Beyond the kitchen, towards social cooking

TU Delft

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BRAUN

Beyond the kitchen, towards social cooking

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“The best way to predict the future, is to create it”

~ Abraham Lincoln

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Preface

Hi,

Already as a young kid I would tell my mom, ‘When I grow up, I want to become an inventor!’. Little did I know that this would be a realistic dream.

And how better could it be, than combining this with food. There is no subject more rich in flavours, cultures, preferences or creativity, and really touching the human senses. It touches all layers of society, all over the world. Therefore perfect for me trying to make the world a little bit more of a beautiful place.

Just as our ancestors already realised, preparing food creates a magical moment which is difficult to describe. It is a play of adding the right ingredients at the right moment, at the right place, with as finishing touch a little bit of love. The resulting dish brings people together and makes them appreciate life!

Since the digital world we live in drives us more and more in isolation, it is now the moment to reflect and adjust our future goals to get most out of life.

Dear readers, I hope you have a good time reading this thesis. Let’s start the conversation, let’s get inspired, let’s go beyond the kitchen.

Enjoy!

Nandus Lemlijn

Delft, April 2026

Abstract

Cooking has been one of the most important activities of mankind throughout history. The Early Humans already gathered around the campfire to prepare and cook ingredients together. This campfire evolved to the kitchen area as we know it today. In the last century, since the introduction of the Frankfurter Kitchen by Margarete Schütte-Lihotzky in 1926, this area has been focused on efficiency. This value supported general wealth and is still visible in our current kitchen.

Looking towards 2040, we need to reflect if this value from 1926 still aligns with our current desires. Looking back to the campfire, cooking was a moment of being together and interact on a social level.

In an ever-busy lifestyle, this social interaction with friends and near ones is more important than ever. Therefore this thesis explores how to replace the value of efficiency with focus on the social interaction. This within the cooking journey of Dutch starters in a 2040 context.

This thesis is in close collaboration with De`Longhi Braun Household, a company in small domestic appliances located in Germany.

This thesis is divided in a research and conceptualisation phase. During desk research an adapted Vision in Product (ViP) design approach is used to reveal the core value of cooking from the past, current and future. This value, combined with a determined focus area and group, results in the creation of a design vision.

Through ideation, conceptualisation and prototyping the final design, Mesa, is introduced. A total replacement of the 2026 kitchen area. This flexible kitchen enables the person cooking to move with the social interaction, and therefore having the opportunity to be included in conversations during the complete cooking journey. This way people can make best use of the time they spend together.

Mesa, developed for a Dutch starters couple in a 2040 home context, considers all stages of the cooking process. Moving with the social interaction, preparing ingredients, cooking on induction technology, fume extraction and fresh water supply are all covered.

After validating this concept kitchen, users indicate a desirability towards this new vision of social cooking. The execution is promising, but further development is required before mass implementation.

Keywords:
Social Interaction, Future Kitchen, Mobile Cooking, Cooking Experience

Acknowledgement

'Rome is not built in one day', and surely not alone.

What I want to say with this is that great things are never achieved by the work of an individual. Just as in this thesis. Without the help of people around me, this project would not have reached the state of how you are reading it right now. Therefore I would like to thank a few people who helped during the process.

First, I would like to thank my chair Marijke Dekker who always took the time when I knocked on the door for some quick questions. Her guidance ensured a strong story and critical reflection on the research.

Also, Peter Kraaijeveld, my other mentor from TU Delft. All the inspirational coffee breaks we had ensured an open mindset through the complete project. I really enjoyed the talks and support to start building stuff.

I really appreciate the great coaching from my company mentor Duy Phong Vu, who pushed to seek the boundaries of design. The great insights in research, looking beyond the horizon and creating a strong and coherent story helped a lot to create a product which matters.

Besides my mentors I would like to thank Marie-Claire Looze for helping with the collaboration between all stakeholders. The informal coaching in-between helped to create new ideas and was great for the team bonding between other fellow students.

Without my fellow students I would definitely be isolated from reality, which is quite conflicting with my thesis. I would like to thank them for all the small coffee breaks, discussions and brainstorms. It created a real warm atmosphere at university.

Last of all I would like to thank my girlfriend, family and all my friends who gave me peptalks, inspiration, creativity and joy during the process. With all this help this thesis became reality.

Glossary

Social interaction	Spending time together with other people
Independant cooking	Cooking without being influenced by the environment

AI usage

As time goes on, new technologies are rising within research studies. Also AI (Artificial Intelligence) is finding its way to the academic world. Therefore it is important to understand how this tool is used during the project. All work from this thesis, such as researching, ideating and reporting, has been done by me as a person. For specific tasks several AI tools have been used for different applications:

Open AI - ChatGPT - GPT-5.1 (2025)	Conversations, Calculations
Open AI - DALL-E (2025)	Image generation
Google - Gemini - 2.5 Flash (2025)	Conversations, Calculations
Google - Gemini image - Nano Banana (2025)	Image generation
Google - Gemini - 3 Flash (2026)	Conversations
Google - Gemini image - Nano Banana 2 (2026)	Image generation
Vizcom (2025)	Quick rendeing from sketches
LanguageTool (2025 & 2026)	Spelling and Grammer checks
DeepL (2025 & 2026)	Translation help

This master thesis contains images generated by AI software. They are all created by me, Nandus Lemlijn. In the Figure title a reference is added to the AI Tool. Because of daily updates, versions are specified with an accuracy of a month.

1 Introduction

Within this chapter, the project will be introduced. It will first clarify the collaboration with the company **De`Longhi Braun Household**. This is followed by the **project origin** and **personal ambitions**. To conclude some **Methods** will be discussed which are used through this thesis.

De`Longhi Braun Household

This product development research has been in close partnership with De`Longhi Braun Household (from here on referred to as Braun), located in Neu-Isenburg, Germany. Braun, founded in 1921, is a company in electric products, like radio sets, record players, shavers, and kitchen and household appliances. Within this project, there is a specific collaboration with the household department. The companies drive has always been to make products that last, and that really matter for the consumer.

In the late 1970s one of the Braun designers, Dieter Rams, asked himself how to create meaningful products. He defined 'the principles of good design', see Figure 1.1. While applying these principles, products tend to become timeless and create value for consumers (De Jong, 2021). During this project, the goal is to implement his vision, with a focus on innovative, useful and understandable design.

To design the product of tomorrow, Braun is interested in the future of the kitchen. Therefore the main question of this project is:

What will the kitchen of 2040 look like?

By analysing mega trends and the core essence of cooking, timeless products can be developed. That's where I present: The kitchen and beyond. Looking further than the 4 walls of the current kitchen and seeking the true essence of cooking.

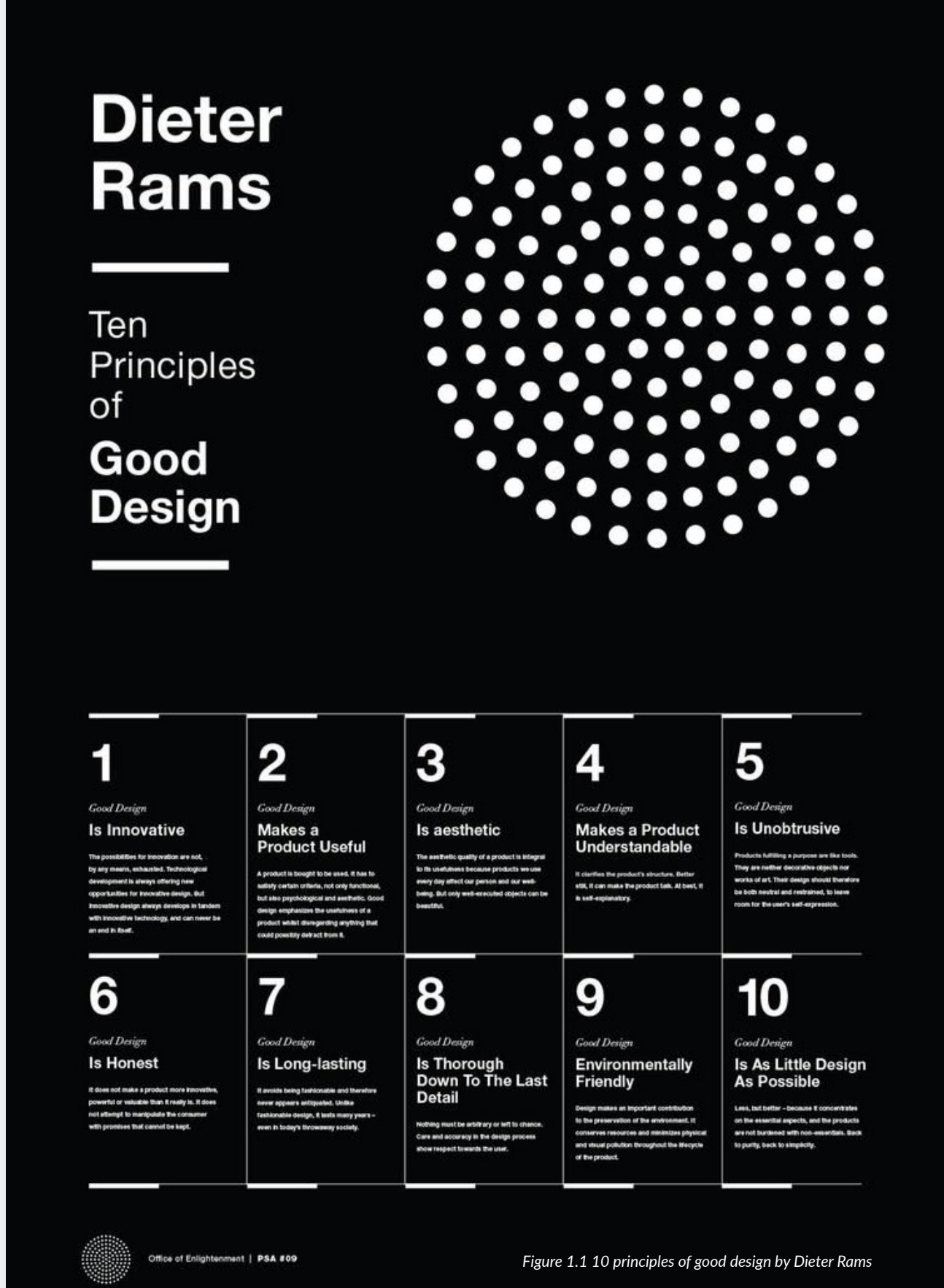


Figure 1.1 10 principles of good design by Dieter Rams

Figure 1.2 Future vision of eating together remotely

Project origin

Braun's inspiration for this project comes from the World Design Organisation which nominated Frankfurt as the world design capital of 2026 (WDO, 2023). A full year in which all design trends and developments will be shared and showcased within the city. Braun Household seizes the opportunity to combine this event with the 100th anniversary of the Frankfurter kitchen, designed by Margarete Schütte-Lihotzky in 1926. This kitchen was designed from scratch, fully focussed on efficiency ("The Frankfurt Kitchen", 2010). During this period in history, Europe was still in a continent broken from war, which seeked resurgence and perspective. The new kitchen was one optimised in efficiency, hygiene, workflow and cheap mass production. This created more time and space for the person cooking, mainly women, in all layers of society.

Nowadays brands in the kitchen market are still focused on the kitchen philosophy of a century ago. Efficiency ensured a stability to grow as a society. As a result, through history of mankind there has never been such a level of wealth compared to now (European Central Bank, 2024). But what does this wealth mean when we don't appreciate it to the fullest?

Now is the time to define the desired future of cooking. Does Braun still fulfil the essence of cooking? Living in a time driven by trends, it is important to understand this new mission. Trends ensure a certainty of revenue and brand awareness, but it distracts us from timeless design.

Personal ambitions

Already from the beginning of my studies I am interested in designing with and for people. I want to understand why people have certain habits and wishes. With this knowledge products can be designed which matter and last.
Cooking is an activity which fascinated me already from a very young age. Cooking with my parents or grandparents, harmlessly experimenting with spices and techniques. But taste and flavour are not the only aspects which make cooking fun, it is the bigger picture. Cooking together, cocreating a dish, exchanging flavour preferences, expressing care and love for the ones you are cooking for, and a moment for good conversations. A space to express creativity, which wouldn't be satisfied by homedelivery of restaurant dishes.

Caused by the industrial revolution, last century we experienced an unimaginable worldwide rise of common wealth. With a focus on efficiency we managed to become really good at optimising systems. Originally to reduce costs, later also to improve quality of life. The result is that technological advancement realised the opportunity to improve workflows even more. This increased profits, but also slowly invaded private time and rose the rhythm of life causing stress (Rosa & Scheuerman, 2009).

Instead of optimising workflows and economics, now it is time to focus on the essence of life. We should make use of the technological advancement from efficiency development, and shift the focus towards a desired experience, provoked by the use of the product.

Methods

The thesis exists of 2 phases. First the analysis, in which the essence of cooking is uncovered. In context of 2040, a design vision is composed. This is followed with research by design. Through ideation, a concept is developed which fits in the defined vision. By a user test the concept is validated and evaluated.

The analyses process is inspired by the Vision in Product design method (from here on referred to as ViP) (Hekkert & van Dijk, 2011). Often, existing products are developed based on temporary trends. Over time, they get improved to optimise functionality or experience which results in an advanced product. But at a certain moment in time you will become distracted from innovative and timeless design since the roots of the products essence gets lost. By using ViP, the analysis starts by looking at the current products, the interaction with the user, and the context of the society. With a future vision, a new context is created, and the values from the current interactions and products are projected to this future situation. This way tomorrow's product can effectively be designed.

Within this design research the aim is to understand the real meaning of cooking. Therefore the standard approach of ViP is adapted a bit, see Figure 1.3. Besides the exploration of the current and future world, also the history is analysed. This reveals the core values of cooking. By implementing the positive values from the past and present in the future context, new product opportunities arrise.

Besides the ViP method, several other common design methods are used.

During ideation and conceptualisation a lot of sketches are made by braindrawing in clusters. The resulting ideas are filtered and validated by requirements and Harris profiles.

Through conceptualisation, components are detailed by research by design and dirty prototyping. Small user tests contribute to discision making.

To convey a coherent story to stakeholders and users, a user scenario is created in which the functions of the final conept are highlighted and explained.

With user tests the final concept is validated. Observations of a simulation, and interviews with the participants create insights in whether the design vision is achieved or if the participants use the concept as intended.

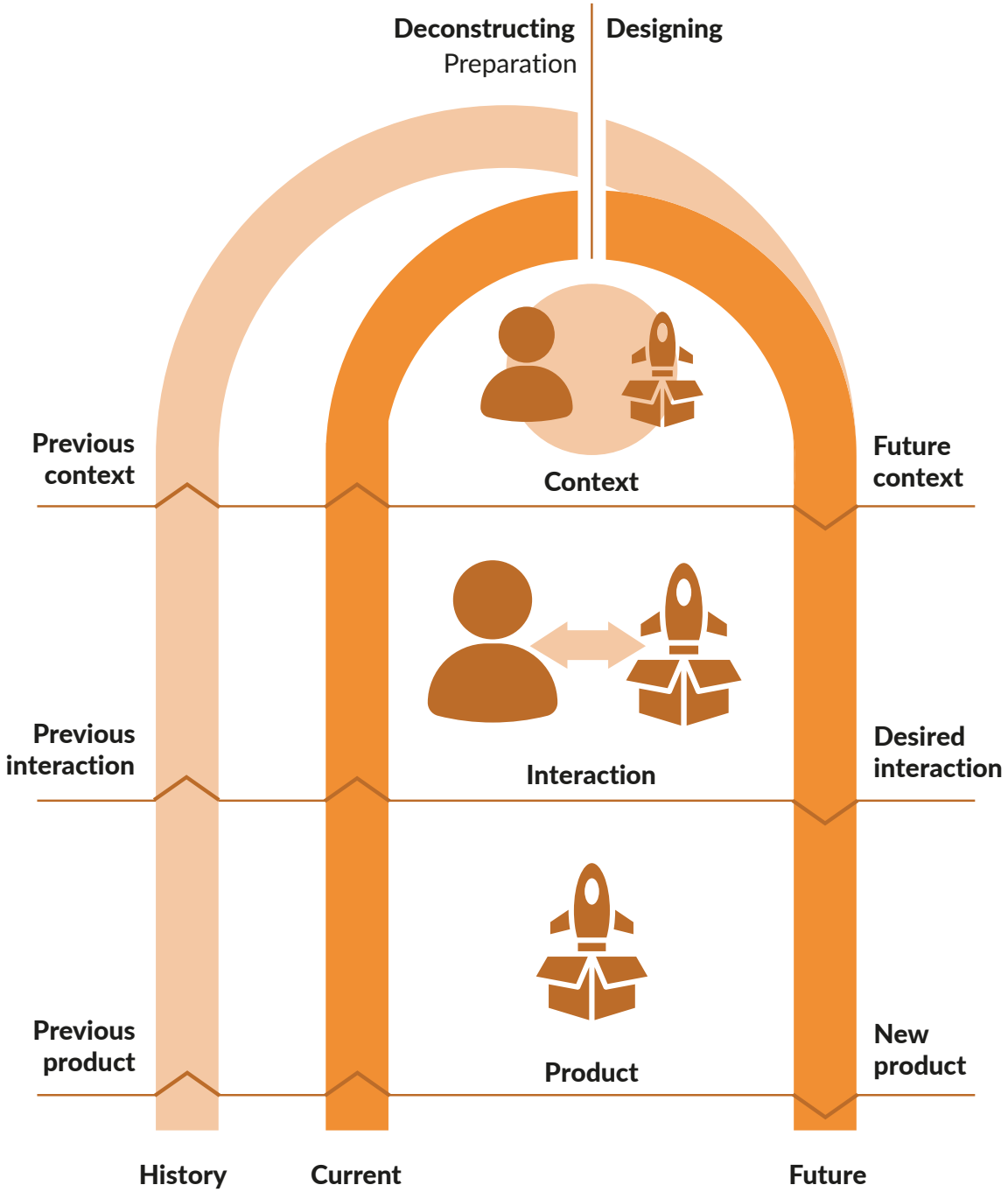


Figure 1.3 ViP method

Analysis

To gain a better understanding of the origin of cooking, an **analyses of the history** is performed. By going through time, we discover how **the kitchen of today** is shaped. In addition, **the future society** is explored to create a context to design for.

Timeline

To get an understanding of how the kitchen of the future will look like, we first need to understand the history behind this daily activity. In the next chapter several moments in time explain how the meaning of cooking has evolved through history.

Hunter-Gatherers

Homo Erectus, 1.8 million years ago, ~50.000 people, NW Africa.

The first interaction between food and the early hominids was functional. Food was the source of energy for the human body to survive. The hunting and gathering technique to obtain food was first applied by the Homo Erectus, which lived in the North-West of Africa. Nomadic people, moving with the availability of food (Buell, 2006) (see Figure 2.1). This food consisted mainly of wild fruits, wild vegetables and meat from animals (Daley et al., 2025). Later, the Homo Sapiens adopted this technique.

Controle of fire

Homo Erectus, 780.000 years ago, ~70.000 people, Africa and Eurazia

The controle of fire had an enormous impact on human life. People were able to warm themselves, process food, deter predators, improve tool development and extend functional daytime (Wiessner, 2014). This ensured an advantage over predators and raised the survival rate. The limitations from this source of energy were related to brightness, controllability and movability. As a result, these firelight activities were limited to cooking and conversating. This last phenomenon caused a major influence on the cognitive development (Dunbar, 2014).

As Dunbar (2014) indicates, after sunset all people from the community gathered around the campfire. This created a **diverse interaction** in which people of different ages, genders and skills came together. Knowledge and perspectives were shared, stories and tales were created, food was eaten and the cognitive abilities improved. This is the moment where cooking and social interactions started to be combined.

Rise of metropoles

Homo sapiens, 12.000 years ago, ~5 million people, Worldwide

Communities advanced and became more efficient. Homo Sapiens discovered how to domestify animals and crops, which resulted in a shift from nomadic groups to sedentary farmers. Primitive cabins worldwide grew out to big farm houses with in the centre a campfire (Wealddown, 2024) (see Figure 2.2). All members of the community separated tasks depending on each individual strengths and abilities. Often the males focussed on heavy work in the fields, while females were busy with household tasks such as preparing food, making clothes and raising the children ("The History Of Household Chores", n.d.). In these years **the preparation of food and the social interaction separated**.

This agricultural development created a reliable food supply. Because crops and animals could be farmed to meet demand, cities and civilisation grew (The Development Of Agriculture, z.d.). Small communities transformed in metropoles (Figure 2.3). A noticeable parallel societal development was the rise of religion. Metropoles were led by individuals who maintained power as political and spiritual leaders (Shermer, 2004). Religions caused an even stronger patriarchy (Swatos, 1994) and often stated that women should restrict to household activities. Through the years, especially in the Dark Ages, these roles were closely handled.

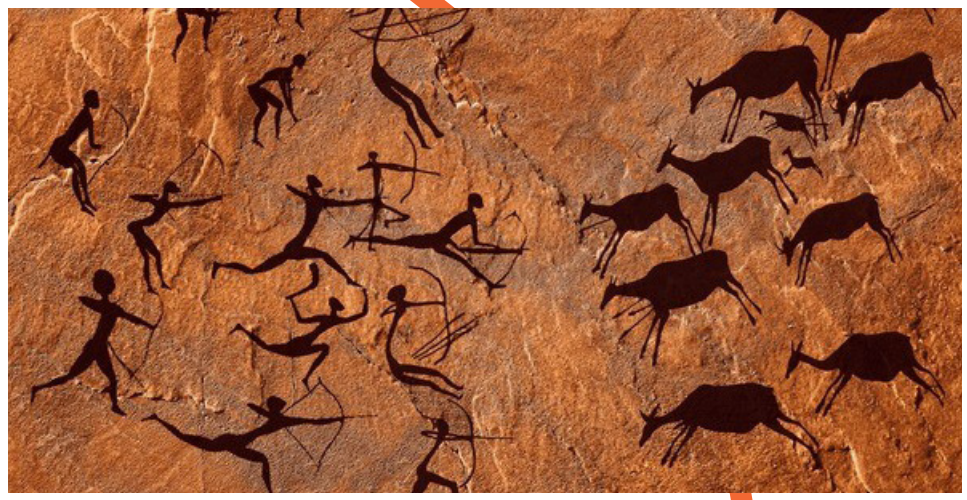


Figure 2.1 Hunter-gatherers

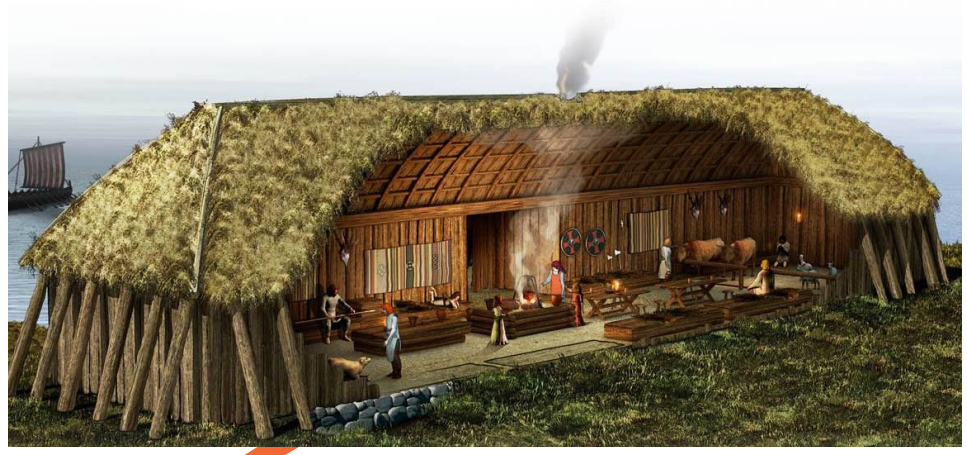


Figure 2.2 Viking longhouse with central fireplace by Viking Heritage

Figure 2.3 Rise of metropoles by COSMOS

Industrial revolution

Homo sapiens, 1712, ~620 million people, Worldwide

In 1712, Thomas Newcomen introduced the first commercial succesful steam engine. This propelled technological and societal development massively (Dickinson & Musson, 2022). With this, the industrial revolution started. Machinery was designed with a focus on efficiency (see Figure 2.4). The main goal of this efficiency was to increase production, and herewith profit. As a result wealth slowly started growing.

Caused by automation there was more time available in other professions such as research and science (Gastfriend, 2022). With all this new knowledge, society kept growing exponentially, in both terms of technological advancement and quality of life.

The influence of the industrial revolution was also noticeable within the kitchen. Women, which still were restricted to household activities, also wanted to profit from this new kind of technology and wealth. At the start of the 20th century, a female architect called Margarete Schütte-Lihotzky experimented with implementing industrial principles in the kitchen area. She started from scratch with a focus on efficiency. As a result, the Frankfurter Kitchen 1926 was born as can be seen in Figure 2.5 (“The Frankfurt Kitchen”, 2010). Mass producible, attention for the actions within the cooking process, a focus on ergonomics, and most importantly, affordable. The kitchen area received a new definition.

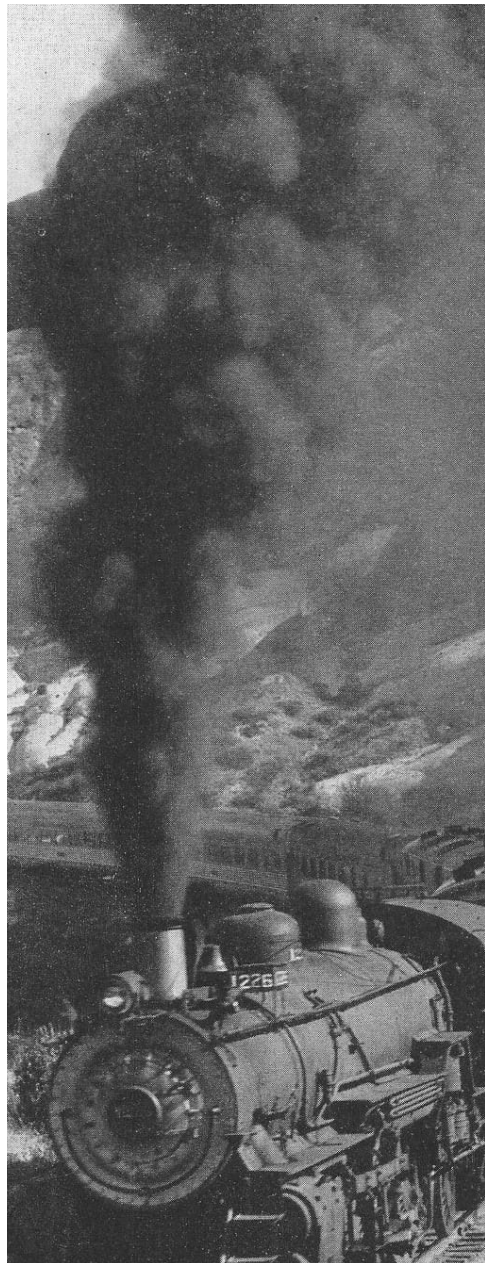


Figure 2.4 The invention of the steam engine by COSMOS

In the following years, one after the other new invention was introduced. For each separate task, a dedicated kitchen appliance was designed, which performed the task as efficient as possible. With all those specialised appliances (mainly) women were able to easily cook complex dishes in a relatively short timespan.

The automation of the industry created new jobs. Jobs with less properties of physical hard work. This in combination with the waves of feminism, women were slowly allowed to participate in the working life (Janssen, 2022). Another growing aspect was room for social activities and hobbies. Regulated working days (Ensie, 2021) allowed more spare time in the evening hours to participate in social activities. The combination of these developments resulted in a **busy lifestyle for the whole family**.

Figure 2.5 The Frankfurter Kitchen, designed by Margarete Schütte-Lihotzky

Current world

As the history analyses reveals, the first signs of cooking arose in Northwest Africa and spread around the world. All different cultures added their own flavour to the cooking process, based on their context such as local ingredients, cultural values and habits. This resulted in endless executions of the kitchen environment.

To narrow down the scope of this thesis, the decision is made to focus on the Dutch society. Some motivators are ease of research in terms of field research, interviewing and testing, since this research is done in the Netherlands. Also, (mega) trends arising in this country are comparable for other surrounding countries in Northwest Europe. As Smith (2026) indicates, Europe still represents two-thirds of De`Longhi's revenue in 2025, which means that this group is a representable scope.

In the current world we live in, daily activities have changed quite a lot. Roeters & Vlasblom (2018) made an animation which indicates the percentage of Dutch residents busy with a specific activity on an hourly base. Figure 2.6 shows these numbers translated into a graph.

Looking at a Dutch household, we can see a noticeable busy life. The day starts with an early morning. All members of the household go through the same routine. They want to make use of the bathroom, kitchen, dining room, etc., all at the same time.

After this short moment of high activity within the house, calmness is restored since the family members leave for their day activities. Children follow their way to school, while adults go to their (full-time) job. Around 4 o'clock in the evening, everyone comes home again. This moment often is used to quickly cook, eat together and gain some energy. This energy is needed for the evening activities such as sports, cultural activities or other hobbies. Because of this rushed lifestyle **there is limited time to spend with family members**. Especially with the current interior layout which is mainly focussed on efficiency instead of social interaction.

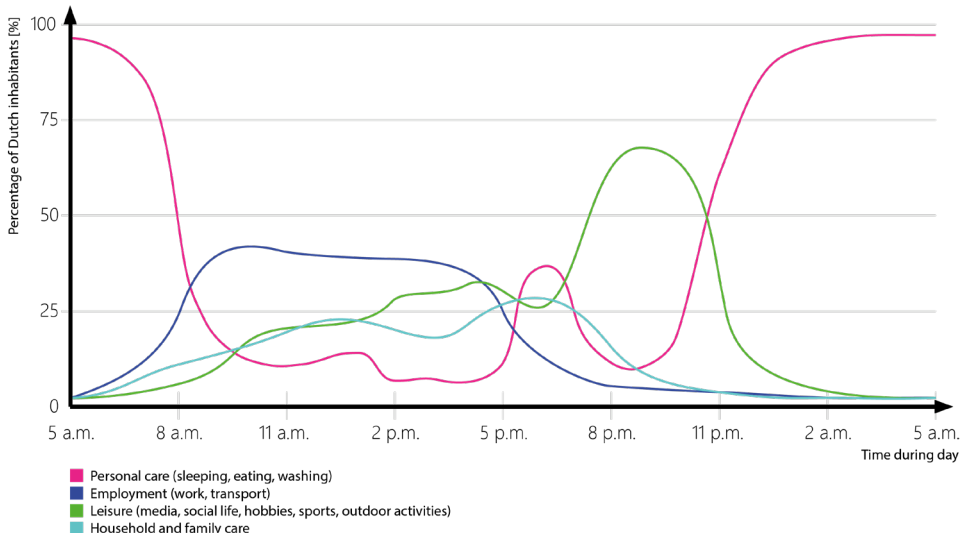


Figure 2.6 Time use of Dutch residents by Roeters & Vlasblom (2018)

When reflecting on the current kitchen, we see an efficient and functional, dedicated area. The small moment between work and evening activities is not designed to interact with other people. Noisy extractor hoods, stoves faced to the wall, noisy appliances, sharp utensils which need attention, and many more signs of an area focussed on functionality instead of social interaction.

An opportunity arises to combine the cooking with the social interaction again, just like back in history. This way the family members are able to spend more time together in this limited timeframe, which will improve the overall social interaction. Just as it all started with the campfire.

Besides, technological developments in the last decades created new opportunities which are not yet exploit. Through the years, different energy sources were used within the kitchen. Woodfire, charcoal, gas and electricity are the most common examples. One shared characteristic is that they all require a dedicated location within the household. For some because of emissions generated during the reaction, for others a required energy supply. Despite technological advancement with which we could gain independence from the kitchen area, we still restrict ourselves to this dedicated room within the house.

Great opportunities arise when we combine the previously mentioned properties of social interaction and independent appliances. With the property of independence, we can create a nomadic kitchen appliance which could move with the social interaction.

Before blindly adapting current products to these new opportunities, we first need to understand the future context in which the products will be used. For that reason we have a look at a general predicted future vision of 2040. This will create the context in which the new product will be designed. The Denktank 2040 performed an interesting research in how the future of the Netherlands could look like (Kraaijeveld et al., 2025). By interpreting their insights, visualisations have been made.

Future society

Homo sapiens, 2040, 9.2 Billion people, Dutch urban area.

The world population keeps growing, and in 2040 there will be around 9.2 billion people walking on earth (World Population Projections - Worldometer, n.d.). In the Netherlands there will love around 20 million people. By urbanisation most of them will live in big, compact cities (visualised in Figure 2.7). The median age increases from 41.5 years old in 2025, to 43.7 years old in 2040 (Median Age, n.d.). Although humans become slightly older, they relatively live in better health for a longer period of time.

Figure 2.7 Future vision of a Dutch city, GEMINI (October 2025)

Housing

As a result of growing population, there is a higher demand for houses. This includes living areas for all different groups, but there is a specific increase in single-person households (mainly elderly who have lost their partner). As can be seen in Figure 2.8, newly build apartment complexes focus on compact living areas. While constructing, possible future renovations or adaptations are already considered for when people are going through different stages of life. These apartments could be seen as modular areas.

Each complex contains its own independent, green energy system. Collective electric batteries store energy generated by offshore wind mils, solar panels and nuclear power. As a country, the Netherlands become for 60% independent from foreign countries in terms of energy supply. Because of these independent energy systems, districts are less vulnerable for electrical grid instabilities.

Next to these green energy systems, the apartment complexes have social areas for people to meet. They also include facilities such as supermarkets, hospitality venues, hairdressers and business complexes. This way the need for human transport is reduced.

Figure 2.8 Future vision of a compact living area, GEMINI (October 2025)

Figure 2.9 Future vision of atransport and nature in cities, GEMINI (October 2025)

Transport

Transport within the country is optimised to safety, punctuality and sustainability. As can be seen in Figure 2.9 All transport is done by electric vehicles. Although private vehicles are still accessible, the main form of transport is done by shared vehicles and public transport. An optimised grid ensures all parts of the city are quickly accessible. Also, the cities are connected with high speed and quality public transport. Additional to these ground vehicles, there are autonomous drones flying around for package delivery. Instead of delivery to the front door, packages are brought to central drop-off points located in the apartment complexes.

Climate

A stable climate represents the backbone of society. The main energy sources are relied on green power such as wind and solar power. Just as most other sectors, the industry is carbon neutral. Next to the reduction of pollution, nature is back in the cities. Besides the fresh feeling, the cities have better air quality, temperatures reduce and biodiversity becomes more enhanced. In general the health improves, for both planet and all species.

Conclusion

With this analyses we know the roots of cooking and how it changed through time. It started after the controle of fire which enabled us to make food better digestible. Cooking, eating and a social interaction were a combined activity. With the first forms of agriculture, cooking separated from eating and the social interaction. Even till the industrial revolution this was maintained, supported by the Frankfurter Kitchen 1926 focussed on efficiency. Towards 2040 it is from importance to again combine the cooking process with eating and the social interaction to improve the limited time together with family and friends in a busy lifestyle.

With electricity as a source of energy we are able to become independant from the current kitchen area. This creates the opportunity to develop a nomadic kitchen appliance which enables the cook to move with the social interaction.

It is important to not consider the future environment of 2040. This nomadic and social kitchen appliance has to be functional in urbanised, compact cities within the Netherlands.

Synthesis

With the insights from previous chapter, potential **target locations** and **focus groups** are explored.
The current **cooking journey** will be discussed, and a new one gets presented. All this comes together in the definition of a **design vision**.

Target location

When the goal is to create a social and mobile appliance, it is important to understand which level of mobility is required. Moving with, or to the social interaction, and the occasion influences the requirements a lot. Besides, the future context of a Dutch city, as discribed in the previous chapter, should be considered. In this section, 5 different locations are proposed with a different level of mobility (Figure 3.1). In addition, advantages and disadvantages are mentioned to compare the different locations.





Figure 3.1 Target areas, GEMINI (December 2025)

Indoor cooking

As mentioned in the future vision, in 2040 living areas are more compact. Towards interior design the focus will be on efficient use of space. While the cooking area has a focus on the social interaction. Since cooking is again combined with eating and conversating, there is no dedicated kitchen area anymore and all of the living space is efficiently used.

+ Cooking is megred with the social interaction
+ Everyday use

- Restricted to the indoors

Outdoor cooking

Outdoor cooking extenses the freedom to cook around the house, wherever the social interaction is taking place. As mentioned in the future vision, compact housing results in less space per person. Therefore in 2040 balconies are more common than gardens.
With cooking outdoors the cook is enabled to enjoy nice weather with family or friends, or to keep an eye on the kids playing outside.

+ Cooking in fresh air
+ Mobility

- Restricted to the outdoors

On the move

In improved social interaction could also be obtained in another way. When being able to cook on the move, the person could arrive sooner at the location of the evening activity. This way more time could be spend together, but cooking and eating will get separated from the social interaction. When focussing on the cooking, as little time as possible should be spend on preparing the meal.

+ Mobility
+ Transport of ingredients

- Cooking process minimised

At location

Cooking becomes a shared activity connected to the evening plans. Instead of gathering at a location with a kitchen area, now the kitchen area will come to the agreed location. This way the users won't have to bother about the cooking journey since this is already done by the kitchen service. Only the fun phases of the cooking journey (preparing, cooking and eating) are included, while the others (sourcing, cleaning) are being taken care of by the company.

+ Mobility
+ Focus on social interaction

- No ownership
- Dependancy

Hiking or camping

With the focus on some more rural areas, the cooking set will completely be optimised in convenient transport and independant cooking. This enables the users to really cook wherever they want. Indoors, in the garden, at the beach or in the parc is no problem. This product would have transport as a key element, with less priority to the quality of the cooking journey.

+ Cooking in fresh air
+ Design for transportation

- Reduced quality of cooking journey
- Occasional use

Conclusion

Within this design research the decision is made to **design for a combination of indoor cooking, and outdoor cooking at the balcony**. This way the product is suitable for everyday use. Within the future context of 2040 the little time together with family and friends will be optimised to enjoy the social interaction.

Focus group

The current kitchen area has many different shapes. It can be build to each individual desires. This includes many different values which should be considered.

Also in 2040 people will still go through different stages of life, and each stage includes its own needs and desires. Students have more focus on cheap appliances. Parents have more focus on a good and healthy lifestyle for them and their kids. Elderly prefer tasty and easy food to prepare. In the next pages multiple generalised stages of life will reveal associated needs and desires for the kitchen, based on personal insights.

Young child
- Safety
- Fragility

High school
- Cheap
- Speed

Middle school
- Health
- Trends
- Ease

College
- Cheap
- Ease
- Compact
- Speed

Starters
- Investment
- Health

Camping and hiking
- Compact
- Low weight

Starter family
- Health
- Ease

Reduced mobility
- Accessibility
- Inclusivity

Figure 3.2 Persona Figures, GEMINI (November 2025)

Family with young kids
- Health
- Safety
- Fragility

On the move
- Speed
- Compact

Retirement
- Ease
- Tasty food
- More available time

Family with older kids
- Health
- Speed

Late work nights
- Ease
- Speed

Elderly
- Ease
- Tasty food
- Inclusivity

3.3 Persona Figures, GEMINI (November 2025)

Focus group

To ensure a broad support for the kitchen of the future, the ultimate goal would be to serve all the desires of potential users. This would lead to many different requirements, quickly becoming to complex for this thesis. Therefore the decision is made to first focus on a smaller group. The result of the project may function as a source of inspiration for future development to other focus groups.

The nomadic and social kitchen appliance will be **designed for a starters couple**.
As discussed in the future vision, housing becomes more compact and efficient. Starters who are purchasing their first own home, perfectly fit in this scenario. Since there are no children yet, there is room for a full-time job and various hobbies or sports, creating a busy lifestyle. In these situations, the social interaction within the couple, as well as with friends, is very important.

The cooking journey

Cooking is not only heating up ingredients so they can be eaten, it is more like a journey. To obtain a delicious dish there are several phases to go through, each containing its own small decisions, actions, emotions and preferences. The result is that each dish is unique and represents the identity of the cook. It is important to question which phases should be implemented in the new Frankfurter kitchen, and which phases contribute to the social interaction.

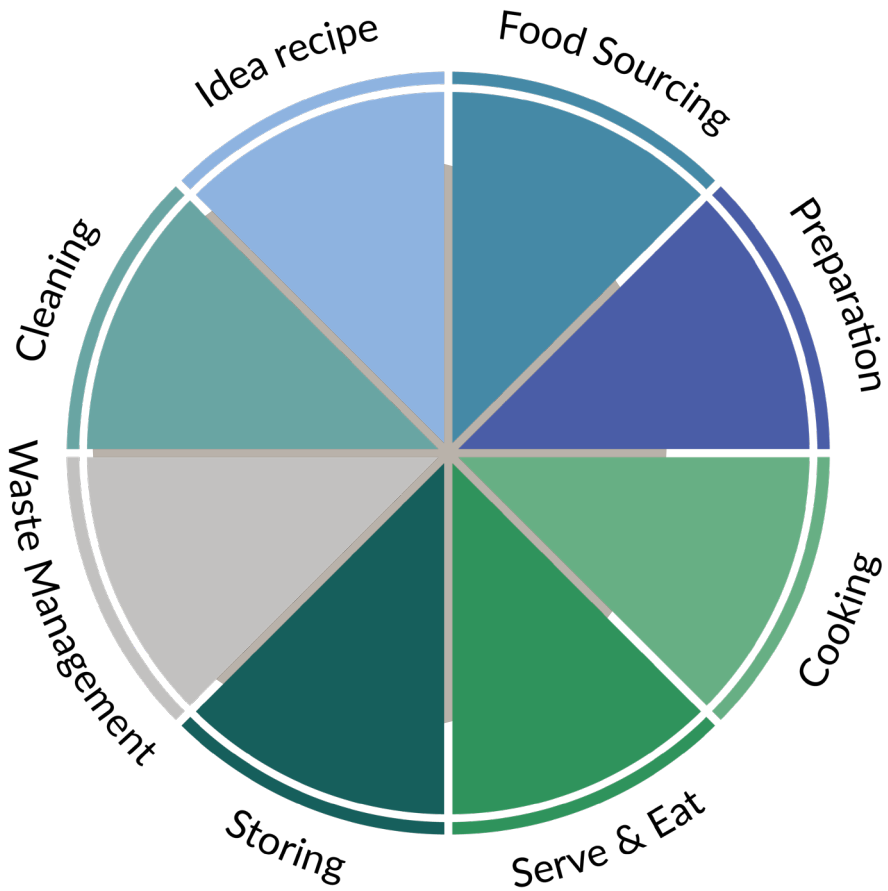


Figure 3.4 2025 cooking journey by Braun Household

Braun analysed this journey and explains it as can be seen in Figure 3.4 (company internal document, 2025). The journey starts with the idea of a recipe. This is often influenced by a lot of factors. Social Media, Friends & Family, advertisement and the environment you find yourself are all examples of how you will decide what you want to eat. After selecting a dish, food has to be sourced. This can be done by supermarkets, delivery services or your own garden. When all ingredients are collected it is time to prepare. Cutting and peeling vegetables, marinating meat, seasoning your creation. This is where the cook's identity enters. Roughly cut pieces, spicey marination or a little touch of the secret ingredient. This is followed by the cooking itself. At this moment a dish comes together. Boiling, baking, frying or steaming the ingredients will influence the taste and digestion a lot.

Next the food gets served according to the occasion. Although this is often considered as in unimportant step during cooking, this will majorly influence the taste and experience (Motoki et al., 2023).
While eating often the pans are placed on the dining table and slowly start cooling down. After everyone is satisfied, leftovers are stored in food containers, thrown in the waste bin or dumped on the compost heap. Nowadays people are often not conscious about the fact that the most amount of waste generated in a household, happens while cooking (Suthar & Singh, 2014).
The last step of cooking entails cleaning. Some people still wash their dishes by hand, while most use a dishwasher. Next to washing plates and cutlery, also all appliances, utensils and kitchen surfaces should be cleaned.

In a previous collaboration with Braun, together with fellow students I performed a small study on the emotional state during the cooking journey (unpublished ACD report). The result can be seen in Figure 3.5.
Since this thesis is also focussed on the social interaction, a second line is added to the graph which estimates the amount of social interaction at each phase (personal interpretation).

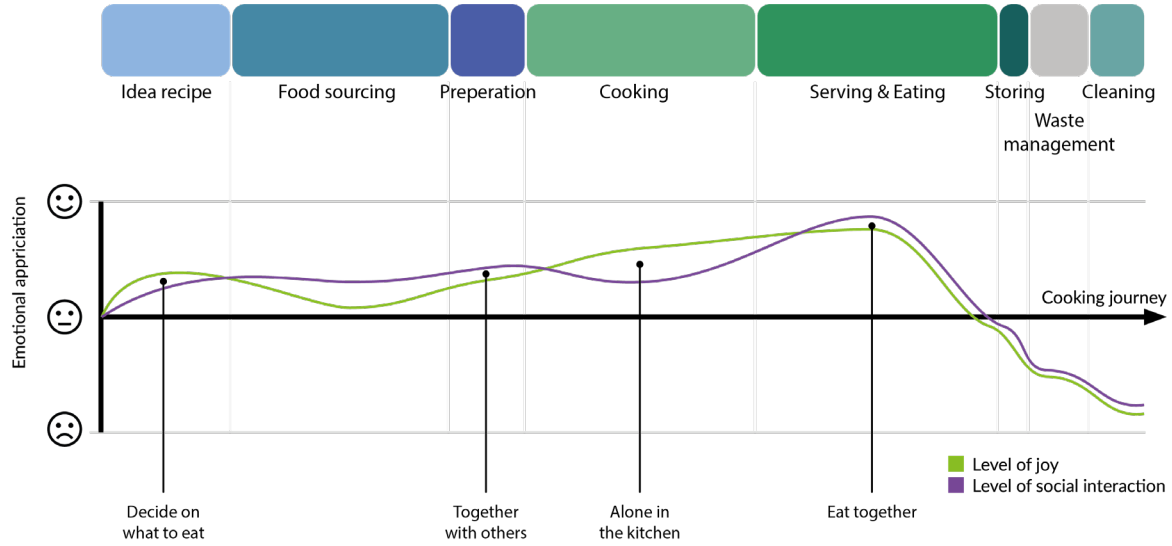


Figure 3.5 2026 level of joy and social interaction during the cooking process

Within the new design, the goal is to improve the overall level of social interaction during cooking. As indicated in the previous chapters this will be achieved by merging the cooking phase with the eating phase. In Figure 3.6 the desired cooking journey is mapped for the new product.

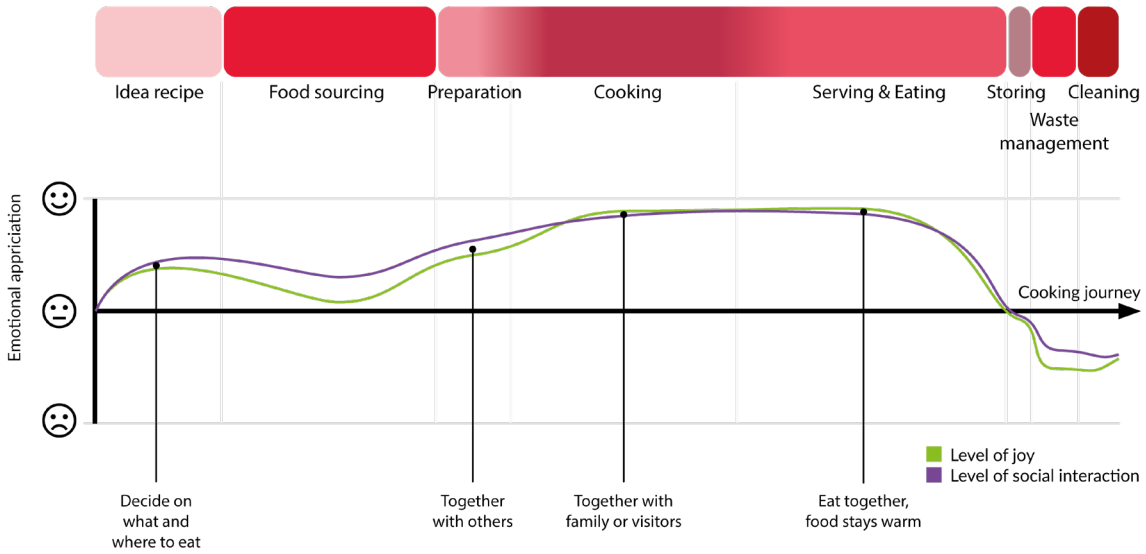


Figure 3.6 Predicted level of joy and social interaction with new design

The moment of choosing a recipe will vastly remain the same. A slight increase for both joy and social interaction is caused by the opportunity to select a desired location. In many cases this will remain at the dinning table, but the possibility to explore new places or enjoy fresh air at your balcony or garden will improve the initial excitement. Food sourcing will vastly remain the same by going to the supermarket, although home delivery of ingredients will become more regular towards 2040.

It is during preparation where things start to change. With the ability to move with the social interaction, no valuable time together has to be lost. There is the possibility to prepare together, but if wanted this can also be done alone. By being near your family, friends or visitors, no gossips, experiences or stories will be missed. As a result of the increased social interaction, the level of joy will also improve. Regarding cooking, the same statements are valid as with the preparation. Being together with other people at the desired location will improve the overall appreciation of the moment.

After cooking, food gets served and eaten. At this phase another small advantage arises with the mobile kitchen. The pans used for cooking, and often also used for serving, can easily maintain heat because the stove is nearby. This way food will stay warm, even at the second round. The cooking journey is than again finished with storing, waste management and cleaning. The goal is to minimise efforts during these phases to minimise their negative impact.

Project vision

With all the insights and knowledge discussed previously, a project vision can be composed. This vision will be used as guidance through the conceptualisation and design phase.

I want to design a kitchen device which improves the social interaction during cooking, by facilitating independence from the current kitchen area to enable the cook to move with the social interaction. This for everyday use of starters in a 2040 societal context.

The cook should be able to easily participate in the social interaction while cooking instead of being isolated in a separate room. The 2040 societal context entails compact living areas, including indoor rooms, extended by an outdoor balcony or garden. The device should be suitable for daily use within this home area.

This vision creates the opportunity to develop a mobile kitchen device which bridges the cooking of food with social company.

Design goal

Thus the formulated design goal is as follows. The aim of this project is to develop and explore a conceptual interpretation of the defined vision. Rather than representing a single solution, the design should be understood as a concept which stimulates discussion, societal reflection and future developments.

Ideation

Within this chapter the creative space will be entered. The ideation contains the 2040 context, nomadic, social and independant cooking, and flexible cooking.

Design sketching has been a core element during this project. It realised a creative space with out-of-the box ideas, subject specific brainstorms and an understanding of user journeys. It helped me to explain ideas and to structure my own thoughts.

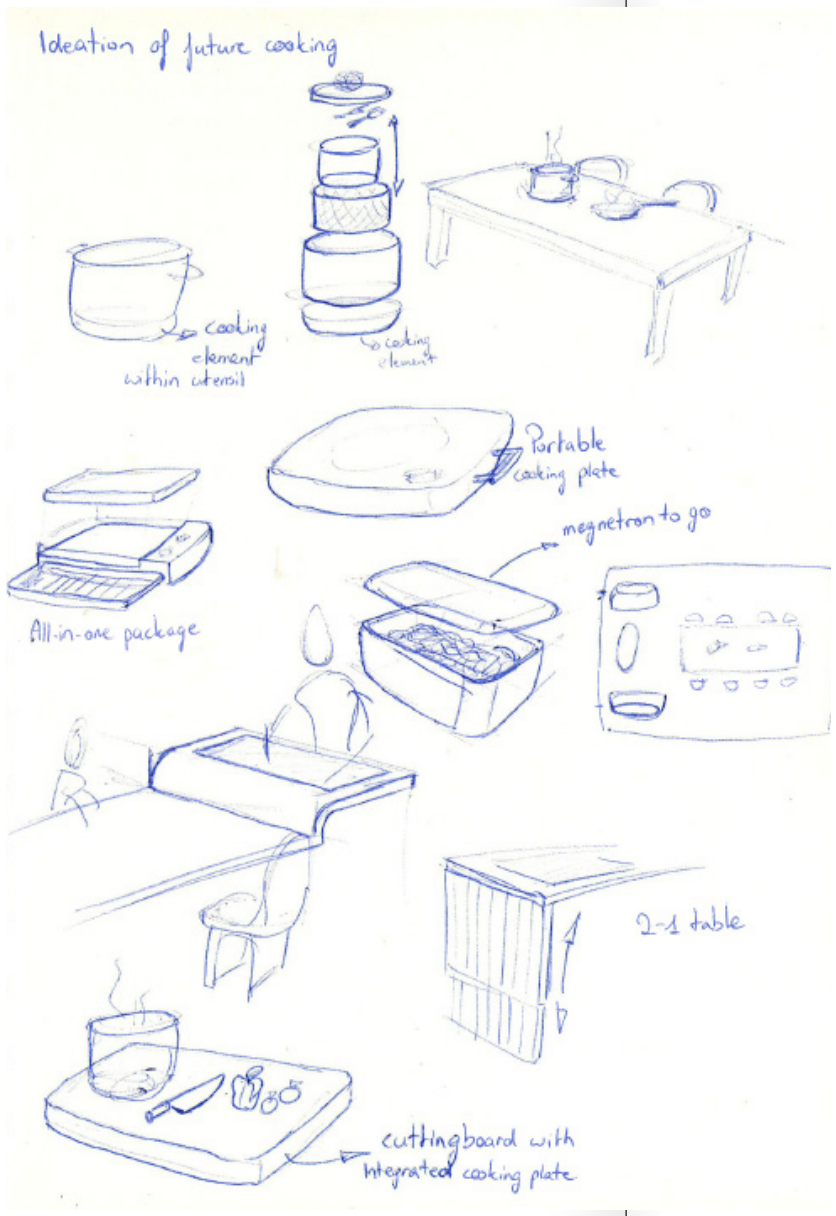
As indicated in the previous chapters, before simply designing a new product it is important to put the design vision in the future context. Will cooking maintain the same position in our daily lives as it does right now?

It is already very common to order food or ingredients at home. Some examples are businesses such as Takeaway, Gorillas, and Hello Fresh. Although we have access to this highly efficient way of getting food, people still prefer to cook for themselves. It is culture, and everyone likes it for their own reasons. Some see it as showing love, some as an act of mindfulness, and others just like to be in control of their own nutrients.

Next to maintaining the basic desires of cooking and implementing the design vision, it is important to consider the future context. As described in the previous chapter some examples are compact housing, autonomous transport and a busy lifestyle.

As can be seen in Figure 4.1, there are countless possibilities to combine the social interaction with cooking.

A solution could be to merge the cooking and eating area (Figure 4.2), to morph the phases of cooking, eating and to linger over dinner. This brings the cook in direct contact with the social interaction. When adding a level of mobility to this idea, the user is able to move through its compact cosy home, or the sunny balcony.



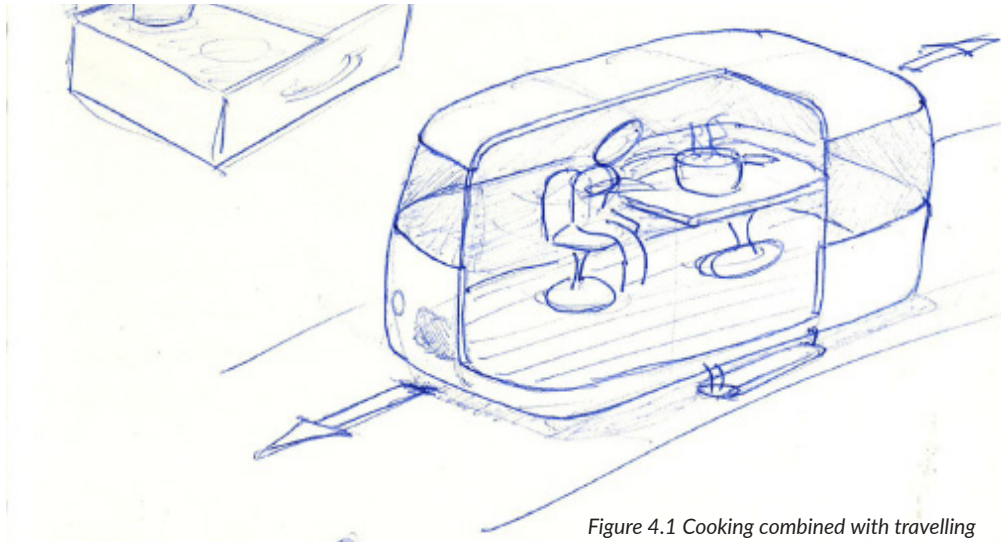


Figure 4.1 Cooking combined with travelling

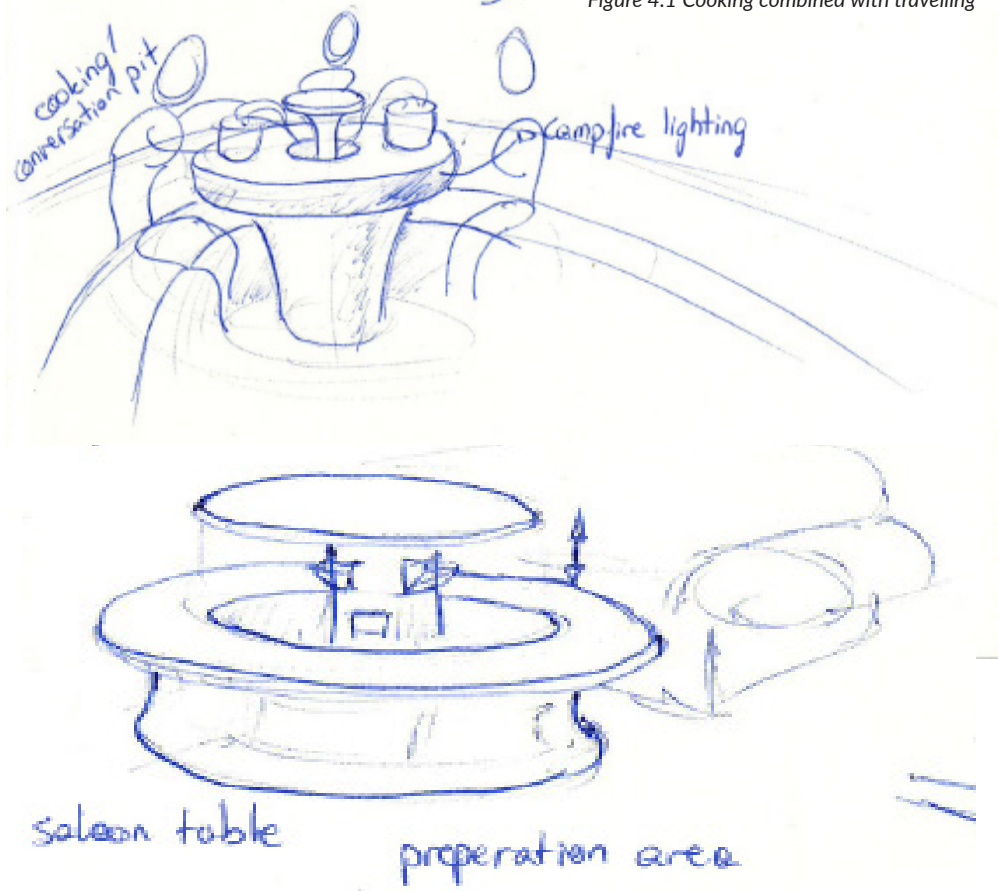


Figure 4.2 Merged cooking and eating phase

Nomadic cooking

When merging the cooking and eating area, and adding a degree of movability, a lot of factors should be considered. While moving all the necessary products, ingredients and utensils should be suitable for transport. The big question is which factors will be included in this process. If people from the future only heat their prefab meals and ingredients, the development should focus on a compact independent heating element.

As mentioned before, also in 2040 people still like to be in control of the cooking process. Therefore it is wise to consider more than only heating, and explore all steps in the cooking journey. Ingredients, herbs, utensils, specific appliances should then be included in the transport. In Figure 4.3 some ideation regarding this transport is drawn.

Additional to the transport, the energy source has to be included (see Figure 4.5). When there is a desire to cook independently, it should be able to function independently. While exploring the possibilities, the products' context is from great importance. As described previously people should have the freedom to cook wherever they want at the daily use. Both indoors and outdoors (balcony or garden) include their own requirements and restrictions such as fume extraction, access to energy and environmental conditions.

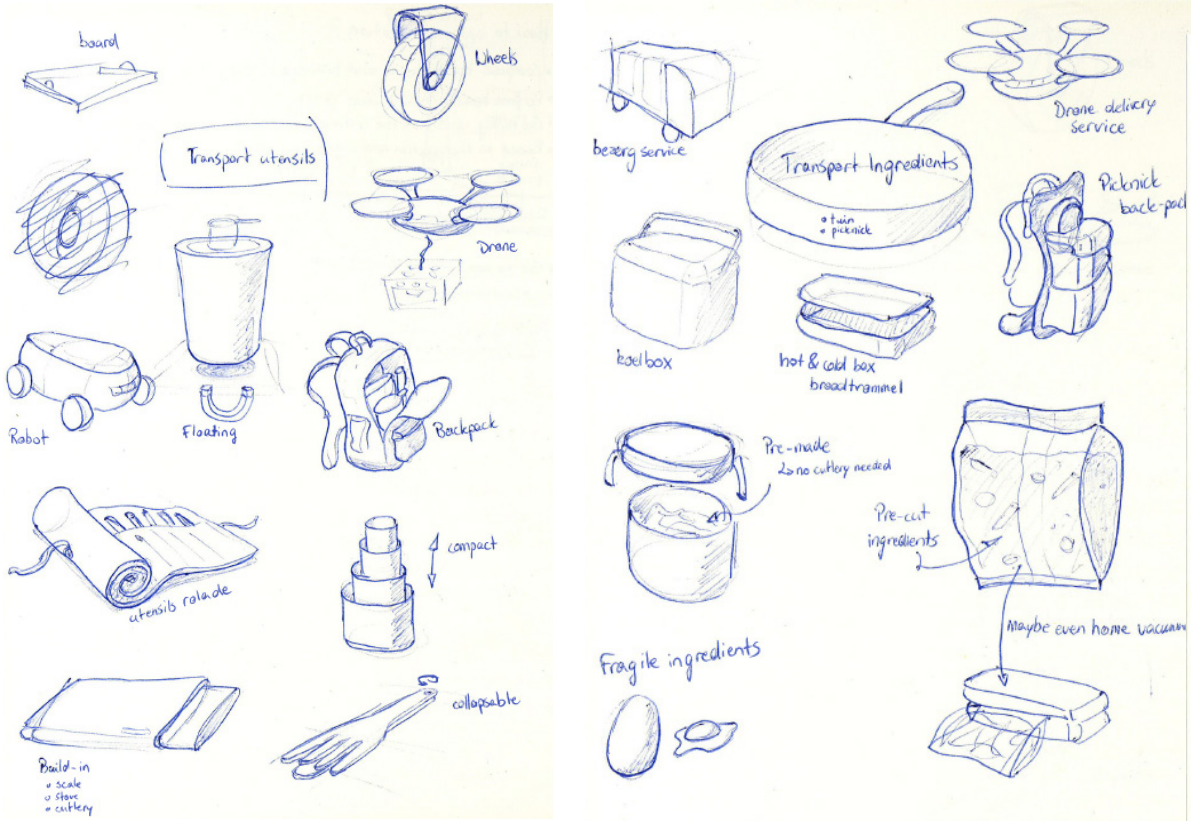


Figure 4.3 Transport of utensils and ingredients

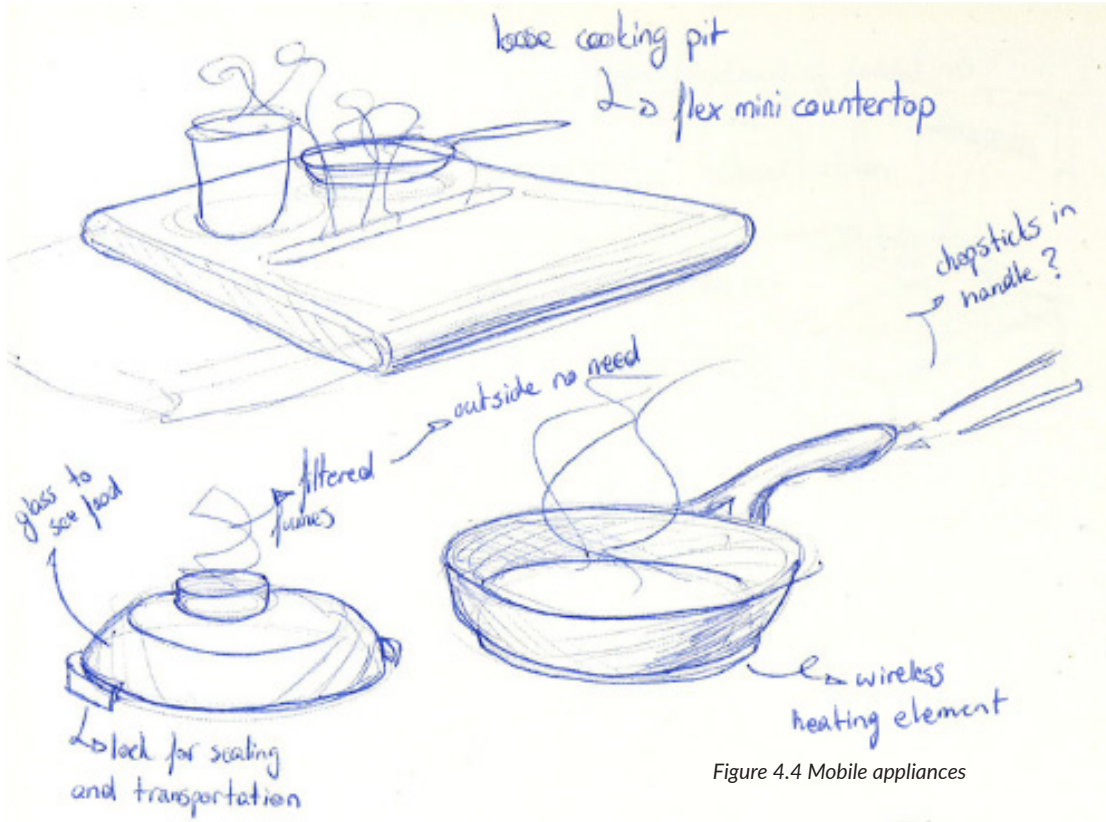
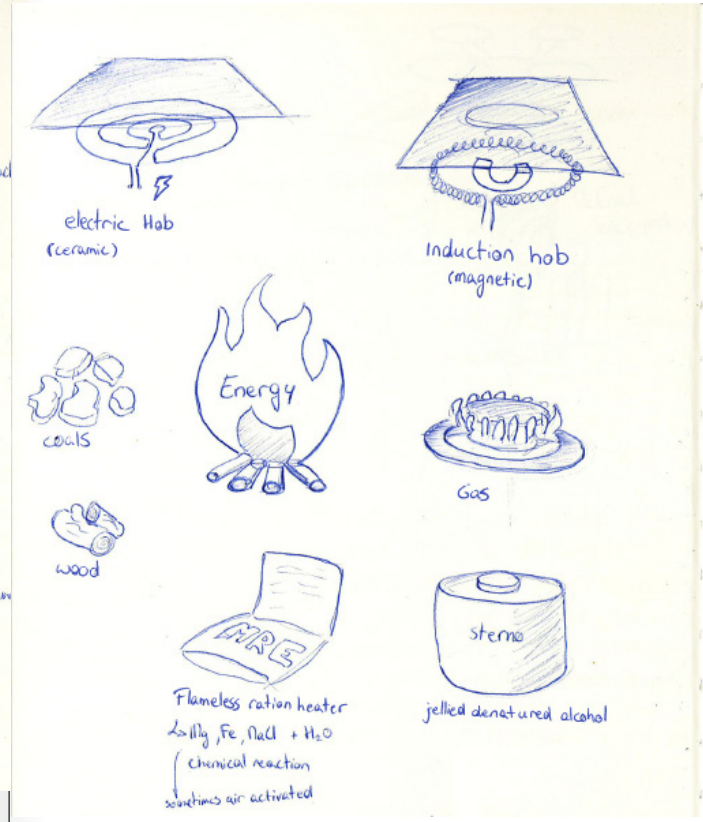


Figure 4.4 Mobile appliances



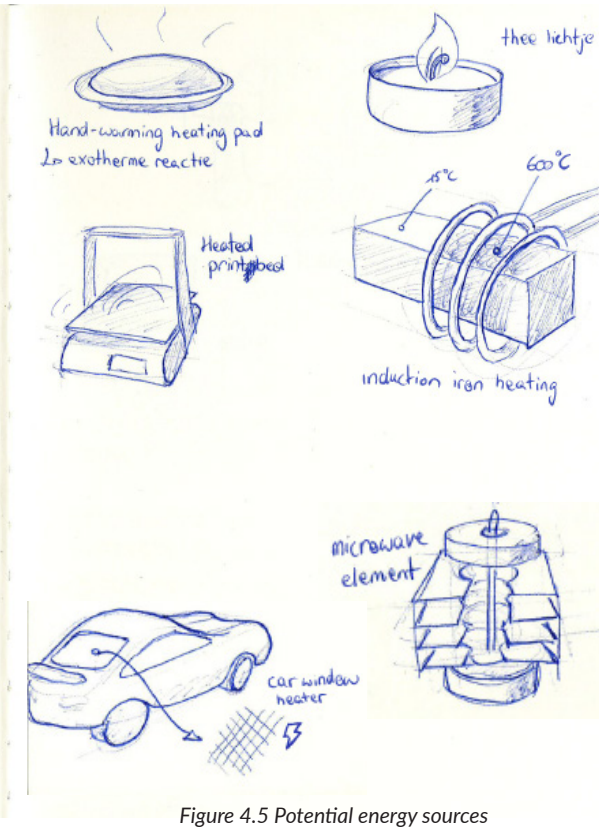
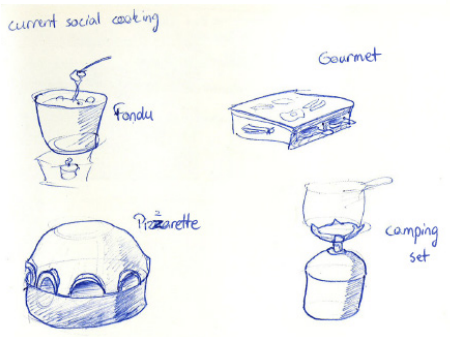


Figure 4.5 Potential energy sources

Social cooking

Today in 2026, many appliances already exist which improve the social interaction while eating and cooking. In the Netherlands we have some well-known examples such as the gourmet and pizzarette (see Figure 4.6). In Europe we are familiar with raclette, and worldwide we all know the fondue and Korean BBQ. These are all concepts which combine eating and cooking, but their usage is occasionally and fail to become the standard for everyday cooking.

Often the eating and cooking with social gatherings differ quite a lot from the daily approach.
On a regular day, after work people dive into the kitchen to quickly prepare a meal.
For the social gathering on the other hand, imagine a hot summer day, people tend to go outside and enjoy the weather. Easy choice to reach out to the BBQ. This product is a good example of cooking with the social interaction in its core. Spending time together while still being in control of the cooking process. In this case, different factors support the social interaction. Some examples are the (regularly) round shape of the grill and easy manoeuvrability of the device. This outdoor cooking can be of very good inspiration for social cooking (see Figure 4.7).



4.6 2026 social cooking apliances

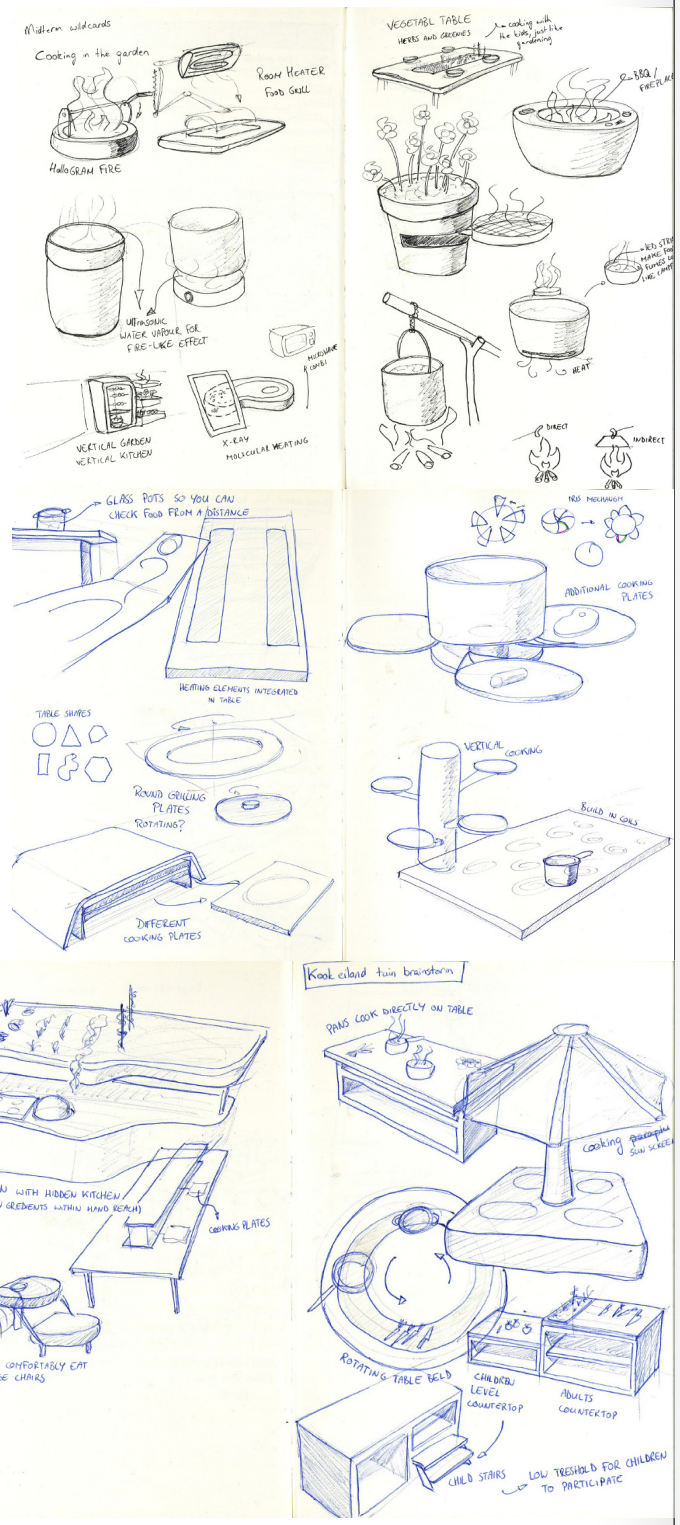


Figure 4.7 Ideation for potential outdoor social cooking

With the obtained insights, some more specific concept ideas arise. Two of them will be described in the next pages.

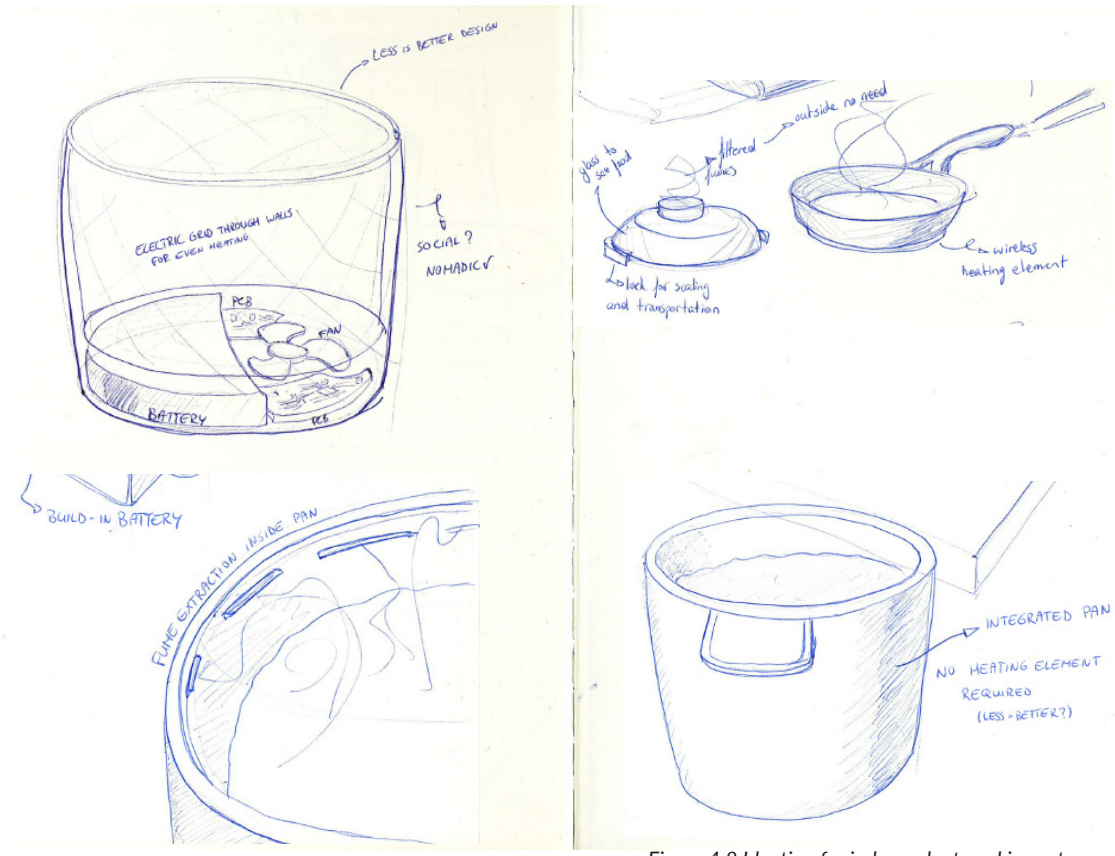


Figure 4.8 Ideation for independent cooking set

Independent cooking

Figure 4.8 shows the idea of an independent cooking pan, with implemented heating elements, an (electric) energy source (speculative) and extraction of toxic fumes. This product would facilitate a complete independency of the current cooking stove, and create the opportunity to move with the social interaction. Besides, a heat distribution grid ensures an even heating of the pan so temperature can be regulated very accurately. This creates the opportunity to discover new cooking techniques, such as smart simmering, maintaining temperature or use it as a small oven.

For this product only the cooking phase would be considered. The preparation could be done by the desire of the user. When having less affinity with cooking you can just buy pre-cut ingredients. Busy lifestyles would prefer last minute delivery of fresh ingredients by 2040 home delivery systems. Some people just enjoy the old-fashioned way of preparing the ingredients themselves by hand.

The social interaction will be improved by giving the cook the flexibility to move wherever they want while cooking. Since the pan is not restricted by a fixed stove, other people easily have the possibility to participate in the cooking process.

Flexible kitchen

The flexible kitchen (Figure 4.9) is a concept which aims to replace the complete current fixed kitchen, by a flexible version. The set-up exists out of a fixed base on wheels, with the ability to make it to your own needs.

People with little affinity for cooking only implement the heating element to prepare their prefab meal.
Home cooks who love the complete process of cooking have the freedom to include e.g. multiple heating- and cooling elements, a collapsable countertop and a utensils' storage.

The flexible kitchen is approachable from all sides, so everyone is able to contribute to the cooking process. The separate modules can be detached easily which creates the possibility to use cooking utensils separate from the base. This way food can e.g. simmer in the middle of the table, in the centre of the social interaction.

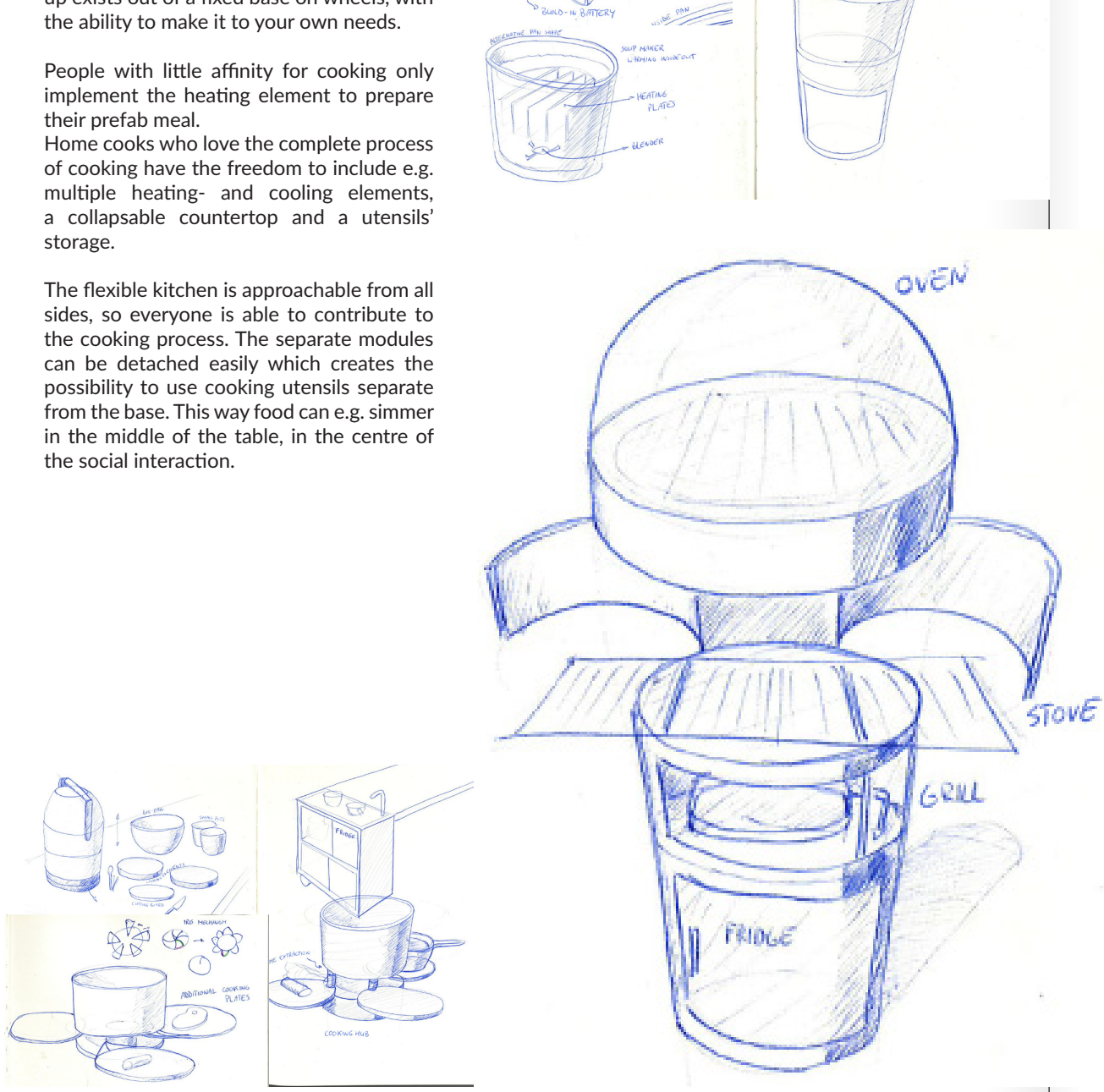


Figure 4.9 Ideation for flexible kitchen

Conclusion

To conclude the general ideation and to convert towards a more specific concept, decisions have to be made. The two concept idea directions, Independent cooking and the flexible kitchen, both serve the key aspects from the project. But compared to each other the flexible kitchen scores slightly better. Therefore this will be developed in more detail towards the next chapters.

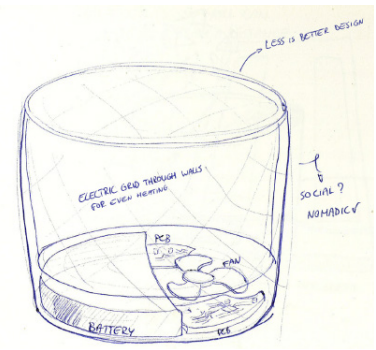
Social interaction
The focus during cooking should be on the social interaction. Both idea directions acquire this by enabling the freedom to move where the interaction is taking place. Since the flexible kitchen considers the complete cooking journey, the cook is not disturbed by walking back and forward to collect utensils. Most of the advantages of the independent pan can also be implemented in this flexible kitchen.

Future context
As mentioned in the future we face new challenges. Living areas are decreasing in size which requires a more efficient and smart interior layout. Both idea directions serve and anticipate this element equally.

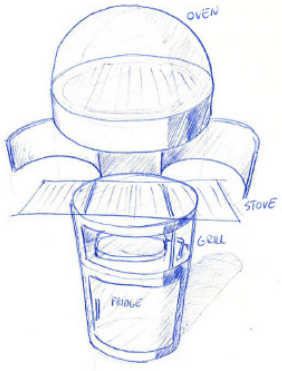
Independence
As stated in the beginning of this paper, we need to create independence from the current kitchen area. While the pan direction only focusses on the cooking phase, the flexible kitchen creates a complete independency from the current kitchen area.

Cooking journey
With the flexible kitchen the complete cooking journey is included. It creates freedom for the users to shape it to their own preferences. This way there is a greater support to serve all future users. It is a clear realisation of the new Frankfurter Kitchen.

Independent cooking



Flexible kitchen



○	Social interaction	●
●	Future context	●
○	Independence	●
○	Cooking journey	●

Conceptualisation

Ideas are becoming reality. First the **future context** is visualised to set boundaries. This is followed by identifying sub challenges and subjects. A **list of requirements** defines the benchmark to validate ideas. All different subjects will be discussed separately.

Future context

As discussed in the analyses chapter, through many years the kitchen area has been evolving to a very efficient area with all required products, utensils, appliances, ingredients and energy sources in one place.

When designing a flexible kitchen the key element is movability. For that reason it is important to specify which elements of the cooking process and current devices should be considered implementing within the new kitchen. Some products are used more often than others, so only the most frequently used ones should be implemented to maximise movability.

As previously discussed, this design project focusses on the 2040 Dutch urban area. Population growth leads to more compact and efficient home interiors. A starters couple has just bought their first apartment. With their busy lifestyle of working full-time, frequently sporting and other hobbies, they cherrish the moments together or with friends. These social interactions mainly take place around dinner.

Figure 5.1 design context, 2040 home interior

Assuming there is a flexible kitchen, aspects from the traditional kitchen will merge with the central area of the house.
Frequently used applainces with little impact on the social interaction, such as the oven and fridge will be implemented in the central area (see Figure 5.1). When using these appliances, the cook often doesn't have to leave the social interaction, or when cooking elsewhere (e.g. on the balcony as in Figure 5.2) only for a short moment of time.

Not daily-used appliances, such as a food processor or blender will be stored to the convenience of the user (cabinet or storage elsewhere such as in Figure 5.3). Direct acces is not required since it will only influence the social interaction incidentally.

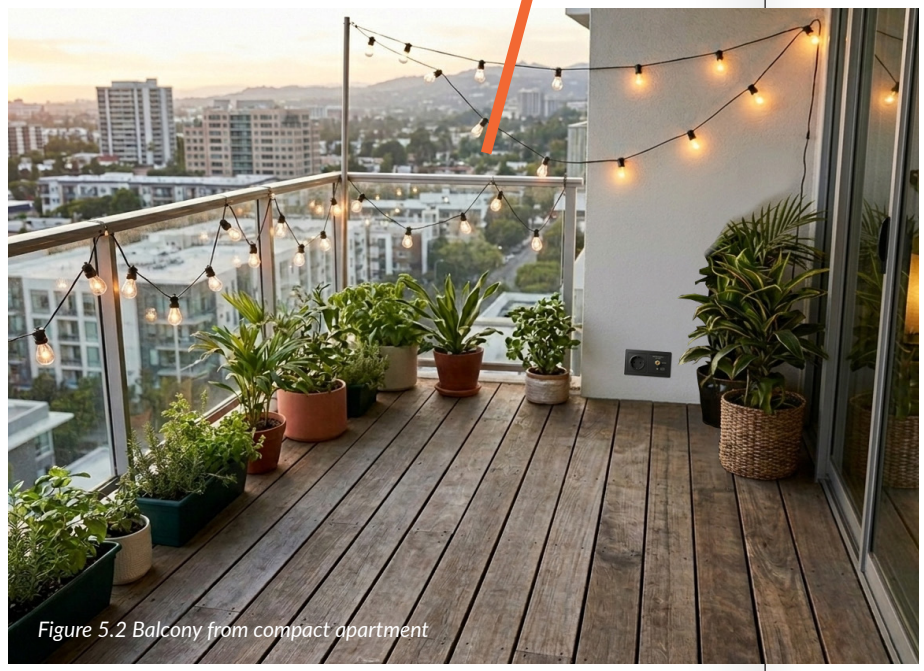


Figure 5.2 Balcony from compact apartment

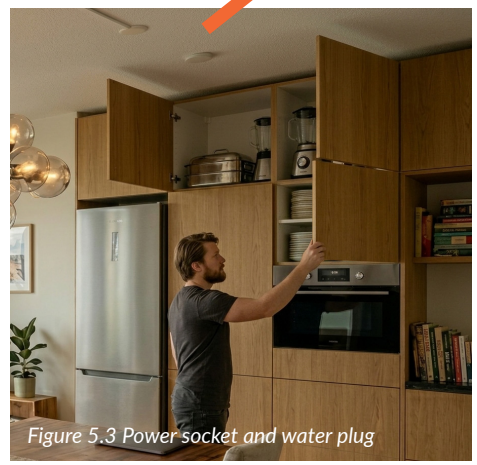


Figure 5.3 Power socket and water plug

Figure 5.4 Power socket and water plug

In 2040 the water tap with sink will not be located in a separate room anymore, but integrated in the main living area (e.g. within the dining table).
Distributed through the home there are multiple electricity sockets and water plugs, as visualised in Figure 5.4. This creates the opportunity for the flexible kitchen to have access to unlimited power capacity and fresh water through the whole apartment, and even on the balcony.

However, there are products which are frequently used and would influence the social interaction when not having a level of mobility. These are visualised in Figure 5.5. Roughly it contains a heating element (stove), cutting boards, cooking utensils, herbs & spices, frequently used cookware storage, energy controle and wheels.

Heating element (stove)
This is the main and most important element in the current kitchen. It is used in almost all situations and transforms the raw ingredients into edible food. This cooking takes some time and causes the user to miss a big part of the social interaction. For that reason it is key to implement a heating element in the flexible kitchen.

Cutting boards
Preparing food is another big step during the cooking journey. When implementing cuttingboards and associate utensils, the cook is able to prepare ingredients at the location of the social interaction without havinf to leave the room.

Cooking utensils
During the cooking process multiple utensils are used. To prevent the cook to walk back an forward all the time, these should be implemented in the flexible kitchen.

Herbs & spices
To create character and taste in your dish, herbs and spices are neseccary to be in hand reach of the cook.

Frequently used cookware storage
On a daily base the same pots and pans are used by cooks. These should be stored nearby to prevent the user from spending a lot of time collecting and storing these and miss out on the social interaction.

Energy controle
Energy is an essential component to cook. Mainly to power the heating element discribed above, but also to provide lighting or electric appliance controle.

Wheels
Wheels create the possibility to move with the social interaction. Therefore enabeling the cook to use all the above mentioned components to create a dish at the desired location.

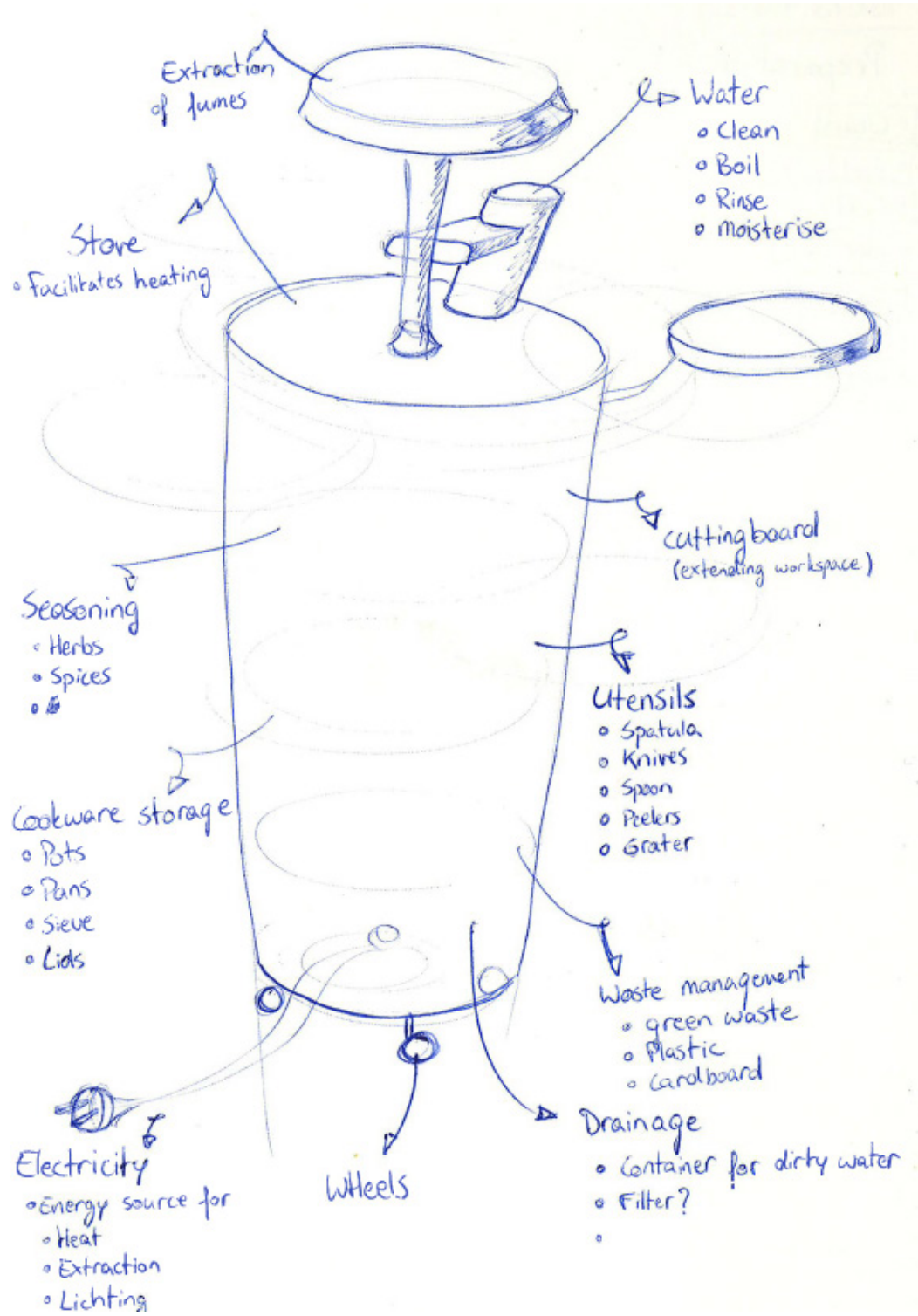


Figure 5.5 Subjects to implement in concept

Scenes

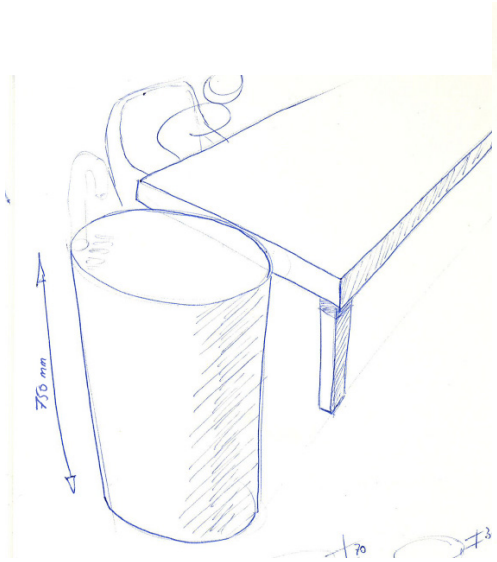
Besides considering cooking activities and products, another aspect becomes relevant to investigate in a flexible kitchen. The influence of the location where the cooking will be done, in combination with the social interaction.

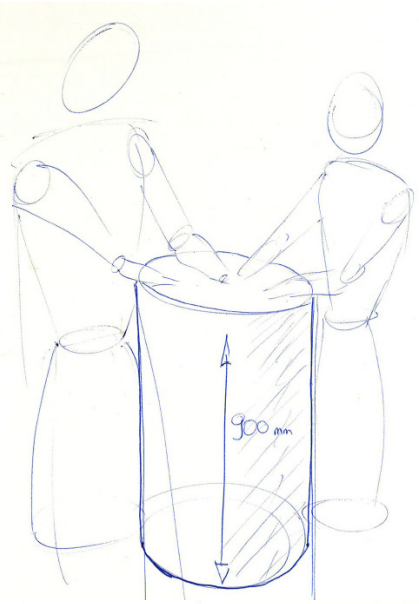
Different heights
Social interactions are often performed while seated. Cooking however is mainly done standing. With a flexible kitchen the opportunity arises to combine these. When applaying flexibility, people are able set their personal measurements to improve an ergonomic posture while standing. When adjusting the height to a seated position, the cook, as well as other people within the social interaction, have the ability to cook, simmer or maintain heat of the dish without having to leave the desired location.

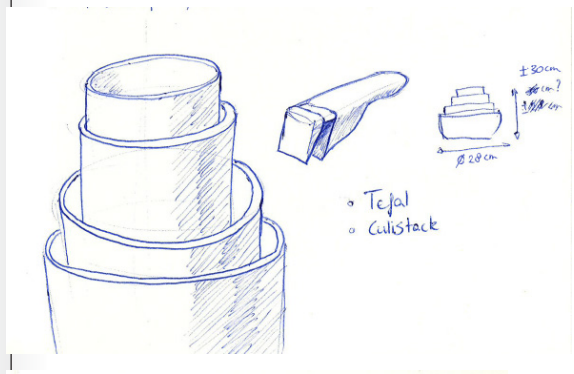
Multiple people
When cooking together it is important to have sufficient surface area and accessibility for all participating members. This both in terms of stoves and personal space.

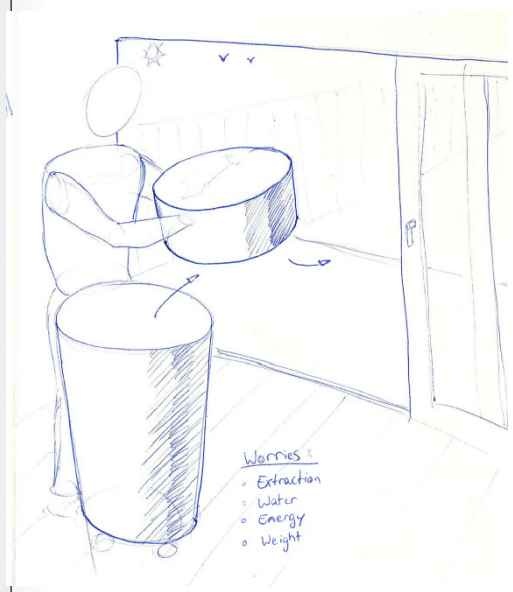
Mobility
As indicated before the device should be mobile so the cook is able to move with the interaction, both indoors and outdoors at the balcony. This could be achieved in multiple ways, by transporting the complete device, or separate components from the device.

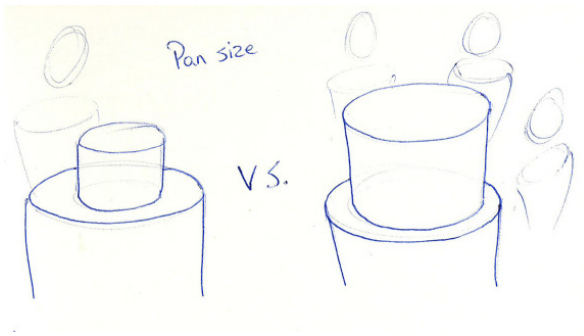
Universal cookware
Although this flexible kitchen is focussed on the social interaction, the efficiency of space utilisation should be maximised. Regarding cookware it is important to consider whether people are still going to use their personal pots and pans, or if universal cookware is implemented within the design. Universal cookware could have an advantage of compact measurements and ability to stack. To create a better emotional value between the product and user, it is from importance to let the user determine their own preference towards their cookware. Therefore the flexible kitchen should consider sufficient storage room for all frequently used cookware.











Main elements and requirements

With this knowledge the key elements for the design are determined and combined in a list of requirements (Table 5.1). This creates a strong base for the conceptualisation phase. It functions as a guidance and benchmark for decision making.

Theme	Requirement	SMART
Social	Ability to move with the social interaction in a 2040 compact apartment context	Indoors living area and the balcony
	Minimise disturbance of the social interaction	No noice polution
	Support to cook with multiple people at once	3 people
Supply	Grant acces to drinkable water serving 2 meals	10 L
	Grant acces to energy serving 2 meals	3,2 kWh
Technical properties	Heating elements compatibel with current cookware	3 stoves
	Storage for personalised cookware	Min. 5 items
	Storage for personalised utensils	Min. 15 items
	Storage for personalised herbs and spices	Min. 8 items
	Facility to prepare ingredients	Min. 2 cuttingboards
	Support to cook in a seated and standing posture	
	Facility for waste management	Min. 5L of storage
Safety	Ensure safety for the cook, bystanders and the environment	
	Minimise risk of burning by hot cookware	
	Minimise risk of wounding by sharp utensils	
	Purification of toxic fumes created by the cooking process	
	The product may not fall over	
	The product must include a braking system	

Table 5.1 List of requirements

With these requirements it is time to start with the conceptualisation. For a better organisation, the different challenges are fragmentised in separate paragraphs. In the next pages multiple possibilities are explored and after validating a selection of these possibilities is made to implement in the final concept.

The different challenges which are investigated are the following: Power supply, Water supply, Induction technology, Water control, Fume extraction, Storage, Mobility and the overall implementation.

Power supply

The first challenge is to select a suitable power source. As indicated in the requirements list, the user should be able to cook 2 dishes without running out of energy. Therefore several options are explored.

Since the product will mainly be used indoors (and occasionally at the balcony), unhealthy emissions should be prevented for safe control in the home environment. In addition, because of the flexible properties, the level of mobility from the energy source (weight and size) must be considered.

After exploring different options of power sources (such as gas, electricity or chemical reactions), electricity promisses to be the most feasible solution regarding efficiency, safety, sustainability and accessibility.

With the choice of electricity, still multiple decisions and considerations should be done. The type of stove to heat food, and the energy supply or storage.

Type of stove
When looking at current electric cooking tops there are two types, ceramic and induction. Ceramic cooking tops work by an electric heating element, halogen lamp or infra red element which heats up the above placed glass plate, which in its turn heats up the pan. The induction plate on the other hand works with an alternating electromagnetic field. When placing a ferromagnetic pan on top it starts reacting and the internal generated friction causes the pan to heat.

When comparing these techniques on efficiency and safety, the induction technique scores better since all energy is transferred directly into the pan, and the countertop cools down faster.

Energy supply
To grant the user access to complete flexibility, the implementation of a battery is to be considered. Before simply implementing, first some calculations and trend analysis towards 2040 should be done.

For the calculations an example is used in which a meal, spagetthi Bolognese, is cooked for 4 people. The numbers are estimations from reality.

Energy calculations:

Boiling pasta:
- Burner power: 2 kW
- Time: 15-20 min. (heat, boil and cook)
- Total energy: ~0.5-0.7 kWh

Sauce:
- Browning meat: ~0.3 kWh
- Simmer: ~0.4-0.6 kWh
- Total energy: ~0.7-0.9 kWh

Total required energy:
~1.2-1.6 kWh

With this information we are able to compose requirements for a potential battery. Since the requirement from the flexible kitchen demands to cook at least 2 meals without being limited by the technology, the capacity from the calculation should be doubled:

Required capacity (kWh):	1.6	3.2
Required continious power (kW):	2	2

With current technologies this results in battery packs such as the Jackery Explorer 2000 v2 or the Anker Solic C2000. In these examples the output of 2kW is sufficient, but regarding the capacity they only deliver 2kWh. In addition, with a weight of 18 kg (~27kg for 3kWh) the flexible kitchen will become significantly more heavy.

Figure 5.6 2026 battery packs, Jackery Explorer 2000 v2 & the Anker Solic C2000

Analysis of Eszoneo (The evolution of energy density in Lithium-Ion batteries over yime, z.d.) indicates the efficiency of batteries will keep improving through the next years. By interpreting their data, a steady energy density improvement of ~4%/year can be seen. As can be seen in Figure X, in an optimistic scenario for 2040 a energy density could be reached of 600 Wh/kg. Knowing that the current weight of a battery would be ~27kg, this could potentially reduce to ~16kg.
These calculations indicate that the implementation of batteries in separate components (e.g. to create wireless cooking tops) are still unrealistic towards 2040. However the implementation of one general battery in the base of the device could be realistic, although the required volume and resulting weight should be considered.

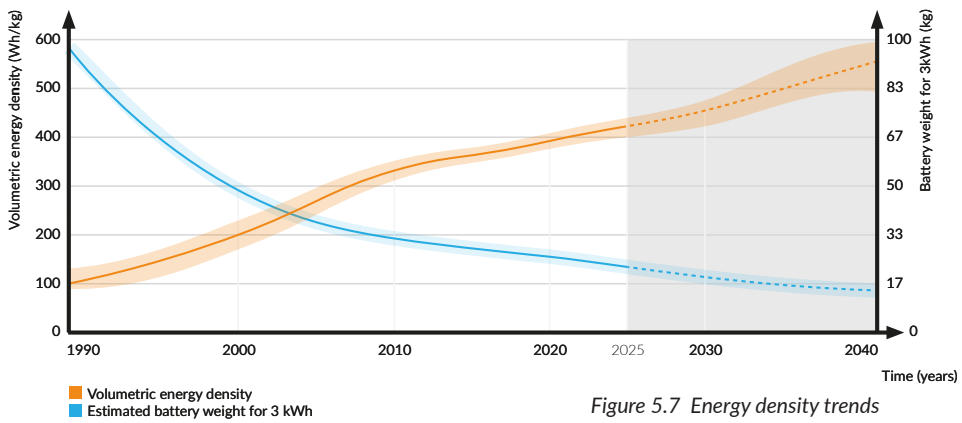


Figure 5.7 Energy density trends

An alternative solution is a net connection by a wire, plugged into a power socket. This method is currently used in many applications since it provides a steady, unlimited capacity of electric energy. It is a fairly simple connection present in all walls (Figure 5.8), even at balconies. They are easy accessible, and offices often have them implemented in floors or ceilings. This proves an almost certain availability to eletricity. However, implementing a power cord will influence the flexibility of the new kitchen. The user will be restricted by the length of the cord. Additionally the action of plugging in a cord, everytime moving the kitchen, can be seen as a hassle.

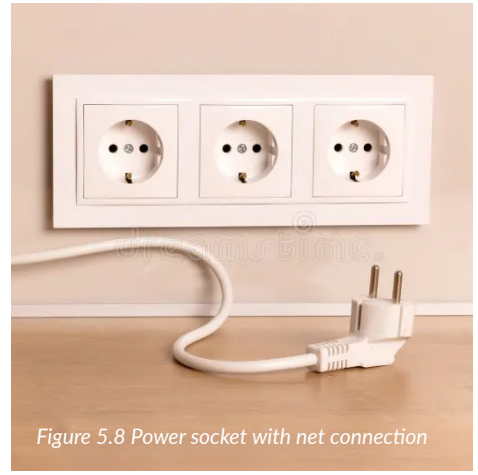


Figure 5.8 Power socket with net connection

To extend exploring the electricity supply, also generating electricity locally is investigated. Calculations in combination with the defined requirements indicated no suitability for direct solar power, wind turbines or manualy powered. All options generate too little continuous power and require a big installation and additional batteries.

Figure 5.9 Local generated power. Solar, Wind and manual power

Comparison

Requirement	Battery	Net connection
Output		
Capacity		
Flexibility		
Experience		
Compact		
Sustainability		

Table 5.2 Harris profile power supply

When comparing with each other, the battery and power cord score quite simular (Table 5.2). With the battery creating more flexibility and the power cord better performances. Driven by better performance, the ability to plug in additional appliances, and sustainability purposes the decision is made to proceed with the power cord within the flexible kitchen. User testing should indicate whether eventually more flexibility is desired.

Water supply

Within the cooking journey, a lot of water is involved. This is for cleaning ingredients, cooking and moisturising food. Additionally in the current kitchen, the water tap is the main location to fill a glass of water. Almost all dishes include adding water, which indicates the necessity of implementing water access within the flexible kitchen. When not implementing this feature, the cook has to leave the social interaction frequently.

Implementing water access can be achieved in multiple ways. With a water reservoir or with a direct connection to the general water supply.

Water reservoir
A water reservoir seems a simple solution to implement within the flexible kitchen. Reservoirs exist in all kind of shapes and usecases (Figure 5.10). Plastic tanks, bags, implemented pumping systems or containers are some examples. These tanks need to be filled with water, and depending on the type of outlet the user is able to easily tap water. The water leaves the tank using gravitational force, or with a water pump.

While making use of gravitational force, it is required to put the water tank above the outlet. The water pressure and flow rate will be determined by the height difference between the water level and output. This limited flow rate is often associated with lower quality such as camping products.

Instead of gravitational force, a water pump could be used. This implementation is able to create a decent flow rate (7-13 L/min) and water pressure (1.5-3 bar). Average dimensions of these pumps are ~200x120x110mm and run on electricity.

Desirable flow rates could be achieved, but these tanks have limited capacity and some implementations need additional energy to run.

Figure 5.10 Different kinds of water reservoirs

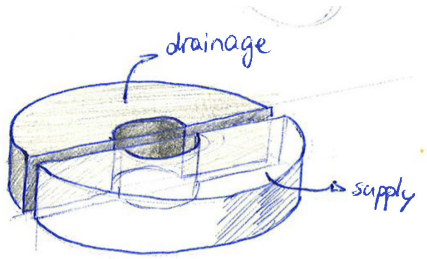


Figure 5.11 Potential water reservoir in flexible kitchen

Direct connection
Houses are connected to a public water network. This means water is stored in a public, central location at a specific height. Caused by the height difference between this watertower and the houses, water pressure is created. Currently within a house, the water is distributed to locations such as the kitchen, bathrooms and garages.

Connecting the flexible kitchen to this system would mean quite some reorganisation of the home infrastructure. Just as electricity sockets, waterplugs should become available at multiple locations through the house, as well as on the balcony. This seems a big effort, but already in 2026 similar concepts exist.

Looking at water supply within a garden, it is very common to have multiple watertaps or garden hose connections. This way there is access to an unlimited capacity of water, to e.g. water the flowers. This example is comparable to our cooking context. Attaching a hose to the water supply to facilitate an access to unlimited capacity of drinkable water. Besides, connecting to this system would provide a desirable water pressure and flow rate.

Of course there is an impact on the home infrastructure, but not as majourly as it seems. Nowadays popularity is gained to have more water tap points within an interior. Some examples are the watertap above the stove, built-in dog bowl taps, or a tap in the coffee corner (Figure 5.12). This indicates that people are willing to divert from the standard home infrastructure to seek convenience. Implementing such a system could be combined with the electronics system. Distributed through the home and balcony there are water connections (push-fit) in which a hose can be connected (Figure 5.13). The willingness to adapt to this new application should be tested in a user test.

Figure 5.12 Alternative water connections within home interior

Figure 5.13 Visualisation of water plug connection (GEMINI)

Drainage
After boiling ingredients, dirty water needs to be disposed. Two options are explored: collecting the water in a tank, or to exclude it from the flexible kitchen.

When implementing a tank in the flexible kitchen, multiple challenges should be tackeled. Hygiene, Volume and Time consumption.
Dirty water means the system should frequently be cleaned, to prevent undesired smells and bacterial growth. This means the water way should be accessible and easy to disassemble.
Since during the cookingprocess a lot of water evaporates, the used water is always less than the disposed water. Therefore the water level of this drainage tank should be visible so the user can check whether it has to be emptied. This results in an unhygienic look, and the user should always be aware of the tank level.
In the end because of emptying and cleaning the tank, a lot of time is spent. This is a solution to quickly dispose dirty water and prevent the cook from leaving the social interaction. But in the end more time is required to maintain the system.

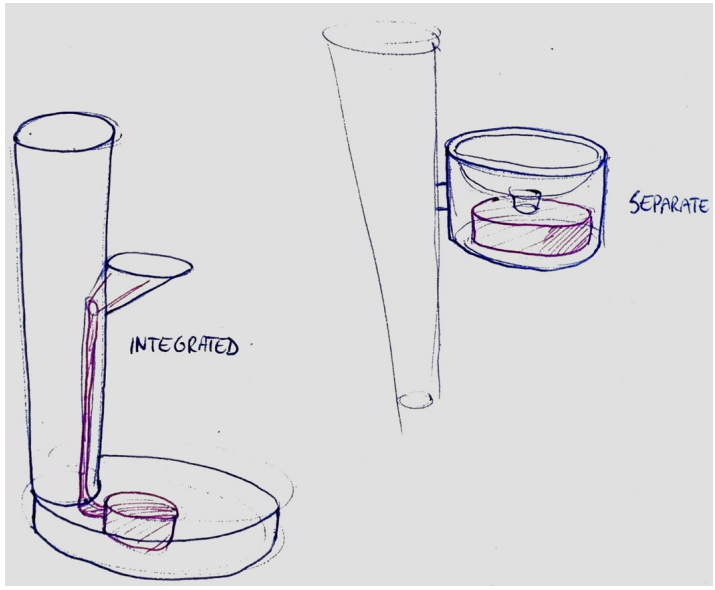


Figure 5.14 Drainage implementation

Excluding this aspect from the system sounds surprisingly. But in the end the draining of water takes only a small moment to leave the social interaction. Besides as previously discussed, within the future home interior aspects from the current kitchen are merged with other areas. This results in the possibility of a sink integrated in the dining area (e.g. within the dining table, as it currently is integrated in the kitchen island). Therefore in many occasions the cook won't even leave the social interaction, and no time is lost outside of the cooking and eating journey.

Regular induction

Previously the basic principles of induction cooking were explained. This technology can be implemented as we know it today. Since it only reacts with ferromagnetic materials, new materials can be explored to extend functionality of the components. This means for example that the cooking plate and cuttingboard can be combined to reduce space. To proof and test this idea, a small prototype was build (Figure 5.15).

Existing induction plate *Induction coil integrated in prototype* *Activating induction coil through wooden plate*

Figure 5.15 Quick prototyping of induction plate

The insights from the quick prototype proof the feasibility of the concept. The induction principles work through the wood and the pan starts to heat when activated. Regarding spaceclaim it should be feasible to limit the height of the cooking top to 35mm to safe space (Figure 5.16).

The drawback from the integration is the heat transfer between the materials. The wood itself is not heating up by the induction waves, but the heated pan will warm up the wooden surface. For a short period of time this is no problem, but for longer exposure it could damage the wood or even catch fire. This problem could be solved by adding a lose silicone plate which isolates the pot from the bottem surface, reducing the transfered heat (invisacook invisamat, z.d.).

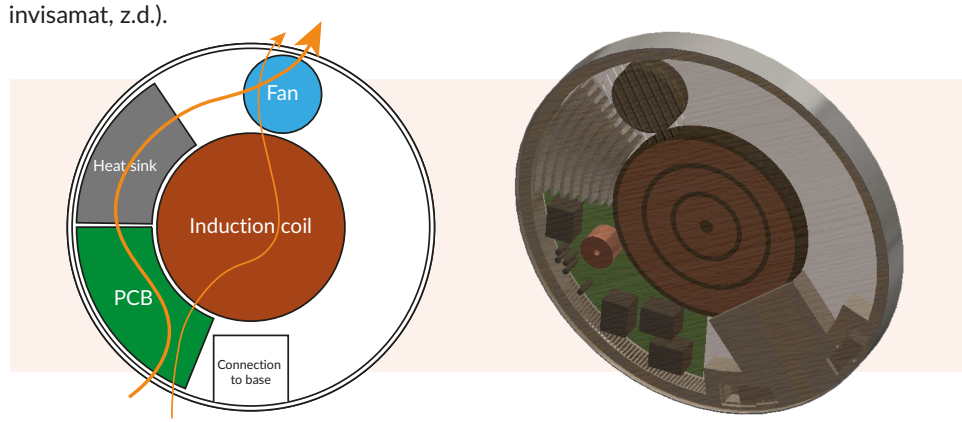


Figure 5.16 Spaceclaim and airflow through the induction plate

Besides testing the feasibility, it is important to understand if this integration is desired. Therefore it is quickly tested with fellow students to gain insights (Figure 5.17). At first they are surprised by the combination, and indicate the innovation is appreciated. Space saving is seen as an advantage. However, second thoughts generally arise concerns and limitations. Most are sceptical for burning marks, degradation of the cuttingboard, cleaning and impractical usage.

When the plate is occupied by a pan, the user will not be able to cut vegetables. Also a property of cuttingboards is the light weight, enabeling the user to slide the chopped vegetables directly into the pan (Figure 5.18). When integrating these two, this won't be possible anymore. This could be solved by adding multiple plates (also adding more workspace and cooking with multiple pans), but the associated weight will cause inconvenience in practice. Therefore the induction plate and cuttingboard could better not be integrated.

As figure 5.19 shows, it is best to introduce a separate cutting board. This can be stored on top of the induction plate. To keep them in place they can be secured by e.g. magnets.

Figure 5.17 User test with fellow students

Figure 5.18 Using cuttingboard to slide vegetables in a pan

Figure 5.19 Splitting cooktop and cuttingboardn a pan

Since the new kitchen is flexible, size is from importance. Therefore when not in use it should be compact. However, while using the kitchen, countertop space could be gained by unfolding the device (Figure 5.20). This creates new opportunities such as chopping vegetables while heating pans, more personal space to cook with multiple people, or to implement more induction plates to enable to cook with multiple pans at once.

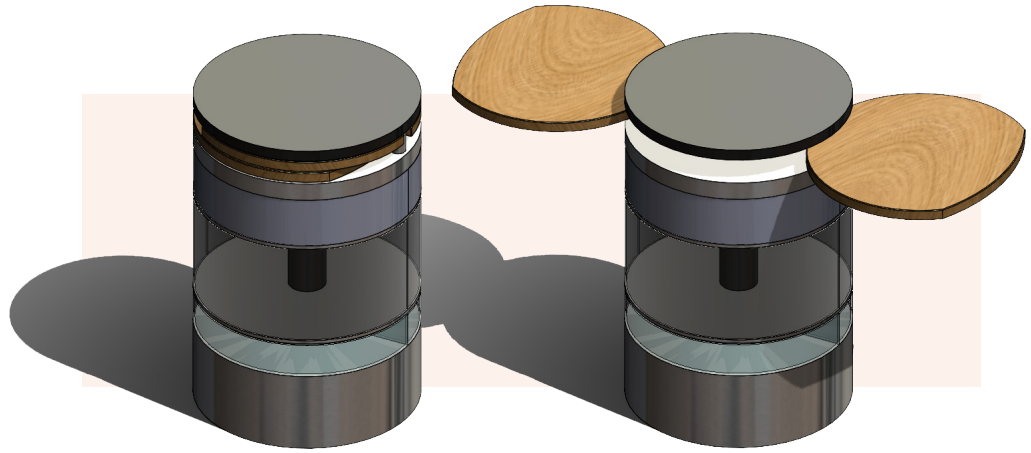


Figure 5.20 Unfolding countertop space

Iterating on this idea of multiple plates connected to a base shows potential. Sliding out, turning around an axis or morphing from the sides are all possible ways to integrate this system (Figure 5.21). In addition, it would be a great advantage if these plates could function both mounted on the base, as well as stand-alone. This would enable the user to also cook on e.g. the dining table while being seated, or after cooking function as a coaster and maintain heat in the pan with a low power function.

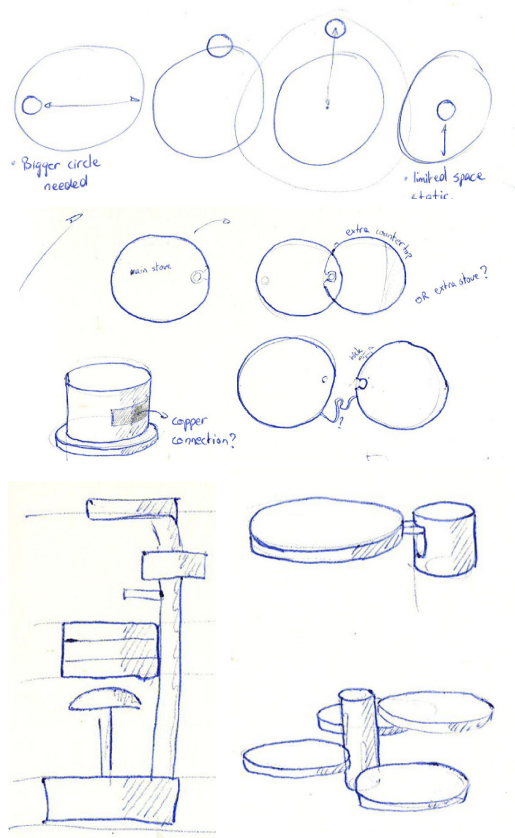


Figure 5.21 Integration iteration on separate countertop plates

Water control

As discussed previously during cooking often water is required. This is for boiling ingredients like rice and pasta, but also for moisterising dishes such as soups or stews. In these situations it would be favourable to add water without having having to leave the social interaction, or to move the pan to reduce ergonomic complaints or chances of spilling.

Nowadays there are many different styles of water faucets. A static tap, pull-out hoses and flexible spring taps are some examples including different types of streams such as a laminar stream, jet spray or aerated stream. After discussing this topic with fellow students, a laminar stream is prefered with not too much pressure to prevent splashing. Furthermore a flexible tap adds value since the stream can easily be directed and controled by the user, which also prevents splashing.


Flexible spring tap

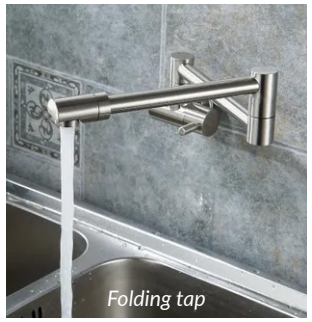


Figure 5.21 Different styles of faucets

Figure 5.22 Different types of flow

Fume extraction

Extractor hoods are standard in current kitchens and serve multiple purposes. During cooking, fumes of burned grease and oils are exposed. This fine particles can reach far into the lungs which on a long term can be unhealthy. Besides these fumes, also microscopical grease particles (aerosols) are diffused in the room which stick to the walls and furniture. This attracts dust, and undesired odours stay in the room. Water vapour is another result of cooking which increases the humidity level. These examples are minimised by the extractor hood, which filters all the undesired aspects out of the air.

Since the flexible kitchen will mainly be used indoors on a daily base, the implementation of this filtering system is of great importance for the user. By implementing a recirculation system, all the above aspects are filtered with carbon filters to maintain a stable indoor climate.

The fumes can be extracted in multiple ways with our flexible kitchen. Top extraction, side extraction and bottem extraction.

Top extraction
This is a reliable way of extracting fumes, since hot air (and emissions) rises. This way less energy is required to guide the air towards the filters. It could be in the shape of one big element, or multiple smaller ones to direct the extractor more specific. The last option is specificaly interesting for the multiple cooktop idea previously discussed.

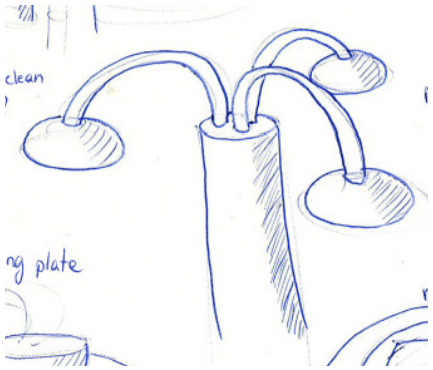


Figure 5.23 Top extraction of fumes

Figure 5.23 Top extraction of fumes

Another option is to implement the hood in the core of the flex kitchen, near the top of the pans. This way the extraction is close to the fumes, and the direction of the rising air only has to be forced slightly towards the filters.

Figure 5.23 Top extraction of fumes

The last option for fume extraction is integration in the cookingtop. This way it is fully integrated and creates a more compact feeling to the user. However, the fumes need to be directed in the opposite direction which requires more energy and higher chance for poor performance. In addition it is very complex to integrate it in the multiple countertop concept.

Requirement	Top extraction	Multiple hoods	Side extraction	Bottem extraction
Performance	☐☐■■	☐☐■■	☐☐■☐	☐■☐☐
Energy efficiency	☐☐■■	☐☐■■	☐☐■■	■■☐☐
Controle	☐☐■☐	☐☐■■	☐☐■☐	☐☐■☐
Compact	■■☐☐	■■☐☐	☐☐■■	☐☐■■
Ease	☐■☐☐	☐■☐☐	☐☐■■	☐☐■■

Table 5.3 Harris profile fume extraction

When comparing the different ideas with each other in terms of performance, efficiency, control, space claim and ease of use, the concept of side extraction scores best. Integrating it in the flexible kitchen ensures a seamless design which is easy to use and to clean. Because of the positioning, it will efficiently filter all fumes and odours.

Storage

As familiar for everyone, the current kitchen is besides cooking also an area of storing. To maintain mobility in the flexible kitchen, it is key to stay compact. Therefore the integrated storage should be restricted to the daily used items. This includes cookware (e.g. pots, pans and strainers), cooking utensils (e.g. knives, spatulas and spoons) and herbs & spices.

As previously indicate, the flexible kitchen will be accepted faster if cooks can be using their personal products. Therefore it is important to consider enough space within the design to store these items. The amount of items are specified in the requirements.

Figure 5.24 contains several options to store cookware. Small racks ensure easy access without having to replace other pans. Also hooks are efficient to store cookware vertically.

This is also the case for utensils. As can be seen in Figure 5.25 these are often sorted to ensure good visibility and to prevent a chaotic look.

Spices are often stored in glass containers (Figure 5.26). This ensures clear visibility and makes it easier to quickly recognise what is inside.

Figure 5.24 Cookware storage

Figure 5.25 Utensil storage

Figure 5.26 Herbs and spices storage

Mobility

For the flexible kitchen, mobility is a core aspect to support the social interaction. Therefore it is of great importance to explore different options.

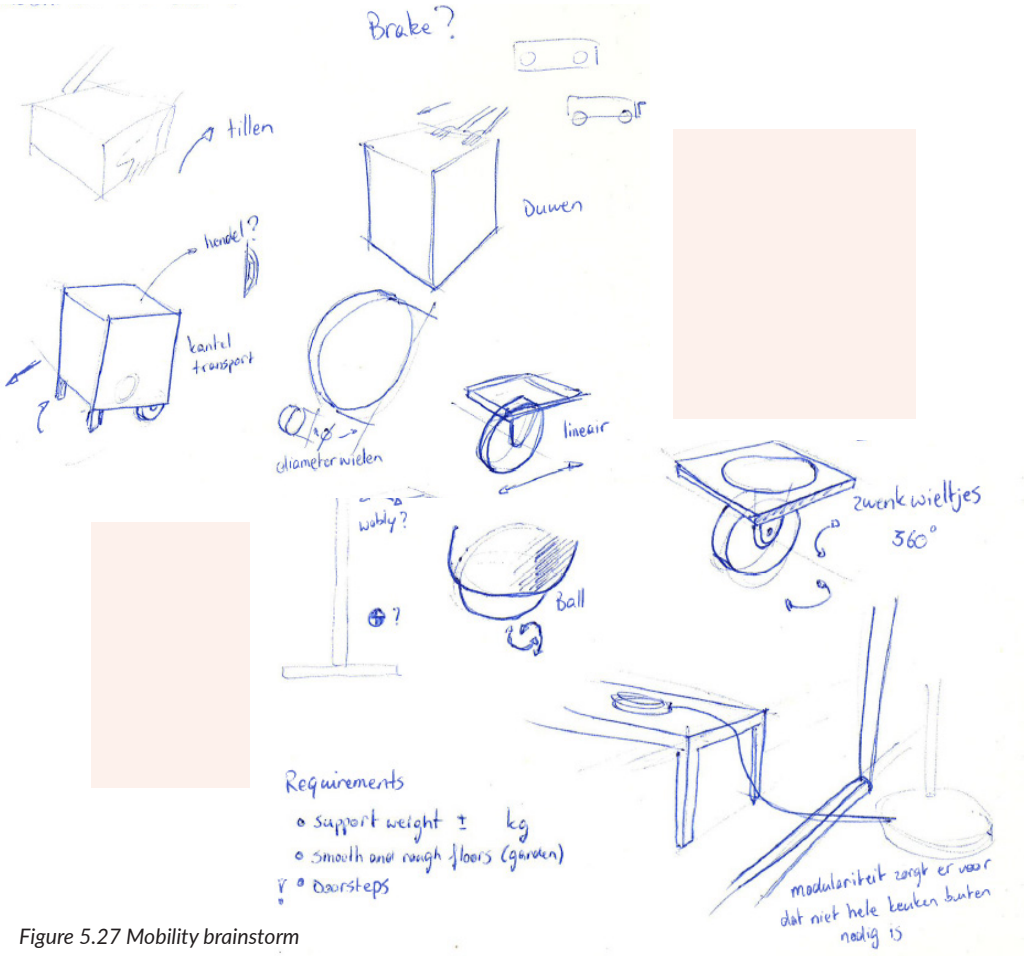


Figure 5.27 Mobility brainstorm

A brainstorm reveals multiple options (Figure 5.27). The flexible kitchen can be moved by implemented wheels, other option are to lift it by hand, push it in the desired direction, or only make part of the design flexible which enables the user to perform specific actions independent from the base. In terms of ergonomics and considering not to damage the environment (e.g. damaging the floor while sliding), the use of wheels is most favourable.

Also while using wheels, a lot of options can be explored. Swivel wheels for easy manoeuvrability, rigid casters for higher strength and stability, or ball wheels for high agility. Besides, since wheels rotate, a strong and safe brakingsystem should be considered.

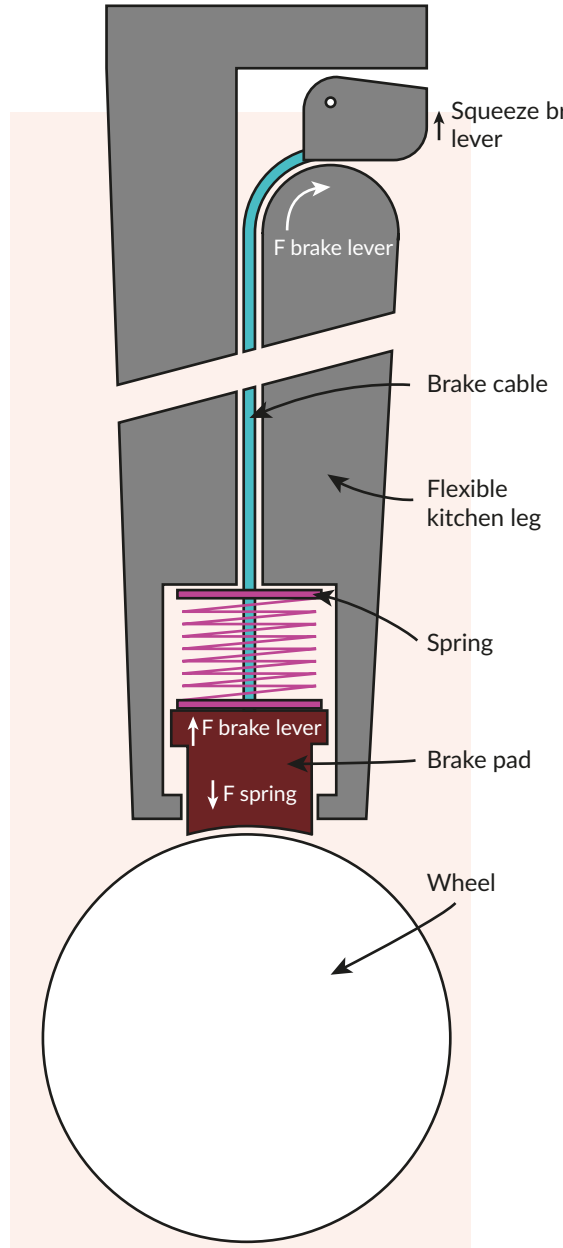


Figure 5.29 Reversed brake systems

Figure 5.28 Brake systems

With all the gained insights and comparing different options, permanent wheels with a reversed brake system are the technical most favourable options. With a high diamater of wheels the flexible kitchen is able to easily move through the house area, and doorsteps won't be an issue. The combination of swivel wheels with rigid ones ensure sufficient manoeuvrability, but also stability. By implementing the reversed brake system (Figure 5.29), safety is ensured to prevent the flexible kitchen from moving while cooking. Compared to other lock switches, this brake system is reachable by the hands. This way locking the system with your feet is excluded. Incovenience caused by only wearing socks indoors gets excluded.

Design iterations

Since the flexible kitchen will replace the complete kitchen area as we know it today, it needs to be more than just a product. It has to convince the user since he has to adapt the complete home interior and slightly compromise on convenience, but it also has to be intuitive for other guests who use it for the first time. Therefore the design and form language are from great importance.

The next paragraph describes the evolution from the design. From the first sketches towards a coherent design.

Figure 5.30 Initial concept visual for communication with stakeholders

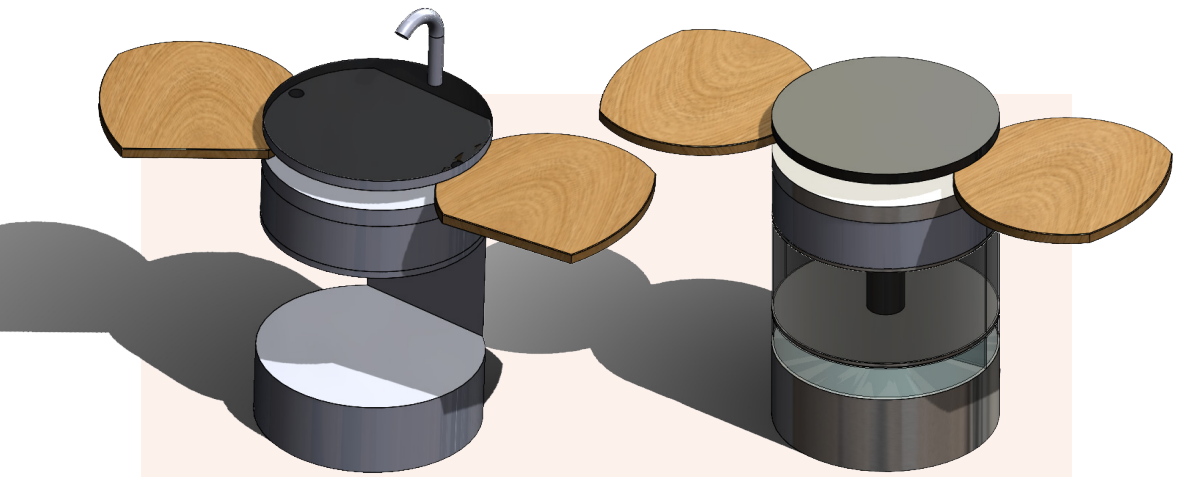


Figure 5.31 Technical setup from flexible kitchen

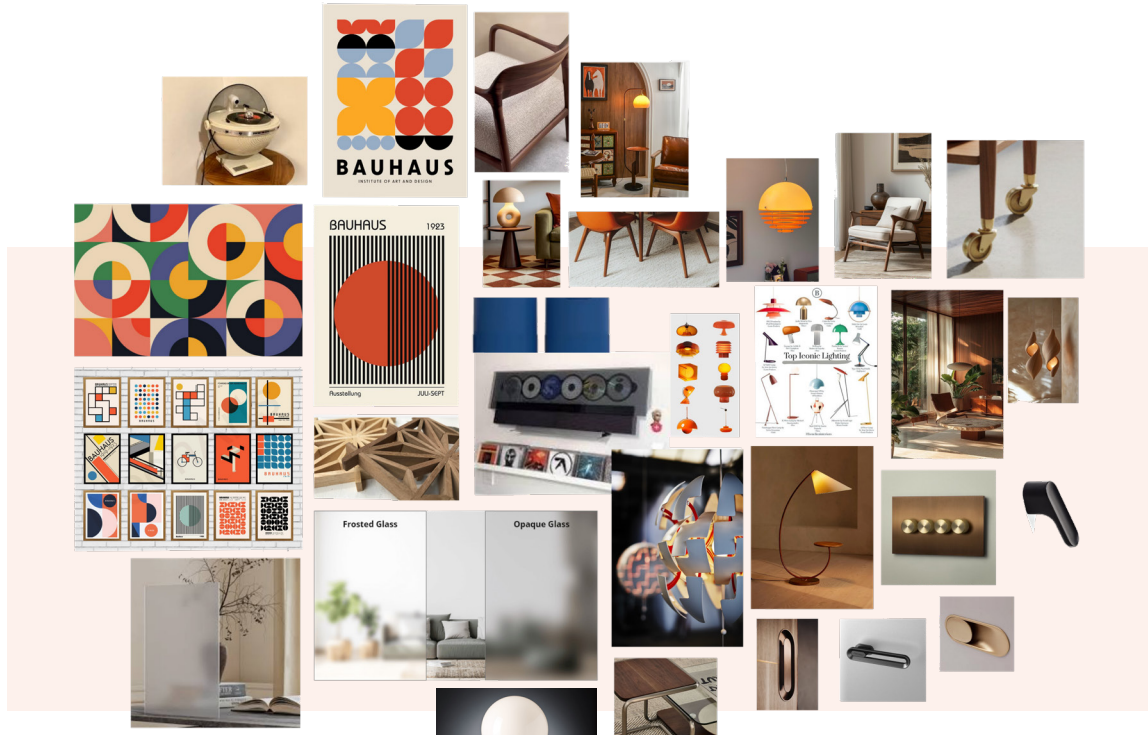


Figure 5.32 Moodboard

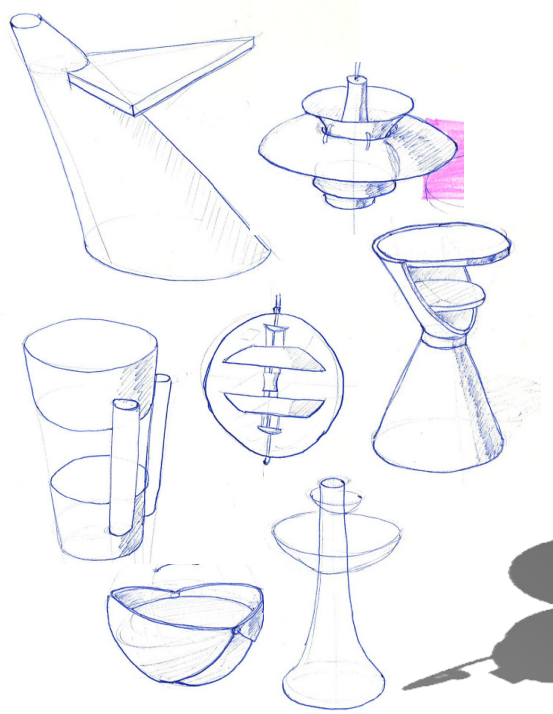


Figure 5.33 From iterations

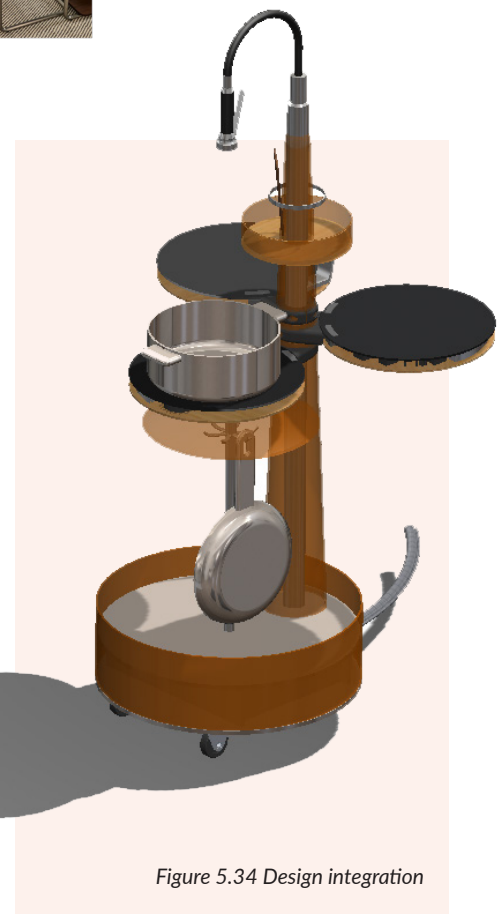


Figure 5.34 Design integration

With the first general integrated design, the next step is to reflect and iterate on the shape. For inspiration the AI tool from Google (GEMINI) is used. With the personal integrated design as an input, and as a prompt the question to adapt the design as if competitors or would determine the design language, interesting result arise (Figure 5.35).

Figure 5.35 Brand and style iterations (GEMINI, Februari)

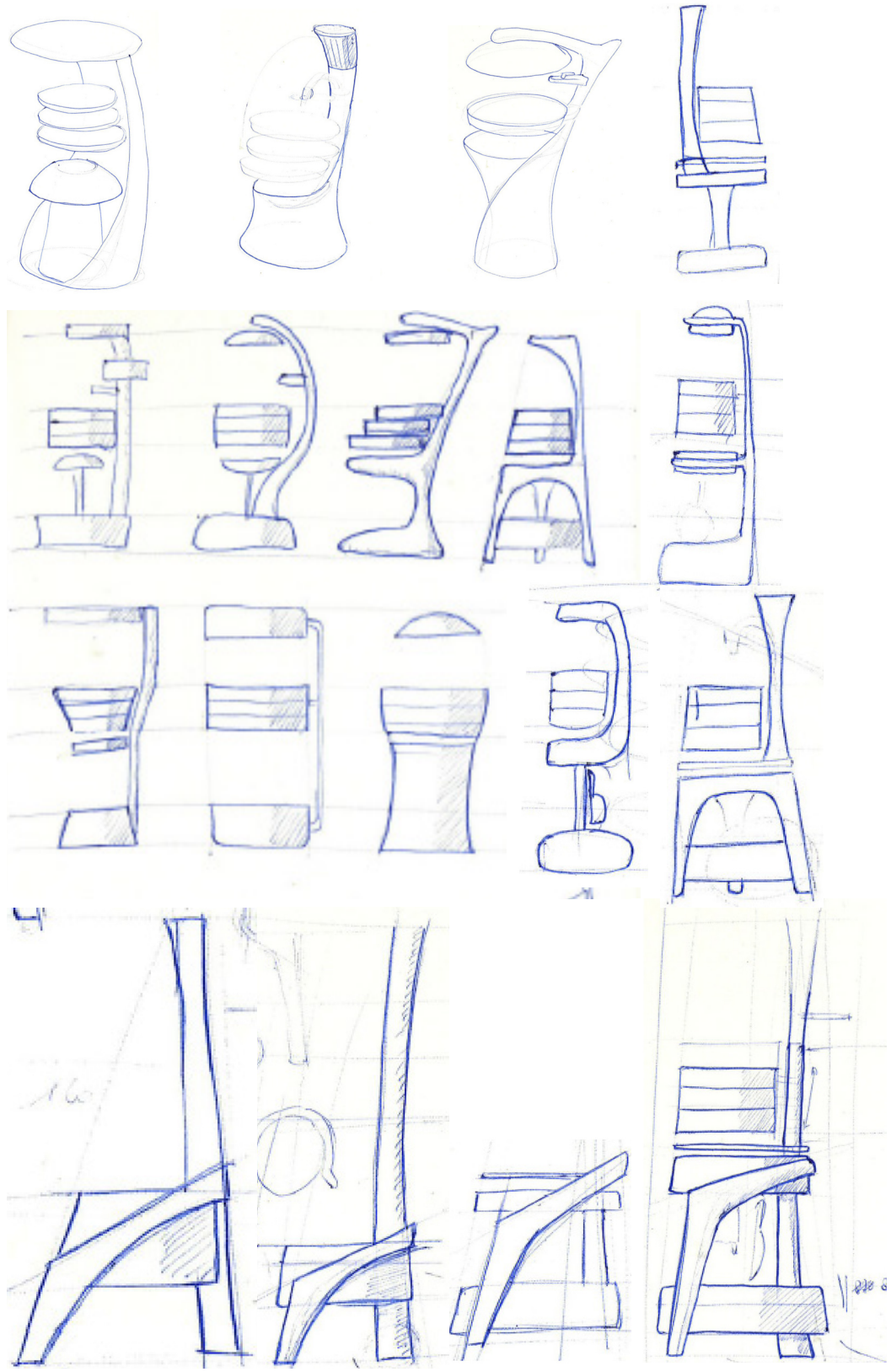


Figure 5.36 Inspirational form drawings

Design

All insights combine in the integration of one product. **Mesa** will be introduced, explaining all functions individually. This is concluded by a **user scenario**.

Mesa

Introducing Mesa, cooking beyond the kitchen!

Designed for the starters of 2040, this flexible kitchen is driven by social interaction. With its mobility, the cook stays part of every moment and every conversation. Around dinner time, Mesa unfolds and invites everyone to help cooking (Figure 6.1). Providing 3 induction cooking plates, fresh drinking water, fume extraction and sufficient storage for your favourite cookware, utensils and spices, ensures everything is within hand reach. Mesa seamlessly blends preparing and cooking food with the environment. Perfect to spend time together with friends and family!

Figure 6.1 Introducing Mesa

Cooking element

With Mesa, the user has the freedom to cook to their own desire. It consists of 3 cooktops with induction technology implemented (Figure 6.2). With a quick meal, the top stove can be activated while the other remain collapsed. When cooking with multiple pans, counterspace can be expanded by unfolding the cooktops around the core (Figure 6.3). This creates the opportunity for multiple people to gather and cook together around the base.

The cooktop has a diameter of 400mm, and a height of 35mm. Therefore, being compact and suitable for all sizes of pans. Besides cooking on Mesa, the user has the ability to disconnect the cooktops from the base and use them elsewhere (e.g. on the dining table as in Figure 6.4). While being connected with a cable, the plate can be powered and used to cook, simmer the dish while conversating, or to maintain heat in the pot while eating. This way the social interaction can proceed undisturbed, and food can be enjoyed optimally. The additional power cable is integrated in the control unit from Mesa.

Figure 6.2 Mesa at standard location

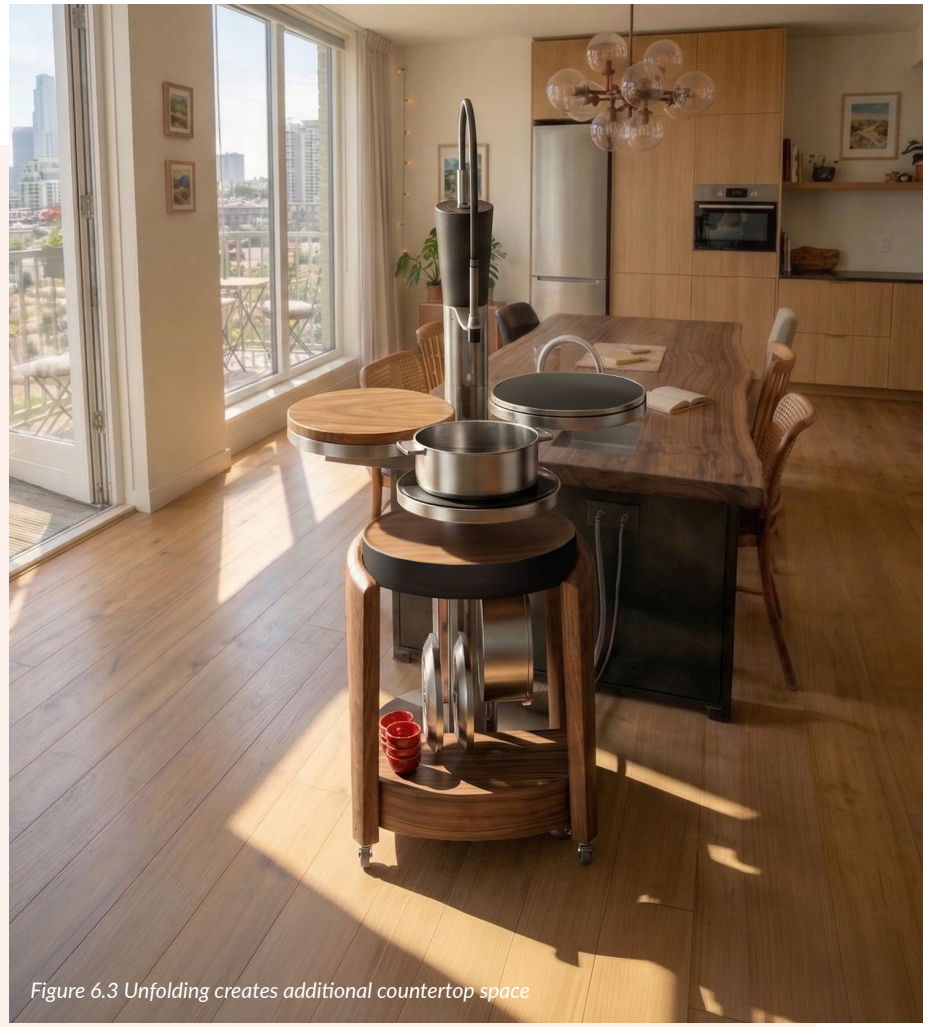


Figure 6.3 Unfolding creates additional countertop space

Figure 6.4 Extending workspace to table

Figure 6.5 Flexible tap

Access to fresh water

Mesa has an integrated water tap (Figure 6.5). This way the cook has quick and convenient access to fresh water during the cooking process. While preparing the dish, pots can be filled with water to cook ingredients or to moisturise dishes (Figure 6.6). The flexible hose ensures precise control of the water stream, preventing unnecessary splashing. Additionally, there is the opportunity to refill a glass of water, or to set a cup of tea without having to leave the activity.

Figure 6.6 Adding water in pan

Figure 6.7 Fume extraction system

Fume extraction

To prevent undesired smells and grease particles to settle in the surrounding area, a fume extraction system is integrated (Figure 6.7). The positioning is located in the base directly above the pans. This way all fumes can be filtered most efficiently. The motor is integrated in the lower controle unit, with the advantage of very limited noise disturbance. This way social gatherings can enjoy a fresh environment without being interrupted by loud systems.

The filtering system works with recirculation. This means air is sucked into carbon filters which extract grease, hazardous fumes, humid air and undesired smells. The remaining, fresh air is circulated back into the room.

Once in a while these filters need to be cleaned. This can be done by detaching the filter unit. This unit exists of 2 components. An outside grease filter, and inside carbon filter. These can be detached from eachtother and conveniently be washed in a dishwasher.

Utensil and spices storage

Levels of cooking differ a lot between people. Some like to cook elaborate meals, others are satisfied with a simple dish. This creates a large range of utensils, herbs and spices used while cooking, all based on personal preferences and taste. Therefore Mesa has an integrated storage for frequently used, personal items (Figure 6.8). Covered by a tinted glass plate, all utensils are quickly accessible. The glass surface has multiple purposes. Visibility for a quick reach, shielding against splashes from cooking, and the dark tone of the glass creates an additional protection against UV light for herbs ans spices to extend shelf life.

With this quick accessibility the cook is not forced to leave the social interaction, so all people can enjoy their time together.

Figure 6.8 Utensils and spices storage

Figure 6.9 Cookware storage

Cookware storage

Just like cooking utensils, spices and herbs, people have strong personal preferences for their cookware. The material of the pan, the weight, brand, sizes, etc., they all are based on personal taste and influence the experience of cooking. Therefore it is key to enable the user to cook with their own cookware.

Mesa contains hooks on which the user can hang the frequently used cookware. Additionally, there is the possibility to place some products on top of the controle unit (Figure 6.9). This way the cook has quick access while cooking. He or she is able to express personality and to cook with their favorite cookingset.

Manoeuvrability

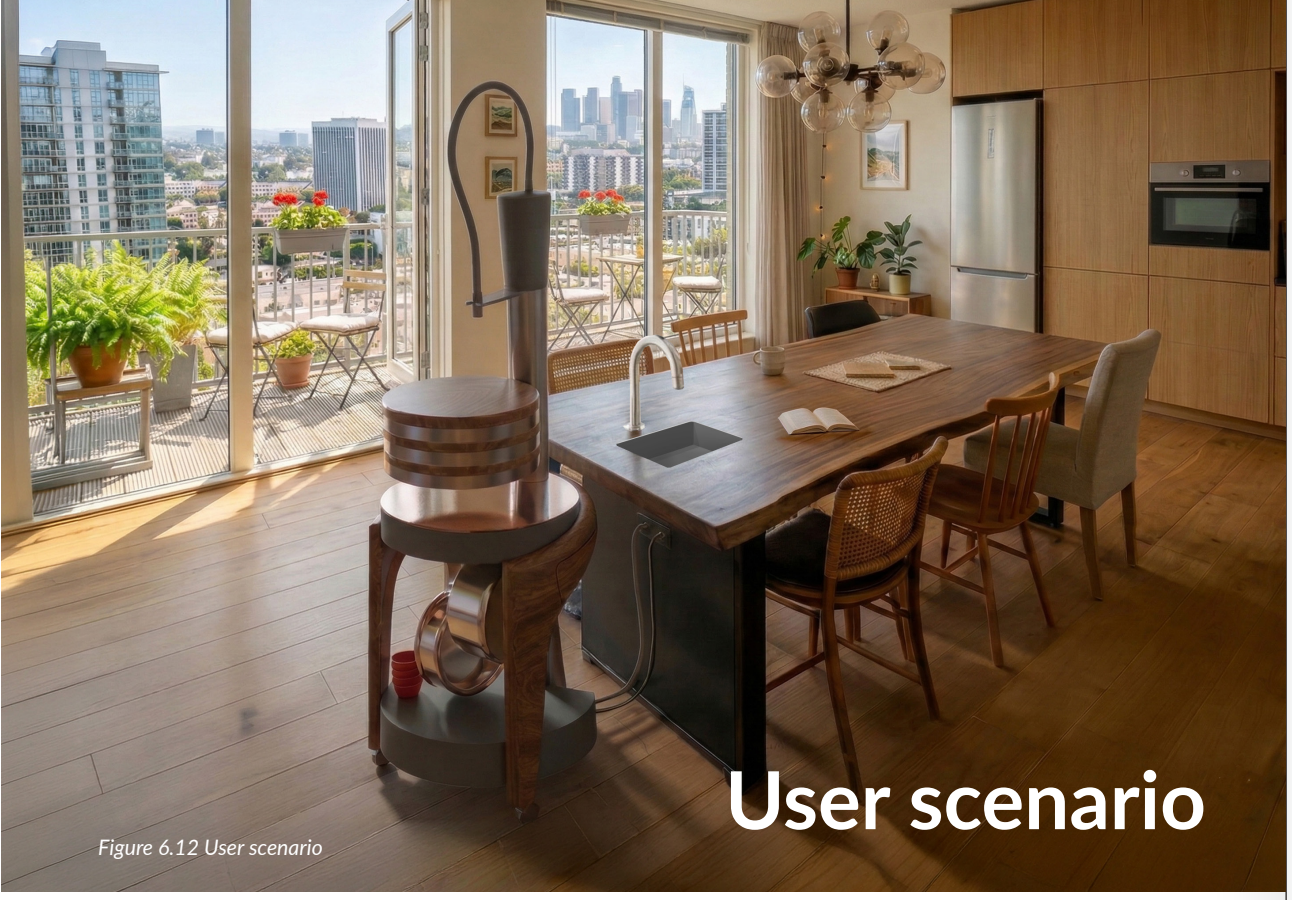
Manoeuvrability is one of the key aspects within Mesa. we a combination of rigid wheels with one big swivel wheel is made (Figure 6.10). This ensures stability and a good force distribution, while maintaining sufficient manoeuvrability within the home area. The high diameter of the wheels ensure moving Mesa will be no problem, also with uneven surfaces such as doorsteps. A rubber outer layer on the wheels prevents damaging the floors.

Figure 6.10 Wheels

Brake system

As in all products, safety is the most important aspect. An inverse braking system is implemented which permanently locks Mesa in its place. By squeezing the wooden brake lever, integrated in the base, the user is able to release the brakes and move the cooking device towards the desired location. With this braking system, the risk of accidentally forgetting to lock the device is minimised. This way the chance of hot cookware falling of Mesa is mitigated.

Figure 6.11 Brake system



User scenario

Figure 6.12 User scenario

Mesa, within a compact 2040 apartment from a starters couple. There is not a lot of space, but with an efficient interior more is not needed. With their busy lifestyle of working full-time, frequently sporting and other hobbies, they cherrish the moments together or with friends. Especially since Mesa is used, no one is left out of the conversation anymore.

After work, friends are visiting the couple. They haven't seen each other for a few weeks, so they are excited to catch up with each other.

Since the weather is nice, they want to enjoy the sunset while cooking. Mesa is moved outside while the others quickly gather the ingredients.

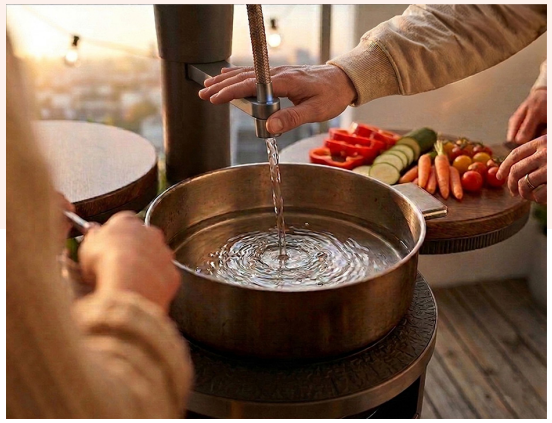
When Mesa reaches the desired location, the user releases the brake lever which locks the device on its location.

To provide electricity and water, Mesa needs to be plugged in. In the back of the controle unit the cables can be pulled out.

Both the indoors and outdoors have regularly placed power and water sockets. Mesa will never be far away from supply.

Now, Mesa is ready for use. All people have the opportunity to participate in the cooking process. The vegetables can be cut on the cuttingboards.

When the preparation is finished, the pans can be taken from its storage.



The convenient located water tap makes it very easy to fill a pan to cook ingredients.

Underneath the cooking modules, frequently used spices and utensils can be stored. This way there is always quick access.

When the pasta has finished cooking, the water can be drained indoors within the central area sink. This makes the user leave the social interaction only for a very short moment.

When the cooking is done, it is time to set the table and enjoy the meal. Since the cooking plates can easily be disconnected from the base, they can be put on the table and serve as a coaster. When attaching it to Mesa with a cable, the cooked food can maintain its heat.

A wonderfull evening with a well-deserved, delicious meal. Everyone had the opportunity to catch up with eachother. The last moments of the day can be enjoyed.

The last task of the day, bringing everything indoors and putting the dirty dishes in the dishwasher.

Validation & Evaluation

Development will be worth nothing without the feedback from users. Therefore Mesa is validated by a **user test**. The resulting **data** is discussed, interpreted and evaluated.

Validation

User test

To validate whether the introduction of Mesa aligns with the composed design vision, a user test has been conducted. The goal, plan and insights will be discussed in the next paragraph. The complete test plan can be found in Apendix X.

Research objective

The goal for this user test is to validate whether Mesa supports the design vision: 'a kitchen device which improves the social interaction during cooking, by facilitating independence from the current kitchen area to enable the cook to move with the social interaction. This for everyday use of a starters couple in a 2040 societal context.'

While participants interact with a prototype, they are observed to analyse the (social) interaction, usage and limitations of the concept. After the interaction with Mesa, the participants are interviewed to gain further understanding of their thoughts and actions.

Research questions

- How is the social interaction experienced by the users?
- How do participants use Mesa, and how does this differ from the intended interaction?
- What potential hazards are revealed?

Method

Participants
For the test several people were invited to participate in groups of 2. A total of 8 people (4 groups) joined the test, from which 7 female and 1 male. All of them were students finalising their studies, with a background varying from civil engineering to medicine. The mean age was 24 (varying from 21 to 25 years old). Two duos already knew each other and already cooked together previously.

Materials
Several materials were provided to facilitate the user test.

- A brief user scenario to describe the 2040 context, and for a better understanding of the main functions of Mesa
- A physical prototype (1:1). The prototype could be characterised as an experimental prototype, focussing on the validation of the interaction rather than technical feasibility
- Basic cookware, cooking utensils, spices and ingredients
- Adapted test environment for 2040 context. In the wall several water plug connections were facilitated next to the energy sockets.

Besides these materials, a smartphone was used to capture data during the test. During the cooking simulation photos and videos were taken. During the interview a voice record was made to later analyse all comments.

Procedure
The test started with a brief introduction of the project. Subjects as the collaboration with Braun, the research opportunity for the 2040 Frankfurter kitchen, and the research core findings were shared.

This introduction was followed by presenting Mesa. The 2040 context, instructions for use, and main functions were explained by showing the user scenario. After the participants were aware of how to use Mesa, it was time to simulate the cooking process. Before starting the simulation, the participants were asked for consent to capture anonymised photos and videos. Additionally, consent was requested for a voice recording during the interview.

As can be seen in Figure 7.1, the participants were presented the scene to cook together at the balcony. Room A represented the indoor area where Mesa had to be picked up. Room B represented the balcony on which had to be cooked.

The experimental prototype representing Mesa contained all required tools, ingredients and functions to simulate the cooking process of making a simple pasta dish. With the knowledge of the context and asking for some additional imagination from the participant, they were able to merge with the scene. They were asked to think out loud while cooking. The full journey of determining the location, preparing ingredients, cooking, setting the table, eating, cleaning and storing was simulated.

After concluding the simulation, the participants were interviewed to reflect on the thoughts and actions. They received questions like 'Did you feel like cooking together?', and 'What difficulties did you experience in the process?'
After these questions the user test was wrapped up by thanking the participants. The duration of the test varried from 20 minutes to 45 minutes.

Pilot
Prior to the testing, a pilot was conducted. This revealed the need for small adjustments to the setup to ensure better empathy for the context. This is where physical spices and vegetables were bought, and some additional use cues and detailing were added to the prototype.

All data captured with interviews and while observing the simulation, was analysed, interpreted and structured within themes.

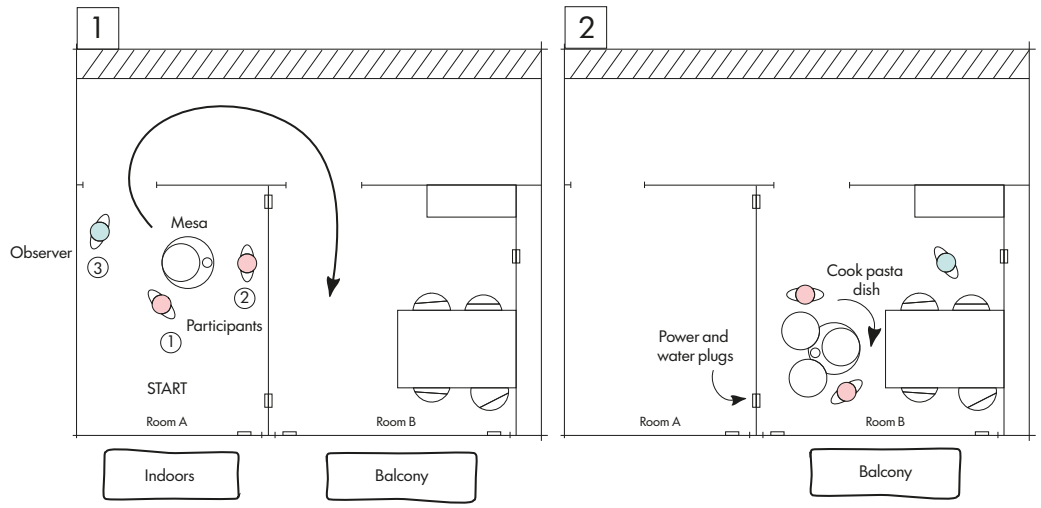


Figure 7.1 Test setup floor plan

Results

The data captured during the observations, in the shape of photos, videos and notes, was combined. After analysing, all insights were written down in one document. Clusters were made and structured within the themes of the 3 research questions (see table 7.1)
The data from the interviews generated by the voice records, was transcribed and all key insights were collected in one document. Just as the observations, new clusters were made which align with the research questions. The elaborate records and clustered insights can be found in appendix X. In the next paragraph the clustered data will be presented.

Research questions	Observation clusters	Interview clusters
How is the social interaction experienced by the users?	Social interaction Emotions	Social interaction Empathy
What potential hazards are revealed?	Ergonomics and posture Safety	Safety issues Ergonomics
How do participants use Mesa, and how does this differ from the intended interaction?	Intuitive interaction Unexpected interaction Movability Remarks and shortcomings	Posititve impressions Concerns Movability Sugestions

Table 7.1 Clusters per research question and test method

Observations

Social interaction
All participants communicated with each other. Both in terms of discovering the main functions of Mesa, and during the cooking process of combining ingredients and tastes. Decisions were made together and they looked each other in the eyes during conversations.

Emotions
When interacting multiple emotions could be observed. All participants started the test with positive feelings. Participants 2.1 and 2.2 acted more playful, and participants 1.1 and 1.2 were energetic. The others expressed happy feelings. While executing the test, all of them switched between happy and investigative emotions. During more critical actions such as cutting vegetables, expressions indicated focus.

Figure 7.2 Cooking together

Figure 7.3 Bad posture

Ergonomics and posture
While transporting Mesa, all participants had to slightly bend over to reach the handle. Also, during the process, they had to bend to reach for the power and water connections, for cookware as can be seen in Figure 7.3, and to have a clear view in the utensil and spices drawer. Additionally, 1 group prepared the dish in a seated position, while the other 3 groups cooked standing.

"I actually quite like it to cook while seated.", Participant 2.1

Safety
Regarding safety several concerns arose, both from quotes and observations. When connecting Mesa to the water and energy plug, most participants already were conscious to not trip over the cables and communicated this to the partners.

A shortage of storage space resulted in piling dishes. This included sharp utensils which could hurt the user when it falls on the ground. Reaching cookware or other products underneath the cooktop forced the user to have their head near a cutting board with sharp knives, or a pan with boiling water. Besides, when standing up participant 3.1 softly hit her head on the cooktop. Finally, when the participants disconnected the cooktop from Mesa to put the pans on the table, as can be seen in Figure 7.4 they all left the heated pot on there while moving. These heated objects could lead to burning wounds for the user.

Figure 7.4 Hot pan near body

Intuitive interaction
Most functions of Mesa were executed as intended. After determining the location, the product was unfolded to get a clear vision on all products within the drawer. Participant 1.1 indicated everything she needed was within hand reach. During the preparation of the ingredients the cutting board was used to easily slide ingredients into the pan.

Unexpected interaction
Some participants used Mesa different than initially intended. One group transported Mesa sideways (they pushed together) from the indoor area to the balcony. When discovering there was no drainage implemented in the concept, the participants from the second group used a mixing bowl as a temporary dirty water container so vegetables could be cleaned (see Figure 7.5). During cooking all participants simulated walking back indoors quite frequently (e.g. to load dirty pans in the dishwasher, cleaning vegetables, ...). After finishing cooking, the participants from the first group detached the cooktops to put them on the table only as a coaster, and not activated to maintain heat.

Figure 7.5 Mixing bowl as temporary drainage

Movability
During the test all participants used Mesa similarly. Figure 7.6 depicts a heatmap of the position of the participants during the cooking process (heatmap not tracked but based on observations). The participants placed Mesa next to the table to extend countertop space. While cooking they positioned themselves in between 2 cooktops and near the storage. Brief moments of walking indoors, collecting plates or connecting the power and water supply are also visible in the heatmap.

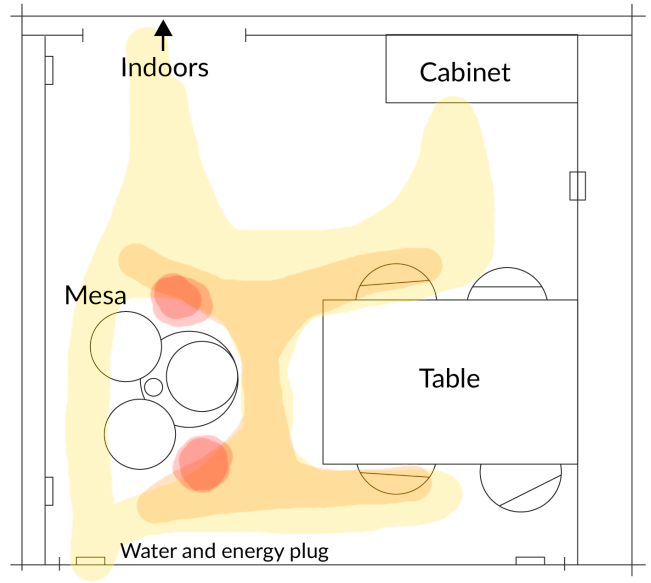


Figure 7.6 Heatmap of the participants' position

Figure 7.7 Missing space to 'park' spatula

Remarks or shortcomings
During the observations several shortcomings were revealed. All participants indicated a shortage in space. This entailed room to temporarily 'park' a product such as a dirty spatula or pan (see Figure 7.7), but also dirty cookware which was not needed anymore in the process. They indicated there was sufficient counterspace on the 3 plates, only if inactive components wouldn't be stored on there. Besides, the exclusion of a drainage, except for one group, was experienced as inconvenient by the participants. While moving Mesa, group 2 and 4 indicated concerns towards rattling cookware. Therefore being focused on driving extra carefully.

Interviews

Social interaction
The conversations with the participants during the interviews indicated a strong feeling of cooking together. They liked how everyone fulfilled a role in a natural way.

"It feels inviting to participate cooking!", participant 3.2.

Mesa was perceived as a nice concept and the fact the users could look at each other was appreciated. In some cases it generated nostalgic memories.

"It reminds me of when I was young, when my mother was baking pancakes in the kitchen. This product would have enabled my mother to join us [participants and sisters] at the table.", participant 3.1.

Other participants indicated an association with a BBQ, a gourmet or Senseo coffee machine (waiter-like shape).

Empathy
All participants were conscious abut the fact that they were working with an experimental prototype, which made them open minded regarding the eventual implementation of Mesa in (a 2040) reality. Participant 1.1 mentioned Mesa differs a lot from the current kitchen, but that the implementation felt logic and familiar. Both cooking in group and individually didn't raise concerns. The fourth group indicated that this test was mainly about discovering the concept, but when using it for a longer period would lead to dexterity. In addition to this, there were still doubts on the daily usage. Participant 3.2 mentioned that with the current world and knowledge she would use it occasionally, and that the desirability also depends a lot on the current house layouts. In the end the concept was experienced as an opportunity to cook with friends, and perfect for during 'een borrel' (tapas or little snacks) (participant 4.2).

Safety issues
As already observed, the participants indicated safety concerns. This included the absence of a visual heat indicator. During the test it was not clear which components were hot or dangerous. An example mentioned by participant 4.1 was when an active plate with boiling water, positioned above the drawer, was turned slightly underneath another plate for better visibility to reach for a knife. Also the water and energy cables caused attention. As participant 2.1 quoted:

"You don't want to be thinking of that during cooking".

Ergonomics
All groups, except for the first, indicated they had to bend over more than desired. First for cables, than for cookware and finally to have better view for utensils. This was not mentioned as a big problem, but slightly unpleasant.

Positive impressions
Regarding the general implementation of the product, the participants were positively impressed. They liked the flexibility facilitated to cook where and however you want. The workspace was in their perception not limited by the product, and the environment could be involved. The product was experienced compact and they were positive about unfolding the device to generate more workspace.

Concerns
The flexibility was praised, but participants indicated they were still depending a lot on the indoor area. Participant 2.1 indicated with the idea of an all-in-one flexible kitchen, she probably had to high expectations. Definitely when compared to the 2026 kitchen. Also as already noticed in the observations, there was a strong preference for more counterspace. This for both storing, and 'parking' dirty cookware and utensils. Additionally, the execution of the drawer created the wish for better visibility and reachability since spices and utensils were difficult to see. The basic ingredients would be within hand reach, but the room was limited for permanently storing rice or pasta.

Figure 7.8 Extending counter area with table

Movability
The participants indicated to have little issues with moving Mesa, but the final implementation raised some concerns. When moving it alone, participant 4.1 indicated she would potentially like to pull the device instead of pushing it. This idea was mainly driven by doorsteps in combination with the 3-leg design of Mesa. Furthermore most participants came up with own ideas where they could potentially cook in the home environment of the future.

Sugestions
While discussing Mesa during the interviews, several suggestions from the participants arose. These countered design choices towards safety and the concept implementation, none of these were focused on the social interaction.

Regarding safety some solutions were discussed to minimise the risk of burning. An example was to implement a visual use cue on hot surfaces. In terms of unfolding Mesa, some kind of rotational lock of the cooking plates was proposed so these could not unintentionally be rotated. In addition, there was a strong request by all participants to create more counter space. This could in their eyes already be solved by adding more storage for dirty cookware.

Also the supply cables were a topic of discussion. These were not experienced as a hurdle, but implementing something of a battery and water reservoir would improve the convenience of the product. Regarding water, participant 1.1 suggested a small drainage reservoir so vegetable could be cleaned at the location. She added that this reservoir still had to be cleaned easily (e.g. in a dishwasher), since otherwise she would prefer walking indoors quickly.

As a battery the second group suggested a small battery in combination with a docking station. In this situation Mesa would be connected to the grid on a daily base, but occasionally have full mobility when cooking at an alternative location. They did add that this battery would need sufficient capacity, and when parked at the docking station all functionalities would need to function instantly. Otherwise they would prefer the current setup.

Figure 7.9 Cooking together

Evaluation

The results from the user test provide insights in several layers of the project. Both on the execution of Mesa, as well as the overarching subject of social interaction within the cooking process. The participants experienced a form of social interaction, they indicated safety concerns and the test revealed intuitive behaviour after the first-time usage, which sometimes differed from the initial intention.

Discussion

Social interaction

The user test indicates that social behaviour is challenging to measure. First time exposure to a product creates an investigative scene for the user, which influences the general interaction. Therefore the results are analysed with focus on the level of communication, while not focussing on the quality of the conversation.

The results indicate users interact quite a lot during the test. Decisions such as where to cook or what spices to add are made together. Mesa invites others to participate in the process, but also how to shape the activity. A standing position creates a more active environment, whereas cooking seated provides a more relaxed scene. The number of possibilities to shape the preparation of a meal increase significantly compared to the traditional kitchen.

The open and flexible properties of Mesa make the users aware of opportunities to be included to the social interaction while cooking, such as the example of the nostalgic memory of a mother cooking pancakes. Overall people are communicating a lot with each other during the complete cooking process which indicates the social interaction does improve compared to the 2026 kitchen environment.

Safety concerns

As the results indicate there are quite some safety concerns. The main topics are dealing with hot elements, ergonomic postures and awareness of the environment.

Mesa makes use of induction elements, which heat the pan, which in its turn heats the surface underneath. Mesa does not contain clear use cues indicating where elements can safely be touched during cooking. This creates risks for both storing utensils on a hot plate, or when a plate is disconnected from Mesa to put it on a table. In addition, plates can be disconnected at any moment, even with a hot pan on top. This increases the chance of a slipping pan and spilling hot water.

Bad posture during the process causes safety concerns in both the long-term usage, as well as increasing the chance of bumping into e.g. a cooktop with boiling water or sharp utensils. In both cases risks are rising for severe injuries.

Finally, some design discissions lead to the need of constant awareness of the environment. This is mainly caused by the cable connections for water and electricity. Users need to be aware not to trip over these cables, to prevent hurting themselves, damaging Mesa, or to drop hot cookware. Besides the cables, most components are not double secured to prevent users from hurting themselves.

User behaviour

In general, Mesa is quite intuitive to use once the user understands the different functionalities. During the first time usage, most uncertainties arise because Mesa has multiple new components which all must be discovered at once. Transporting and

unfolding the device creates no problems, and extending the surface area by a nearby table is intuitive. Also cooking on the induction plates functions familiar for the cook.

Unintended usage is caused by elements which are excluded from the concept, e.g. the limited surface area and drainage. Participants from the test indicate they are still depending a lot on the indoor area, to collect cookware or utensils which were not included in Mesa. This does not create that many concerns since users in the future have the freedom to personalise the kitchen as they desire. Shortage in cooktop area does influence the behaviour. Used and dirty cookware currently is being stored on an inactive cooktop, which initially was intended to be put on the table temporarily. For this reason, participants make more small trips to the indoors to already store dirty cookware in the dishwasher, which in the end will also influence the social interaction.

Also, the exclusion of a drainage leads to unexpected actions. Washing vegetables is the main cause. Instead of washing them beforehand, or all at once, new ways are explored like using a small mixing bowl to temporarily store dirty water. This action can be a result of test limitations, namely first-time exposure to the product. In the future when understanding the new cooking process, these actions can adapt like washing vegetables beforehand. Although, since using a mixing bowl is the intuitive action of the user over walking indoors, this issue should be considered in further development of Mesa.

Recommendations for Mesa

As mentioned before, regarding social interaction Mesa is satisfying for the user. The intended interaction and goal of the project is achieved. Although, safe implementation of Mesa in the real world still needs several iterations.

Regarding the timeframe of this graduation project, further iterations unfortunately are not possible. Therefore insights and further development will be implemented in the shape of recommendations.

The main concern which needs to be solved is the general safety. Mesa creates multiple moments in which the user could get hurt. Therefore an iteration on the general use cues is proposed, which indicate dangerous areas. The hot cooktop requires visual stimuli of heat-zones such as in Figure 7.10. In combination with a small LED which maintains activated when hot, the chance of people accidentally touching a hot surface is minimised.

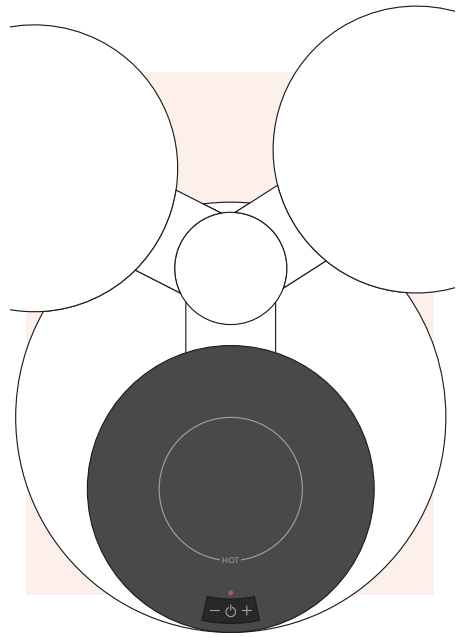


Figure 7.10 Visual stimuli of heat-zones

Another recommendation is to relocate the locking mechanism of the cooktop to the side of the plate, see Figure 7.11. This in combination with some kind of handle to indicate where the user should reach when disconnecting the plate from Mesa. This ensures a better grip for the user, and the risk of holding a hot pan near the body would be minimised.

An iteration is proposed to revise storage possibilities. This includes space to temporarily park e.g. a spatula during cooking, but also dirty cookware which is not needed anymore during cooking, and a redesign of the drawer underneath the cooktops to gain better sight and reachability for utensils and spices. Improving these items elevates the general experience caused by ease, prevents the user from bad posture, and prevents unsafe situations like reaching underneath a boiling pan of water.

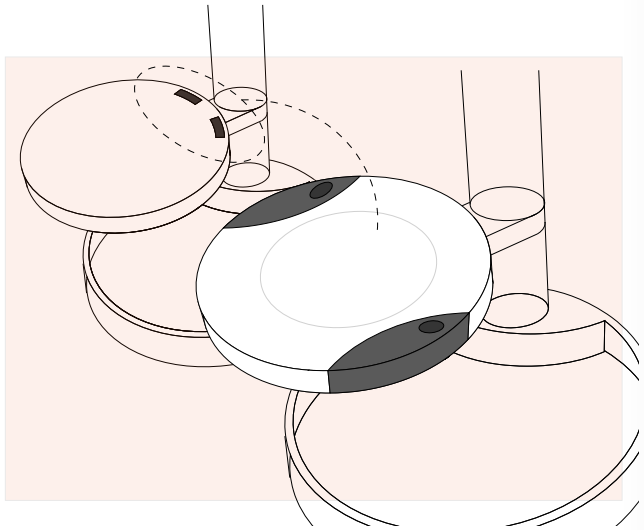


Figure 7.11 Alternative unlocking mechanism

The final recommendation is to iterate on the power and water supply. Cables on the floor do not make Mesa undesirable, but the implementation of a battery would improve the general experience. This subject is partly covered in this design research, but as participants indicate this scenario is accepted to have limitations. By investigating the scenario of a small electricity battery in combination with a docking station (see Figure 7.12), the user can occasionally cook elsewhere while still having full functionality at the standard location of Mesa within the house. Although the users accept potential limitations, they should be able to cook at least one meal without being disturbed in the process. This process includes preparation and cooking, but also the moment after eating to e.g. make some tea. The implementation of this system needs additional research for feasibility.

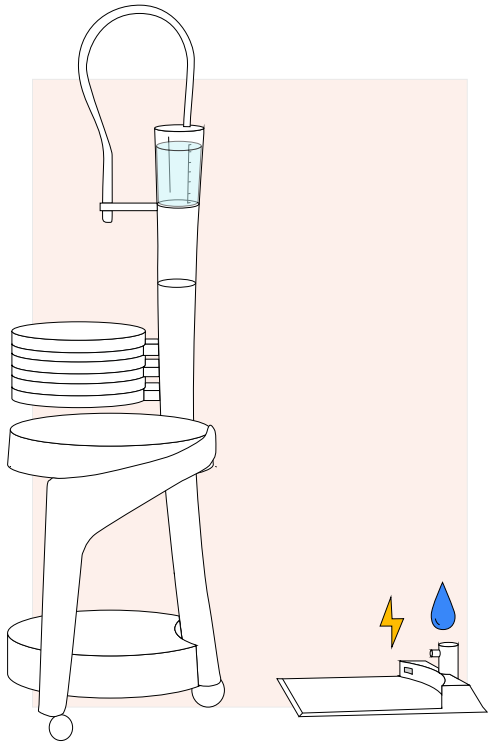


Figure 7.12 Docking station

As well as electricity, the water way can receive an upgrade. By implementing a small fresh water and drainage reservoir, the user will be independent from the water supply. Already a small volume of 5L is sufficient for one meal. By integrating the fresh water supply on top of the extraction system, no additional water pumps are required. Both reservoirs must be easily cleaned in a dishwasher to prevent a waste of time after the social interaction. By integrating a water connection in this energy docking station, fresh water can automatically be refilled.

Conclusion

In general, the user test proves Mesa to be a success if some future adaptations are covered. The social interaction is perceived as inviting and inclusive. The execution of the concept in combination with de design vision appeals to the participants from the test, indicating a general desirability of Mesa. As mentioned in the discussion, there are several recommendations for further research which need to be solved to ensure safety and acceptance.

Conclusion

The thesis is coming to an end. The next chapter discusses the overall impact and contribution of the **result** to our society. After reflecting on the design research, also a **personal reflection** is included.

Discussion and conclusion

This design research reveals that the properties and layout of the 2026 kitchen do not align anymore with the current societal values and needs. Towards 2040, a changing environment and lifestyle forces us to reflect and adapt to address our inner needs. A busy lifestyle of working full-time, with multiple hobbies or other activities in the evening, minimise moments together with friends or family. By introducing Mesa, the preparation and cooking of food merges with the dining phase. With the social interaction as the main gaol, people can optimally enjoy and spend the available time together. With the mobility aspect this can be done wherever the social interaction is taking place.

Desirability

As this research proves, social interaction is important for human wellbeing and cognitive development. Last centuries focus on efficiency created wealth and good physical health, but mental load caused lower appreciation of life.

Mesa places social interaction in its core and testing proves users appreciate this focus shift. Since Mesa is designed for the 2040 context, immediate implementation is not completely desired by the current user. The concept still requires design iterations, but for occasional usage the current execution is already accepted. The idea of more social interaction during the cooking process appeals to the user.

Feasibility

The main goal of this design research is to communicate a vision and to start the conversation between visionaries. Since this product is designed for a 2040 context, mass production is not yet considered. Although, technical design discissions are made with feasibility in mind. The main technologies, induction and fume extraction, are based on already existing products proving it is feasible to make a functional product.

To make Mesa functional, further research and detailing is required. Challenges such as power connections on a normal power socket, or the water supply need more detailed research but will be feasible to execute.

Viability

Since Mesa is designed for a 2040 context it is difficult to state whether the product will survive on a longer term. Changing the habits from the current kitchen requires a strong alternative. The social interaction will improve the general experience of cooking, but limitations can cause users to fall back to the ease of the 2026 kitchen. This viability could be tested in a further stage, by creating a functional prototype and test for a longer period.

Limitations

This design research reveals valuable insights, but several limitations determined decision making during the process. In further research this could be considered to validate the quality of the results.

- The timeframe of 100 days is the main limitation of this project. In a relative short timeframe research had to be done and a complete concept was designed. With a constant eye on the planning, complex alternatives for solutions were excluded from development.

- The validation of Mesa had limitations since the product is designed for a future context and focus group. Therefore participants were selected which are near to the eventual group. Also validating the social interactions encountered challenges since first-time exposure influences the behaviour of the users.

- The limited sample size causes generalised statements. Only cooking in groups of 2 was validated and other scenarios like e.g. cooking alone or with more people were excluded.

- Mesa aims to be the kitchen of the future. Within this project, starters are selected as focus group. Further research should expand this group, to ensure a broader societal support.

Opportunities

The presentation of Mesa creates new opportunities. As indicated before, this forms the basis to expand to other focus groups. Different groups contain their own preferences and requirements which should be considered. This also creates the possibility for the user to personalise the product and increase the emotional connection between user and product.

Besides, this flexible kitchen will be about supply and demand. Market development creates the opportunity to make different design styles. This way desires from different focus groups will be covered.

Whereas the Frankfurter kitchen from 1926 was focussed on efficiency to align with values of growing wealth, the Frankfurter kitchen from 2026 will be focussed on social interaction, aligning with values of mental wellbeing and enjoying life.

Figure 8.1 Edward Hopper - Office in a small city (1953)

Personal reflection

A graduation study exposes personal working habits, strengths and weaknesses for each individual person. For me as a student I try to learn from this by reflecting on different aspects. Within this paragraph I will analyse specific tasks (hard skills), the overarching project level (soft skills), and on a personal level (soft skills) (Figure 8.2). For each I discuss some examples of what I have done and what lessons I learned for future projects.

Specific tasks

Through the project I went through different stage, both on project base as well as emotional base. It could be experienced as a rollercoaster. I learned that I enjoy certain stages more than others during design research.

In general, I noticed I enjoy the moments where I discover new insights, and the moments of realising ideas into physical objects. Adapting the VIP method, making quick sketches during ideation, rough prototypes from the PMB (workspace at university), and building a 1:1 scale concept feels very pleasing and gives energy.

At the start of the project, I composed a few goals in which I mentioned I wanted to improve my prototyping skills, more specifically to learn lathing, welding, and vacuum forming. Although I did not manage to implement these techniques within this project, I did manage to learn other techniques. I already worked with laser cutting and 3D printing before, but within this project I seeked the boundaries of these techniques with complex and large-scale parts. I really enjoyed this phase, and in future projects I still want to push myself in discovering new prototyping techniques.

I struggled most during the reporting phase. Connecting all insights in one coherent story was quite challenging. I learned that frequently discussing topics with other people helps to maintain a strong and understandable story. In future projects I aim to reflect more frequently on the storyline and write down key takeaways per research fragment.

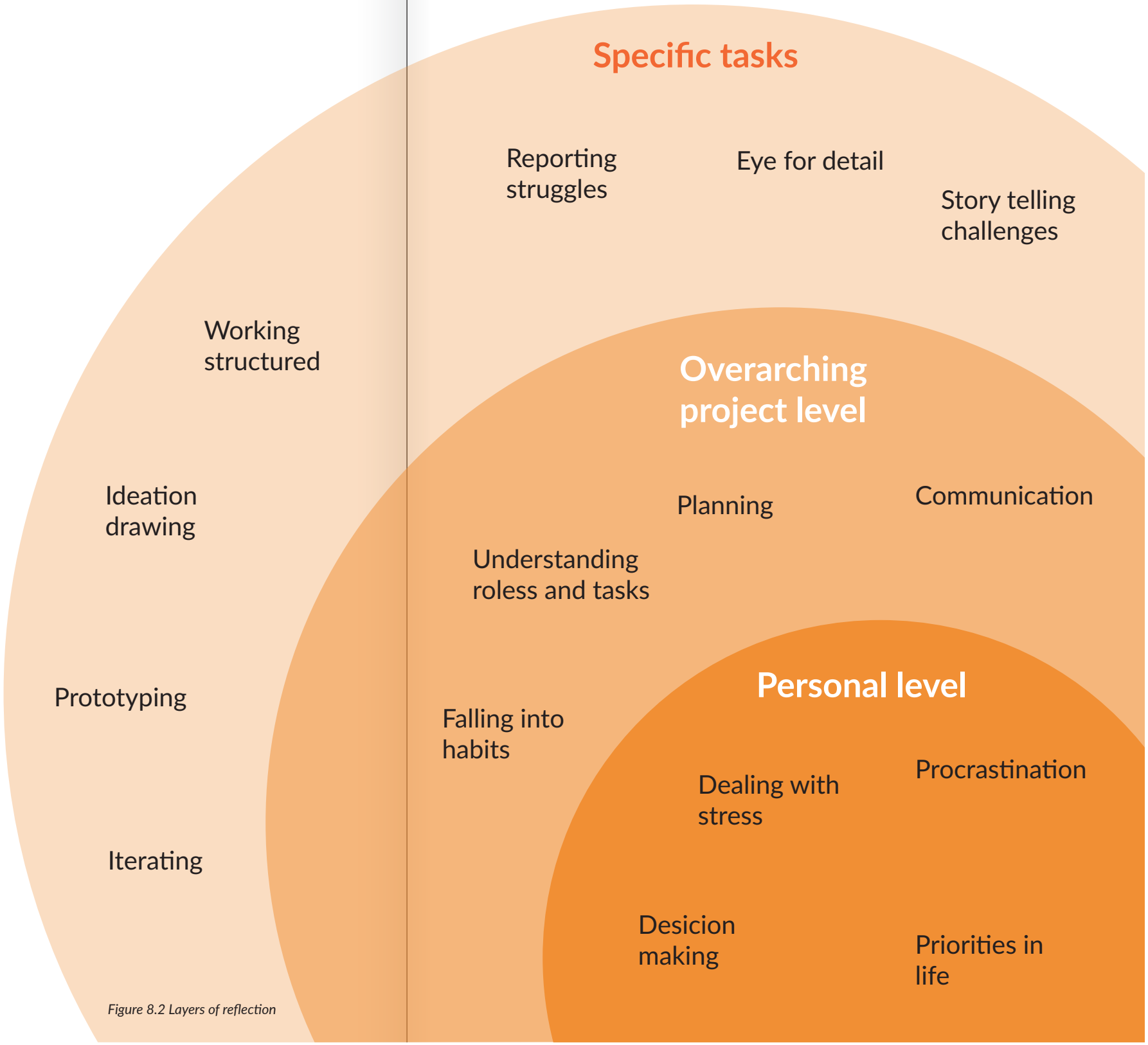


Figure 8.2 Layers of reflection

Overarching project level

When looking back at the structure of my project I can state that the approach was promising, but the execution can be strongly improved. This is mainly caused by planning issues. At the beginning of the project I was aware of planning challenges, since this is a topic which multiple students experience. At the start I made a schedule with sufficient buffers, but for multiple topics delays arose. This was mainly during the research phase. A combination of difficulties with decision making, getting pushed by mentors for another research iteration, and unexpected private events made the planning challenging.

Reflecting on this I realised multiple things. During a graduation project the student responsible for the complete process. This means you need to take on different roles, with different goals and responsibilities.

- The most important one is the project leader responsible for planning. This role needs to assign boundaries to the other roles and keeps track of the planning. During meetings he needs to satisfy stakeholders but also stand firm to maintain a realistic planning and make stakeholders aware when desires don't fit in the time span of the project.

- The researcher wants to investigate different topics, and tunnel vision can lead to delays in the project.

- The ideator is most flexible in time. The more information he gets, the more elaborate the ideas will get. The available time will influence the quality of the outcome.

- The conceptualiser ensures feasibility of the concept. He likes to jump into detailing of specific components but sometimes needs guidance to maintain the goal of the concept.

- The builder always scratches behind the ears of what the conceptualiser came up with. The project leader always forgets that the builder needs more time because he is limited by the boundaries of prototyping techniques and available tools.

- The reporter creates a coherent story to sell the concept. Although this task is seen as a simple deliverable, he always needs more time and iteration than expected. In the end he is the one who gets confronted by the initial goals and high expectations of the project leader and stakeholders.

During this design research the project leader could gain some more confidence. The biggest learning points are standing firm towards stakeholders and making decisions. The other roles could improve their communication with the project leader, in the shape of summarised take aways.

Being aware of these different roles with their individual goals and responsibilities, I think in future projects I will be able to communicate more clearly and be in control over the complete span of the project.

Personal level

The results visualise quite well how I am as a person. I really like to spend time with people, build physical prototypes, and try to improve quality of life. Therefore I always like to satisfy stakeholders, which is not beneficial for the project leader. This results in issues in decision making and being firm to others, both at a professional and personal level. By making promises to others, stress levels rise which influence all aspects.

I learned that this is not only a personality, but that your body communicates when expectations are too high. It is important to listen these signs and act accordingly. Of course this is mitigating consequences, towards the future this should be prevented.

Towards future events, both professional and personal, I aim to become firmer in my own planning and decisions. Small steps, not unflexible but open for discussion when new desires arise for stakeholders or team members. This will improve the general managing skills, and prevent having too much on my plate, mitigating the risk of stress.

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Appendices

A. Project Brief
B. Insights in ideation
C. Validation test plan
D. Transcription interview
E. Clustered insights

A. Project brief

DESIGN FOR our future

TU Delft

Personal Project Brief – IDE Master Graduation Project

Name student Nandus Lemlijn **Student number** 5,302,528

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT
Complete all fields, keep information clear, specific and concise

Project title Beyond the kitchen, towards nomadic cooking

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

This graduation will be investigating the independence from current kitchen areas.

Currently kitchens are dedicated rooms within a household. During history and by the industrial revolution this is shaped into one efficient area. Energy sources such as cooking on gas forced us to stay within this room to prepare food. Nowadays most appliances run on electric energy, which enables the opportunity to explore alternative interactions and environments.

Within this project there will be different stakeholders. To begin with, the collaborating company De'Longhi Braun Household GmbH (hereinafter referred to as Braun). Braun proposed a research in the envisioning of the future kitchen, 100 years after the creation of the Frankfurter kitchen. This kitchen designed in 1926 by Margarete Schütte-Lihotzky, was optimised for efficient work and low-cost production.

The Group director of the De'Longhi Group, Prof. Duy Phong Vu, will be a guide within the research to share the companies' expertise, insights and to maintain their interests.

Another important stakeholder will be the future customer. The focus will be on users who desire independence from the kitchen. This is where an opportunity arises for a nomadic setting in which appliances function unconstrained.

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.
(max 200 words)

Societal norms and trends create various opportunities for future developments. Living areas are slowly shifting towards places to come together and celebrate. These areas, including their activities, are merging. In addition to this, we as a society are striving towards certain goals such as lowering emissions and product waste, which encourage technological development. All these different trends are related, and will influence each other. This slow transition is where companies struggle within their development. Brands related to kitchen appliances are all competing on the few square meters available at the countertop. Opportunities arise when taking one step back and act to this societal transition, which create a complete new market.

By mapping and linking these tendencies, we gain a lot of insights to develop meaningful products for the eventual user. This is also where Braun will gain an advantage to their competition. Also, consumers will get in touch with a less restricted way of cooking. By enabling them to explore new environments, the market will indicate its own desires towards specific niches.

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence) As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

Develop a mobile kitchen appliance that improves the independence from the current kitchen area in Nord-west European countries.

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

The project would kick off with research in cooking in alternative environments. It is important to understand the user, and how influences such as habits and cultures play a role in the current kitchen. In this stage, methods like trend analysis and interviews will increase insights. After that, the knowledge can be projected to a nomadic context. As a source of inspiration I will have a look at travelling people such as picnickers, camping people and cooking in the workplace or home gardens.

With the insights from the research, a future vision of nomadic cooking can be created. With this knowledge, ideation can be started to investigate appliances which fit in this envisioned system. Further within the project I plan to go through phases like prototyping and validation to create a physical model which proves the basic principles of a mobile appliance.

Project planning and key moments

*To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a **kick-off meeting**, **mid-term evaluation meeting**, **green light meeting** and **graduation ceremony**. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).*

Make sure to attach the full plan to this project brief.
The four key moment dates must be filled in below

Kick off meeting	17 sept 2025
Mid-term evaluation	26 nov 2025
Green light meeting	25 feb 2026
Graduation ceremony	1 apr 2026

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	✓
For how many project weeks	25
Number of project days per week	4,0

Comments:

Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.
(200 words max)

Already from the beginning of my studies I am interested in designing with and for people. I want to understand why people have certain habits and wishes. With this knowledge products can be designed which matter and last. With this as a driving factor, I want to start my master graduation.

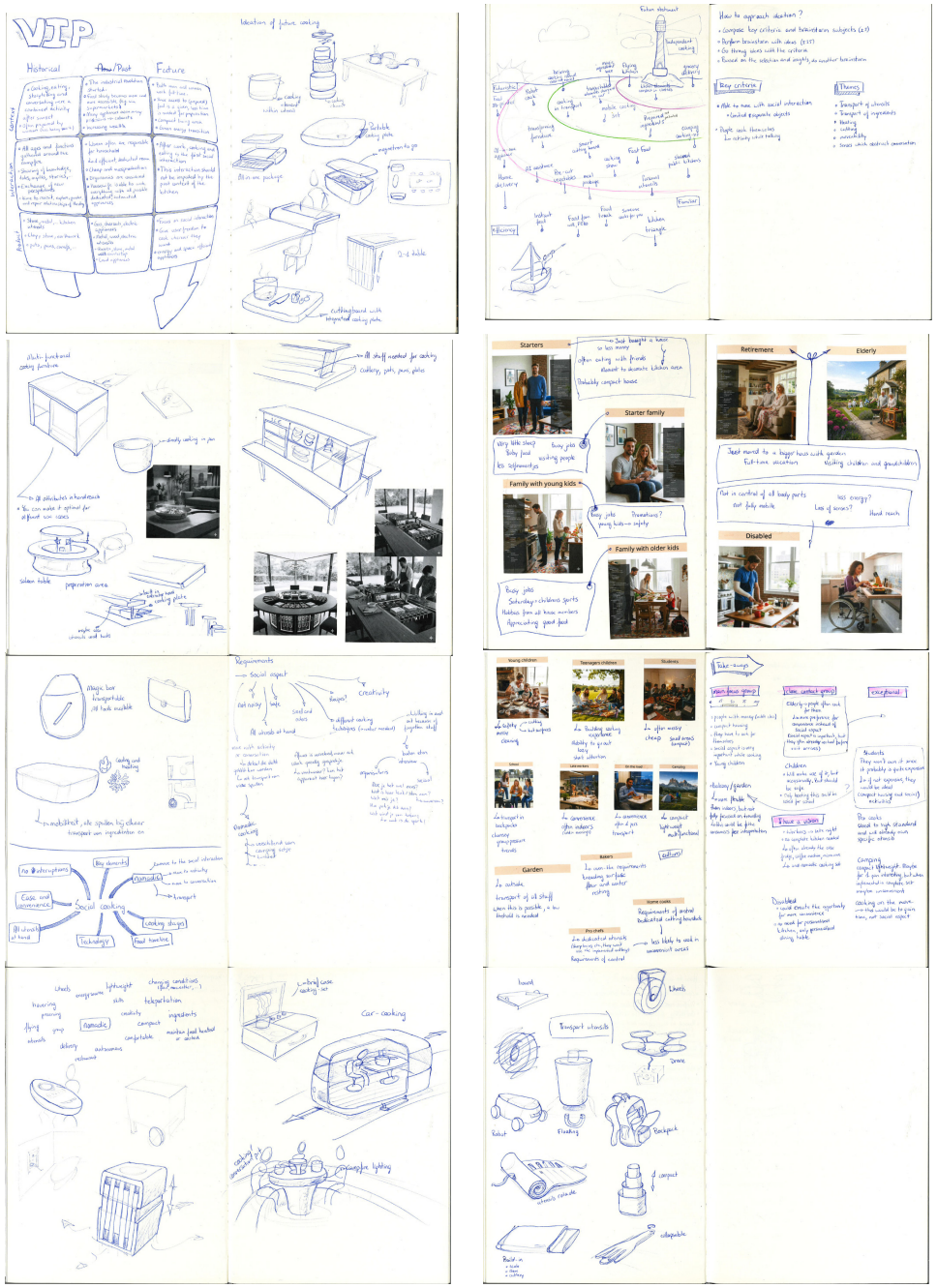
During this project I aim to develop a product, based on scientific research. During this process I would like to strengthen my analytical and communicative skills. I want to explore how we can predict the desires of our users within a future unknown context, and how we can prepare our product development for this transition.

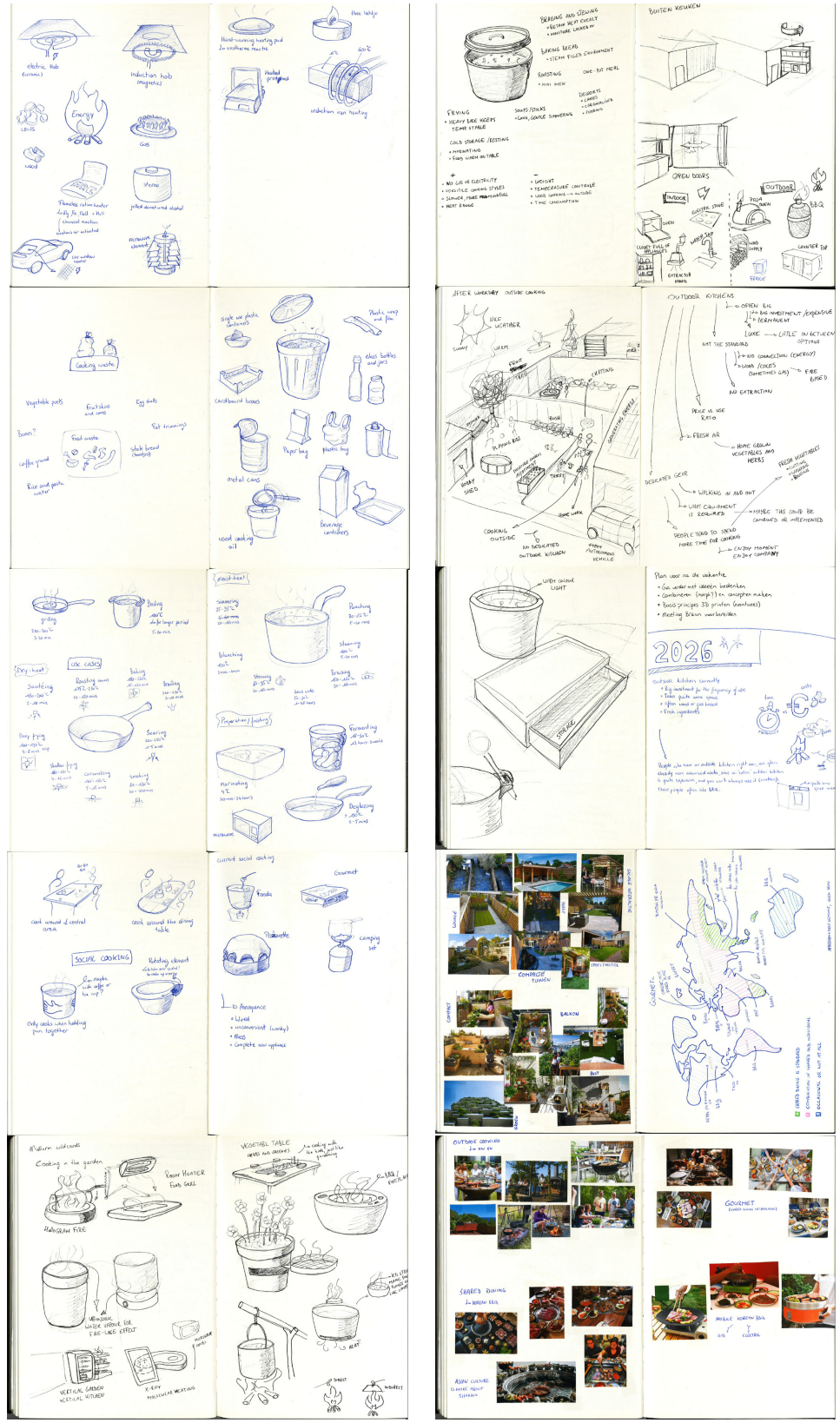
Next to these soft skills I would like to broaden my physical skill set of prototyping techniques. I am already familiar with quite some techniques such as 3D printing, injection moulding and milling. During my thesis I want to work towards a physical prototype, in which I could potentially implement techniques such as lathing, welding, or vacuum forming.

introduction (continued): space for images

image / figure 1 Frankfurter kitchen 1926, designed by Margarete Schütte-Lihotzky

B. Insights in ideation






COMMUNAL TUNNEL
BALKON
BBQ
OUTDOOR COOKING
SHARED DINING
ASIAN CULTURE
GOURMET
MOBILE WORKING AREA
MOVE RESTAURANT
Communally shared dining is occasionally in northwest Europe
cooking in garden → outdoor kitchen is expensive
BBQ built in table
cooking
MOBILE COOKING POT, BARBEQUE
AMERICAN BBQ STYLE
Kook eiland tuin brainstorm
HOME GARDEN WITH INDOOR KITCHEN
TABLE TO COMFORTABLY EAT AT OUTSIDE CAFES
PAND COOK DIRECTLY ON TABLE
ROTATING TABLE BASE
LOW TRESHOLD FOR CHILDREN TO PARTICIPATE
GLASS POTS SO YOU CAN CHECK FOOD FROM A DISTANCE
HEATING ELEMENTS INTEGRATED IN TABLE
TABLE SHAPES
ROUND CERAMICS PLATES
DIFFERENT COOKING PLATES
ADDITIONAL COOKING PLATES
VERTICAL COOKING
BUILT IN GRILL
COOKING IN AND OUTDOORS
INTEGRATED PAN
AIR HEATING ELEMENT REMOVED (USB-WITHFIT)
COOKING HUB
BUILT IN BARBECUE
OVEN
STONE
HEATING PLATES
HEATER
Essentials of cooking journey
Heating
what scenarios
current kitchen also in use by all of planners
single person
family standard
group dinner
SOCIAL
NOMADIC
COMPACT

C. Validation test plan

Goal

Validate whether Mesa supports design vision. Does it, compared to the 2026 kitchen area, improve the social interaction during the cooking phase?

Research questions

How is the social interaction experienced by the users?

- Communication regarding decision making
- Interacting with each other
- Discovering cooking habits and preferences
- Complete cooking phase included in the interaction

What potential hazards are revealed?

- Instability of Mesa
- Hot surfaces
- Hot cookware
- Sharp utensils
- Cables
- Shortcuts
- Ergonomics

How do participants use Mesa, and how does this differ from the intended interaction?

- Movability (touchpoints)
- Unfolding of Mesa
- Extending working surface to environment
- (Dis)connecting of cooking plates
- Storage of dirty cookware
- Exclusion of drainage

Method

Participant data

Participant	Age	Gender	Background	Comments
1.1	24	Female	Medicine	Dietary wishes
1.2	24	Female	Industrial Design Engineering	Dietary wishes
2.1	24	Female	Industrial Design Engineering	Dietary requirements
2.2	24	Female	Industrial Design Engineering	
3.1	25	Female	Civil Engineering	Dietary requirements
3.2	22	Female	Architecture	
4.1	21	Female	Technology, Policy & Management	Dietary wishes
4.2	23	Male	Industrial Design Engineering	

Materials:

- A brief user scenario to describe the 2040 context, and for a better understanding of the main functions of Mesa.

- A physical prototype (1:1, non-functional). The prototype could be characterised as an experimental prototype, focussing on the interaction validation rather than technical feasibility.

- Basic cookware, cooking utensils and ingredients

Cookware		Utensils		Ingredients		Additional	
Skillet	1	Knives	3	Carrots	5	Towel	1
Stockpot	2	Whisk	1	Bell pepper	5	Vegetable basket	1
Wok	1	Spatula	3	Orecchiette pasta	500g	Wastebin	1
Strainer	1	Sauce spoon	1	Spices & herbs	8		
Mixing bowl	1	Fork	2				
		Tablespoon	2				
		Peeler	1				

Apparatus:

Apparatus		
Device	Type	Method
Smartphone	Photos	Observation
Smartphone	Videos	Observation
Smartphone	Voice recording	Interview

Procedure:

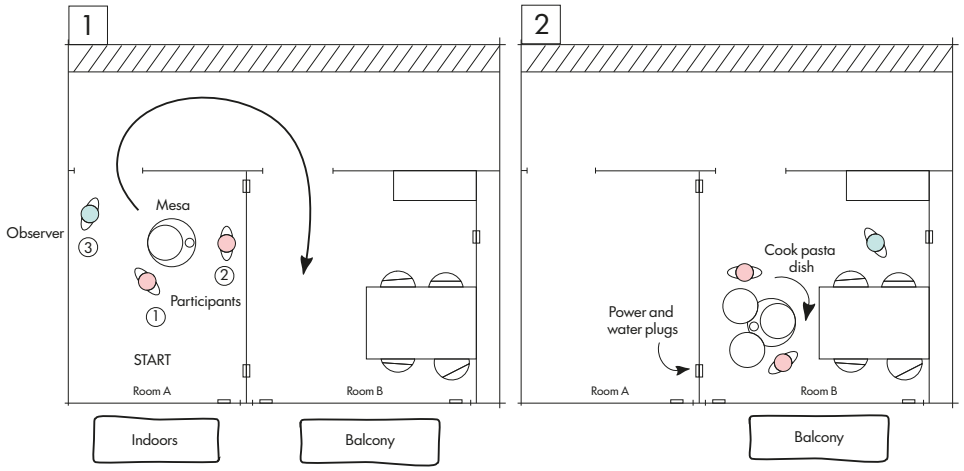
The following information was shared with the participants in an informal setting.

Introduction:
- Collaboration with Braun
- Project origin (Frankfurter kitchen 1926 → New Frankfurter kitchen 2040)
- Research core findings (social interaction, flexible approach, 2040 compact living environments)

Context:
- Presenting the user scenario. Together with the participants going through the user scenario.
  - Context: A starters apartment in a 2040 urban (Dutch) environment. Because of a growing population society must be more efficient in household layout. The 2026 kitchen has completely disappeared. Functions like the sink, oven and fridge have merged with the living environment. Also, a new item is introduced in the home area, water plugs (comparable to power sockets) distributed through the house for fresh, running water.
  - Further description of the scene was done by going through the images, explaining the functions of Mesa.

Simulation of cooking process:

- Before starting the simulation, the participants were asked for consent to capture anonymised photos and videos during the simulation (observations). Additionally, consent was requested for a voice recording during the interview.
- This test was executed in the IDE faculty building of the TU Delft. The participants were asked to think out loud during the test. Room A represented the indoors area in which Mesa was located (Mesa in this case was represented by the experimental prototype). The participants were asked to cook together at the balcony (Room B). With the knowledge shared in the user scenario, the participants had the opportunity to discover Mesa themselves (without tips from the observer). Tasks like plugging in the connections, unfolding Mesa, cutting vegetables and detaching the cooking plates got some more attention during the observations.



- After concluding the simulation, the participants were interviewed to reflect on the thoughts and actions.
  - What are your first impressions?
  - To what extent did you feel like cooking together?
  - What difficulties did you experience in the process?
  - What functions do you miss in the concept?
  - What concerns do you have regarding ergonomics?
  - What concerns do you have regarding safety?
  - What concerns do you have regarding mobility?
  - At what locations do you see potential to use Mesa?
  - What functions should be revised or added before you would prefer Mesa over the 2026 kitchen?

Pilot:

A pilot test was performed to see which aspects of the test setup required some changes.

Measures:
All data captured with interviews and while observing the simulation, was analysed, interpreted and structured within themes.

D. Transcription interview

Example transcription from group 3:

Interviewee Wat was jullie eerste impressies over het algemeen?

Participant 3.1 Ik vind het wel echt leuk. Maar ik denk wel dat je je af moet vragen wat voor settingen je dan echt nodig hebt. Zeg maar, zoals met de balkon setting vind ik dan wel realistisch, maar ik vraag me af. In hoeverre het dan makkelijker is dan gewoon een keuken hebben een paar meter verderop. Maar ik vind het wel leuke ervaring.

Participant 3.2 Ja, Dat is het inderdaad.

Interviewee Om een keer in de zoveel tijd te doen?

Participant 3.1 Ja, nou ja, wat ik wat ik al een beetje zei. Je moet misschien wel een beetje op camping stijl voorbereid zijn. Maar dat is zo een soort setting. Maar ik snap heel goed het doel van samen komen en samen koken door dit product. Zoiets als een barbecue.

Participant 3.2 Ja precies. Daar liet het mij ook gelijk wel aan denken, ook wel toen je dit [user scenario] liet zien. Ik dacht een soort barbecue, maar dan gewoon lekker te koken.

Interviewee Voelt het wel alsof je ook Samen aan het koken bent? Of in ieder geval samen bezig bent?

Participant 3.2 Ik denk wel dat het leuk is dat je tegenover elkaar kan snijden en dat je elkaar ziet, want dat heb je een normale keuken natuurlijk niet, want dan sta je gewoon met je rug daar naartoe naar iemand die aan het snijden is.

Participant 3.1 Ik denk dat je natuurlijk ook gewoon alleen kan koken, maar ik denk dat het makkelijk is om even te zeggen, Hé, doe jij even dat snijden, en dat je dan door kan gaan met je gesprek

Participant 3.2 Maar het nodigt er wel voor uit.

Interviewee En het stukje dat Je kunt meebewegen met de mensen om je heen?

Participant 3.2 Als in dat je ermee kan rijden?

Interviewee Ja, het verplaatsen van de keuken.

Participant 3.1 Ja dat was geen probleem. Ik moet een beetje denken aan vroeger. Als wij pannenkoeken ging neten. En mijn moeder dan altijd in de keuken stond. Nou ja, de tafel zat bij ons ook In de keuken maar dat zij dan altijd bezig was met koken. Voral als je zo'n gerecht hebt waar je wel de hele tijd even moet roeren, of de hele tijd even dit of dat moet doen. Dan is het wel heel leuk als je deze keuken gewoon bij de andere mensen kunt zetten. Dan kun je makkelijk even roeren zonder dat je weg hoeft.

Interviewee Ja.

Participant 3.1 Dat is denk ik wel een toevoeging.

Interviewee Ja.

Participant 3.2 Ja ja ja ja dat zag ik ook wel voor me ja. Ik zat heel erg te denken aan compo weekend, dat je dan maar één keer hoeft te lopen vanuit de keuken met zo'n groot kartje. Maar ik was wel een beetje bang dat als je met deze keuken over een hobbel heen moet, dat hij dan schuin gaat en dan dingen er uit gaan vallen. Maar dat was nu niet.

Interviewee Ja precies, hier heb je ook geen hobbels.

Participant 3.2 Misschien wel in het balkon.

Interviewee En zien jullie het voor je dat je dit ook in de toekomst zou gebruiken?

Participant 3.2 Ik denk dat ik het zelf voor nu, omdat ik gewoon niet anders gewend ben, het als een tijdelijk iets zou gebruiken dat je één keer de zoveel tijd uit de kast haalt. Als het mooi weer is, dan pak ik het gewoon even uit de kast.

Participant 3.1 Als je het een beetje gewoon bent zou het wel kunnen. Als ik nadenk over hoe ik nu woon of ook hoe mijn moeder woont dat je daar eigenlijk ja, niet echt de ruimte hebt om zoiets te doen, de keuken is zo onze woonkeuken eigenlijk dat je daar niet echt perse ruimte hebt voor zoiets.

Interviewee En in de toekomst is dan ook wel je omgeving daarop aangepast.

Participant 3.2 Dus Misschien. Omdat je dus wel de vaatwasser en al de de zeg, Maar dat je water dan toch nog ergens anders moet weggooien dat is dan misschien nog wat mist om de volledig te keuken te vervangen.

Interviewee In de situatie dat je dan inderdaad op het balkon gaat koken, maar stel je kookt dan gewoon naast de eettafel.

Participant 3.2 Denk ik niet. Ik denk als het in de buurt is, als het dichterbij dan een paar stappen, zeg maar Je moet een paar stappen kunnen zetten en dan het weg kunnen gooien.

Interviewee OK, zijn er nog dingen waarvan je denkt, dit mist nog in het product.

Participant 3.1 Ja, Ik denk dus een een plek om je spatel neer te leggen.

Interviewee Alleen je spatel of gewoon uberhaupt spullen?

Participant 3.1 Ja, gewoon een soort van wegzetstukje.

Participant 3.2 Ja

Participant 3.1 Iets wat je eigenlijk meteen in de afwasmachine wil zetten. Zo van, Oh ja, ben hier klaar mee. Ik ga het zo afwassen.

Participant 3.2 Ja, en daarnaast iets wat duidelijk aangeeft dat je dus niet die plaat nog aan moet raken. Weet je, Als je verplaatst dat je je dan verbrand.

Participant 3.1 Of iets wat laat zien waar wat warm is en wat niet.

Interviewee En ik zag ook dat jullie wel vaak Als je dan In de bak gaat kijken, wat heb ik hier allemaal? Ook al zou je weten wat er allemaal staat, dat je alsnog alle kookplaten opzij begint te duwen. Had je hier liever iets anders gezien?

Participant 3.2 Eigenlijk ideaal zou zijn als die bak ook mee verplaatst kan worden dat je die gewoon eventjes erbij kan pakken en weer weg kan doen, want dan kan je tenminste ook zien wat daaronder staat.

Participant 3.1 Ja op zich denk ik ook wel dat je weet wat erin zit? Ik denk dat je dat wel houdt dat je even gaat kijken. Van waar ligt het en wat pak ik.

Interviewee En wat vinden jullie van de kabels?

Participant 3.1 Ik denk als kabel is lang genoeg is, net als met de stofzuiger. Als de kabel lang genoeg is, dan ligt die gewoon op de grond, dus dan denk ik dat het niet perse een probleem is. Denk wel dat een batterij, voor de barbecuesetting, wel van toegevoegde waarde zou kunnen zijn zodat je makkelijk naar buiten kan. Of zoiets dat je iets verder kan dan je huis.

Participant 3.1 Maar voor deze toevoegen of deze bestemming denk ik dat en kabel niet perse erg is.

Interviewee Dan de laatste vraag, heel algemeen. Stel alle opmerkingen van net zijn verwerkt, zou je deze keuken dan verkiezen boven de traditionele keuken?

Participant 3.1 Ik denk dat het heel erg ligt aan wat voor huis je het. Dus Ik kan me wel voorstellen dat als je veel ruimte hebt in je huis, dan ook gewoon naast je tafel in de woonkamer laat staan en je daar gaat koken. Als je een huis hebt waarbij je inderdaad naar het balkon toe kan gaan of je een beetje mogelijkheden hebt om op verschillende plekken echt te koken dan wel ja.

Interviewee Nou, dat waren de vragen. Ik wil jullie allebij bedanken dat jullie wilden meedoen. Ik hoop dat jullie het leuk vonden!

E. Clustered insights