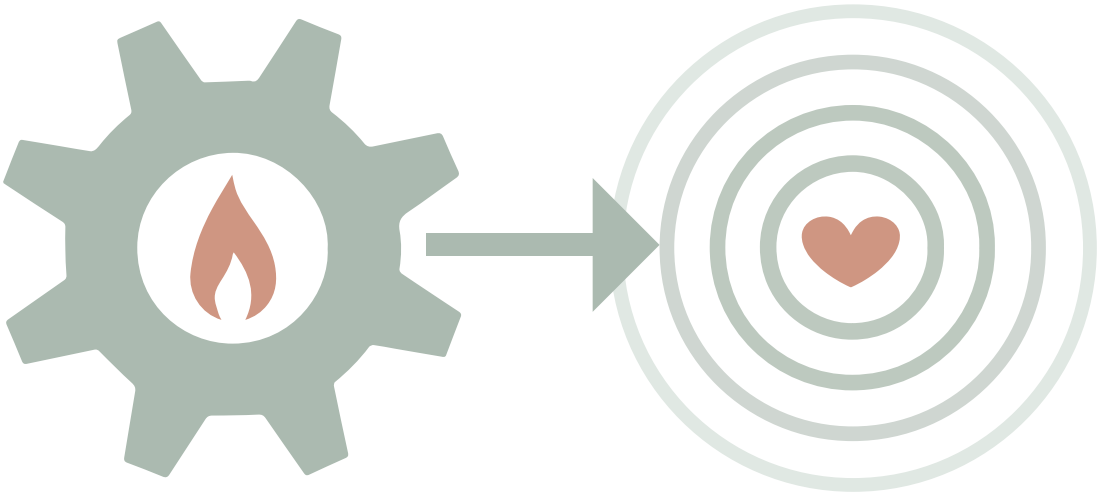
Turning heat into warmth

A neighbourhood ecology of people, technology and warmth



Research Plan

Architectural Engineering
Graduation Studio

Thomas Misset

Research Plan
Architectural Engineering

Anne Snijders (Design)
Craig Martin (Research)

Motivation

Why did I choose the Architectural Engineering Graduation Studio?

I believe the contemporary role of an architect is mainly to be an integrator and communicator between various fields of knowledge, through different scales, relating to society. Thus, we need to adapt a transdisciplinary approach.

More specifically, I am interested in the bridge between (large-scale) technical solutions and people. I like working between the large systemic scale and the detailed hands-on level that is closest to people and their perception.

I feel the Architectural Engineering Studio's emphasis on technology in the broad sense of the word and it's multidisciplinary even transdisciplinary approach serve my interests the best. Furthermore, I feel they are crucial aspects to create actual value in complex contemporary challenges our (global) society faces.

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Keywords

sustainable transformation, energy transition, collective services, public space, neighbourhood quality, techno-societal synergies, District Heat Networks (DHN), Thermal Energy Storage (TES), social infrastructure, user-centred design

Warmth has turned into heat

Warmth (embedded in experience) has turned into heat (removed from experience).

From the beginning of their existence, humans have used knowledge for the aims of life (= technology). One of the first examples of this technology addresses two basic human needs: keeping warm and heating food.

Throughout the centuries, driven by new insights or adapted knowledge, our heating systems have also changed. Its latest adaptation is informed by the effects and reality of global climate change, urging us to invent emission-free and renewable heat and energy devices, sources and systems.

Although the evolution of technology is inevitable and much-needed. My argument is that important qualities of previous technologies have been lost along the path of progress. This loss is influenced by globalization, industrialization and Western (post)modernist society.

The subordinate parts (= infrastructure) of technology have become distant from human life. Each part is separated, optimized and serves one need. Its qualities have been reduced to this one function. Supply chains are organised on a global scale and transport is hidden from sight. They always deliver. As technology is drifting away from direct human experiences, indifference is on the rise.

To enforce my argument, and show the loss of the human experience in technology, the diagram on the next page shows five anecdotes in chronological order. Each anecdote depicts a form of technology and how people might relate to it. An indicator shows where the technology lies on the spectrum between warmth and heat.

In the latest transition, from gas to induction cooking, not much changes in the human experience, except for the new consumer goods (induction hob, pans) and required installations. Without adding much positive to the user-experience, the balance for the individual user quickly becomes negative. If not for the financial burden, then for the inconvenience experienced by the implementation of new infrastructure (Sociaal Cultureel Planbureau, 2019).

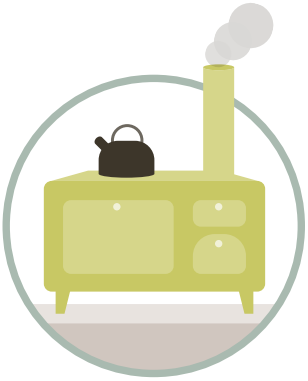
Bonfire

On a starry night, a group of friends and families gather around a wood-lit fire. The members of the gathering spent the afternoon collecting logs and twigs in the forest nearby. The wood crackles as cave-entrance fills up with the smell of burnt wood and glowing embers. The shadows dance on the cavernous surfaces. Food is prepared, animals are kept away and the people share stories as the night lingers.

Hearth

In the living space of a family, a hearth is glowing bright orange, luminating the room. The logs on the fire were cut from the forest behind the house. A stew is brewing in a cast iron put while water is heated in a bucket. When the sun sets, and the air gets cold. A large family gathers around the hearth, warming their hands while holding conversation. Copper bed-pans with heated stones from the fire warm their beddings

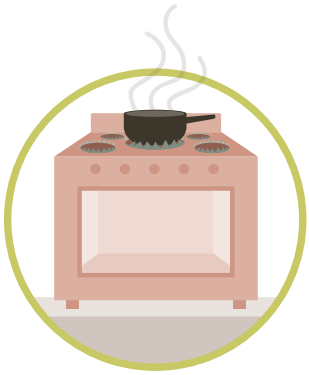
Coal Stove



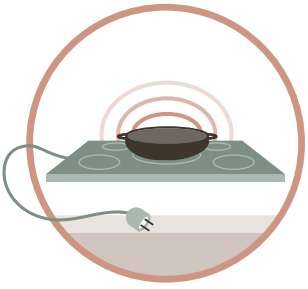
A large coal stove is puffing in the kitchen at noon. A maid jumps up as her clothes burn. She tried to open one of the hatches to check on the fire. The black-stained coal man has just filled the coal shed with a fresh supply from the mines in Limburg. Water is heated in a separate compartment as the kitchen temperature rises to intense heights. Dinner won't be served for another few hours.

Gas Stove

The white metal stove-top hisses as it is turned on. A matchstick is struck when a consistent, blue flame appears. A few hundred kilometres away, in a gas-field deep beneath Groningen, the gas is extracted and transported through pipes to end up here. The reliable combustion heats up the pots and pans with ease. A smell of heated metal and food spreads through the house. A wife calls her children inside as her husband arrives. They eat and converse at the dining table.



Induction Panel



A sleek black panel beeps and lights up as it is touched. When a pan is placed, it starts to make a soft buzzing noise. Long and hidden cables power the device. The power source is a gas plant, whose gas arrives through pipes stretching to Norway, Russia and the Middle East. A man quickly draws his hands away from the pan. It didn't seem that warm. The family changes their own screens for the television, as they eat together in silence.

The 'us' in sustainable

Striving for sustainability affects all layers of society. However, as I will elaborate in this part,It becomes clear that the energy-transition goes hand in hand with inaccessibility, a lack of agency and poverty for marginalized groups in society.

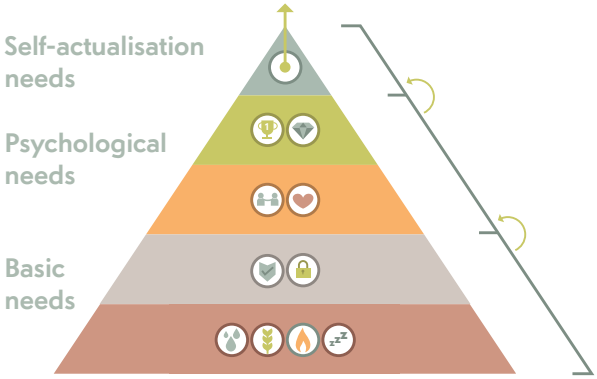
Income, housing situation, and energy-poverty are all directly related to the basic needs (food, water, heat, rest) Maslow (1943) defined in his hierarchy of needs. His theory suggests that when the needs of lower, more important, scales are not being met, the motivation to tend to higher needs is lower. In more simple terms, marginalised people have more acute matters of survival on their mind than the 2050 sustainability goals meant to help the survival of our species.

By using the definition of sustainability used in the UN Brundtland report (1987):

"Sustainability can be defined as fulfilling the needs of current generations without compromising the needs of future generations"

We could even go as far to say that ignoring these aspects of the energy transition makes it un-sustainable, for the needs of the current generations are not being met.

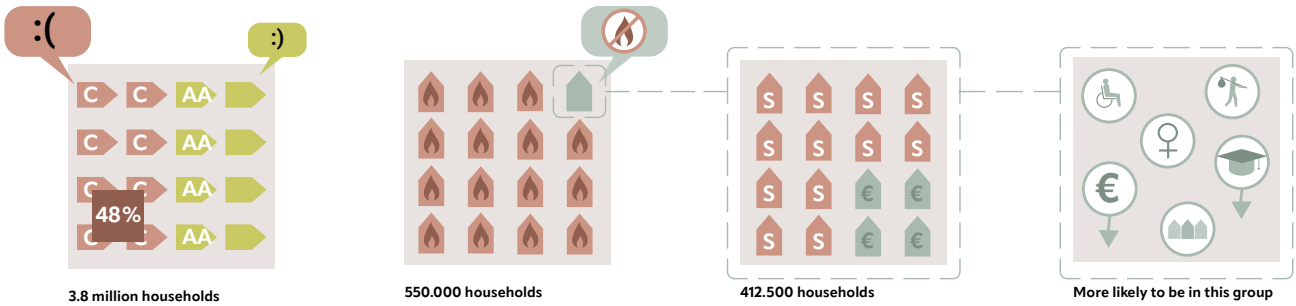
Considering these statements along with the current housing crisis, rising costs through inflation and trends of social polarization and collective decline, it is not surprising that sustainable practice is experienced as exclusive, limiting, imposed and simply unpleasurable.



Maslow hierarchy of needs show different scales of human needs. When basic needs on the lower end of the pyramid are not met, people show less motivation to tend to needs higher on the diagram.

Thus, there is a need to revise sustainable practice. Especially for those that do not have a lot. The interventions that we need to sustain life for future generations should provide society with directly experiential benefits, more agency and a higher quality of life.

In doing so, we can increase the support base for sustainability and start healing the growing socio-economic gaps in society.



Almost half of dutch households has a house with relative energetic performance without the ability to improve its performance due to dependancy on landlords or a lack of financial means. 8% of dutch households deals with energy poverty. The majority of these households live in social housing. Energy poverty is seen more often with row- and corner houses, poverty, disability, being a woman, having a migration background and being practically educated. (Mulder et al., 2021)

The 'our' in neighbourhood

In search of the people that are most negatively affected by sustainable development, the post-war neighbourhood seems to be an important spatial cluster. They are built roughly between 1950-1980 according to modernist principles.

As these type of neighbourhoods are abundant in the Netherlands and Europe, and often show similar characteristics and challenges. Research outcomes have the potential for broad applicability. However, to limit the scope of this research, we will focus on one particular post-war neighbourhood in The Hague: Moerwijk.

Moerwijk makes an interesting case specifically because it is subject to a controversial sustainable development project. The main pipeline of a large-scale heat distribution network is rolled out through the core of the neighbourhood. This line connects the heat-supplying fossil industry in the port of Rotterdam with various heat-distribution nodes across the metropolitan area of Rotterdam/ The Hague. Its construction has a high impact: trees are cut, trenches are dug, streets are blocked. Construction is taking place as we speak.

While the municipality intends to keep Moerwijk warm using a sustainable heat distribution network by 2030, it remains uncertain whether the balance of this transition will be positive for residents. Especially considering people's lack of agency and participation, and the disadvantages of the implementation.

The challenge then becomes: how can we make sure the balance turns out to be positive. The answer requires bringing the systems of this transition closer to the people living in Moerwijk. To do so, we need to uncover their needs and aspirations, and integrate them with technical knowledge and design.

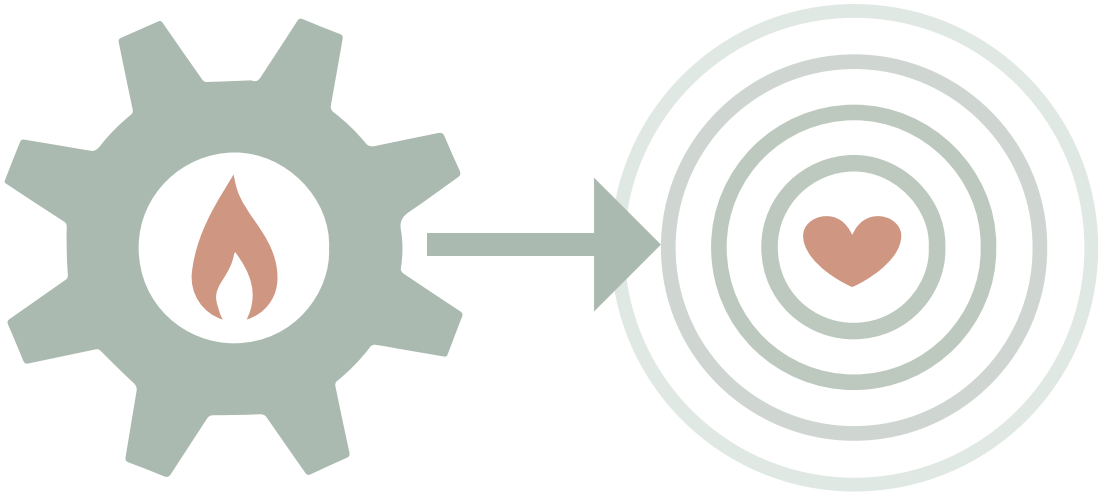
By giving shape to the soft qualities of this boiling heat network, we can turn heat into warmth again.

The main distribution pipe of a regional district heating network runs along an important axis of Moerwijk. Some parts are dug in, and some are placed with directed drilling, needing no excavation.

A quarter of the Dutch neighbourhoods can be identified as 'post-war neighbourhood' (Koöperatieve Architekten Werkplaats, 2020). Thus, trategies for such context could prove beneficial for large amounts of people. Comparing the numbers above, Moerwijk has more social minima, more social housing and more low energetic performance than the Netherlands and the average post-war neighbourhood.

Addressing the challenges

To sum up, technology has become indirect and stripped down, the costs of sustainable transformation lie heavy on agency-lacking and marginalized people, and the post-war neighbourhood is a spatial cluster where these problems converge. To adress these challenges and place them within the field of architecture, the following objectives and questions have been formulated.



The objective

To bridge the gap between sustainable practices (technology) and people (society) by inserting soft and beneficial spatial layers within the systems and infrastructures of sustainable practice, essentially turning heat into warmth.

The design question

How can spatial design in the public and collective spaces of Moerwijk form synergies between sustainable technology and the people of the area, considering their needs, attitudes and aspirations?

The research

What is and is not present in Moerwijk regarding both sustainable transformations and the needs, attitudes and aspirations of people in Moerwijk, and what are means, thresholds and pre-conditions of participation and the combination of technical and social infrastructure?

1. *What positive initiatives are already happening in the neighbourhood of Moerwijk, and how can we enforce these initiatives?*

2. *What needs and aspirations of the people in Moerwijk remain absent in the neighbourhood, and which thresholds might occur when trying to implement them?*

3. *What are the people of Moerwijk's attitudes towards sustainable developments in their neighbourhood, where do these attitudes stem from and how might these attitudes be improved?*

4. *What are means and preconditions of combining soft- and hard infrastructure, looking at relevant case-studies?*

5. *What are means and preconditions of combining sustainable neighbourhood transformations and resident participation, looking at relevant case-studies?*

Lexicon

In this lexicon, important and frequently used terms are defined in relation to the scope of the research and the project. In doing so, it becomes possible to speak more specifically on these terms and to ensure a shared understanding.

Technology
The use of knowledge to the aims of human life.

Users
People that have large personal investment in the chosen context and spend a significant area of their daily lives within the area. This includes but is not limited to residents and local entrepreneurs.

Needs
Something that people require to survive and prosper. More than a 'want' in the sense that the lack of a need causes a clear adverse outcome: a dysfunction or death. Fulfilment of needs lower on Maslows pyramid leads to more attention to tend to higher needs (Maslow, 1943).

Heat
A purely functional result of technology. Term used to signify the loss of warmth of technology, meaning the technology and its infrastructure has been stripped of human and social qualities in favour of optimalisation and functional separation

Warmth
A warm emotional result of technology. The social and human qualities that are the side effects of technological operations.

Synergies
The interaction or cooperations of two or more agents to produce a combined effect greater than the sum of their separate effects.

Infrastructure
a collective term for the subordinate parts of an undertaking, substructure, foundation, supporting higher-order projects (Klinenberg, 2018).

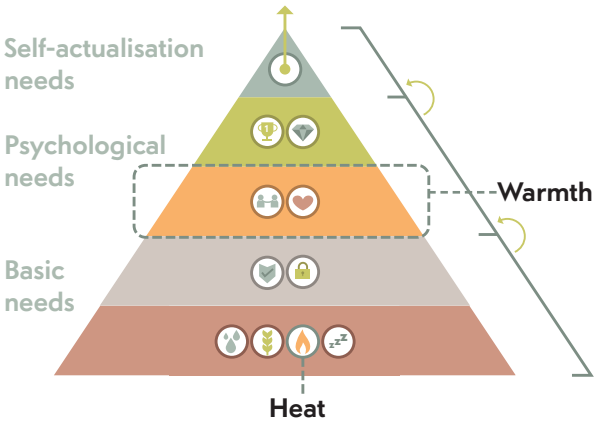
Soft infrastructure
The physical spaces and organizations that shape the way people interact. The physical conditions that determine whether social capital develops (Klinenberg, 2018).

Social capital
A concept used to measure people's relationships and interpersonal networks.

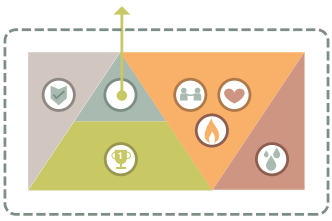
Hard infrastructure
the basic physical and organizational structures and facilities (e.g. buildings, roads, power & heat supplies) needed for the operation of a society or enterprise.

Sustainability
Sustainability can be defined as fulfilling the needs of current generations without compromising the needs of future generations (Brundtland, 1987).

Sustainable transformation
The implementation of changes in a physical environment that are needed to fulfil the needs of current and future generations.



Warmth is an emotional side effect from the operation of certain technologies. Rather than the basic need of heat, warmth is a psychological need. The design will cater to different people and scales of Maslow's pyramid.



The design

Methodology

The goal of this research is to deliver practical ingredients that can be used for the design of combined technical and social infrastructures in the collective and public spaces of Moerwijk. The design will address the needs and aspirations of the people living in the neighbourhood and relate it to spatial interventions and sustainable developments.

A large part of the data to answer these questions is retrieved from actual people in society, and is not excluded from subjectivity, ambiguity and also not necessarily true or false.

To help shape the research trajectory, with the intention of turning contradicting input into coherent and innovative design and knowledge, we take a look into Concept-Knowledge (C-K) theory (Hatchuel & Weil, 2009)

Firstly, it places a formal distinction between a Knowledge-space (K-space) where information is logical and can be qualified as true or false and a Conceptual-space (C-space) where information is ambiguous and not necessarily true or false.

It then goes on to describe how knowledge acquisition in the K-spaces triggered by input and testing within the ambiguous C-space. In turn, the acquired knowledge reveals new development directions to be tested within the C-space.

The two spaces continuously interact and need each other to further develop concepts and knowledge that was previously invisible, ultimately leading to innovative solutions.

Conclusively, this research will take place in two parallel and interacting spaces: Moerwijk (C) and University (K)

Moerwijk is an emotive space where subjective, ambiguous and empirical research is conducted. It is a testing grounds for ideas and designs.

(K) University: a logical space where measurable, knowledge-based and scientific research is conducted. It is used to conceive means, preconditions and ideas for testing in C-space.

The following pages will discuss the research methodology in both spaces, and show which steps have already been undertaken as part of this methodology.

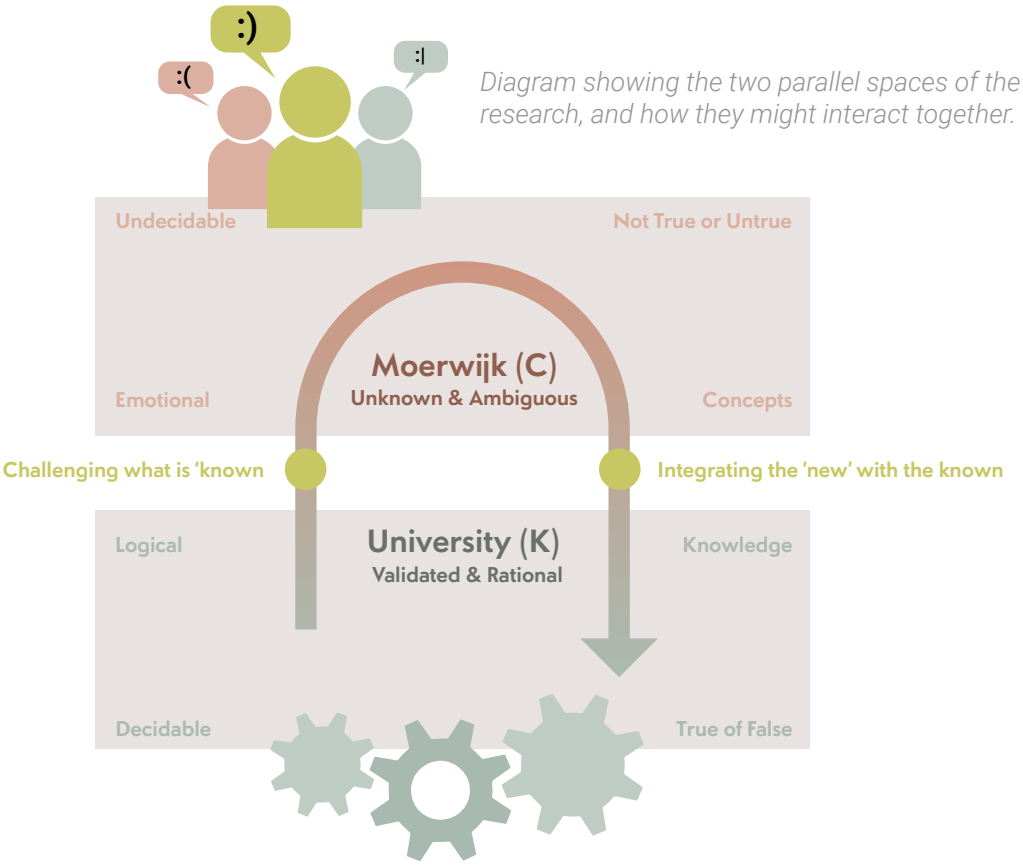


Diagram showing the two parallel spaces of the research, and how they might interact together.

Ref: C-K Theory, Hatchuei & Weil, 2008. Diagram adapted from Frido Smulders (TU Delft) 2017 & 2018.

Moerwijk: ambiguous space

The aim of the research conducted in this emotive space is to find out the needs and aspirations of people living in Moerwijk, and relate it to sustainable development. This includes both directly engaging residents of Moerwijk and researching this area with a more architectural lense through empirical and observational data.

Firstly, this requires uncovering positive initiatives that are already happening and figuring out the best way to enforce them.

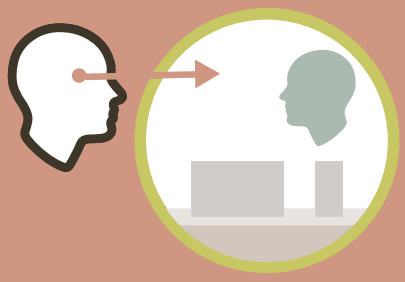
Secondly, this requires identifying what needs and aspirations are currently absent in the neighbourhood, and which thresholds might occur when trying to implement them.

Lastly, this requires finding out people's attitudes towards sustainable developments happening and plausible to happen in their neighbourhood, figuring out what the root is of these attitudes, and then formulating how these attitudes might be improved.

It is important to realise that input from people will most likely differ from my own perspective. My perspective is shaped by a design and engineering background, education on the topic of sustainability and a specific world-view and living environment.

To help ensure that their voices are truly heard and understood, we take a closer look how empathy can be addressed in the design process. Four distinct stages can be defined: discovery, immersion, connection, detachment (Kouprie & Sleewijk, 2009). We will discuss each stage of the research within the emotive space of Moerwijk.

1. Discovery



The designer makes first contact with the user either through direct contact or through studying relevant materials. In doing so, his curiosity and willingness to engage with the user is sparked.

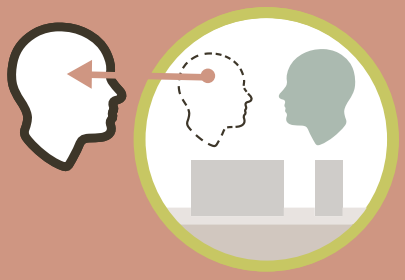
2. Immersion

The designer enters the context of the user and expands his knowledge on their world and experience by taking their point of reference.

3. Connection

Through his own memories and experiences formed through immersion, the designer is able to reflect and create an emotional bond by resonating with the experience of the user. He understands the users feelings (affective) and the meaning of these shared experiences (cognitive).

4. Detachment



The designer takes a step away from the emotional bond with the user. Through reflection, his K-space is expanded with more understanding of the user and their world. Finally, these insights can be implemented in further development of his ideas and design.

Ref: Adapted from Merlijn Kouprie & Froukje Sleeswijk Visser (2009) A framework for empathy in design: stepping into and out of the user's life, Journal of Engineering Design.

The discovery phase

In the discovery phase, the researcher makes first contact with the physical and social context of Moerwijk, sparking interest to dig deeper. This phase has already started, as various steps have been undertaken to discover the context of Moerwijk. These will be discussed in the following pages

Thesis Program

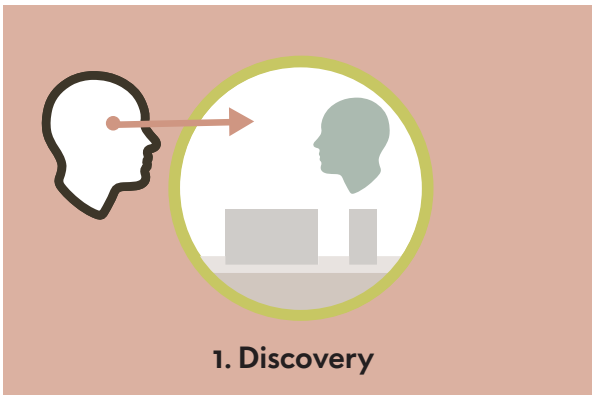
With previous experience of social design projects in The Hague Southwest, I got in contact with Mandy Koenraads. She runs a thesis hub program for students that do their research on relevant topics addressing wicked problems in this area of The Hague. The hub functions as an important local connection between academic efforts, governing institutions and residents.

The program consists of a kick-off meeting, presenting the work to relevant stakeholders. Additionally, various workshops are given on the topic of ethics, creative research methods and data communication. During the project, I can make use of valuable resources of this hub, such as social networks and a place in Moerwijk I can use to work or invite people.

Through this process, I got in contact with Bettelies Westerbeek, a young pastor and key-figure in the neighbourhood. She can introduce me to residents and representatives of the municipality and WarmtelinQ, the company installing the heat distribution network.

At the end of the project, results are discussed again with relevant stakeholders.

During the Ethics-workshop, Dr. Rodrigo Mena and Dr. Nanneke Winters gave presentations on ethics in research and the concept of othering. We also discussed our own research and reflected on our own assumptions.



Ethics workshop

As part of the thesis hub, I attended the Ethics workshop by Dr Rodrigo Mena and Dr Nanneke Winters in Moerwijk. We discussed the goals of research ethics (doing no harm, not creating risk and conforming to local norms of conduct) the ambiguity of them and the importance of embedding them throughout the whole research process.

Then we talked about the concept of othering: reducing someone by treating them as intrinsically different than themselves. We discussed how we sometimes lose sight of the other persons humanity in our research, and our own assumptions regarding our research subjects.

I found out my assumptions of residents in Moerwijk are that they have an indifferent or negative attitude towards sustainable transformations, and that they probably have more important matters on their mind because of mental, social and financial burdens. It is important to realise this, so I can listen to residents as open-minded as possible when I will engage them.

Praktijkdag WijWest

I attended the Praktijkdag WijWest, an initiative by an alliance of stakeholders involved with the neighbourhood Delft-West. Its goal is to collect information from young people living in these neighbourhoods, with a focus on increased liveability, resident participation and equal opportunities. During this day, 50 students from different backgrounds went out in small groups to engage people on the streets.

Myself and two others formed a group and held about fourteen different conversations with strangers in a timespan of three hours. After that, we synthesized our findings in a presentation to the alliance, presenting our analysis and recommendations. Our group was chosen as the winner out of 9 presentations for its all-encompassing analysis.

The experience was a good way to test out ways of reaching out to strangers and get more comfortable doing so, and to think about user involvement. Approaching them with friendliness, keeping it light and casual while also asking more about relevant topics seemed the best way of getting results.

Looking back, the whole day had some exclusive elements to it. There were not much local residents present during the presentations, which were attended by the Mayor of Delft and many more representatives. I could also feel some young-adult residents voices weren't yet heard because of a mutual reluctance to engage. Something to consider when carrying out my own research.

As a bonus, I also found three contacts for my personal research, a student living in Moerwijk, a social worker dealing with resident participation and the energy transition and design students dealing with a similar topic.

Map with shops, services, churches, schools and more, constructed through extensive research with Google Maps and GIS-software, helping to embody the context. See the appendix for a larger image.

Other discoveries

At last, I immersed myself in the physical context of Moerwijk. I spent a day walking through the neighbourhood on Google Streetview and analysing the area through open data in GIS software. I found out where all shops, institutions, an public spaces are, the trees where the heat distribution pipes are placed, energetic performance, building heights and years and more. This gave me a pretty good spatial idea of the neighbourhood.

When I attended the Ethics-workshop. I also took it as an opportunity to make an initial walk through the neighbourhood. I walked along some important areas considering the heat distribution network and I took photographs. The knowledge I had through my previous online research helped to navigate these places.

During the Praktijkdag WijWest, we did field research with residents in Delft West. My group of three won the first place for an accurate analysis and recommendations for young-adolescents in this area.

Network of people

During the discovery phase, I came in contact with various people in Moerwijk and related to other aspects of the research. As people are a paramount aspect of this project, the established network and its development in the next phases will be discussed.

Within the first weeks of the research, I e-mailed Mandy Koenraads. I had formerly done some work in the area of The Hague SouthWest and I knew she runned the Thesis Program there. Mandy is an important figure in the network of The Hague Southwest, and she can get me in contact with a lot of stakeholders and other interesting people relevant to this project. While we enjoyed a coffee, we discussed potential topics and contexts for my fascinations. This led me to the heat distribution network of WarmtelinQ within Moerwijk. I joined the thesis program soon after.

Mandy connected me with Bettelies Westerbeek, a resident, pastor and key figure in Moerwijk. We talked on the phone about my subject and she mentioned that she could introduce me to various stakeholders of WarmtelinQ, the municipality and residents of Moerwijk. Through her, I can join at the food bank to talk to residents and get in touch with people.

In the next phase, Mandy and Bettelies will be key-figures in gaining more contacts and research subjects involved in the neighbourhood.

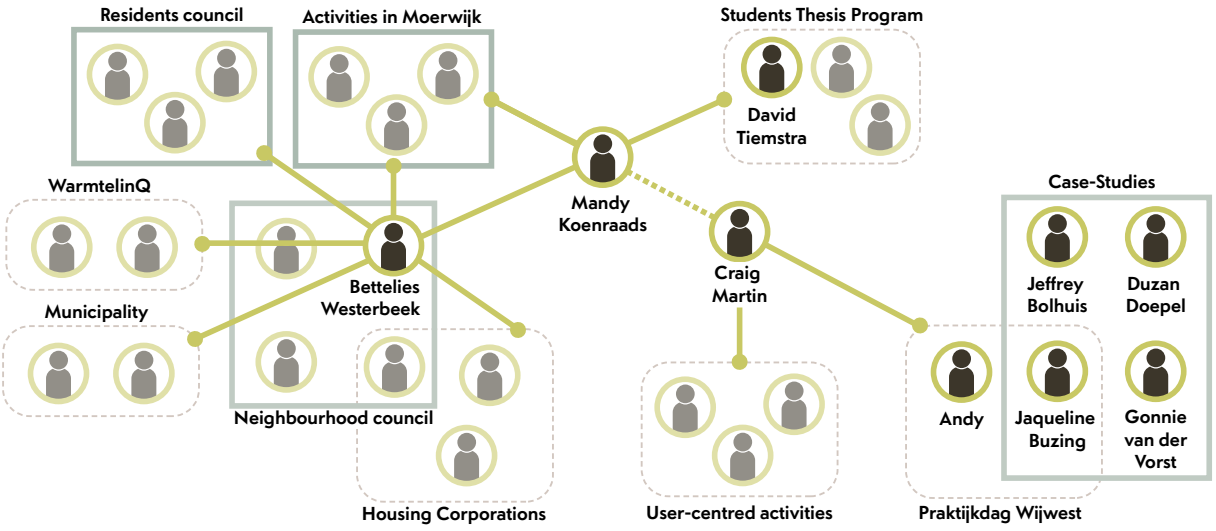
Craig Martin, my assigned research tutor also proved to be an important network actor, as he was able to get me to join various workshops and field-activities on the topic of user-centered design.

Through him, I could join the Praktijkdag WijWest and will join another user feedback session with residents of Building Technology students.

During the Praktijkdag WijWest I met with Andy, a fellow student who had joined the activity. He lives very close to the construction site in Moerwijk. We exchanged numbers so I could get in touch later. Because he is also a student, we already have shared experiences, which makes him a good starting point for fieldwork.

Additionally I met with Jacqueline Buzing of the municipality in Delft. She is a spokesperson at walk-in sessions on the sustainable transformation of the Multatulibuurt in Delft. She invited me to join there sometime. In the end, the Multatulibuurt became one of my case-studies.

Relating to other case-studies, I spoke with Gonnie van der Vorst and Duzan Doepel. On the topic of high thermal storage and the design of the Hofbogen respectively.They provided me with technical information. I can get in contact with them later might I have more questions.



This network map shows the different people I met relating to the topic. Mandy Koenraads and Bettelies Westerbeek will be my main contacts to get in touch with residents and important stakeholders. I also met with representatives of some case-study projects.

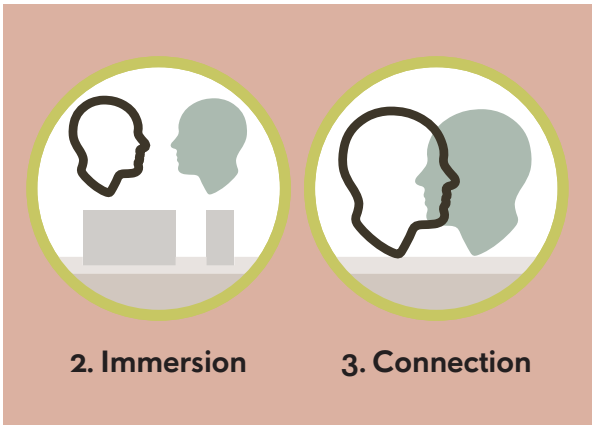
Immersion and connection

Moving on to the immersion and connection stage, qualitative data will be gathered from the people of Moerwijk through interviews, conversations, experiences and observations. At first, these conversations will have low focus. Along the way, focus will be increased according to previous results.

Through my network of people, as shown before, it becomes possible to get in touch with residents of Moerwijk. I will follow up on the proposals made by Bettelies to join the food bank and meet with representatives of the municipality, housing corporations and WarmtelinQ.

Another way to get in touch with stakeholders are the buurt- and the bewonersoverleggen which take place monthly. In here, residents and stakeholders get together to discuss important matters, among which the heat distribution network. I will attend these meetings with an open focus to identify problems and get in touch with residents and other involved parties. These meetings can also help to identify people who are open to explorations, to ultimately help embed my proposal in actual developments

Data will be gathered through conversations. In this, I will keep the scope of the research in mind, but I will also pursue interesting topics that others bring up as to keep an open mind in terms of challenges, problems and solutions.



Besides the conversations, spatial observations, documentation and observational work are conducted. People can not always verbalize what they might need, and can be focussed on personal matters. This part is more concerned with implicit knowledge, patterns and the larger scale.

In the end, these will complement the conversations and interviews and help to connect the individual with the collective.

Detachment

At last, we arrive at the detachment stage. As this research is also serving my design and graduation project, and ultimately, I am working for myself, it is needed to zoom out again and see how I can give shape to all the experience and input I have gathered.

As I will need to make a design proposal, for which I need a certain amount of creative freedom and control, the detachment phase is an important stage where I can balance the input between Moerwijk (C) and University (K), and establish a sense of autonomy.

The input from Moerwijk will trigger new knowledge acquisition which can be tested within the context again. To do so adequately, I will create design scenarios based on the gathered data, both in Moerwijk and in University.

This will deliver 3 or 4 design scenarios that I can then use to re-initiate the immersion and connection stage again, getting feedback from residents. This might need several iterations and can take place parallel to other research stages.

Communication is an important factor in this part, as the scenario's should be understandable without former knowledge.
Different methods of representation will be researched and tested.

University: rational space

In this research space, rational and scientific knowledge aquisition and development will take place. Acquired knowledge will be tested in the emotive context of Moerwijk. The end result is a kit of tools and scenarios that can be used in the design proposal.

This part is about the establishment of 'the known' on relevant topics. Research will be conducted through case-study analysis and literature studies.

Once the gathered knowledge is questioned and tested in the more ambiguous research space of Moerwijk, 'the known' is developping into more precise means and guidelines for the design proposal.

Input from Moerwijk can also trigger new research directions in the logical space, leading to different and unforseen outcomes.

The goal of this research is mainly to provide the design process with practical know-how, means and pre-conditions that give direction and purpose to the design proposal. The kit of parts will become design knowledge for proposals in Moerwijk with similar goals, but can be adapted to Post-war neighbourhoods and sustainable neighbourhood transformations in general.

An uncomplete list of topics on which knowledge is pursued is given below:

- District heating networks
- (Thermal) energy storage
- Combinations of soft and hard infrastructure
- Collective services and social infrastructure
- Sustainable neighbourhood transformations and user participation
- pre-existing knowledge of Moerwijk
- Socio-spatial and socio-economic injustices

More topics might surface through the research.

Case-studies

In order to deliver concrete design ingredients, case studies will be studied. These cases are often pre-tested in a societal context, meaning the comparing of the idea and the implementation can deliver new knowledge.

The case-study projects are chosen because they combine soft (human) and hard (technical) infrastructures together, or because they involve the user in the process of sustainable transformation.

In the next part, the nature and relevance of each case-study will be described briefly.

Thermal energy storage & Neighbourhood centre eco-dorp Boekel

Cesar Energy Storage & Huub van Laarhoven

600 solar panels power the steel slag mass in the centre of the neighbourhood centre. Its energy serves to heat all 37 housing units of eco-dorp Boekel. Both the technology of high-thermal energy storage and the social function around the battery are of interest. I spoke with Gonnie van der Vorst, representative of the Cesar Energy Storage about the technology of the sustainable battery.

Cascading district heating & Repurposed public space Hofbogen

Doepel Strijkers

An old railway viaduct is transformed into a public park that resembles the Highline in New York. Heating pipes run beneath its flooring, delivering warmth at cascading temperatures. I already had contact with Duzan Doepel about this project, gathering more information and planning a meeting to discuss the project.

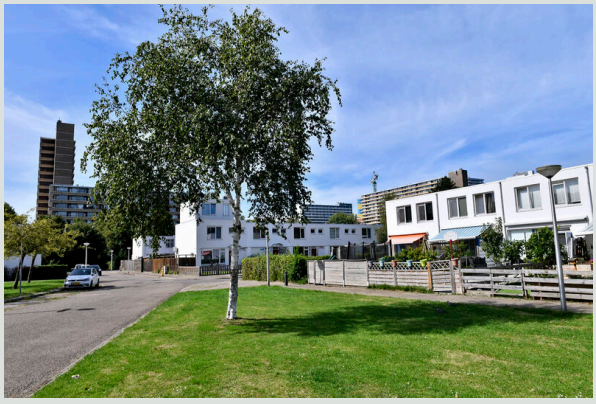
Decomissioned Pipe Bay & Central public space at Strijp-S

Piet Oudolf

The central distribution line of the former philips campus in Eindhoven is transformed into a central routing element for pedestrians. The steel pipe-bearing cannopy is dressed with view-point, lights, paving and vegetation, creating a vibrant public space.

Heat transition of the Multatulibuuurt & Resident participation

Municipality of Delft



The Multatulibuurt is one the first neighbourhoods in Delft to transition to sustainable heating systems. Various methods of resident involvement are held. Jaqueline Buzing invited me to join the walk-in information sessions in this area.

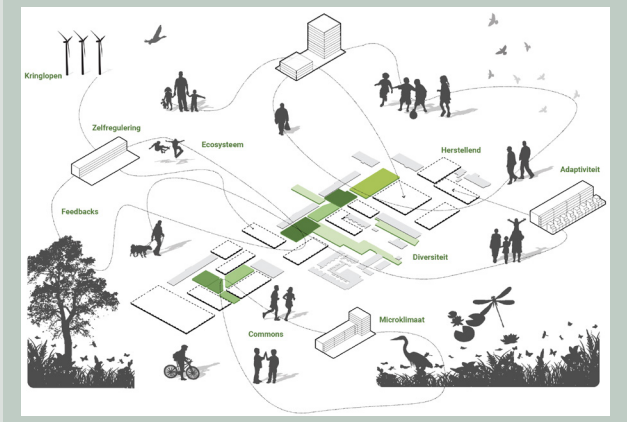
Construction drain-pipes & Dynamic landmark in the streets of Berlin

Pollems Gmbh

The pink pipes in Berlin serve a functional goal, the drainage of basements and construction sites. The dynamic presence of the pink, modular pipes have made it a landmark in the urban landscape.

Framework for transforming Schalkwijk & Resident participation

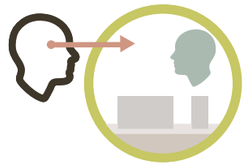
AP+E



Through different commissions. AP+E Studio has made an extensive proposal on the transformation of Haarlem Schalkwijk, making use of the existing strenghts and networks and involving people in its process. The result is a strong framework for development dealing with social, spatial and sustainable challenges.

Visualisation of the research

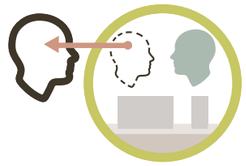
Here the overall research within both the ambiguous and rational space is visualised, imposed with important moments in time. The result is a research diagram showing how, when and what types of research are taking place. Notice that the overall process shows three main loops of empathy in Design. In reality, a larger number of smaller loops will take place, and happen more simultaneously.



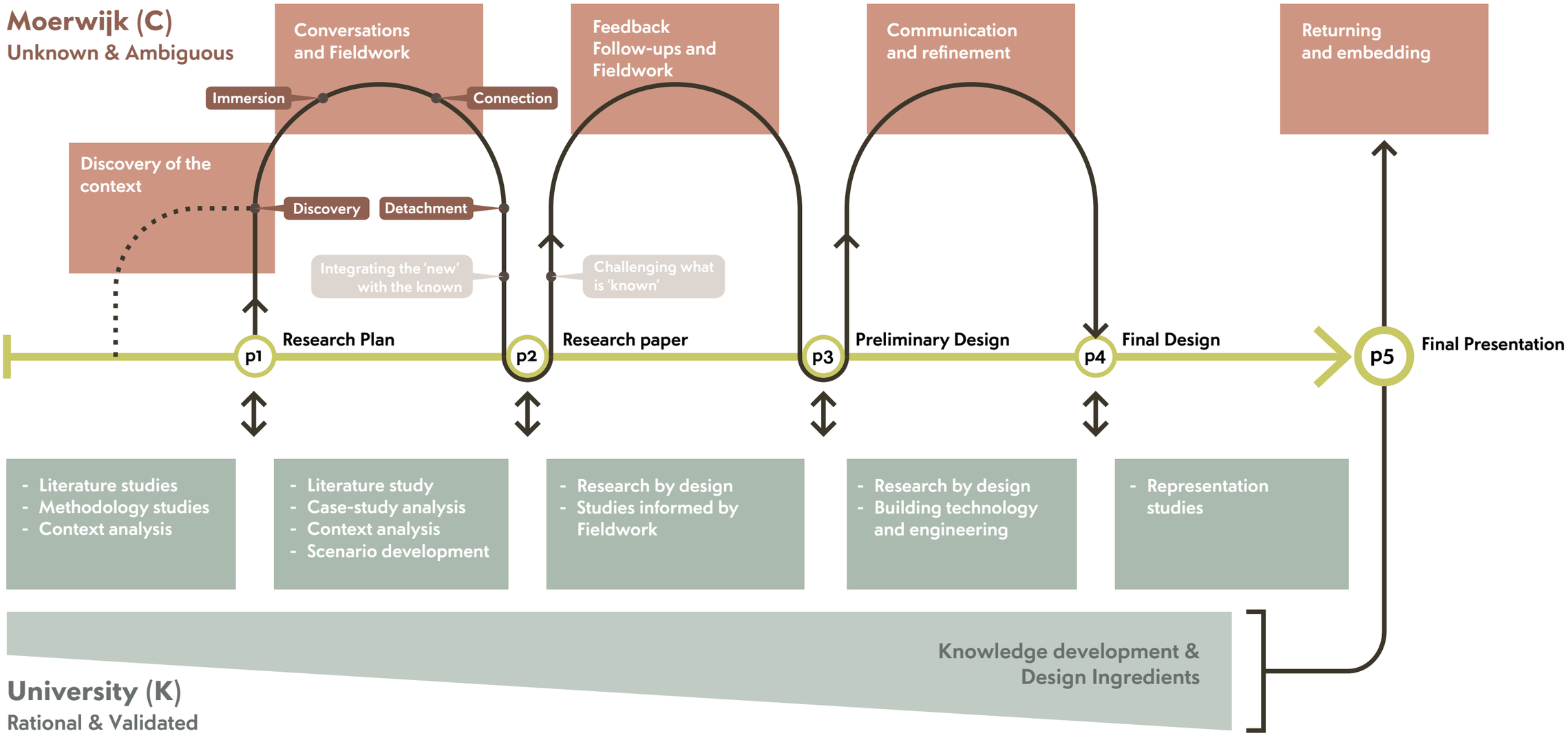
1. Discovery

2. Immersion

3. Connection



4. Detachment



Planning

This planning describes important moments of assesment, research related events and other matters that are significant. During week 1.10 until 2.6, fieldwork and network engagement are the main focus. Simultaneously, other research activities will take place to synthesise the input into a research paper and towards a preliminary design.

Week	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	2.1	2.2	2.3	2.4	2.5	2.6	Holiday	Holiday	2.7	2.8	2.9	2.10	3.1
Monday	4	11	18	25	2	9	16	23	30	6	13	20 Optional Meeting	27	4	11	18	25	1	8	15	22	29	5
Tuesday	5	12	19	26	3	10	17	24	31	7 **P1**	14	21	28	5	12	19	26	2	9	16	23 **P2**	30 **P2**	6
Wednesday	6	13	20	27	4	11	18	25	1	8 Method Workshop 10:00 - 12:00	15 Food-bank	22 Food-bank	29 Food-bank	6 Food-bank + Overleg Bewoners	13 Food-bank	20 Food-bank + Optional Meeting	27	3	10 Food-bank	17 Food-bank	24	31	7 Final Meeting 10:00 - 12:30
Thursday	7	14	21	28	5	12	19 Optional Meeting	26 Kick-off 14:30 - 16:30	2	9 **P1**	16	23	30	7 Optional Meeting	14 Poster Workshop 9:30 - 12:00	21	28	4	11 Optional Meeting	18	25 **P2**	1 **P2**	8
Friday	8	15	22	29	6	13 Ethics Workshop 10 - 12:30	20 Herfstfeest Moerwijk **+ADE**	27 Deadline Research Plan	3	10	17	24 Final registration P2	1	8	15	22	29	5	12	19 ± Deadline Research Paper	26	2	9
Saturday	9	16	23	30	7 Optional Meeting	14	21	28	4	11	18	25	2	9	16	23	30	6	13 Birthday	20	27	3	10
Sunday	10	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28 Pizza night	4	11
	September			October					November			December						January				February	

Personal	Thesis Hub	Deadlines	Conversation
	Optional		

Developping and engaging network of contacts
Kick-off meeting: Wijknet and bewonersoverleg
Fieldwork: conversations and observations
Case-study analysis
Supplementary research
Developping design scenarios: research by design

Following up on contacts
Feedback sessions
Progress communication
Research by design

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Appendix - Map of functions and points of interest