthur Foundation, opened the way to this approach. The outcome has been a new consciousness of preventing waste through maintenance, reuse, refurbishing and recycling.

From locally harvested materials and energy to agri-food strategies addressing the overpopulation of contemporary metropoles, the finiteness of resources becomes a catalyst to produce a different type of architecture, in which sustainable production processes are integrated and put in evidence rather than kept hidden from the citizens, as it has been for too long in the modernist era of urban zoning.

Integration can happen through the realization of efficient buildings-machines, or even neighbourhoods, for the production and harvesting of energy and food, or the transformation of components and materials. In those living communities, production processes become an opportunity to create awareness in the population, improving life quality and enhancing the integration of natural and technical processes without any detriment to the neighbourhoods where they sit.

The interesting aspect of the current transitions is the inevitable proximity between production and living, industrial and residential functions, anthropic and natural. This proximity can be a cause of tensions in a modernist urban environment, but it has to be addressed and implemented in a post-modern city, where digitisation and deep awareness of natural equilibria can become the key to more integrated urban densification.

Circularity of materials is also about circularity of components. Buildings cannot be made over and over again from new resources that lose their value once put together in a building. The value of materials has to be preserved also through reversible construction techniques, smart maintenance, and dismantling planning. In this sense, we should see our cities and buildings as processes.

Circular buildings are designed as growing (and decaying) entities in their environment: generous in offering shelter to humans and animals, generous in production of energy, generous in storing CO^2 and materials for future use, generous in flexible space, natural light, healthy indoor air quality, open to different uses and users.

Prefabrication and digitisation play here an important role in reducing material waste. Factory-made (wooden) building components are placed on site almost without waste and with limited local pollution. If we combine the use of biobased materials, preferably locally harvested to contain the emission of carbon dioxide in the air, with the application of nature-inclusive solutions to buildings and neighbourhoods, we start seeing the advantages of a technology that is fully integrated into nature and contributing to new planetarian natural equilibria.

Since designing the city of the future implies a technical design approach addressing the limitation of resources, the potential loss of biodiversity and the development of hostile living conditions in cities due to the effects of climate change, we are all called, as designers and policy-makers, not only to try preventing those effects but also to address them as potential constraints influencing and stimulating new solutions.

3

Perspectives

Sonja Drašković
Marcelo Carreiro Matias

This chapter presents a range of perspectives on multidisciplinarity in the built environment with the City of the Future studio experience as central point. While previous chapters focused on content, either educational or technical, this chapter presents personal experiences. These, drawn from graduates and practitioners, contribute to building a comprehensive picture of the experience of multidisciplinarity in education and practice.

The chapter is composed of a graduates' essay, written jointly by all graduates participating in the book, and interviews with practitioners.

Graduates' essay

The graduates' essay presents the experiences of the group of graduates on the CotF studio in technical terms, with emphasis on their projects, and educational terms, such as educational setting and process. The essay provides a fresh perspective from those who experienced multidisciplinary education from within.

Interviews

Interviews took place with a diverse body of practitioners that were somehow involved with the studio. Those are namely Alexander Wandl, assistant professor of Environmental Design at TU Delft; Bart Mispelbloem Beyer, architect at Tangram Architecture and Urban Landscape; Fabrizia Berlingieri, associate professor of Architecture at the Politecnico di Milano; and Tom Daamen, assistant professor of Urban Development Management at TU Delft.

Interviews were set up in a semi-structured format based on four guiding questions sent out beforehand. During the interview, there was space for follow-up questions, which allowed each interview to take its own shape and lead to discoveries.

The questions were the following:

1. *What is your **approach** or **opinion** towards multidisciplinarity in your field of expertise and, if so, what is your **experience** with that?*

2. *How do you see these ideas or experiences translate towards **education** in the built environment?*

3. *How would you see the paradigm of multidisciplinarity in **future** education in the built environment? How would such an approach work in practice/your field of expertise?*

4. *How would you see multidisciplinary education in relation to the **design** needs of cities of the future?*

Graduates' essay

Gerjan Agterhuis

Introduction

The central thesis in this essay is the following: *Did the City of the Future studio successfully address the challenge to design for the future?*

This thesis will be handled from the perspective of the graduates of the 1st, 2nd and 3rd generation of graduates. The body of this essay is informed by both the studio setup and literature, as well as graduates' personal perspectives on their experiences in the studio. In the essay, the debate of 'nature versus nurture'—one's intrinsic motivation and ability to perform versus the resources provided by the environment—will play a critical role.

In general, the studio has succeeded in providing most of the necessary resources to enable graduates to set-up their own projects. There were no consistent shortcomings and most of the projects saw a timely delivery of the final result.

One important point to be considered is that graduates from Generation 3, disregarding the disciplinary background, mentioned the severe impact of the COVID lockdown and working from home on their experience of the multidisciplinary character of the studio.

Freedom

Graduates consider freedom as a highly positive aspect of the studio. That touches the freedom to define your own topic and location and to work with other disciplines that are of interest. The support of tutors has been noted as also positive because they offer guidance while keeping space for experimentation.

Due to this level of freedom, unsurprisingly the output has shown a broad variety of results. Differing individual interests greatly influenced the outcomes, from *design-focused* to *technology-focused* and *concept-focused*. One could argue that one might be more important than the other, but the studio specifically does not aim to do so. If the goal is to be as open-minded as possible in creating future scenarios, the output of the studio can be qualified as appropriate.

Shared vocabulary

The second point raised across the board of graduates is vocabulary. There are a number of disciplines in the studio with their own vocabularies, both with respect to content (concepts, models and frameworks) and process (methods). For instance, architecture is known for the *research by design* approach; urbanism applies comprehensive multiscalar frameworks; and engineering has a prevalence of quantitative methods. Each field also has its own way of outputs, for instance drawings, models, written texts, interactive models or calculations.

The overall consensus is that the studio could benefit from an increased definition of shared values and goals across all graduates. Setting some ground rules whilst leaving some themes open to the interpretation of graduates and their mentors in a way they see fit. The studio already attempts to generate some of this atmosphere by encouraging graduates to study a shared set of literature that specifically aims to bridge the gaps between disciplines. This is a strength of the studio. Developing these types of shared activities, without infringing on creative freedom, is believed to be an opportunity to further differentiate the studio in TU Delft.

Multidisciplinary process

Individual projects in the studio have the ability to sprout in whichever way the student and supervising tutor see fit, and for good reasons. Depending on how this is used, students can benefit from multidisciplinary inputs if they look for them, or they might take the other route and actually create barriers to multidisciplinary collaboration, which is not uncommon. We will touch experiences of graduates in and outside architecture on this matter.

For graduates outside architecture (and urbanism to some extent), not having the obligation to work towards a designed solution allowed them to maintain this multidisciplinary character for longer into their graduation process. This disparity is based on many variables and is a subjective one as it is based on personal experiences. This is also reflected in the process of finding a third mentor which which is experienced as a slightly challenging process across the selection of graduates. We believe that more guidance in this process will ensure a better variety of mentors assisting each student.

In the case of architecture, students are asked to develop a technical elaboration of their design in which these multidisciplinary goals can be brought back into the design, however already some opportunities have been missed at this point. This is reflected in the fact that many comments at the final presentations were on the fact that the research did not inform the design clearly enough. Did these two then for some reason get disconnected? Perhaps we should then have more checkpoints through which students have to prove the multidisciplinary character of their design and research.

Almost all of the graduates showed motivation to work in a multidisciplinary environment, but the various ways in which the studio was experienced by graduates from different fields indicates that there still exists an opportunity for the CotF studio to embed multidisciplinarity better in the educational process. We propose some ways to do so: applying a set agenda; a consistent vocabulary; clear objectives; and agreements on ways of working.

Curriculum

Graduates outside architecture mention the difficulty to integrate the curriculum of their specific programs with the studio. This led to a scenario where they couldn't take maximum advantage of the resources of the studio (interaction, lectures, etc.). The university as an organization could make more effort to allow for cross-disciplinary courses, integrating and attuning educational programs in such a way to allow cross-pollination.

Architecture graduates have mentioned the requirement to create an architectural design. This means that, no matter what the research topic is, an architectural intervention has to be proposed to address a certain problem statement. However, given the nature and creative freedom of the studio, one could also argue that the curriculum can perhaps be more flexibly interpreted, relying on the motivation of the student to come up with a suitable plan to address the architectural issues. In so doing, creating less of a 'one size fits all' education system could benefit the research of complex research themes. It is believed that this is already catered to to a degree, which is experienced as positive.

Conclusion

In the introduction the following main question was proposed: *Did the City of the Future studio successfully address the challenge to design for the future?* By and large this question can be positively confirmed. The graduates' results were well-received and a high level of creative freedom exists in the studio environment. Whether these results can be qualified as *multidisciplinary* remains to be researched.

The multidisciplinary character of the studio can be clarified more to steer towards *nurturing* multidisciplinary collaboration. The overall motivation of graduates to work in a multidisciplinary environment can be considered as high, so the *Nature* aspect is considered to be sufficient.

The freedom to set-up their own research topics and map out their graduation project was experienced by the graduates as positive. Simultaneously, this amount of freedom appears to generate some challenges for the studio. Due to the diversity of projects, students struggle to maintain a shared vocabulary throughout the graduation. This is not necessarily a weakness, although it does pose a challenge for the early stages of the studio.

Interview

Alexander Wandl
Associate Professor of Environmental Technology and Design, TU Delft

Introduction

I am Alex Wandl, I'm an associate professor at TU Delft and head of the Section of Environmental Technology and Design of the Department of Urbanism. I have a background in landscape ecology and urbanism, so with a double degree, I myself am a bit crossdisciplinary.

Approach and experience with multi-disciplinarity

What is your approach or opinion towards multi-/crossdisciplinarity in your field of expertise and if so, what is your experience with that?

In urbanism, when we design, plan and negotiate the future of cities and regions, multiple disciplines and people from different places are involved. So in that sense, multidisciplinarity is a precondition. The Delft design approach to urbanism has a tradition of integrating engineering, research and design. The urbanism department has, in recent years, also integrated urban geosciences and urban studies into the mix.

I have worked on several co-creative research projects and have developed co-creative decision support tools. Additionally, I have been developing situated learning environments for education.

Multidisciplinarity in education

How do you see multidisciplinary ideas or experiences translate towards education in the built environment?

The urbanism department applies the Delft Design approach in research and education because you can't design and plan part(s) of the city without including the traffic engineer, the water engineer, the climatologist, biologists etc. and specifically the people of the place.

If I talk about my personal way of teaching, then I mostly work with situated learning environments that are connected to participatory and co-creative research projects. In this way, students work with stakeholders. If you have different expertise on the stakeholder side, we have to match that from the students' side as well. Therefore, I try to bring students from our different master programs together, mostly urbanism, architecture, and landscape architecture students, but also industrial ecology and civil engineering students.

Urbanism is multidisciplinary by nature. Would you say this is essential for practice? Is there a strong connection between what you're taught and how you apply this knowledge in practice?

It depends on the type of practice and project you are working on. But a certain level of crossdisciplinary collaboration is always needed. With smaller private commissions, collaboration is often related to different engineering fields. The larger the project, the more diverse and complex the forms of crossdisciplinary working. Plus, economic, social and ecological questions become more important, not forgetting the legal issues. In short, increasing uncertainty asks for more cross-disciplinarity.

Having said that, I have to admit that, in my experience, the difference between spatial planning and urban design in practice is much stronger than what we teach here. The compartmentalisation of different disciplines in practice is very evident. Very often, they come after each other instead of in a co-creative process.

Is there a moment where you collaborate with architects or other disciplines?

In education, we usually collaborate with other departments either in elective courses or graduation studios like City of the Future. We have electives in architecture, civil engineering, industrial ecology and even at the University of Leiden. One example is my elective *Circular economy in metropolitan areas,* in which we work with groups composed of at least three disciplines.

Multidisciplinarity in future education

How would you see the paradigm of multi-/crossdisciplinarity in future-based education in the built environment?

Firstly, it is essential that you are well-rooted in your discipline. We should educate people with a so-called *T-profile*. Those are experts in their field but broadly enough educated and open enough to adjacent areas to be able to constructively work together. Without expertise, people are only talking about processes and not about the actual work, or the design, which is a loss.

We must not hinder students from choosing between multidisciplinarity and specialism. Not everybody has to become a universalist or work crossdisciplinary. We need mix and diversity, and the faculty should provide this diversity in possibilities. Students themselves should be prepared to make these choices, including later in their careers. We are adapting our curriculum in that direction; in a few years, interdisciplinary courses for students across faculties will become part of every master program at TU Delft.

How do you see the relationship between practice and academia in the future?

Practice and academia should be always in critical discourse with each other. Important is to understand that the task of the university is broader than training people for the job. It's a Master of Science. You should be able to think critically, understand what science is and base your decisions on theories and facts. But.. the relation between academia and practice changes over time. This is a good thing, as long as the critical discourse is there.

Are there other essential aspects for the future of education?

I think research by design will continue to be one of the foundations of education in the future.

Another important aspect should be the interaction with users and stakeholders, e.g. action groups, neighbourhood groups, citizens, provinces, municipalities etc. We are giving some steps in that direction in Urbanism. But I see that particularly the citizen is still absent.

Multidisciplinarity and the needs of the city of the future

How would you see the paradigm multi-/crossdisciplinarity in future-based education in the built environment?

I think multidisciplinarity is crucial for the future of the city in general and a sustainable future in particular. We need to understand and deal with complexity. And complexity requires a systemic approach.

I also think the city of the future will be built on the dialogue of approaches or movements. Human-centred or techno-efficiency are examples of commonly used approaches in recent times.

Another important aspect is time dynamics. The city is in constant transformation and adaptation. When designing for the future, changing needs should be incorporated as much as possible.

Interview

Bart Mispelbloem Beyer
Architect and Director, Tangram Architecture and Urban Landscape

Introduction

My name is Bart Mispelblom Beyer. I'm one of the directors of the office *Tangram architecture and urban landscape*. Our office started in 1985 and integrality has always been part of our DNA. We've always had a research mindset. We've done lots of work in complex locations and we published studies on several issues, for example, the study *Prachtig Compact NL* (Splendid Compact NL) and the exhibition *Ma-ssa*, the last being about the balance between the built and the empty in hig-density contexts. I've been involved in the City of the Future studio giving a few lectures about the perspective from the practice.

Approach and experience with multi-disciplinarity

What is your approach or opinion towards multi-/crossdisciplinarity in your field of expertise and if so, what is your experience with that?

We always say multidisciplinarity starts with the program of requirements. Since the beginning, we put everything into a discussion based on the physical, socio-cultural and economic triangle.

Let me take the example of *Rhapsody*, one of our projects that was awarded with the Okasha Prize for architecture and urbanism and the SKG Prize. First, the physical side of it. In the program of requirements, the only demand was that there should be 30,000 square meters of housing. Clearly this is too limited. We wanted to create a completely new living environment, not only for this plot but for the whole neighbourhood. In our design, we tackled noise, air pollution, fine dust, green, and water. We looked at functional and landscape aspects.

Now the sociocultural side. We invited inhabitants from the neighbourhood to talk about their wishes for this area. In our design there are now little greenhouses where residents can grow bio crops; the building serves as a meeting point; and we have some apartments for renting reserved only for the locals, who many times want to host their relatives coming from Morocco and Turkey. And beware: none of this was in the program of requirements.

Now the economic side. There were 7,000 people interested in the new building but only 240 houses were available. We told the real estate investor that we wanted at least 15% of future apartments for the existing neighbourhood.

And how was your experience of collaboration with developers, designers, engineers and other disciplines?

I have friends in all kinds of different fields, like philosophers and developers. We couldn't be more different from each other. My philosopher friends tend to listen first and then talk while developers are doers who usually talk and don't listen. I noticed how they couldn't communicate. Sometimes developers were laughing at the philosopher's input. If a developer doesn't understand why the human behaviour specialist is important on the table it is simple: he doesn't listen. And that was my experience. At the university in Delft, I did a lot of work in civil engineering. Miscommunication was common there as well. My message is that you have to learn to respect and understand each other.

Fields create many stereotypes of other fields. Do you agree?

Yes, absolutely. This is exactly the right word. And there are two ways around it, because from the architect's side, we also think 'oh, these stupid concrete details'. But here near the office, there is a construction engineering office and we have worked together for 30 years. From the earliest stages of the project, we collaborate. If I say something about their structural design, I know they will consider it seriously because we respect each other and value each other's work.

Multidisciplinarity in education

How do you see multidisciplinary ideas or experiences translate towards education in the built environment?

First of all, they should. I'm a fan of this studio trying to get integration in a more structured way in the Technical University, but I know it is difficult because the whole world is sectorally divided–our ministries, universities–which is a shame.

For me, integrality would never work if everybody knows everything. The only thing you have to know from the other discipline is where the overlap lies. Let's take mobility as an example. Our vision of mobility is changing rapidly because the use of the built environment is getting diversified and intensified, but there are still rules and regulations that say otherwise. For instance, in one of our projects at the Kop van Zuid, the guidelines from the Municipality required a minimum of parking space, even though the building was right near the metro station. Why not integrate the mobility guidelines into the urban context?

Do you think the studio is succeeding in making this connection?

The whole education curriculum should be formed around learning to work with other disciplines. That includes learning to value their inputs, being able to evaluate them, and knowing how to present your discipline. That means a complete reshuffling of university programs. However, that doesn't happen because it takes time and effort and there is never enough time. But this should be adjusted.

Multidisciplinarity in future education

How would you see the paradigm of multi-/crossdisciplinarity in future-based education in the built environment?

I think scenario testing is the first and essential step in future education. This is about picking up big questions and dividing them into packages that are easier to answer. These are the scenarios. The next step is translating these into the real world; here digital tools come in handy, for instance, digital twins.

Multidisciplinarity and the needs of the city of the future

How would you see multi-/crossdisciplinarity education concerning the design needs of Cities of the Future?

From this day on we will have 1,000,000 people per week extra on this planet. That's two or three billion extra coming in the next 25 years. There is a lot of growth in the Nether-

lands as well. Imagine facilitating that in such a small country. On top of that, we have so many other spatial claims such as energy, planting our crops instead of getting them from Russia, and restoring our forests. If you put all these demands on top of each other, we need five or six times the size of the Netherlands.

In this alarming context, infrastructure students need to know what's happening in the world and what's the connection between infrastructure with spatial, urban landscape, ecology, human behaviour and architecture. And the architecture students have to be interested in how mobility works. Multidisciplinarity is a condition *sine qua non* to answer these questions. You cannot do it differently.

Interview

Fabrizia Berlingieri
Associate Professor of Architecture, Politecnico di Milano

Introduction

I am an associate professor in the Department of Architecture and Urban Studies at the Politecnico di Milano. It's a quite large department with different competencies—architecture, urban planning, landscape, sociology and geography—so we do experiment with multidisciplinarity. In parallel, I have my architecture practice in Calabria, the region where I come from, mainly related to architectural design. I am also a visiting researcher in Delft at the Department of Architecture for two years now.

What is your relation with the City of the Future Cross Domain Graduation Lab?

My interaction with the studio was mainly related to the Venice Architecture Biennale in 2018. We hosted a workshop in cooperation with the universities of Venice, Rome, Calabria and Delft. Besides that, I was participating in the *Stations as Nodes* Summer School organized by Delft in 2018.

Approach and experience with multidisciplinarity

What is your approach or opinion towards multi-/crossdisciplinarity in your field of expertise and if so, what is your experience with that?

I would say that I have maybe a naive way of seeing the terms multidisciplinarity and crossdisciplinarity. For me, they are quite different. The main characteristic of multidisciplinarity is the horizontality between disciplines. There are no leading disciplines through which the perspective is explained. Multidisciplinarity is quite needed to research complex phenomena because you need to expand your perspective. Crossdisciplinarity is about combining disciplines with a clear direction and a clear focus, usually with a dominant discipline over the others.

Multidisciplinary is a tough job because to reach horizontality you have to first create a common ground. This takes time. My experience is that multidisciplinary research is more difficult due to the negotiation of terms, meanings and context, but it's quite engaging because you expand your knowledge towards other disciplines.

In the practice of design, do you think that one of these approaches is preferred?

It depends on the context. The more you go to complex topics, the more you need multidisciplinarity. In the context of architectural design, multidisciplinary is not the main focus, even though of course you need engineering and landscape architects. As the scale becomes larger towards the urban scale, then you need to use multidisciplinarity to combine policies from different perspectives. Usually, in this case, the team is composed of many experts representing the different fields and led by a coordinator, for example the Municipality.

What has been your experience in teaching students to work on a multidisciplinary project?

I think multidisciplinarity works if you have a proper position yourself. For instance, as an architect, if you have a position about infrastructure as pieces of urban architecture in the sense that they have to maintain a publicness. A transport engineer will focus on the issues of flows and people and then we start a discussion. The final outcome is a negotiation of positions.

Where do the boundaries of each position lie?

Having a position does not mean that you have to create walls, but at least you have your point of view. The danger is when competencies are transgressed or transposed, for example, if a landscape architect would like to act as a botanist and vice-versa. The context in which this negotiation happens must be respectful, that each discipline respects the others' ideas.

Should there be someone to coordinate this process?

Coordination can create efficiency in terms of time and defining the rules of the game. But, at the same time, the coordination might direct the process too fast towards the objective. A horizontal platform allows more mistakes and different trajectories, which I think is maybe more fruitful.

Multidisciplinarity in education

How do you see multidisciplinary ideas or experiences translate towards education in the built environment? What is your experience at Politecnico di Milano?

Sure, let me share an example. This year we had the thematic studio on the role of architecture in marginal conditions in Italy. We combined architectural, landscape and construction design in this studio. It worked quite well because we maintained respect towards each other at the same time that we had a horizontal cooperation, so the three disciplines were always at the same level of intensity and attention. We looked for coherency in scales, from landscape to detail, across the whole process. Obviously, the constructive part came a bit later, but it was mandatory to consider from the beginning the materiality, the construction, the reality on the ground, as well as the landscape and spatial settings.

Multidisciplinarity in future education

How would you see the paradigm of multi-/crossdisciplinarity in future-based education in the built environment?

I think we are already testing multidisciplinary and crossdisciplinarity in education and practice. But I see a double sword there. The challenge is that if we start from the first year to give a method of multidisciplinarity, the students might leave the university without and a clear position, a clear point of view. On the other hand, it is good that students are trained to work together with other competencies. I will give you an example. We have professors with an academic background in philosophy a specialisation in urban planning. In that sense, they have unique profiles. We can be more effective in developing this type of training in the future.

I don't have an exact answer on how to balance both sides but what could be is that a part of the curriculum is devoted to training personal skills and another part is devoted to developing an attitude of multidisciplinary collaboration.

Multidisciplinarity and the needs of the city of the future

How would you see multi-/crossdisciplinarity education concerning the design needs of Cities of the Future?

I think this is a problem of time. In the last 10–15 years, education has been trying to work on short-term and mid-term transformations of the city, a kind of problem-solving approach. However, this approach is similar to what is there outside in the practice. This is not only what we as designers are called to do. We are called to think long-term. Education should keep room for groundbreaking research on the city of the future: unexpected visions, impossible visions or impossible features. Such tests are always useful. In fact, the design needs of cities of the future is about getting a long-time perspective and working with uncertainty as a topic.

How would you see the interaction between academia, industry and government in the future?

I see this connection as a benefit. But if we have a position. Academia has the role to see impossible things and explore impossible scenarios. The industry has the role to challenge academia with reality. The encounters of the two spheres are a benefit for both of them, because for academia is a kind of pushing back to experiment visions, testing them and grounding them, and for the industry, it is a push to think further than their immediate issues.

Who do you think will be the main industry players in the future?

Look at all the industries of technologies, ICT. They are becoming the new developers of the future, also in the built environment. The industries of biofabrics, materials and waste are also becoming more important for the city.

Final remarks

Do you have any final remarks?

You have a bigger responsibility as a generation for the future than what we had. But also you have a bigger chance in the sense that you can focus on developing your interest within your curriculum. In this case, this should be based on crossdisciplinarity rather than multidisciplinarity as approach, so you have a perspective, you have a personal interest and then you expand your knowledge towards related disciplines or topics. This possibility that education nowadays is given is important and it's equally important to take it consciously. For that reason, I appreciate your work in the book because it is urgent to develop consciousness from the new generations on how to approach the formation of their curriculum.

Interview

Tom Daamen
Associate Professor of Urban Development Management, TU Delft

Introduction

I am Tom Daamen, Associate Professor of Urban Development Management at TU Delft. I have been part of the Faculty of Architecture since 2004, where I have been working on large-scale development projects, also including the theme of crossdisciplinary collaboration.

What is your relation with the City of the Future studio?

Five years ago, I worked with Roberto Cavallo on the City of the Future [Stad van de Toekomst] project commissioned by the Ministry of Infrastructure. After that, the idea to form a cross-domain studio at TU Delft emerged. I supported the studio from the start and did some thinking along with them on the initial setup of the program. I have been participating in studio editions since then.

Approach and experience with multidisciplinarity

What is your approach or opinion towards multi-/crossdisciplinarity in your field of expertise and if so, what is your experience with that?

This is a heated debate right now, especially with the rise in the demand for innovations. The current practice of project management has a focus point on efficiency; the goal is to control budgets and reduce risks as much as possible. This naturally moves towards sectoral projects with a rigid structure, which is of course easier for bureaucratic control. In the Netherlands, but also in other countries, you can see that the organization of the planning system and everything around it is based on sectors. For example, the housing sector is now very dominant and therefore it is pushing the development of many more housing units, bringing along the tendency to neglect all of the other important aspects.

This type of logic does not match interdisciplinary projects partly because they have an innovative character. If you apply for funding for an interdisciplinary project, you're automatically diverted to an experimental project because you do not fit within the normal category. The main question then is: how can we approach interdisciplinary projects more as innovations, or in other words projects that have more open questions in terms of spatial solutions?

What are the specificities of a project with an innovative character?

It requires switching the perspective from managing a project in terms of efficiency and time planning to deliver creative solutions. It favours stakeholders to contribute more creatively.

This type of project requires adaptability and flexibility in the project briefing and assignment. But then it requires better risk management and, of course, more budget because the cost of failure also needs to be taken into consideration. It also requires a learning process with feedback and documenting lessons learned.

How willing is the practice to change this sectorial way of organising things?

Eventually, it will have to change. However, there is a reluctance to change because there are vested interests in how things are organised now. People would have to alter their type of work or change some of their positions of power. Some of our colleagues from the Ministries mention that the only way to implement change is to have a political will from the responsible politicians. It has to come from the top.

Multidisciplinarity in education

How do you see multidisciplinary ideas or experiences translate towards education in the built environment?

Universities are too slow to think about interdisciplinary studios and programs like City of the Future. TU Delft is trying to catch up, so that's a very good development. They are trying all kinds of interdisciplinary research and education programs, for example, the cooperation with Erasmus University. The reason for this change is the increasing demand from industry and government agencies for this type of education.

However, it is striking to see that it is not easy to do something multidisciplinary at the university because of course we are also siloed. It is a challenge to arrange something that follows the different rules across the faculty. It is also a challenge to communicate to students what these programs are about and what they would look like.

Is the practice interested in interdisciplinary professionals?

In the Netherlands, there is a huge shortage of experienced practitioners that have this interdisciplinary skill set, so interdisciplinary students are valued, even though they lack practical experience. There are still industries that want to keep the sectoral approach to education and practice, but this will eventually change because there's a real need to think differently to tackle the problems we see in society. I would certainly encourage students to be interdisciplinary.

Multidisciplinarity in future education

How would you see the paradigm multi-/crossdisciplinarity in future-based education on the built environment?

I think it's great to have these kinds of programs like the City of the Future, but we as professors need to do some more work to balance the program in the right way both in terms of content and lectures and in welcoming students from different disciplines.

This does involve us communicating better our ideas to prospective students. Sometimes there is already an inclination among them for interdisciplinary programs. In other cases, for example with some MBE students, the demand is not that high because they think design is not that important for their goal to be developers. I try to convey that design is an important part of MBE and that a crossdisciplinary education will benefit them in their profession and future careers. I also invite practitioners from the outside to tell them that, so they hear it from the developers themselves.

Is that the same case for architects or engineers?

Of course, it is the same. Architecture professors should ask architects who are very experienced in doing interdisciplinary projects to tell students how important it is to talk about target groups and negotiate with the government and developers. You must understand the different angles of the project to be successful as a designer.

Multidisciplinarity and the needs of the city of the future

How would you see multi-/crossdisciplinarity education concerning the design needs of Cities of the Future?

There are many angles to answer this question. The first one is that design is a universal language; designers can translate information into a visual language that enables people to understand and engage with the problem. In a way, designers are process managers because they engage with different stakeholders.

The profession of design is also changing. 99% of designers need to work intensively with their clients or stakeholders before they get an idea of what will be a feasible solution to an urban problem. What I've learned from designers in projects is that they're very skilful in talking and listening to people, absorbing a lot of different information and then synthesising that into an urban concept. Of course, some firms are better than others in this respect. In general, designers are less of 'all-knowing engineers' with a perfect solution to a problem. There is an immense effort to collect all this information to create a good design.

And what about stakeholder relations?

I try to teach the students not only to think about what the client or the key stakeholder wants, but also to think in terms of what the project needs to get realised. You need to distance yourself a little bit from all the different stakeholders involved. And you need to place yourself as a designer that has a part in leading the project. I think this is an important mindset to have.

Interview

Hans de Boer
Project manager, DIMI, TU Delft

Introduction

My name is Hans de Boer. I have several functions at TU Delft. First, I'm a coordinator of research affairs and innovation of the Deltas, Infrastructure and Mobility Initiative (DIMI) at TU Delft. I co-initiate and coordinate all kinds of design studies on behalf of DIMI, for example, the City of the Future and City x Space (Stad x Ruimte). I collaborate with all kinds of external parties, ministries and municipalities, especially in research by design, which is the main instrument and process for future exploration and paradigm development. My other role is coordinator of the interfaculty minor Integrated Infrastructure Design (IID), working with bachelor students from architecture, industrial design engineering, computer science, governance and civil, mechanical and aerospace engineering. In the minor, we are dedicated to integrated approaches encompassing transport, water and the urban environment, e.g. bridges, stations, highways, underpasses, water defence systems etc.

What was your interaction with the city of the future studio?

I've been involved in the original City of the Future project commissioned by the Ministry of Infrastructure and Water management. The MSc2 studio from Architecture and Urbanism was part of it. After that, I was involved as *Liaison officer* between the project and involved scientists from TU Delft, also keeping connections with external parties such as architecture offices and the Municipality of Rotterdam. Now I give some support here or there.

Approach and experience with multidisciplinarity

What is your approach or opinion towards multi-/crossdisciplinarity in your field of expertise and if so, what is your experience with that?

My approach and main motto is *analyse outside in and design inside out*. That is about integration on and between several layers. First, we've got functional and structural integration of an infrastructural object. That particular object should be integrated into the transport system and the water system. Both systems should be integrated into the built environment. Finally, this should be further integrated into the morphological and ecological system. This approach is similar to the layers approach used in the Faculty of Architecture, which combines the occupation, network and subsurface layers.

What do you think are the roles of government, practice and academia in an innovation economy?

We have to functionally interconnect these entities. Exchange and collaborate, while being aware of the different roles. As academia, we have the obligation firstly to educate students. To prepare the students for their role in practice. This means the university needs to understand the need for practice and translate those into a scientifically founded academic curriculum. The municipality and the ministries are the problem owners. The practice is supporting the problem owners with market knowledge. By the way, engineering and architecture firms are very experienced and they have a lot of applied knowledge. I'm convinced that on particular issues they are further than academia. In some disciplines like quantum computing, fine, probably university is a bit further, but don't forget the laboratory of large firms! Google already has a quantum computer, while TU Delft still doesn't. You see the same with self-driving cars—they come from firms, not from universities.

I also see a fruitful collaboration in connecting education and research to these external parties—municipalities, engineering firms, and architecture firms. We invite them for presentations and reviews and then we can learn from them and see how they work. By the same token, we've seen real policy impacts of our projects on the municipality of Rotterdam and Delft. We see that the ideas and elaborations of our students are taken up by the municipality, even in their masterplans.

You mention the urge for multidisciplinary collaboration. What do you think are the challenges of multidisciplinary collaboration, both in education and practice?

It costs time. In our experience with the minor, the final project is nine credit points in the second quarter but the minor must start in the first quarter because students need to get familiar with each other and develop a common language to support their interdisciplinary discussions. In the minor, it takes about two months for this process to happen. We do that with smaller assignments, plus teaching a bit of discipline to each other, a bit of engineering to design students, design to governance students, and vice versa.

One of the learnings in coordinating the minor is that setting up a cross domain approach requires defining the learning objectives very clearly. Then, you need to translate these to the different courses and see how they fit together in achieving the learning objectives. Also, we see that multidisciplinary collaboration is quite difficult in the master stage due to the different education structures and faculty schedules.

Multidisciplinarity in education

How do you see multidisciplinary ideas or experiences translate towards education in the built environment?

We are working with multidisciplinarity in the IID minor. This is a great hands-on example of multidisciplinarity that I can share because we are already in the 7th year of the minor, so we have a good view of the challenges and potential of multidisciplinary education. The minor focuses on three learning objectives: developing design skills, multidisciplinary collaboration and contextual awareness. We develop design skills and multidisciplinary collaboration by learning with each other and exchanging different ways of approaching design.

About contextual awareness, you see, for example, that in the Faculty of Architecture and the Built Environment most students are quite contextually aware, while we've noticed that students from engineering are very focused on particular aspects but not contextually aware. On the topic of design skills, we've noticed that students from civil engineering consider functionality and performance highly relevant aspects; for architecture and urbanism, perception and experience are more relevant.

Could you give an example of interaction between engineering students and architecture students in the minor?

Let's say the task is designing a metro station and three or four students from different disciplines are involved. We see many times that students divide tasks. The architecture student says "OK, I will do the 3D modelling". The civil engineering student says "OK, I will make the structural calculations". And the TPM student says "I will do multicriteria analysis". There is a tendency that they will take their role from their discipline. We try to emphasize to the students to try to incorporate some of the techniques from other disciplines in their way of working. For engineering students, we ask them to draw some sketches and convey their ideas visually. For an architecture student, to make some calculations.

Multidisciplinarity in future education

How would you see the paradigm of multi-/crossdisciplinarity in future-based education in the built environment?

I'm very glad that you have used the word *paradigm*. I think we have to start with a kind of paradigmatic representation of the built environment with its several components—buildings, public space, infrastructure, subsurface, and spatial layout. With this, we can understand better how the city works and how far it changes in response to different transitions. I've contributed recently to the book *Design actions for shifting conditions* that touches on the need for new paradigms of the built environment. It's available at TU Delft Open Books!

Paradigm creation has been one of the foundation roles of academia. What do you think in paradigm creation that should be changed?

The difference from the current situation is that in the future there should be a better interchange between the involved parties. Government, business and academia have to collaborate better with each other. And that is a real challenge because within themselves they already have difficulties collaborating. Usually, organizations are divided into sections related to specialisms. How to combine those thematically? Perhaps projects could be a basic entity of an organization. But this conflicts with the notion of how specialist knowledge develops.

The Transport Institute, the Climate Institute and DIMI at TU Delft are examples of this thematic organization, but you see that those initiatives are parallel to the existing organization and are usually temporary. DIMI has been standing for more than 10 years when it was in theory temporary, but we have to survive to maintain all inter- and multidisciplinary efforts... This should be more solidly institutionalized.

You mention thematic organization. Do you think we should collaborate within roles of specialism, or perhaps should we even break these specialism roles?

I think you have two legs to stand up. One leg is about disciplinary development, and another is about multidisciplinary participation. It is relevant to do both. So you have to work on a project with other specialists, understanding and learning from their perspectives; at the same time, you need to be updated on the developments of your discipline. Of course, that will take a lot of effort I think because each discipline has its own gravity forces. People are drawn into their discipline because disciplinary development is highly rewarding for your promotion. However, for me, it's more interesting to have a career in a more horizontal way between disciplines.

Multidisciplinarity and the needs of the city of the future

How would you see multi-/crossdisciplinarity education concerning the design needs of Cities of the Future?

There is a big urge for multidisciplinarity in solving the multifaceted issue of climate change and the many transitions of our time—energy, mobility, and circularity. These will take 50 years or more. So the city of the future will require institutionalised multidisciplinarity in education and practice.

Plus, we need paradigm change, which is already taking place in many disciplines. I will take the example of the mobility transition. Infrastructure in the last 60 years has been highly dominated by cars. The mobility paradigm is car-oriented. This has an influence on the urban spatial layout—public space is mainly paved and dimensioned for the car, creating heat and water stress. In practice, you see the need for the greenification of the city. The mobility paradigm is changing from the car to walking, cycling and public transport. Then you have to redesign your public space as well.

Final remarks

Do you have any final remarks?

I am very grateful that we have the City of the Future Cross Domain Graduation Lab at TU Delft. I think that it is highly relevant that the studio will continue and hopefully attract more students from outside architecture. It would be great if in five years the studio is a real interfaculty graduation program, then we would certainly have done some revolutionary changes in this university!

4

Conclusion

EIGHT POINTS
On the future of multidisciplinary education on the built environment

This book presented a reflection on experiences of multidisciplinary education in the context of the Cross Domain City of the Future Graduation Lab at TU Delft, addressing the educational framework of the studio (Chapter 1), graduation projects from the 2019–2021 editions along with student interviews and essays (Chapter 2), and a graduate essay and practitioners' interviews (Chapter 3). Based on these outcomes, this conclusion looks ahead to the future of multidisciplinary education in the built environment.

The conclusion is structured into eight concise points, each followed by a short substantiation. The goal is to propose future pathways of multidisciplinary education in the built environment, which may inform future students and practitioners in their upcoming multidisciplinary endeavours.

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I

Process is central to multidisciplinary collaboration. Negotiating positions, ensuring an environment of respect, balance and open-mindedness, and setting a common vocabulary.

Debate and negotiation are intrinsic to multidisciplinary collaboration. Therefore, a healthy collaboration environment must be in place in which disciplines respect each other, value mutual contributions and are open to constructive criticism. A first step in this direction is to build bridges in the form of shared understandings. Secondly, a collaborative environment should strive for a balance between disciplines as much as possible because it ensures a balanced arena of collaboration and negotiation.

In practice, the collaboration setting is influenced by contextual aspects, for instance, client relationships (e.g. one discipline as a 'client' to the other, such as an urbanism office hiring an engineering sub-consultant), contractual relationships (e.g. a firm contracted for a specific task without participation in the wider process) and time (e.g. as the design process evolves some disciplines become more relevant than others). These practical aspects may function as opportunities or constraints depending on the case.

II

Multidisciplinarity can be a way to foster innovation. It triggers complementarity and confrontation. As with any innovation, there is potential for greater outcomes, but, at the same time, extra risks emerge. These need to be managed.

A valuable contribution to managing multidisciplinary processes is seeing multidisciplinarity as innovation. Innovation is by nature a creative, exploratory process, where 'the higher the risk, the higher the reward'. The quality of multidisciplinary solutions is notable but it also bears extra risks. Assigning risks and responsibilities among parties is one of the challenges in incorporating multidisciplinarity in organizational structures. For instance, within an organization, which department is ultimately responsible for a multidisciplinary project? In case of extra revenues or a failed exploration, how would they be distributed among parties? The question of goal setting is also relevant. Interviews diverge on this matter; some consider clear goals necessary while others see a bit of misdirection as essential.

Multidisciplinarity as innovation also brings attention to the importance of social infrastructures. These are networks that support knowledge exchange–ideas, know-how, and lessons learned. The links of social infrastructures are social connections. Several students mentioned the importance of social connections to create inspiration and new ideas, while their lack can be negative, as experienced during the COVID-19 pandemic.

III

Multidisciplinarity could be better integrated into organisational structures.

There is an ongoing debate on how multidisciplinarity could be better embedded in organizational structures. One possibility is the format of theme-based organizational units, in which disciplines are arranged around a theme. There are already examples of this format in TU Delft, e.g. the Transport Institute and DIMI, which are set in parallel to faculties and departments. Within companies, they could take the form of units around specific projects. Theme-based units tend to be less permanent than discipline-based ones, partly due to their dynamic nature as needs evolve and new themes emerge, which can be somewhat more challenging to manage. On the other hand, dynamicity is the very advantage of theme-based structures because it gives flexibility to better address ongoing debates in each period.

In education, an important step in integrating multidisciplinary into organizational structures is the streamlining of program schedules. The CotF experience shows that dealing with conflicting program set-ups from different faculties, such as graduation timelines, student intakes and weekly schedules, can be a limiting factor for a multidisciplinary program. A good example of a solution is the upcoming introduction of a 5th quarter for all master programs in TU Delft, meant explicitly for experimental multidisciplinary projects.

IV

Disciplinarity and multidisciplinarity are in mutual coexistence. They are inseparable. They can complement and contradict each other.

Multidisciplinarity does not mean abolishing disciplines. On the contrary, it draws on disciplines for its existence. The real world is a unified reality, therefore by nature multidisciplinary. Disciplines are building blocks and multidisciplinarity is the arrangement of those blocks into a holistic understanding of a problem. However, disciplines do not always harmoniously complement each other; they might contradict and challenge each other in their partial understandings.

V

Problem precedes solution, not the opposite. Framing the problem, or 'problematizing', is a considerable share of the actual solution. This is particularly applicable to multidisciplinarity.

There is currently an emphasis on solutions–designing solutions, applying new tools–partly driven by the new technological possibilities of this time. But the definition of the problem should always precede the solution. Framing the problem is the first and not rarely a very challenging step, especially in a networked world, where it is more difficult to identify causal relationships. In the case of multidisciplinarity, more attention is required on problematization because a wider toolbox is available and therefore methodological choices should be soundly informed by the problem.

VI

Multidisciplinarity is by nature composed of fluid boundaries. Navigating through an enormous diversity of perspectives requires agility, flexibility, independence, spirit of adventure and embracing uncertainty.

An inviting feature of multidisciplinarity is the freedom for experimentation. Students unanimously appreciated the freedom provided by the studio to pursue their fascinations and set up their working method, while guided by supportive and open-minded tutors. Freedom as an educational tool can be effective, particularly in the context of master's education, where students are trained to be independent researchers. Nevertheless, it is a fact that every experimental process naturally involves some level of uncertainty and frustration, especially in a multidisciplinary process, which demands rethinking several aspects of one's core discipline. Students may sometimes be lost or confused with the multiplicity of approaches and literature they encountered. Freedom goes hand-in-hand with motivation, independence and a spirit of adventure.

VII

Professionals should be trained as ‘T-shape’: grounded in their field while able to dialogue with other fields.

A T-shape professional is grounded in his discipline (‘verticality’, ‘I’ part of the T) while in constant movement towards adjacent disciplines (‘horizontality’, ‘–’ part of the T). Both should be present because grounding in a position creates a starting point for discussion, informed by robust expertise, whereas horizontality embeds a spirit of dialogue, curiosity and humility.

VIII

Both generalists and specialists are needed. Education should provide opportunities for both.

There is a need for diversity in generalists and specialists. Some people are naturally inclined to horizontal thinking, others to vertical thinking, or a mix of both. Some prefer well-defined, structured problems while others are interested in fluid boundaries, creativity and freedom. There is a spectrum of how vertical or horizontal professionals can be according to one’s profile. But in every case, it is essential to consider the ‘T-shape’ concept–having a spirit of dialogue with other disciplines no matter how detailed a problem is.

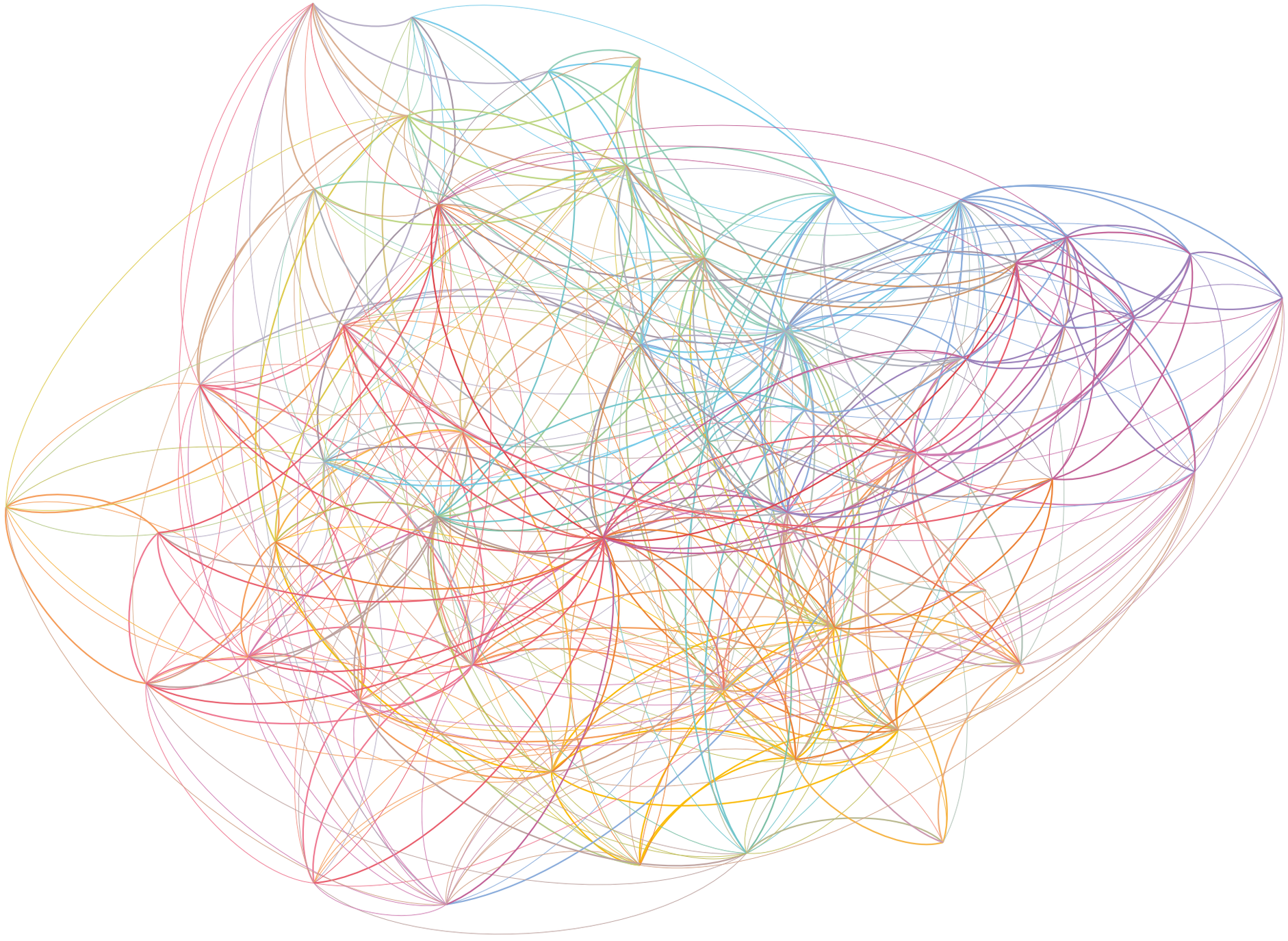

Image by Marcelo Carreiro Matias, Mesut Ulkü and Sonja Drašković

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Roberto is a member of the steering group for the Department of Architecture research program. Between 2014–2019 he has been the faculty Director of Education and he is the initiator of the Cross Domain City of the Future Graduation Lab. Currently he is a council member of the EAAE and a member of ARENA research network. He worked as a guest professor in 2013/2014 in China (Shanghai, Hong Kong, Beijing), and in 2020/2021 at the Politecnico di Milano. His expertise involves interdisciplinary & multiscale approach in architecture and urban design, design-driven research, and experimental pedagogies. Roberto has extensive experience in workshops, symposia, conferences, exhibitions, keynote lectures and as a scientific committee member in international academic and professional events. As a practitioner he worked for the offices of Cees Dam & Partners and Studio di Architettura (Aldo Rossi); in 1999 he co-founded Studio-AI in Amsterdam. Since 2013 he collaborates with the European Commission as a built environment advisor and in 2019 he has been appointed as an expert for the Dutch Architects Board.

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In the academic environment, Joran has been a member of several editorial teams, for example in 2012 for the international conference titled 'New Urban Configurations' and for the publications 'Stations as Nodes' in 2018, 'Mapping Wuhan' in 2021, and 'Future Cities—City Futures: Emerging Urban Perspectives' in 2023. He tutors in Bachelor and Master architectural design studios and has been involved in the City of the Future Graduation Lab since its beginning.

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Maurice has an uninterrupted focus on public space, particularly related to urban design and the architecture of the city. His international oeuvre, both in research and in education, brings urban design back to its fundamental interdisciplinary nature; in the overlap of responsibilities; in a non-structural way, and with users involved. In doing so, he specifically clarifies future challenges for designers based on socio-spatial dynamics. Synchronically, he reframes histories from the questions we have today. He does this within the Leiden-Delft-Erasmus University network, Delft Deltas, Infrastructures & Mobility Initiative, and among others Delft Design for Values Institute, and through various alliances at places elsewhere. He also works at the Architects Registration Board of The Netherlands and he is a guest professor at various foreign universities.

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Cum laude MSc Architecture graduated from TU Delft, Netherlands in 2021. She completed her Bachelor's at The University of Edinburgh and her her graduation project was nominated for the Young Talented Architecture Award (YTAA) and was displayed at the Venice Biennale 2021. After that she continued her masters in TU Delft where she was an active member of the Delft Solar Decathlon team (Team SUM) that proposed the redevelopment of post-war tenement flats. Her passion is creating timeless and sustainable designs that will leave a positive impact on others,and our environment.

The Cross Domain City of the Future Graduation Lab, situated in the Faculty of Architecture and the Built Environment at TU Delft, has been a pioneer in experimenting with a multidisciplinary approach to education on the built environment. Drawing upon this expertise over the past years, this book reflects on multidisciplinarity in the built environment and its implementation in education on the built environment. How should one approach multidisciplinarity in education and practice? What encompasses its core elements, benefits, and challenges?

By addressing these questions, the book aims to inform students and practitioners within the realm of the built environment by sharing insights from experiences in multidisciplinary education. It presents eight conclusions regarding the future of multidisciplinary education and, thereby, seeks to contribute to a more humane and sustainable future for cities:

I Process is central to multidisciplinary collaboration. Negotiating positions, ensuring an environment of respect, balance and open-mindedness, and setting a common vocabulary.

II Multidisciplinarity can be a way to foster innovation. It triggers complementarity and confrontation. As with any innovation, there is potential for greater outcomes, but, at the same time, extra risks emerge. These need to be managed.

III Multidisciplinarity could be better integrated into organisational structures.

IV Disciplinarity and multidisciplinarity are in mutual coexistence. They are inseparable. They can complement and contradict each other.

V Problem precedes solution, not the opposite. Framing the problem, or 'problematizing', is a considerable share of the actual solution. This is particularly applicable to multidisciplinarity.

VI Multidisciplinarity is by nature composed of fluid boundaries. Navigating through an enormous diversity of perspectives requires agility, flexibility, independence, spirit of adventure and embracing uncertainty.

VII Professionals should be trained as 'T-shape': grounded in their field while able to dialogue with other fields.

VIII Both generalists and specialists are needed. Education should provide opportunities for both.

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