From Exhibition to Innovation

A Case Study on MAACQ Oase to Increase the Impact of Critical Design

Master Thesis by Pim van Everdingen
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Colophon

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A Case Study on MAACQ Oase to Increase the Impact of Critical Design
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Summary

There are many societal issues, which industry and policies have been unable to manage. One such issue is the nitrogen acidification crisis; this topic is so prevalent and controversial in the Netherlands that in the summer of 2022, farmer-led demonstrations against climate policies rocked the nation.

Critical design is the development of non-obvious design concepts that challenge the status quo (Spacey, 2023). It is known for its ability to entertain, caution and reflect, but receives critique for a lack of impact. The cultural and creative sector, one of the primary producers of critical design, might be the source of ideas needed to bring change to nitrogen acidification and other issues of similar wickedness. However, there is a gap in knowledge on how impact-oriented projects from the cultural and creative sectors can turn ideas into innovation. This thesis seeks to answer to what extent innovation management strategies can be used to identify where and when critical design projects made by SMEs placed in the cultural and creative sector have value in other societal sectors and what design activities can be performed to achieve a design with a deep impact.

Research through design method is employed in a case study with, and for, Fillip Studios and Omlab on the MAACQ Oase project, to observe the design activities of experienced practitioners of impact-oriented creative designs. The MAACQ Oase project develops 3D-printed sculptures made with a biobased circular material which degrades when to the weather, this gradually delivers calcium to the surrounding soil, repairing some of the damage done by nitrogen acidification. This project is a good example of the types of projects which are both critical of existing solutions and hold substitute offerings to address the wicked problem.

The outcome of this case study is a design-research product called Birdbead. This was thought of by identifying research questions about interactions with nature, which must be answered for MAACQ Oase to make a positive impact in the future. Birdbead is an algorithm for making nestboxes, which would create a sanctuary for species threatened by nitrogen acidification. The use of parametric modelling allows for an adaptable shape which can be fitted to different species of birds, as well as updating to new 3D printing specifications. Birdbead could become a platform for Fillip Studios to test out how MAACQ Oase sculptures perform in nature, specifically research into interactions with animals and water. A full-size prototype of Birdbead printed in 'Itbettermatter' was presented at Dutch Design Week '23.

The process of designing, producing, and exhibiting showed that SMEs in the cultural and creative sector are modulating the amount of influence art has on the design process to be both disruptively creative and impact-oriented. Furthermore, it was found that impact can be achieved through repeated exposition and that the models for innovation lack a crucial self-reflective step for designers from the artistic sector.

Topics

3D Printing, Critical Design, Design Driven Innovation management strategy, Design Management, Conceptual Design Methods, Small to Medium Enterprises, Parametric Design, Generative Design, Bio-Design, Sustainability

Artificial Intelligence Statement

In the making of this thesis, various Artificial Intelligence tools were used, use of services of this nature must be transparent. This section will disclose which tools were used for what reasons following the instructions of the Technology Enhanced Learning & Teaching Team of the University of Twente (TELT, 2023).

For the editing sentence structure of the text and making improvements on spelling, grammar and language in this thesis, limited use was made of: the **Grammerly generative AI** to suggest improvements on handwritten text, **DeepAI chat** to provide writing suggestions and to assist with setting up paragraph structures, **Reverso** to assist with translating Dutch turns of phrases and jargon.

For generating inspiration images in the case study **CrAIyon** and **Hotspot** were used. A full disclosure of these images can be found in Appendix 7 – AI generated images.

For writing the transcript **Descript** was used for layout and voice recognition, followed by **Google Cloud Translation** for translating to English.

While researching the topics of this thesis, various literature sources were found using **Elicit**, which identifies literature for you relating to a research question.

After using each of these tools, the author reviewed and edited the content as needed. The author takes full responsibility for the content of the work presented in this Thesis.

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The past year has been a incredible jourey. I am immensely appreciative of the knowledge, skills and experiences I learned in during my gradiuation in Arnhem. Therefore, I would like to express my gratitude to everyone who helped me throughout this amazing project.

I want to thank my supervisor Wouter for all the positivity and encouragement. Time and time again you helped me feel that my project mattered.

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I had the incredible fortune of being able to present my case study at the Dutch Design Week, an opportunity I will never forget. Therefore, I want to thank Huub Looze and Margreet van Uffelen of Omlab for sharing your knowledge, time, and efforts to make a prototype with your proprietary machine and material. My gratitude to Daniel Saakens, Marijke Idema, and Kris Pals for organising the exhibition and my participation therein. I want to commend Marica de Michele & Laura Papke for shooting and sharing the beautiful video of Birdbead and gratitude to the design studio Lucas & Lucas for co-designing the stand in Klokgebouw with me.

I also want to thank everyone who helped me along the way. First, special thanks to Charlotte Hak, for your support and help which I can only hope to return to you in kind, now that you have started your thesis journey in Arnhem. Remko Waanders of the Tekenafdeling for inviting me into your office and listening to my experiences with interest. David, Merijn, Rowen and Tiemen for the helpful feedback which has made this thesis into the best version it could have been.

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Abbreviations

SME,	Small to Medium Enterprise
DDW,	Dutch Design Week
DDI,	Design Driven Innovation
DIM,	Delft Innovation Method
UU,	Utrecht University
UT,	University of Twente
GSS,	Global Sustainability Science
MKB,	Midden- en Kleinbedrijf
KMO,	Kleine of Middelgrote Onderneming
EIF,	European Investment Fund

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1. Introduction

This chapter will introduce the Master Assignment description as it was formulated together with Fillip Studios. Based on this description, this thesis's objectives and research question will be formulated. The introduction chapter will end with a description of the academic relevance of this thesis and its topics—the chapter its contents are based on Appendix 1 – Project plan.

Background

Fillip Studios is an art and design studio situated in Arnhem that creates tangible objects and experiences that evoke a sense of wonder by combining art, science, technology, and social issues. Their work is in part for research and in part for artistic exposition. The studio creates both independent works and runs collaborative projects with universities, institutions, museums, and companies.

Fillip Studios is currently collaborating with Omlab on the development of 'MAACQ Oase' (Figure 1.1), a 3D printed sculpture made from alginate, cellulose, Kaumera and calcite obtained from residual flows of water treatment facilities. MAACQ Oase should become a sustainable solution that protects nature from the harmful effects of nitrogen acidification by releasing calcite (a base) as it erodes, neutralising the nitrogen. At the start of this project, a proof of principle scale model prototype

Figure 1.1. The MAACQ Oase. *On the left, is an overhead view of the MAACQ Oase scale prototype, showing its textures, shapes, and colours, photo by Omlab. On the top right the MAACQ Oase is presented at DDW21, photo by Fillip Studios. On the bottom right, a visualisation showcasing the envisioned erosion and integration of the product in nature, by Fillip Studios.*

Figure 1.2. Examples of comparable critical design projects to the MAACQ Oase.
On the left, s°03_seat by Marijke Jans, part of a collection called KAFFA, biodegradable design objects made from spent coffee grounds to de design research on our use of organic waste, presented at DDW22 picture by Marijke Jans. On the right, Rootfull by Zena Holloway, a dress grown from grassroots to imagine sustainable futures presented at DDW22, picture by Zena Holloway.

was built, which highlights how a filament can be produced and printed in various earthy colours has been made and displayed. The MAACQ Oase is considered an example of critical design for the purposes of this thesis since it critiques society its failure to apply its resources to resolve natural disasters sustainably.

Objective

In its current form, MAACQ Oase is most effective as a conversation object at exposition: the ideas and form in the design help spark new ideas, bring people together and challenge people to rethink their conceptions about nitrogen acidification. Some other projects that are comparable to the MAACQ Oase are KAFFAs furniture pressed out of coffee grounds (Jans, 2022) and Rootfull clothes grown from roots (Holloway, 2022) shown in Figure 1.2. Such projects are presented at events like the Dutch Design Week, which can be the end goal of critical designs. However, as is the case with MAACQ Oase, many projects hold further merit than exposition. In my research, I want to investigate *how SME product owners create value in the cultural and creative sector and how to apply that value in other sectors to have a deeper and more effective impact of their products on society.*

The MAACQ Oase project has the potential to make an impact on how Dutch society restores its nature to become sustainable, as there is a clear need for solutions that can counteract the nitrogen problem. Because the project has an innovative character, and improving the nitrogen levels is part of a wicked problem the design decisions on the product its functionality, shape, target group and production scale need to be carefully considered and fitted. Currently, more can be learned about the production process and the impact of the erosion of the product. Researching these topics will provide structure and answers on how to develop this specific project strategically further but will also provide a model on how other critical design projects could be managed. *So, it will be the goal of the assignment to design a structured approach on how to develop critical design projects further and to apply that approach in a design case study resulting in a producible MAACQ Oase design that will have a deeper and more effective impact on the Dutch ecological health, and the societal view on the nitrogen problem.*

Assignment Description

An analysis of preconditions (past and present client projects, literary study, comparisons to industry, academic models) together with observations of the Fillip Studios working method on the MAACQ Oase project shall lead to a substantiated framework detailing the activities that can be performed to further develop critical design projects and products from the cultural and creative sector into applied and impactful innovation for other societal sectors.

The MAACQ Oase project is the case study on which the framework will be based. Throughout this assignment, Fillip Studios will continue developing the MAACQ Oase in a new direction. The framework shall be drafted, tested, evaluated, and redefined in tandem with this project. As part of this case study the student is assigned with co-developing the MAACQ Oase *culminating in a proposal for the product its implementation approach and a digital prototype showcasing a MAACQ Oase design that is fit for industrial production, as an adaptive parametric CAD model made in the software Rhinoceros 3D written in the Grasshopper language.*

As part of this case study, through an experimental and explorative material study, the influence of the designed form on the product features 'erosion speed', 'erosion steerability', 'integration with nature' and more will be researched. The assignment deliverables and the intermediary steps are represented in Figure 1.3 The deliverables of this project are:

- A framework for classifying critical design projects and selecting activities for structured development.
- An expanded MAACQ Oase concept that is adapted to have the right impact for the right target with the right form which aligns with the developed framework.
- A product proposal with geometry is defined by a parametric CAD script which matches the Fillip Studios brand and is accompanied by an outline of the production process and a cost overview.

Research Question

The project will have two research questions; the first has a broad perspective on critical design projects and aims to underpin the framework under development, and the second relates to the specific project of Fillip Studios and aims to underpin the design decisions relating to the MAACQ Oase design, formulated as requirements.

1. To what extent can **innovation management strategies** be used to identify where and when **critical design projects** made by **SMEs** placed in the **cultural and creative sector** have **value** in other **societal sectors** and what **design activities** can be performed to achieve design with a deep impact?
2. What are the **functional** and **non-functional requirements** that the **MAACQ Oase** must adhere to for it to deepen its impact on society while reflecting the **strategic position** and the **design vision** of **Fillip Studios**?

Relevance

This thesis is of relevance to all three of its stakeholders, Fillip Studios, the author, and academia.

To Fillip Studios new knowledge on the method, rhetoric, and implementation of designing with parametric software in the context of the MAACQ Oase project will open new strategic possibilities. Including but not limited to, the acquisition of bio-design projects, intertwining future design projects with the work of researchers, and collaboration with field specialists. Furthermore, the development of new MAACQ Oase products can serve as inspiration for the project its future, new exposure, and momentum.

Developing designs with a parametric approach is to the benefit of the author, as a vehicle for developing new skills and methods for design. Biodegradable materials and organic shapes will likely be part of the future of design, having experience in such projects is very valuable. Furthermore, bringing a technical background into an environment with creative freedom provides a unique learning experience, as much of Industrial Design Education is aimed at bringing a creative vision to a technical setting. Analysing this subversion plays into a personal interest towards the questions and methods surrounding how we approach design.

The new age of engineering with high precisions and workflows allows for tailored solutions rather than wide-sweeping ones. Projects which combine rapid prototyping methods with flexible digital design are needed to drive this innovation process. To academia, this thesis will be a valuable example of finding new ways to collaborate with experts from the cultural and creative sector to cultivate fruitful ground for fresh ideas. Furthermore, this thesis its research through a design approach into the connections between the fields of innovation, prototyping and critical design will broaden the knowledge in the design research field.

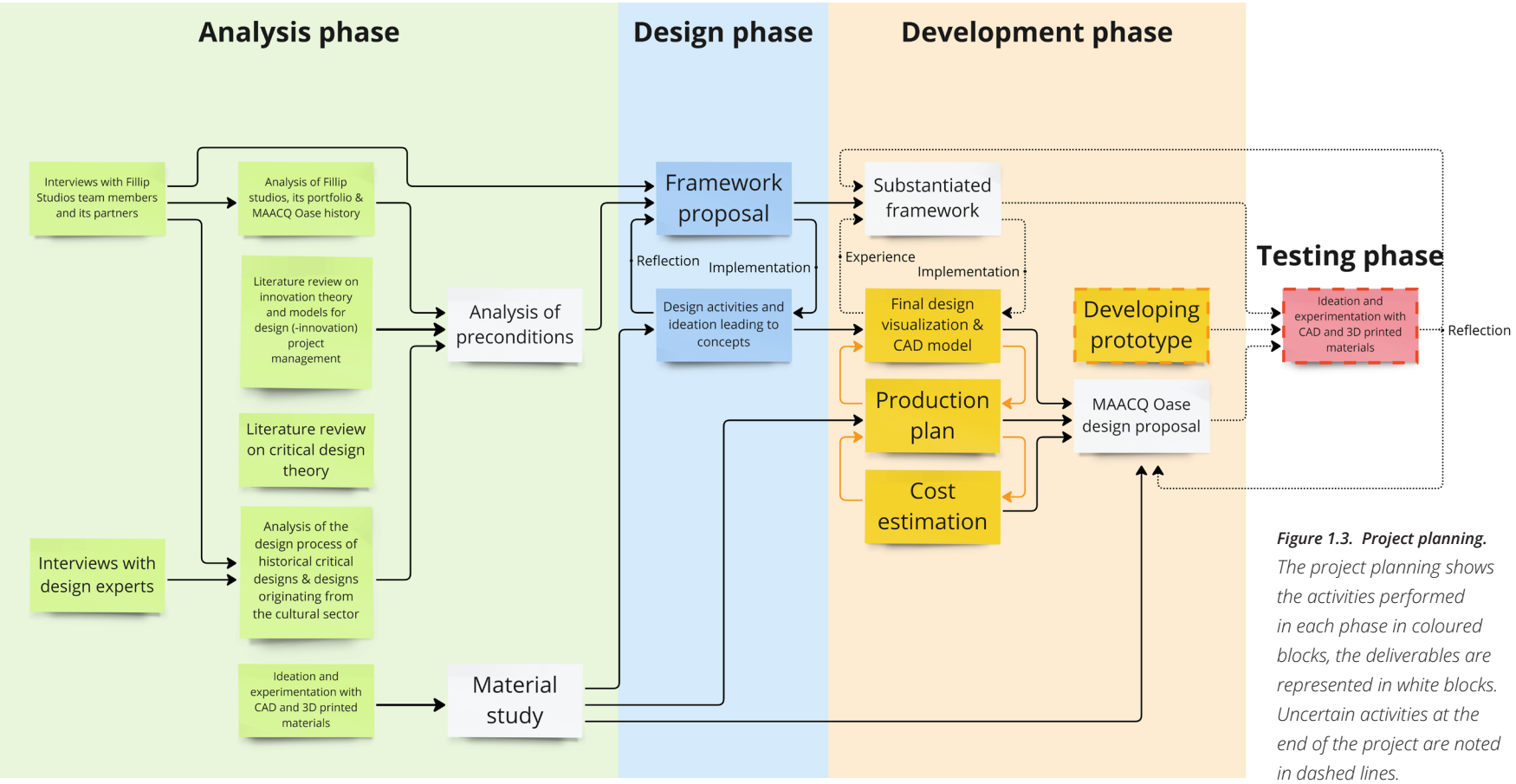


Figure 1.3. Project planning. *The project planning shows the activities performed in each phase in coloured blocks, the deliverables are represented in white blocks. Uncertain activities at the end of the project are noted in dashed lines.*

I

Analysis

Photo by Francesco Ungaro

Part I

This first part of the thesis concerns research into the four main research topics; Fillip Studios, MAACQ Oase, Critical Design and Innovation Management. The research done in chapters 2 and 3 occurred concurrently with the design process in PART 2.

Context Analysis on page 18

This chapter will provide background information on the companies behind MAACQ Oase. Following this, the Nitrogen problem was analysed to contextualize the problem space that the MAACQ Oase products. Lastly, the MAACQ Oase project itself will be dissected to find a deeper understanding of the goals of the project, as well as an understanding of past design activities to avoid doubling back. This chapter contextualizes the case study and serves as preparation for a meaningful contribution to the development of MAACQ Oase.

Literature Analysis on page 30

For this chapter state-of-the-art information is gathered about critical design and innovation management. From this analysis new insights are gained on how critical design relates to industry and innovation.

2. Context Analysis

The leading method for gathering information was the proprietary documentation on MAACQ Oase belonging to Fillip Studios. Additionally, Tom Kortbeek, co-founder of Fillip Studios was interviewed for input on this chapter, to offer an insider view of the project's history. The interview is based on the sub-research questions and the transcript can be found in Appendix 3 – Interview.

Fillip Studios Company Background

The company is a creative design agency founded by Roos Meerman and Tom Kortbeek in 2014. The studio uses innovative creativity to make an impact through 'wonder' (Fillip Studios, 2023).

Fillip Studios cooperates with universities, interns and graduates, institutions, museums, and commercial companies They are situated in the Coehoorn in Arnhem, an old school building that has been repurposed as office space for small creative organisations.

Fillip Studios is a small enterprise, they employ two designers, one social media manager, one office manager and three to five students doing internships or graduation projects. The company has a sociable and unconstrained working culture, supported by a flat organizational structure with the founders Tom and Roos at the helm, together with an external supervisory board. Figure 2.1 shows the Fillip Studios team.

The projects of Fillip Studios are often about sound design, new materials and experiences, bio-design, algorithm-based design, and human-technology relations. The company's portfolio holds various artistic projects, which have been developed for exposition in museums and events. Additionally, Fillip Studios has made diverse designs and products for commercial or research partners. The artworks of Fillip Studios are shown across the world and their business and designs have won various awards.

What makes Fillip Studios an interesting company is their proficiency in connecting artistic design to technological innovation projects, Fillip Studios is very proud of their ability to create value in this way. This ability to interweave artistic and technological thinking is highly sought after, and very closely aligns with initiatives that seek to stimulate the innovative capacity of the creative Industry (European Commission, 2016).

Figure 2.1. Fillip Studios team.
From left to right, on the top row Pim, Niels, Kamilla, Tom, Roos, and Liselot. On the bottom row Siebe, Jonne, and Jens. Photo by Fillip Studios.

Fillip Studios Portfolio

In the publicised portfolio of Fillip Studios, there are multiple projects which are linked together, where an artist design project precedes a design research project. This section will shortly describe three examples to create familiarity with how artistic projects can lead to innovative projects.

Tactile Orchestra & KozieMe

The first is **Tactile Orchestra**, the project that incited Fillip studios as a company, shown in Figure 2.2. It focussed on new fabric experiences and non-linear music, from this several pieces were developed that allowed an audience to stroke a furry wall to manipulate string orchestra music. At Dutch Design Week 2015, the project piqued the interest of an initiative looking to develop audio-based products for dementia patients.

In this way the concept was developed into a new form; **KozieMe** and **KozieWe**, two products which could provide feelings of comfort and security for dementia patients by playing sounds that are no longer available to them because of their restricted living situation. Both objects are responsive to tactile interaction, the KozieWe is a wall object for shared listening while the KozieMe is a pillow for private listening. The KozieMe could also play deeply personal sounds, selected specifically for one user. The timing of the Kozie product launch at the beginning of 2020 was unfortunate, the COVID-19 pandemic made the target group unreachable. Furthermore, the products were produced at local social workplaces, and reliance on the import of computer chips from China halted that production. Ultimately, KozieMe was liquidated, but its approach resonated in other FS projects and directly elicited this graduation assignment.

Bio Orchestra & Arabidopsis Symphony

The second is **Bio Orchestra**, which began in 2016 when researcher Sander van der Krol (Department of Plant Physiology from Wageningen University) was at the matching event of the Bio Art & Design award, looking for methods to turn visual data on plant activity into audible data. He believed that this transmutation would improve researchers' ability to detect small, but important changes in the plant.

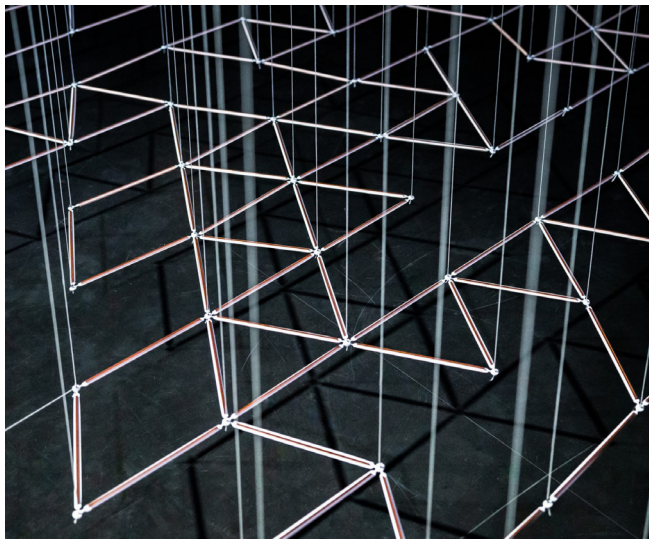
Figure 2.2. Tactile Orchestra and KozieMe.
On the top is the Tactile Orchestra at Trapholt Museum in Denmark as part of the SENSE ME exposition Photo by Kenneth Stjernegaard. On the bottom is the promotional photo for KozieMe Photo by Fillip Studios.

The Tactile Orchestra prompted a collaboration between Fillip Studios and Sander, and from these several musical art pieces were made, the most recent of which is the 2022 **Arabidopsis symphony**, an AR experience where the music changes based on the environment (time and weather), location and age of digital plants, shown in Figure 2.3. These two projects illustrate FS their familiarity with bio-data-driven design and showcase how research can inspire art.

Auxetic Landscapes & Adaptable Auxetics

Thirdly, Auxetic Landscapes, shown in Figure 2.4, in this project FS created several kinetic art pieces based on an algorithm from TU/e which randomly generates auxetic patterns. Such a pattern has the property that compression in one direction directly relates to compression in another direction. Interestingly, in the process of creating the art piece several previously unknown possibilities for optimisation of the algorithm were discovered.

Figure 2.3. Bio-Orchestra and Arabidopsis symphony. *he right, is the Bio-Orchestra installation at Wageningen University & Research. On the left the Arabidopsis Symphony Artificial Reality app showing the digital plants at the Sint-Eusebius church in Arnhem. Both photos are made by Fillip Studios.*



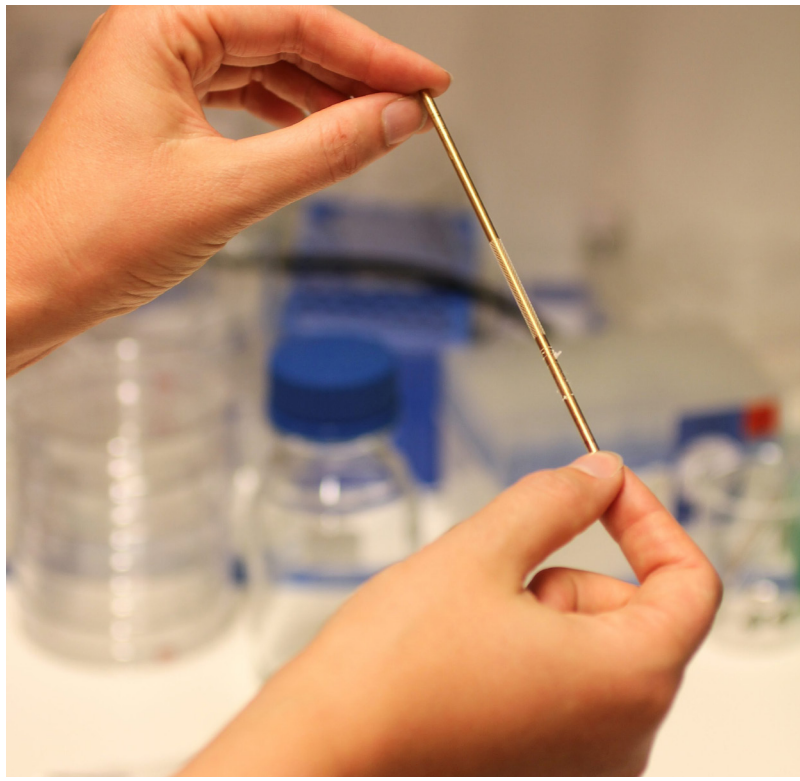


Figure 2.4. Auxetic Landscapes and Adaptable Auxetics. *On the left, a close-up of the Adaptable Landscapes at Museum Jan Cunen as part of the Kunst en Vliegwerk exposition. On the right is the Adaptable Auxetics prototype in Pi-Lab in Eindhoven, a photo by Miguel Dias Castilho.*

The collaboration was continued in Pi Lab as Adaptable Auxetics where real-world applications for the models for auxetics are researched, most prominently a medical application where an auxetic structure is being developed into a medical stent to open clogged arteries. This project showcases how the process of materialization, and the creative process leading up to that, can provide new academic insights and can help ideas to find new applications in sectors previously unconsidered.

Portfolio Conclusion

By analysing the portfolio of Fillip Studios, we can conclude several things about how artistic projects and applied projects can strengthen each other and create innovations.

- Artistic projects have the potential to inspire applied projects as a direct follow-up *(Tactile Orchestra to KozieMe)*
- Artistic projects have the potential to inspire and attract new directions of artistic and applied projects *(tactile Orchestra to Bio Orchestra & Arabidopsis Symphony)*
- In the artistic approach using 'maker technology' like 3D printing and material experimentation can uncover new applications and forms.
- The artistic approach of making ideas ready for exposition can elicit improvements on those ideas at an earlier stage than the academic approach.

From this portfolio summary, Fillip Studios has shown itself to be aware of its ability to work on technologically advanced projects. Yet, they also consistently choose to initiate projects with an artistic outlook first, only later followed by projects with an applied or industrial outlook.

The reason for this approach is captured in their mission statement, impacting through wonder. This stems from their belief that all progress starts with wonder (Fillip Studios, 2023). In this way, Fillip Studios is working on design projects directed at developing a future which is fairer, kinder, more sustainable, and beautiful.

Omlab company background

'There is no planet B', Omlab's mission is to make a difference in climate change and the loss of biodiversity by doing biobased design research on the waste streams of corporations and sectors with maker technologies. Omlab is a design studio based in Arnhem, founded by Huub Looze and Margreet van Uffelen (Figure 2.5).

They have set out to develop a circular alternative to concrete, the most used, and because of the massive quantities also the most polluting material used by industry (Kuijpers, 2020; Wolfs, 2023). The work of Omlab is circular, which means that it should consist solely of society's waste streams and 100% without the use of natural resources like mining and quarrying products. In this pursuit Omlab developed an intermediary 'Itbettermatter', this material is fully circular but is water soluble and therefore yet not a complete alternative to concrete.

Figure 2.5. Huub Looze and Margreet van Uffelen in the Omlab studio.
Photo by Change Inc.

Itbettermatter

The MAACQ Oase is made with Omlab's Itbettermatter and its proprietary 3D printer. The makeup of Itbettermatter can help restore soil biodiversity by gradually resetting the soil acidity levels. There are 3 potential target groups for such a product, large landowners (governments, nature reserves) looking to reset acidity levels in nature, consumers who want to purchase sustainable products and lastly organizations looking to compensate for their acidic pollution (Fillip Studios & Omlab, 2022b). 'Itbettermatter' used in MAACQ Oase is made from 5 ingredients: Cellulose, alginate, Kaumera, Water and Calcite. These materials, their function and their sources will be described below since these components outline the specific properties which need to be considered when designing with itbettermatter.

Calcite

This is the ingredient in the MAACQ Oase which drives its climate-restoring capabilities. The calcite is won from drink water decalcification, or softening, a water treatment process which prevents limescale in our plumbing. When calcite, a chemical base, interacts with acidic solutions in the soil it acts as a neutralizer, according to the following basic chemical reaction, which allows the calcium to be used by nature again (Science Learning Hub & Pūtaiao, 2012):

$$CaCO3\ (s)+2HCl(aq)\rightarrow$$
$$CaCO3\ (s)+Cl2\text{-}(aq)+2H+\ (aq)\rightarrow$$
$$Ca2+\ (aq)+Cl2\text{-}+CO2\ (g)+H2O(l)\rightarrow$$
$$CaCl2\ (aq)+CO2\ (g)+H2O(l)$$

The process for collecting and marketing this calcite is a relatively new process, the calcite factory was opened only in 2015 (Aquaminerals, 2015). The calcite forms pellets, shown in Figure 2.6, when produced but can also be ground up to a powder.

Cellulose

In the Netherlands alone 180 000 tonnes of toilet paper are used per year. After use, toilet paper is burned or landfilled, companies based in Friesland have been working on a method for upcycling toilet paper by reclaiming the cellulose from the sewage.

To retrieve the cellulose sewage is treated in steps, during which all contaminants are removed. It is dewatered, undergoes hygienist, is dried, polished and packaged as either fibrous fluff or pellets under the name Recell, as shown in Figure 2.7 (Cellvation, 2018). After treatment it has a biosolids classification of EPA class A, meaning that it is free of pathogens and safe to use. Furthermore, Recell is water-absorbent and biodegradable (Recell, n.d.).

Alginate

This is a hydrophile polymer won from farming brown algae, a type of sea kelp. It can absorb great amounts of water which causes it to solidify. It is used in industry to emulsify or bind liquids together, for example as a thickening agent in ice creams (Zeewierwijzer, n.d.).

The use of alginate in MAACQ Oase makes it possible to 3D-print plastically and solidify into a solid shape. However, it might make it difficult to work at larger scales, as adding water causes alginate to begin solidifying. Therefore, Itbettermatter must be made in much smaller batches than for example concrete.

Figure 2.6. 'Dutch calcite' pellets.
Refined calcite used for MAACQ Oases, Photo on the right by AquaMinerals B.V.

Figure 2.7. Recell cellulose fluff.
Cellulose used for MAACQ Oases, photo on the left by Recell B.V.

Kaumera

The facilities which treat our sewage make use of various methods, some involve the use of microbes which feed on waste. These multiply, resulting in a waste product, the Rijkswaterstaat has invested in a method where a microbe is dehydrated after use. In this state it acts as a biopolymer meant to partially replace petrochemicals; this material is called Kaumera Nerada® gum, shown in Figure 2.8 (Kaumera Nerada Gum, 2022).

In the MAACQ Oase, this polymer has a comparable function to alginate as a binding and curing agent. Its position as a waste product makes it attractive to use, as it makes the material more circular, however, it is more expensive than alginate.

Water

By adding water, the mixture becomes plastic and malleable. The different minerals are dissolved. After printing the water evaporates, which is accelerated by adding heat and airflow to the drying process. Even though the material is similar in hardness to concrete or ceramics, it is chemically very different since water is not part of the chemical bonding process like in concrete and heat is not necessary for bonding either, like in ceramics.

Optional additives

There are several possible additives, which can change the properties, function, or appearance of the MAACQ Oase. Natural dye powder, like turmeric, carbon dust, iron oxide, or cocoa can be kneaded into the printing paste to change the colour of a segment of the print.

Adding seeds could increase the speed at which biodiversity returns and could make the MAACQ Oase attractive for animals to snack on. Such interactions are not yet proven to be realistic or safe. Similarly, other waste streams could be a source of the minerals that nature requires, like magnesium, potassium, sodium, and magnesium (van Dijk et al., 2022).

Spraying Itbettermatter with chloride-based chemicals can cause a reaction which makes the outer layer harder and more water-resilient. If a good, circular compound is found for this, there is a potential method for steering the degradation process.

Figure 2.8. Kaumera Nereda® gum in a bottle
Photo by Kaumera.

Nitrogen problem

There are multiple sources of nitrogen, different nitrous compounds, and multiple harmful effects. This section will briefly discuss the nitrogen problem to back the need for solutions like MAACQ Oase.

Sources and types of Nitrogen

Generally, ammonia gas (NH3) is released from livestock manure and chemical fertilizers, and nitrogen oxides (NOx) are released as exhaust fumes from combustion engines (Milieu Centraal, 2021). For this reason, the sources of nitrogen are agriculture and transport, but also industry and construction for their use of heavy machinery.

Harmful effects of nitrogen

The presence of excessive nitrogen negatively impacts public health and nature (Government of the Netherlands, N.D.). The nitrogen compounds in the air can react to create particulate matter, these particles fall back to the earth.

These particulates, as well as Nitrogen dioxide (NO2), one type of NOx, are unhealthy to breathe in.

Where the particulates are deposited on the ground they create an unnatural excess of nitrogen, which brings nature into imbalance in two ways; eutrophication and acidification (Milieu Centraal, 2021). When eutrophication

occurs, species of plant that thrive on high levels of nitrogen begin to outperform other naturally occurring flora, resulting in monocultures. Acidification is the process of increasing the sourness of the soil. Minerals like calcium, potassium, sodium, and magnesium bind to the acidic nitrogen. This makes them soluble and causes them to sink deeper into our soil (van Dijk et al., 2022). When this happens microbiology, plants, and animals' diets are deprived which weakens and endangers them. A more neutral soil allows for a more diverse range of vegetation to grow, while the current acidic situation pushes out some species and leaves monocultures. This process must be stopped, as it makes our nature less resilient and can endanger species.

Strategies against nitrogen

According to TNO (2022), about 85 million KG of nitrogen is deposited yearly on Dutch soil, this means that 25kg of nitrogen is added per hectare each year, as calculated by van Dijk et al. (2022). To impact the nitrogen acidification problem two things, need to happen, the deposition of nitrogen needs to be lowered drastically and the acidity level of the soil needs to be restored.

To lower the output of nitrogen, major reform of our core industries is needed, this is why the nitrogen crisis is controversial.

The MAACQ Oase project is occupied with the second part the solution, to restore the damaged soil. By degrading Itbettermatter, limestone is brought back into nature and acidification is halted.

The one substitute offering is stone flour and seashell dissemination with helicopters, as shown in Figure 2.9. Some larger experiments have been held in Dutch nature reserves (Moons, 2019; Trouw, 2020). By using helicopters, the soil is not disturbed, and a lot of material can be deposited, the flour dissolves over time to deacidify the soil. Despite targeting the same problem with similar chemical interventions, the helicopter method has a very different character than the MAACQ Oase. The method is quick-acting and fails to give a sense of urgency to the public about the problem, it lacks in potential to inspire a societal change in nitrogen usage.

Consider the satire in Figure 2.10, where global warming is solved by dumping extraterrestrial ice in the ocean. This approach opposes the vision of Fillip Studios and Omlab, it uses imported natural resources. Quarrying, transporting, and distributing stone flour creates new by-products and is not a circular solution. Furthermore, concerns have been raised about the method, since it delivers a spike of new minerals and the black blanket of dust might disrupt the forest, as shown in Figure 2.9 (Moons, 2019).

To compete with this technique MAACQ Oase should make use of its potential to engage with people in a personal way. One possible meaning was already named in the project documentation, namely to empower people to work on the nitrogen climate crisis (Fillip Studios & Omlab, 2022a).

MAACQ Oase

MAACQ Oase is an ongoing collaborative design research project between Fillip Studios and Omlab. MAACQ Oase is a 3D-printed sculpture that makes use of the solubility of the Itbettermatter material to deposit calcium minerals back into soils deprived by industrial nitrogen usage. Their artistic concept addresses the ongoing nitrogen problem in the Netherlands, by displaying to an audience that we can rethink our position on this massive problem and use our waste streams to begin healing the damage done to nature by nitrogen acidification.

As the project is ongoing the following two sections will describe what the project and the product have been up to 2023. The project will continue to develop and change throughout this graduation project.

Figure 2.9. Stone flour spreading. over the forest near Someren,
On the left, is the process of helicopter fly-over spreading. On the right, the coverage of stone flour in the forest. Both photos by Koen Verheijden.

Figure 2.10. Futurama season 5 episode 1
Still from the satirical animated science-fiction television series Futurama, where global warming is managed by dropping a mountainous slab of ice into the ocean regularly to cool it (Ervin & Vebber, 2002).

Project Timeline

Because the project is ongoing every aspect of it is still subject to change, its name, goal, business model, concept, stakeholders, and production method. There is no definitive MAACQ Oase yet, by creating a timeline of the project's history and foreseeable future certain instances of MAACQ can be identified (Figure 2.11).

Q4 2019 - Q1 2020 Lead up

- The regional water authorities Rijn & Ijssel, a stakeholder of Aqua Minerals collaborate with Omlab to find applications for Kaumera.
- Omlab invents 'Itbettermatter' with Kaumera (see Figure 2.12) a biobased circular concrete alternative. Which can be 3D printed (see Figure 2.13), the project is called Maacq^4.

Q2 2020 - Q1 2021 Design round 1: Commission

- Omlab commissions Fillip Studios to design with itbettermatter using funds from 'Arnhemmade' (Fillip Studios, 2021b).
- A Meeting an expert on moss leads to experimentation, but results in infestation of fungi instead.
- Non-woven 3D printing concept, acoustic plating concept and (partial) pressed material concepts are disregarded before prototyping.
- The 'Vase' MAACQ Mossery (see Figure 2.14), 'Wall' MAACQ Mossery (see Figure 2.15) and 'Rock' MAACQ Oase concepts are presented to Omlab and the advisory commission (Fillip Studios, 2021a).

Q2 2021 - Q4 Design round 2: Search

- Rapid development process cuts out the vase and wall concepts were cut out. And the 3D-printed human-made rock was selected for further development.
- Both organizations believe in MAACQ Oase, through connections to an exhibition curator the project is qualified for DDW21. This provides the necessary goal and motivation for development.
- The concept is strengthened by incorporating seeds, solidifying the shape language, and creating a prototype from the right material with various colours (Figure 2.17). This is the most recent prototype preceding this thesis.
- MAACQ Oase is presented at Dutch Design Week 2021; It's in our nature at the Klokgebouw exposition (Figure 2.16) (Fillip Studios & Omlab, 2021).
- After the DDW the concept is presented in CODA Apeldoorn, but this requires no further development (CODA, 2022). To keep momentum in the project a connection is made to Utrecht University and an MIT (Medium to small business Innovation stimulant regional and top sector) request begins development.

Q1 2023 - Q4 2024 Design round 4

- Create the algorithms, materials, prototypes, and final product to place in the Utrecht Ridge according to the defined work packages.

Figure 2.11. Timeline of the MAACQ Oase project.

2019

2020

-2021-

2022

2023

2024

2025

Feb 2022 - Jun 2022 University of Utrecht Consultancy 1

- UU (Utrecht University) students of GSS (Global Sustainability Science) bachelor provide consult on the ideal location for the MAACQ Oase while considering both the impact on tourism/social and nitrogen acidification.
- The result is advice to begin the MAACQ Oase project along a walkway in the Utrecht Ridge nature reserve, where the need for deacidification and public exposure is highest (Fillip Studios, 2022; van Dijk et al., 2022).

Aug 2022 - Sep 2022 Design round 3: MIT request

- MIT, a fund for SMEs that want to innovate in Dutch top sectors has several requirements, which provide a clear goal for development. Drafting the request is a process, it helped with coming up with a business model, defining work packages and giving a timeline.
- The request is written for the MAACQ Oase project with the help of a third party; Hezelburcht, a consultancy that is an expert on technical innovation subsidies and operates on a 'no cue no pay' basis (Fillip Studios & Omlab, 2022a).
- The extensive formal document outlining a two-year plan for the development of the project is accepted. Omlab is tasked with developing and testing the Itbettermatter material, Fillip Studios is tasked with innovating upon the concept and the development of the shape by way of parametric algorithms.

Nov 2022 - Jan 2024 Master Assignment Industrial Design

- Master Assignment on the process of shaping critical design projects for impact. Throughout this master assignment, there will be changes to the concept.
- Design proposal for the MAACQ Oase and the parametric software.

Feb 2023 - Jun 2023 University of Utrecht Consultancy 2

- UU students of GSS bachelor will work on research on the implementation and communication strategy of the MAACQ Oase at nature reserves.
- In addition to answering research questions, the students also presented a prototype website for civilians to read more about MAACQ Oase and to catalogue all the MAACQ Oase variations, locations and sponsors (van Snek et al., 2023).

Figure 2.12. Materials used in Itbettermatter.
Photo by Omlab.

Figure 2.13. 3D printing setup.
Photo by Omlab.

Figure 2.14. The Mossery Vase.
Image by Fillip Studios.

Figure 2.15. The Mossery Wall.
Image by Fillip Studios.

Figure 2.16. MAACQ Oase prototype.
Photo by Omlab and Fillip Studios.

Figure 2.17. MAACQ Oase close-up.
Photo by Omlab and Fillip Studios.

Project Stakeholders

The MIT request denotes a significant point in the MAACQ Oase project, as it concretises the financial involvement of multiple stakeholders. To give an overview of this Figure 2.18 was made. This figure shows on the left the relationship between MAACQ Oase and nitrogen acidification as well as important elements in the project. On the right, it shows direct stakeholders in the MAACQ Oase project in bold text as well as significant connections to the stakeholders who have been involved in MAACQ Oase in the past, are involved currently indirectly or could become involved in the future.

This figure shows that the MAACQ Oase project is at this stage not interacting with key players in the nitrogen problem, and it also not competing directly with the heliair company behind the stone flour helicopter method. The nitrogen problem is sufficiently large that, for the time being, these stakeholders don't need to interact.

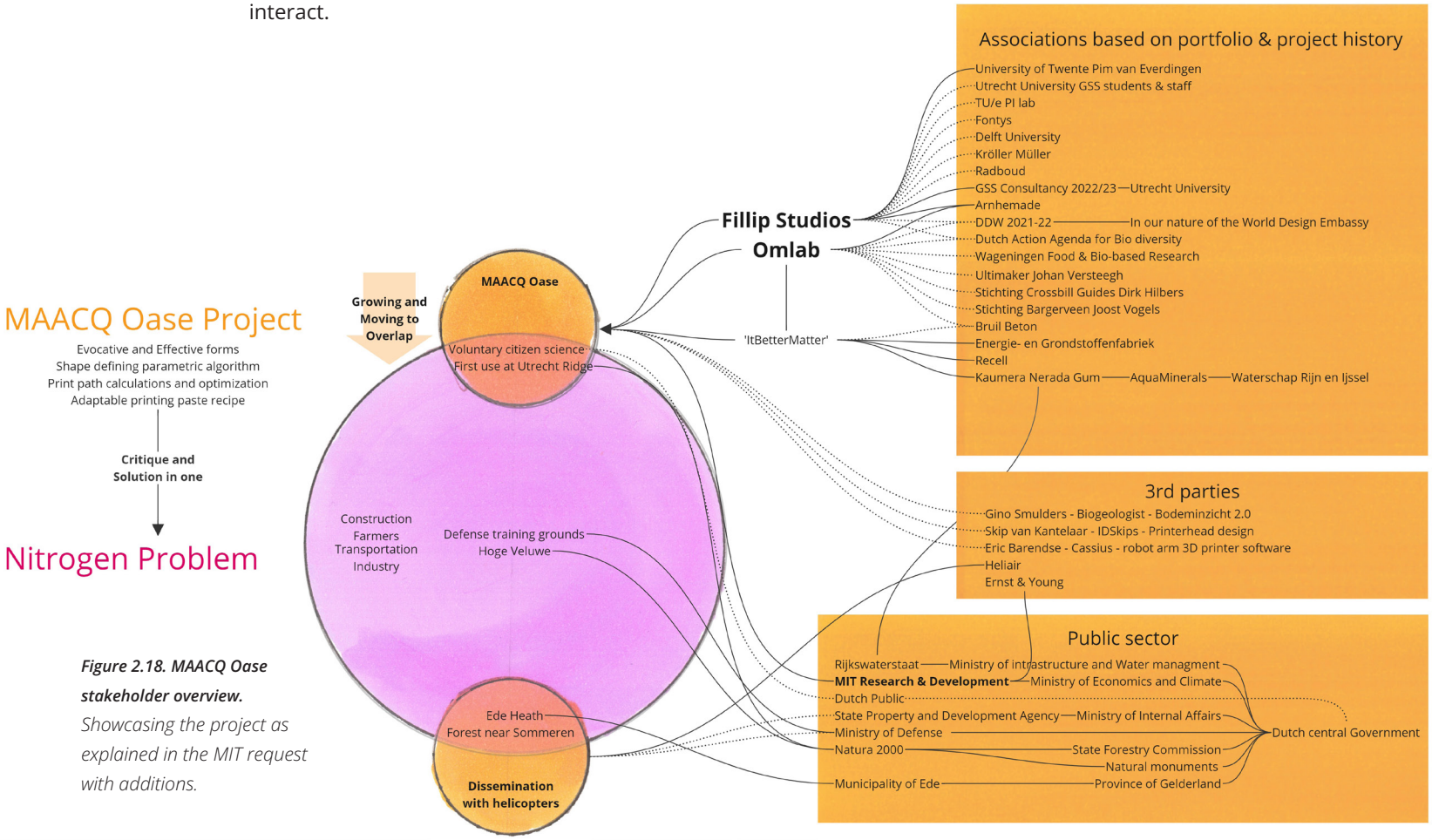


Figure 2.18. MAACQ Oase stakeholder overview. *Showcasing the project as explained in the MIT request with additions.*

The MAACQ Oase Development Plan

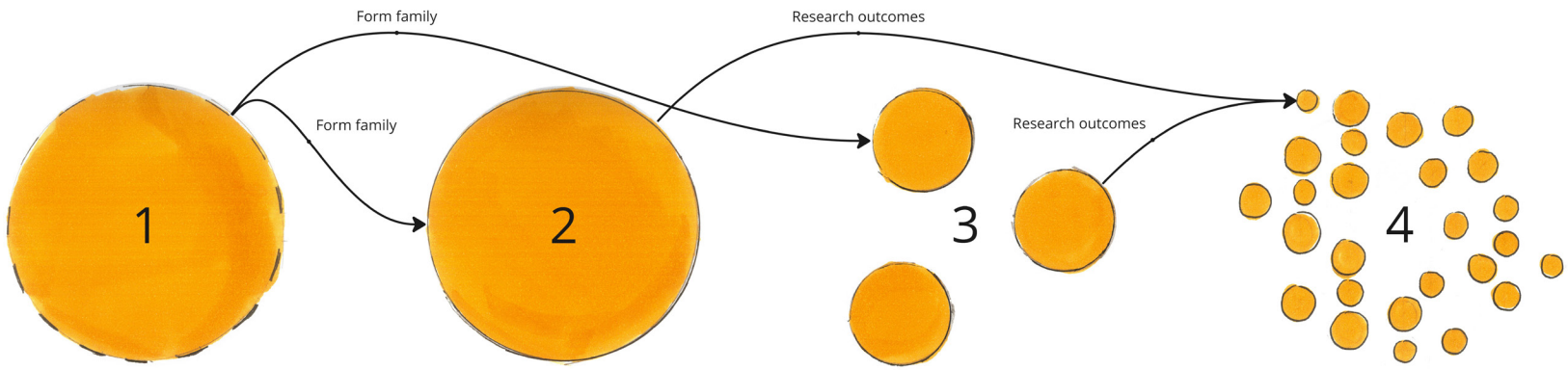
The companies envision 3 future versions of the MAACQ Oase, roughly outlined in the MIT request (Fillip Studios & Omlab, 2022a).

- **Goal 1;** The large 'conversation piece', sculptures as high as trees which are placed in sight of the public at the most afflicted nature reserves, likely starting at Utrecht Ridge.
- **Goal 2;** The small 'consumer product', a quickly producible sculpture which can be sold to the public to put in their garden.
- **Long term;** The 'deep impact version'. Fillip Studios believes that somewhere in the future, beyond the 2-year plan, the MAACQ Oase concept can be developed to have a deep impact on the Netherlands sustainability in the form of a 'netting tool', which would enable people and organizations to buy off their nitrogen footprint. This draws parallels to carbon footprint offset initiatives. This version is not directly tied to the current stakeholders and might not be a 3D printing project.

This plan misses the short-term planning of the project. The conversation piece is still a large leap from what was made at DDW21. To create a full overview Figure 2.19 was made, outlining the different roles of each version.

The makeup of MAACQ Oase material will likely remain mostly the same for the foreseeable future, but the current rock design of the MAACQ Oase is not yet conducive to the project goal of placing a conversation piece in nature. This suggests that in further developing the MAACQ Oase project, a redesign of the sculpture's appearance and meaning is imminent.

Figure 2.19. Overview visual of the future versions of MAACQ Oase.
Figure adapted from Fillip Studios and Omlab and expanded with the Proof-Of-Principle version.



Proof-of-principle
- New concept direction
- Define the shape language of V2 & V3
- Research parametric designs

Conversation piece
- Attention grabbing, form over function
- Small production volume
- Story telling device
- Attracts publicity
- Involves launching costumers
- Citizen science; observe and document natural interactions like birdwatching
- Impact starter
- Parametrically adaptable for the precise soil requirements

Consumer product
- "Collectable"
- Medium production volume
- In your own garden
- People feel like part of the movement
- Citizen science; observe break-down process, allow for visits

Nitrogen netting product
- Function over form
- High production volume
- Maximize efficiency for dispersing calcium
- Large scale impact
- Well researched

3. Literature Analysis

The approach to the literature analysis was to focus on multiple topics at a time, to find overlap in ideas between authors and fields. To begin two seminal books in the innovation management field; Verganti (2009) Design-Driven-Innovation (DDI) and Buijs (2012) Delft Innovation Method (DIM) were read cover-to-cover. In addition, The works of Malpass (2010, 2013, 2015) were used to gain an overview of the critical design field.

Following this groundwork, other works cited by or related to the same topics were reviewed. To find relationships between these topics in the context of Fillip Studios and specifically MAACQ Oase, conversations were held periodically with Tom Kortbeek.

Critical Design

The wide scope and ideas behind critical design practice make it one of the liveliest fields of design. It generates unprecedented amounts of strong design projects. Critical designers detach themselves from the constraints of industrial and commercial design, to be able to associate more freely with what we want our future to be, and what we do not want it to be. Why do we need these projects, and what value do they bring? This section will answer these questions about critical design with a breakdown of the critical design field and its history, highlighting key designers and describing the characteristics of critical design. The field is young and has strong ties to art, because of this there are many individualized views on what defines critical design. Therefore, this section will also disambiguate the language surrounding critical design, art, and industrial design for the context of this project, resulting in a definition which describes what kind of Critical design project the MAACQ Oase is.

The History of Critical Design

The birth of critical design is attributed to Dunne and Raby in the 1990s when they designed their first speculative projects and coined the term. They used to term to describe prototypes designed for pseudo-realistic futures for the first time in their 'Hertzian Tales' (Dunne, 1999). Following this work, they stuck with the term and laid out the groundwork for what this new way of designing meant. According to Dunne in an interview "Critical design is not for solving problems or aiming for things to be put into production, but to raise issues, ask questions and challenge assumptions" (Dunne & Raby, 2007).

The products designed by Dunne and Raby are almost always set in a specific fictive future scenario and hold functions that we don't need in our current world; they are science fiction. However, other than famous science fiction works like Star Wars, these fictional worlds are crafted to be believable, likewise, the designed products are also believable. Some authors have therefore dubbed work in this category as plausible design or speculative design, as it is about the possible products of the possible future (SpeculativeEDU, n.d.). Often speculative designs show us scenarios that we would rather avoid, like the Faraday Chair out of Hertzian Tales (Figure 3.1). This is a utilitarian design concept by Dunne and Raby that shields a user from electromagnetic pollution if they lack the financial means to shield their entire home.

Figure 3.1. Faraday Chair. *Made in 1995, part of the permanent collection of the Victoria & Albert Museum in London, photo by Dunne and Raby.*

Figure 3.2. The Pink Chicken Project
Proposal for using Gene Drive biotechnology to colour all chickens pink by Nonhuman Nonsense.

Another striking example is the Pink Chicken project (Figure 3.2), a critical-speculative design exploration of the 'Gene drive' technique containing CRISPR. The project shows the possibility of changing the DNA of all chickens, colouring them pink and encoding an apologetic message into the DNA for future generations to read (Nonhuman Nonesense, 2018). The project is seeking to clarify the impact of misusing this technology.

Others have taken to the term Diegetic Design, which references diegesis, a term from the field of narratology that describes the position of things between a non-real place and the real world (Coulton, 2016). A diegetic representation is 'behind the 4th wall', a term from theatre describing the separation of the audience and the performance. By calling it diegetic the designer makes it explicit that their product or prototype is interior to a similar but different reality than our own, many designs in video games and movies fall into this category, and the Faraday chair fits this description too.

Dunne and Raby were not the first to design products as a form of critique. In the 60s and 70s, in the Italian Radical movement, designers like Andrea Branzi and Ettore Sottsass designed objects with the express goal of critiquing the modernist design industry, consumerism, and Western society and its infrastructures, now known as radical design (Nguyen, 2021; Oxford Reference, n.d.).

A prominent radical design example is Superarchitettura, a theoretical and conceptual framework made physically, to embrace the logic of production and consumption and to get away from tradition and kitsch (Figure 3.3) (Fernandez, n.d.; van der Ley & Richter, 2008).

Figure 3.3. Exposition of Superarchitettura.
Designed by Archizoom and Superstudio, part of the Radical Design movement which critiques society. As per its manifesto; "Superarchitettura is the architecture of Superproduction, Superconsumption, Superinduction to consume, the Supermarket, the Superman, Supergas" Archizoom Associati and Superstudio (1966). Photo by the Fondazione Sozzani Foundation.

When Dune and Raby coined the term 'critical design', others pointed out that Italian Radical Design already had provided this critique. To Dune and Raby, however, critical design encapsulates more than just criticality, it concerns speculation, futureneering, awareness and more.

The Open-Ended Field of Critical Design

So, both critical and radical designers are doing design work to address, explore, emphasize, or otherwise note the role of industrialized design. Critique can come in many different forms, it is not always about pointing out flaws, just like design is not always concerned with consumer products. Because of this great variety, the 'critical design field' began expanding, as not all designers in the field wish to use critical design in the same way as Dunne and Raby. Some designers have come up with other names to describe their variations on the critical design methodology.

What becomes apparent is that the 'field' of critical design can mean different things to different academics. This variety complicates the second section of research question 1, (critical design projects made by SMEs placed in the cultural and creative sector), all these options obfuscate how to describe the MAACQ Oase and comparable projects. This thesis too will therefore have to take a stance on what critical design means. To achieve this the following sections will analyse the 'field' of critical design, the relationship between critical design and art and the relationship between art and industry to parse what project attributes are fertile for innovation management.

Design Discourse about the 'Field' of Critical Design.

There is an ongoing discourse on what the 'field' of free-thinking design can or should be like. Currently, it is un-unified, there is little establishment on what terminology is fitted to describe different design projects. Often the designer comes up with a term themselves. These include Design art, Koncept design, Fictional Design, Discursive Design, Deceptive design, Design Poetics, Design Futures, Design Probes, Ludic Design, Adversarial Design and, Parafunctional Design on top of the beforementioned Critical design, Diegetic design, Speculative design, Plausible design and Radical design (Bleecker, 2009; Coulton, 2016; Dunne, 1999; Dunne & Raby, 2001; Malpass, 2010, 2013; Oxford Reference, n.d.; SpeculativeEDU, n.d.; Sterling, 2013; Tonkinwise, 2015)

The appending of design — to add an additional term after writing 'design', in general, is criticized. As Cameron Tonkinwise (2015) states in an often-quoted medium article; "Designing that does not already Future, Fiction, Speculate, Criticize, Provoke, Discourse, Interrogate, Probe, Play, is inadequate designing". Leading to the conclusion that it all should be just design, full stop. The renouncement of the academic process of design definitions is to Tonkinwise 's own admission dogmatic. Nevertheless, to conclude that attempting to comprehend individualised design definitions is unnecessary to the goal of developing 'adequate' design is reassuring.

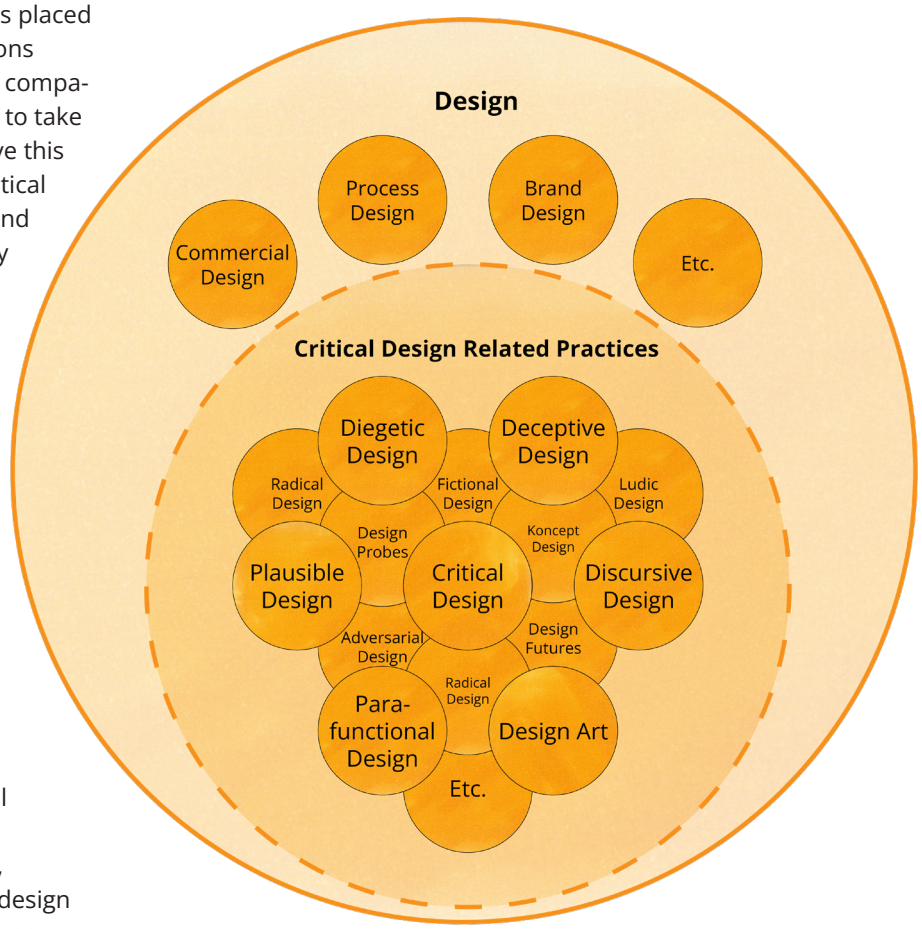


Figure 3.4. Bubbles of design practises.
The collection of critical design related practises are set apart from design.

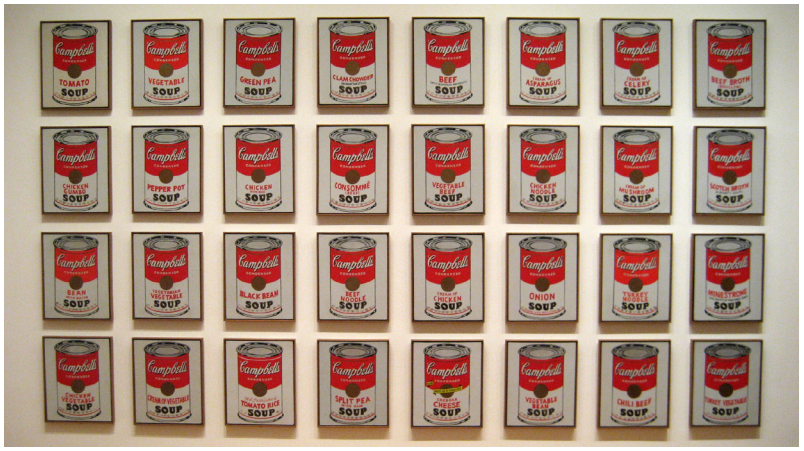


Figure 3.5. Andy Warhol's 'Cambell's Soup Cans' and Katharina Mludek's 'Toast'. *On the left is Andy Warhol's 1962 'Cambell's Soup Cans', a work of art for reflection on what we as consumers hold dear, it is an example of These works are examples of design-centric art. Photo by Wally Gobetz. On the right is Katharina Mludek's 2023 'Toast', a design exposition presented at DDW23, it reflects on the modernity and industrialization of bread and is an example of an artistic-looking design photo by Michel Klehm.*

Malpass (2010, 2013)provides a different perspective, according to him, speculative design and other 'related practices' are all modes of critical design. "They serve to challenge orthodox conceptions of design and extend the agency of design and the matters of concern that design might typically engage."

To summarize these views, there are many little bubbles of specialized design practices which are all related but also distinct, as shown in Figure 3.4. This splintering of design makes it difficult to compare projects set a scope. Tonkinwise (2015) suggests piercing all these bubbles to have 'just design'. Malpass argues that there is a bubble of related practises which are all similar to critical design, but each with a slight twist.

Both Tonkinwise's and Malpass' views make critical design into a form of Design Philosophy. To declutter this space, some researchers have tried to set up a taxonomy that structures designs based on the type of critique they embody (Malpass, 2013). Others, like Ferri et al. (2014) define the project according to the type of critique arguments that the designer uses. These efforts prioritize the mindset of the designer over the content of their work.

This lack of universally recognized language for this area of design can lead to confusion or frustration, especially for those who are not in the space themselves. The role of the designer's intent will be further explored in the following sections to come to a clearer understanding of what connects these practices.

Is Critical Design a Form of Art?

Some may call critical design art, but why is that? This section will set out to disambiguate the similarities and differences between art and design.

The Reasons for Similarities Between the Two

It might be difficult for these designers to explain to institutions what it is that they exactly do, without providing an extensive and detailed account of their unique relationship with the industry. This is one reason why some designers defer to the term 'art', as it quickly communicates a personal approach.

Some designers also work similarly to artists. One reason is that, when critical design is directed towards social problems, there will never be a straightforward solution. One needs to embrace failure and serendipity to find solutions, these qualities require you to 'think like an artist' (Cousijn, 2022).

Often critical designs are made to move people, triggering new ideas and emotions just like art. Furthermore, in critical design, the products are often a one-off because the value lies often in its process, research, or message. The product is then displayed on a pedestal or behind a velvet rope at academic conventions, expositions, or events. In this 'gallery' context the design is presented very much like artworks would be.

The results of critical design work can also visually and content-wise be indistinguishable from art pieces. In the examples in Figure 3.5, to know which of the two works is intended as art and which is intended as design, the explanatory plaque and knowledge about the context is needed (Mludek, 2023; Warhol, 1962).

The Reasons for Differences Between the Two

So, at times, critical designers call their work art, it is worked on like art and it might even look like art. Nevertheless, fully reframing a prototype or product, from design to art inadvertently changes the meaning and associations of the work. For this reason, lumping art, and design together, or using the terms interchangeably is highly contested.

According to some, the distinction between design and art is made on the basis that art has no given function while design does (Monopoly et al., 2021; Senturk, 2023; Tonkinwise, 2015; Trochut, 2016; WWD, 2009). The kind of designs made by critical designers are not always usable in the same way that a pen is, which obfuscates the distinction. Malpass (2015) helps us to make sense of this distinction, they expand functionality beyond the modernistic view and describe often unnamed types of function in design. These include social, cultural-existential, psychological, ideological, and sociological functionalities. This expanded view of functionality does capture the most critical design projects. Especially considering that products are capable of multi-functionality. For instance, the MAACQ Oase has a physical function of disseminating calcium, but also an intellectual function to make us think about our collective climate future.

Making Critical Design Impactful

The goal of the thesis is to determine how critical design can be used to make impactful designs. This section will analyse some of the criticism surrounding critical design and its impact, or lack thereof. Following that the relationship between critical design, and similar design practices, in both art and industry will be used to create a new model for describing and analysing those projects.

Critique on Critical Design

The similarities between art and design commonplace in the critical design field, are a source of criticism. Critical design and other design frameworks like it, which are aimed at intellectual exploration and research through design, are said to share a common 'bug' (Agid & Olander, 2017; Ferri et al., 2014; Malpass, 2015). Often the design remains confined to 'safe spaces' like galleries, conferences, books, articles, art stations and exhibitions. The designer's work becomes trapped in a bubble and is put behind a red velvet rope with a helpful accompanying plaque. This makes the work digestible and helps it reach an audience that is open to the designer's message. Design becomes more art-like by being in a gallery (Tonkinwise, 2015), which weakens its ability to generate impact.

In an interview by Malpass (2010), Ralph Ball argues that, because the critical design work is conceived with design language, it has a latent possibility of becoming product design later. But this is a very uncommitted attitude towards making change.

Possibly as a reaction to this critique the third wave of speculative designers have become more concerned with the 'real-world' applications of speculative design than their predecessors. They intend to go beyond the gallery by asking themselves; What are the business applications? According to Michaela Büsse, *"Speculative Design is mainly used as a tool to critique or question a certain implication of a technology … it is more and more used as a method to innovate (Circumflex.studio, 2019)."* These designs will play into the new values of consumers, people are no longer satisfied with design focused on commercialism and aesthetics.

According to Rynning (2023), reaching the target group will yield more results than yet another good idea on a pedestal. According to Rynning the key to achieving

this is making design activism. This proactive stance is sensible, but being artistic, free, and critical are vital parts of tackling big problems. So, avoiding the 'art side' of design could deprive a project as well. Another approach to this would be to find a way to continue moving after exhibiting critical design, to tap into the 'latent potential'.

The case of MAACQ Oase has some characteristics of artistic-critical design, but the project intends to transcend the artistic sector, and it is impact-oriented. Since Dunne and Raby invented critical design to challenge the design discourse, not to solve problems, some associate critical design with passive designs. Fillip Studios themselves opt not to use the critical design term as a descriptor for their projects for this reason, even though their projects do provide non-obvious solutions. The following section will analyse the shared characteristics of the 'field' between art and other industries.

Letting Go of Taxidermy-Based Classification

It might not even be necessary to find a model or argumentation to classify projects as either design or art. As Jakobsone (2019) poignantly states in their paper on the 'critical design mindset', there is no need to "legitimize the practice of critical design as such, nor to prove its usefulness and efficiency, as it has already extensively been done by other researchers and practising critical designers themselves". The mindset, principles and characteristics of critical design have an underused potential to benefit other kinds of design practice. Interestingly they add that this is true specifically in commercial contexts, even though critical design is associated more strongly with anti-commercialism and activism. The author theorizes that this is because, like designers, consumers are becoming increasingly invested in the responsibility of products and services. Jakobsone their ideas don't place critical design in the camp of art nor industry, but between the two. This also gives a good idea of why, in the critical design field, the terms art and design are used so interchangeably.

On top of that, the methods and terms used to pinpoint the language and position of designs in the critical design field are focused on describing the content of a project, as a taxonomy for different designs. However, this thesis is specifically considering a partially completed design work that has the aim of transforming from a concept born in critique towards an applied solution in a societal sector. Therefore, classifying such projects with preestablished terms does not encapsulate the project.

What can be concluded is that, in general, the classification of a project is best up to its creator. The intent behind the creative act is in this case more important than the result of it (Trochut, 2016). Furthermore, when the designers of a project are actively researching both what the design is, and where the innovation can be best applied, they must be free to name their projects according to their intentions. Only in hindsight can a project be compared in full to other projects and be definitively classified.

Model for the Space Between Art and Industry

Art and industry are both broad terms that can be applied to many different subjects and projects, and they overlap in many places. The author proposes a new model to describe projects which are influenced by both art and industry, as shown in Figure 3.6.

In the model, attributes are chosen, in part based on the differences between the Author- and Demand-driven design described by Eggink (2012) to represent each of these fields. The intersection between the two is populated with several of the design terms discussed in this analysis since project examples in this space often marry seemingly contesting attributes of art and industry. Furthermore, the space is informed and influenced by the types of design and art that lie outside of this middle space.

Take for example the MAACQ Oase, which is simultaneously politically active, provocative, and social, since it addresses the nitrogen crisis and is targeted towards public spaces. At the same time, the investment request describes that MAACQ Oase will be made available as a utilitarian industrially produced commercial product (Fillip Studios & Omlab, 2022a).

This figure for defining the field surrounding critical design makes it possible to reinterpret and learn from the position of projects that are in the cross-over between industry and art. The following section will apply this new model to analyse the character of projects by Fillip Studios.

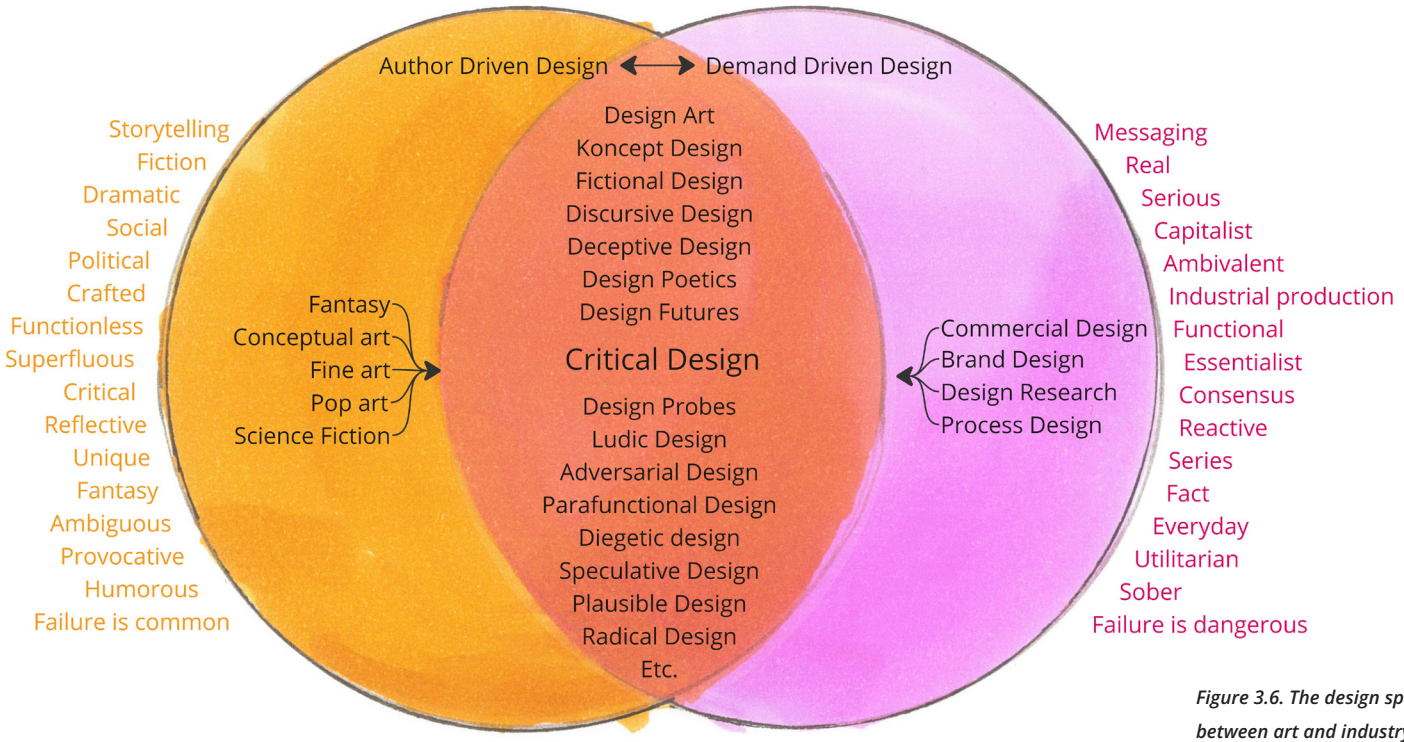


Figure 3.6. The design space between art and industry. *This space is populated by prominent design types that are related to critical design and share some of the associations found in both art and industry.*

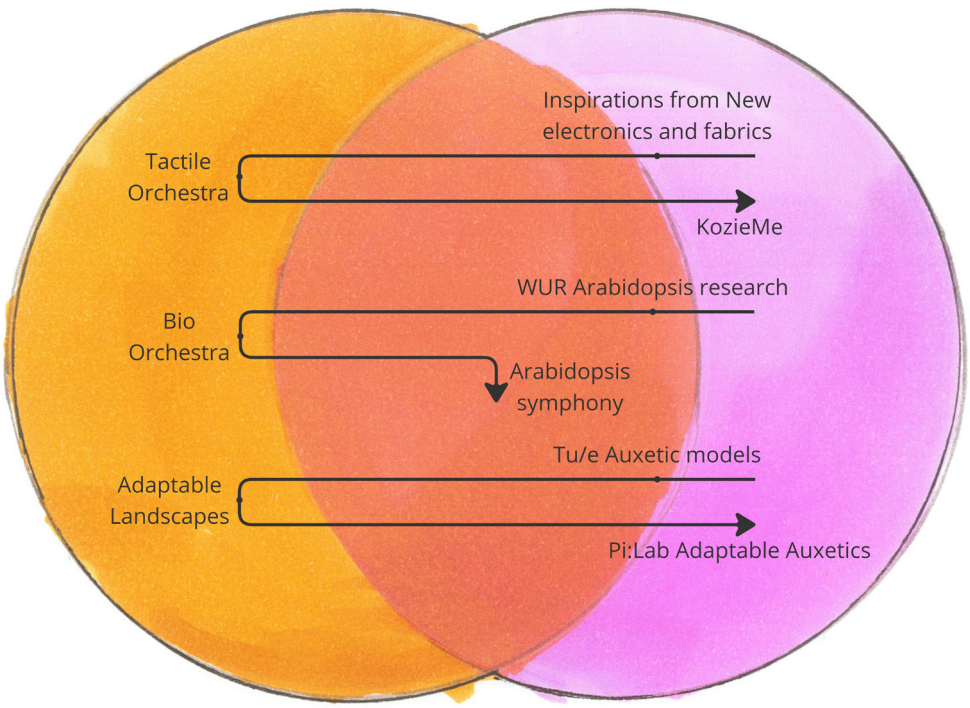


Figure 3.7. C Pattern trajectory of Fillip Studios projects between art and industry. *A sketch illustrating the strategic trajectory of projects from the Fillip Studios portfolio through the art and industry space.*

Applying the Model to Examples from Fillip Studios

As noted in Chapter 2, the portfolio of Fillip Studios has a pattern; Inspiration is found in industry (new sensors, materials, research, models); That inspiration is applied in an artistic project first; Following the exposure or findings of the first project, a secondary more impact-oriented project is made. Placing these observations in the new model shows a C-pattern movement (Figure 3.7).

What this analysis has shown is that projects from the artistic sector are at risk of getting trapped on the pedestal—meaning that the project ends after building a one-off prototype for exposition. One solution to this, presented by

Rynning (2023) to avoid the pedestal and apply the design directly to the target group. The Fillip Studios portfolio demonstrates that there is another solution, which is to use the pedestal as a new jumping-off point.

Using the new model for the space between art and industry, critical designers can strategize about where to place their project, whether is it art or design. Furthermore, it becomes clear from Fillip Studios' portfolio that the position of a project can even move over time.

To relate this to the MAACQ Oase project, consider the scenario sketch presented in Figure 3.8, at the DDW21 the project was presented as a scale model (left). The higher goal of MAACQ Oase is to nullify our nitrogen levels, but this is unachievable within the foreseeable future. So, it is up to the designers to strategize what the next step in development is, will it be a product for exposition or for in nature? Both directions would contribute to development in their own way but through different routes. By creating prototypes which are ready for both exposition and implementation Fillip Studios and Omlab are sharing their vision with the world.

Critics of critical design argue that to make an impact the product must reach its target group and critical design is failing to do so. However, as the scenario shows, whatever the next step is of the project, the project is developing, becoming more advanced and more 'real'. Simultaneously, critical design can take advantage of people their imagination, by continuously inviting people to reflect on the meaning of the design in its fictional or artistic state it invites new ideas. Herein lies the advantage of embracing critical design as a start for impact-oriented projects. Critical design enables designers to work on and share ideas for impact-oriented projects.

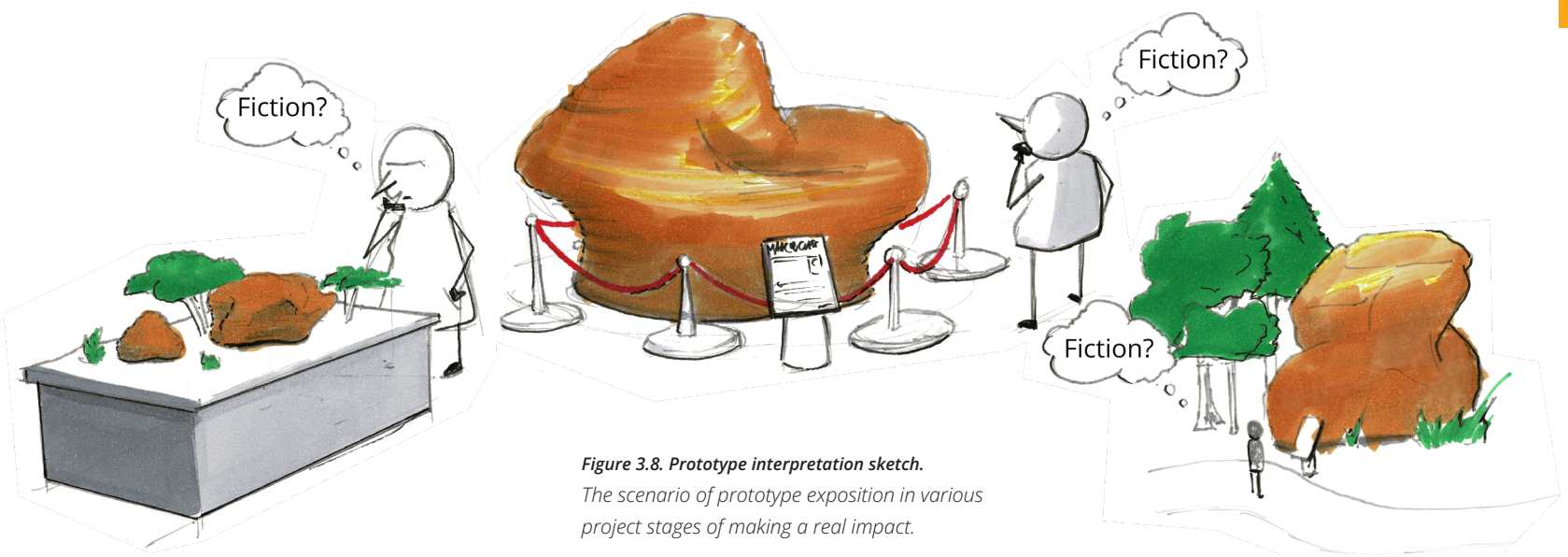


Figure 3.8. Prototype interpretation sketch.
The scenario of prototype exposition in various project stages of making a real impact.

Innovation Management

The following sections will analyse the innovative character of the cultural and creative sector and will analyse the established and dominant methods for managing innovation processes which relate most closely to design. It will compare the language and tools used in the field to the context of critical design and the MAACQ Oase project.

Field History

When an invention makes a meaningful impact on a market or society, it is called innovation. When well-managed, such work can bring positive change and often great economic rewards for its owners.

Identifying innovations and coming up with ways for systematically cultivating innovation began with research on creative destruction by the economist Schumpeter in the 1930s. He determined that entrepreneurs sustain economic growth. When they bring forth innovation it destroys previous paradigms and replaces them, this change drives economies (Schumpeter, 1942). In its time this view subverted common conservative values on economy, the belief that the strength of organizations came from their longevity, not their disruptiveness.

Innovation has since become associated with financial success and can be a goal onto itself for countries and corporations (Swiss Learning Exchange, 2021). Historically, whether an invention is an innovation was determined in hindsight when the impact can be observed. By analysing successful projects, innovation management strategies and tools have been made (Aulet, 2013; Systems Innovation, 2016). These help those who want to innovate to trigger creativity, assess the trajectory of a project and arrive at innovation more speedily and consistently.

Innovation is often accompanied by technological newness, however, Drucker (1985) identified seven distinct sources of innovation. These are unexpected, incongruity, process need, industry/market structure, demographics, mood or meaning, and new knowledge. Classifying the innovation source of a project can provide a structure to differentiate between projects. From examples, Drucker observed that most innovations sprung from multiple sources.

Innovation's Likeness to Design

Organizing innovation is inherently difficult and paradoxical, in its newness and novelty, innovation will never be able to provide a concrete plan or proof towards success. It cannot answer questions about ROI, required skills and people, timeline, or risk, which makes it difficult to start. Innovation is a process, not a result. The process is made up of conversations, ideas, playing and doing. It is a process of learning on the go, and because of this, it is like design (Stompff, 2016). When innovating you do not only think of problems, but more so about options. Having options gives choices, and visualizing allows for communication about new ideas.

The Industry of MAACQ Oase

The MAACQ Oase project belongs to two micro-enterprises, companies with very few employees. These companies fall into a category of business referred to as SME (Small to Medium Enterprise) or in the Netherlands either KMO (Klein of Middelgrote Onderneming) or MKB (Midden- en Klein Bedrijf), which means they have fewer than 250 employees. Companies in this classification make up most of the business in most countries. In the Netherlands, the art sector (SBI-code 90) counts 94 thousand businesses, from which only 40 businesses have over 50 employees and only 5200 businesses have more than one person, this means that 95% of businesses in the Dutch art sector are single-person businesses, (CBS, 2021).

The cultural and creative sector is well acquainted with disruption, renewal, and creativity. SMEs from this sector have been shown to have untapped innovative potential, they are hampered by legislation and regulation which restrict the possibilities of capital investments in innovative activities (Ysabel Nauwelaerts & Iris Hollaender, 2012). This problem has been in part addressed by the creation of additional investment funds, a significant one is the European Investment Fund(EIF), founded in 2016 (European Commission, 2016; European Investment Fund, 2022).

In this sector it is more common to only produce a limited series of products, limiting the breadth of impact. The concepts are not always practical but might innovate on an intellectual, political, cultural, or emotional level. Furthermore, the artistic sector has an

aversion to being managed, optimizing workflow for time over quality as well as financial incentives can oppress the creative process. It is perhaps for this reason that the annual reports of multi-million investment funds like EIF, Stichting Doen and Stimuleringfonds all argue for innovation-oriented projects to be interdisciplinary (European Investment Fund, 2022; Stichting Doen, 2022; Stimuleringsfonds, 2022)

3D printing and open innovation

The MAACQ Oase is a 3D-printed product. In the 3D printing culture, it is common to find companies with open-innovation structures. Designs for plastic FDM prints can be reproduced, changed, and applied by anyone with a simple 3D printer. But as this technology is maturing, even the more niche forms of printing, like clay printing, can expect to grow their open-innovation communities. As open innovation becomes increasingly common, companies might find open innovation to be a necessity in the future for being part of the community. Currently, Omlab and Fillip Studios are not employing open innovation.

The advantages of sharing MAACQ Oase designs in an open innovation space could be that other enthusiasts or professionals engage with and improve upon the ideas and designs. They could spread faster than Fillip Studios and Omlab would be able to support on their own. The downside of sharing proprietary data is that as an initiative taker, there is no guarantee to end up being the leading profiter of the innovation. Furthermore, by sharing the data control of how the knowledge is used will be lost, with the risk of the knowledge aiding projects that the inventors do not support.

Design-Driven Innovation

Innovation is connected to business success, so many innovation management tools and practices are aimed at business optimization for fiscal gain.

Verganti (2009) is critical of this business-oriented approach to innovation management and presents design-driven innovation as a more competitive approach to innovation. This method is based on the sustained innovation output of Italian design firms like Alessi, Artemide and Superflux, but also tech giants like Apple and Nintendo.

The DDI method promotes radical innovation, rather than incremental innovation as a basis for sustainable business practice. So DDI holds insights into the management opportunities for critical design projects, which are inherently occupied with exploring radical patterns outside of market demands. The following sections will highlight key insights from the DDI method.

Meaning as an innovation

It is well known that providing new technologies can lead to success in the market, but according to Verganti (2009), another dimension that impacts innovation is meaning, as shown in Figure 3.9. This refers to the ideas, feelings and views held by those who make use of your offerings. When innovating on meaning companies offer something which people do not yet know they need. The most successful products, those with lifespans and success in the market beyond anyone's expectation are most often a radical innovation on meaning.

Design-driven innovation is aimed at the innovation of meaning, separate from technological innovation. When the two meet in one project, a project provides radical innovation.

The MAACQ Oase project could radically change the way technology is used, by bringing together material streams and production processes never combined before. At the same time, MAACQ Oase might be on the way to radically changing the meaning of an existing product category. For example, if it is made into a bench, it to change the meaning of public furniture. To sit on a bench in nature allows you to appreciate it, to sit on a MAACQ Oase could mean to support natural rejuvenation. As a consumer product, MAACQ Oase could mean the democratization of climate issues, enabling anyone to choose to fight the nitrogen acidification problem where

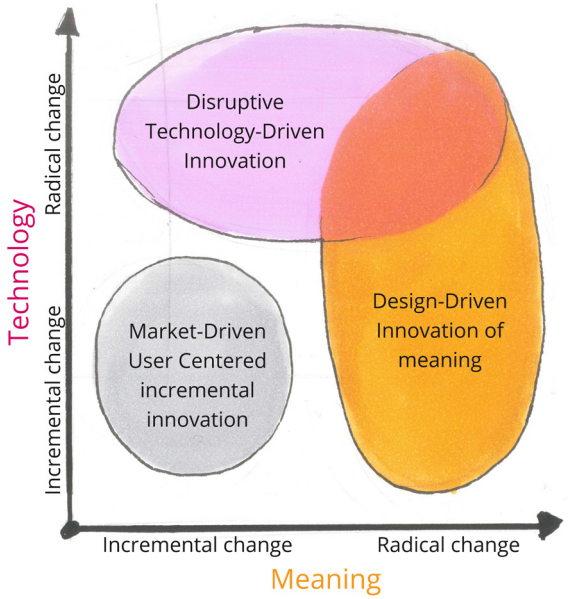


Figure 3.9. Dimensions of Innovation diagram. *Diagrams show two independent directions in which innovation can introduce change. The diagram was adapted from Verganti (2009).*

they want. As a sculpture, MAACQ Oase could change how people appreciate outdoor art, from a static and indefinite object of beauty towards a changing and finite object which is used up over time.

MAACQ Oase requires development on multiple fronts. But when strategizing on how to develop MAACQ Oase using this model one could consider a few directions, presented in Figure 3.10. Striving for a huge jump in technological execution would introduce a lot of risks, developing the production technology gradually while making leaps on a conceptual level fit better to the expertise of Fillip Studios.

According to Verganti (2009), a meaning-forward approach requires the "Management of innovations that customers do not expect, but they eventually love" (pg. vii). By assigning new meanings, foreign to the current market, firms give customers new reasons to buy. This implies that companies do always need to be concerned with what people want, it can be more insightful to research what people could want.

So, in DDI the firm is not responding to the market but instead pushes forward a proposal based on a company's vision and design outcomes. Since the designer is not necessarily basing the design on their views, but also not basing the design on real demand, DDI blurs the categories of Demand and Author Driven design described by Eggink (2012) which were used in Figure 3.6

To design is to perform work on the function which follows the meaning of a product. Product language (material, texture, smell, name, form). Meanings cannot be designed, but can be learned, understood, and gratified. A product's design can be a response to a learned meaning of a previous version or competitor. Because of this iterative approach to idea generation, the design process can be a source of innovation.

How to discover future meanings

When doing research for impactful radical innovation of meaning, the thing you are building will change the context you are trying to research. The most consistently successful innovation companies do not rely on their vision alone to come up with new meanings. They instead craft future scenarios on what could be and invite others to give meaning, to interpret. They make use of interpreters from the technological sector and cultural production, as laid out in Figure 3.11.

These contacts help the firm to make sense of culture, technology, and future scenarios. Especially forward-looking actors, like artists who are 'business unaware' can conjure 'design-driven innovation' thanks to their freedom.

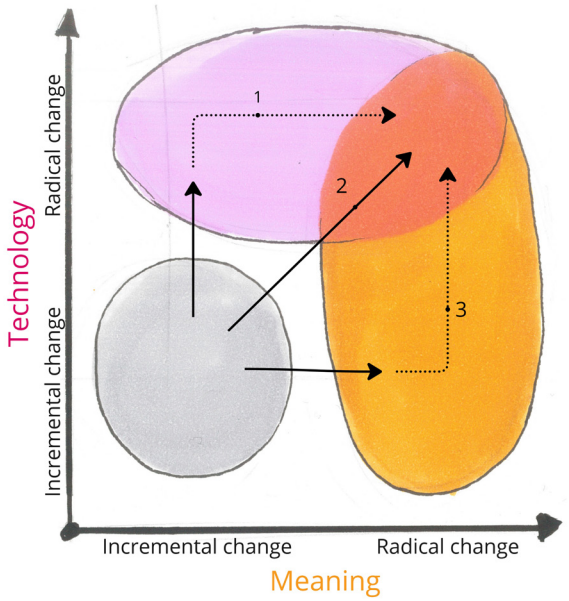


Figure 3.10. Possible radical innovation directions.

For critical design, the initial design can enable interactions with interpreters, followed by the development of a marketable product. For example, the meaning interpreters attribute to the Faraday chair, presented in Figure 3.1, could have been used to foresee the fear of new wireless technologies. It might then be used to inform the design of a 5G network pole to be made less threatening.

Roles in innovation management

Verganti (2009) notes that the process of doing 'creative research' is paradoxical, as creativity is built on fast divergent exploration and abandoned while research is concerned with making knowledge deeper and more robust. Similarly, Verganti (2009) believes that designers who have educated themselves about business administration, with the intent to become pragmatic and insightful, run the risk of becoming overly aware of the constraints of business dynamics. Causing those designs to hold back on exploring radical patterns outside of market demands.

Simultaneously, when considering small or one-man enterprises, as is common in the cultural sector, it is apparent that the people who perform creative work fulfil more than only the creative roles, making business thinking unavoidable. Therefore, it can be concluded that designers in SMEs should strive to modulate between creative and business-oriented thinking, as doing both at the same time results in lacklustre concepts. The Fillip Studios portfolio shows multiple creative projects, followed by design research projects. This is an example of such modulation; one project is made purposefully and temporarily artistic to free up constraints. This further explains the movements in Figure 3.7 in the critical design analysis.

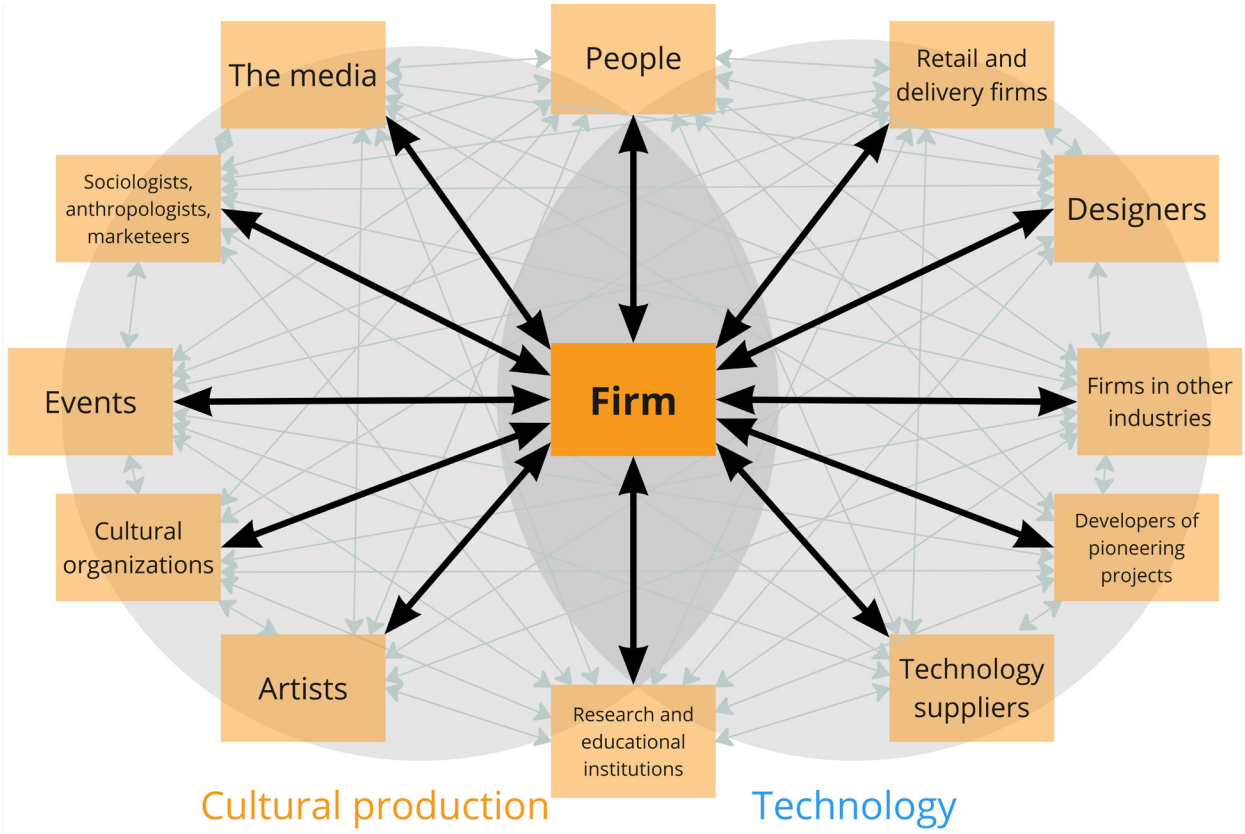


Figure 3.11. Diagram of the interpreters in collective research.
In design-driven innovation, the firm is placed between cultural and technological producers which help the firm with interpreting innovations. Figure adapted from Verganti (2009).

Delft Design Method

The Delft Innovation Method (DIM) applies design thinking to innovate from within the company. Though similarly based on design processes, the DIM method is more organizational than DDI.

Buijs (2012) remarks that the activity of innovating must be both repeating and unstandardized. It must be repeated since success in the market can only be achieved by trial. Next, it must be unstandardized, since standardizing innovation would remove its disruptive role in development, effectively killing it.

The DIM consists of five elements; a model shown in Figure 3.12; a leadership style; team composition; creative techniques; and connections to the external world.

The DIM is a step-by-step circular approach to structuring activities that lead to innovation, it emphasises that one rotation does not equal one innovation. This relates closely to how the portfolio of Fillip Studios is built up where artistic projects precede impact-oriented ones.

Applying the DIM helps with creating a structured way of working which is still responsive to the change that the innovation is making. By repeatedly evaluating where the project is, it is possible to select activities that fit the goals of the project. In more frugal, collaborative, and open-ended projects it can become unclear what the status of the project is, and the design phase could become overly long. The DIM helps to validate the need for market introduction as part of the larger innovation process.

Comparing this cycle to the design process of critical design projects, most steps could be followed. The product is introduced at an exposition or museum where it can be actively evaluated by both the company and the environment. Engaging with the audience provides direct input for an evaluation to come up with new search areas. The DIM also sheds light on what sets innovation-oriented critical design apart from other critical design orientations. Critical design is impact-oriented when it is concerned with the needs of the external world and some form of development of technology, products and markets takes place.

This also sheds light on the difference between the critical design of the Faraday chair and MAACQ Oase. Namely, the Faraday chair targets fictional needs and only illustrates a solution, no technological development into radiation shielding went into the product. Whereas MAACQ Oase targets real needs and develops technology to meet those needs.

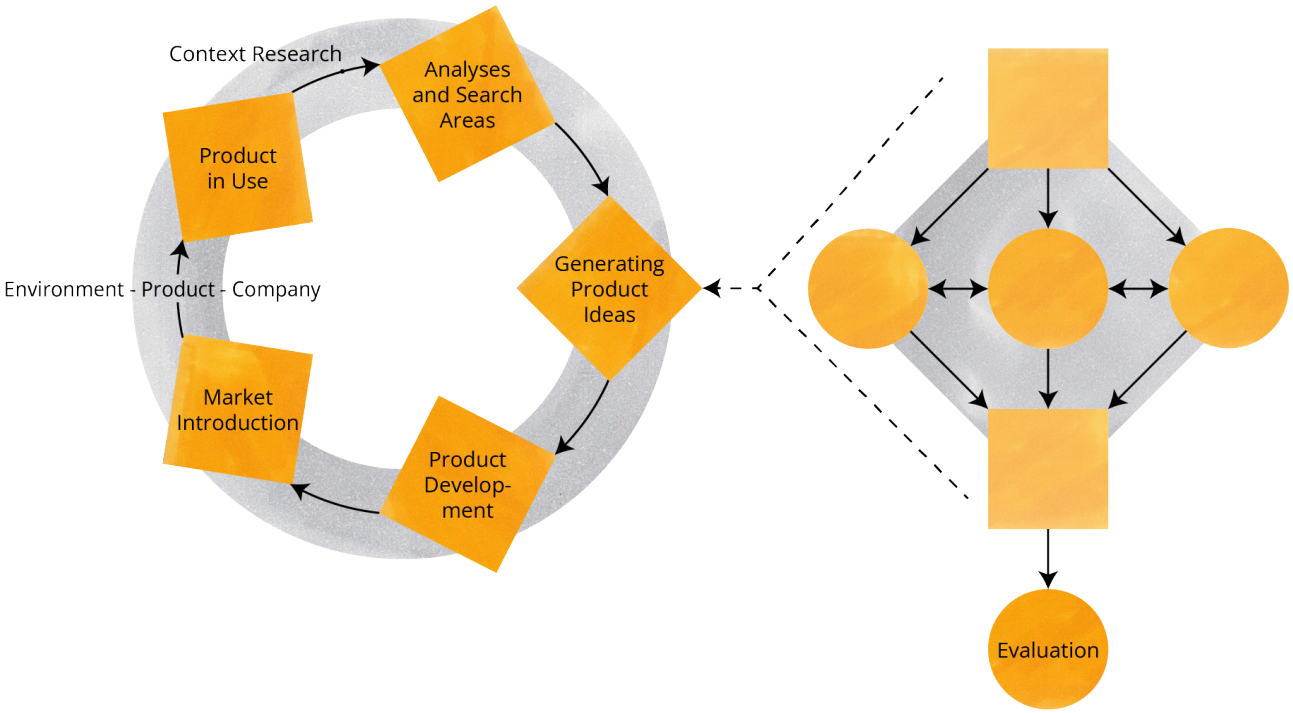


Figure 3.12. Simplified diagram of the Delft Innovation Method.
The DIM follows a looping model of 5 elements (diamonds) which each have unique embedded deliverables (squares) and activities (circles). At each element some activities relate to the company (inner area), the product (middle area) or the environment (outer area) The figure was adapted from Jan Buijs (2013)

Innovation Critique

Like design, innovation is becoming increasingly commonplace as a term, and this leads to a dilution of meaning. Innovation is quite rare, not many ideas achieve substantial impact. Bessant (2020) suggests that this proliferation of 'innovation calling' is the result of 'partial models—ideas that capture part, but not the whole concept of innovation. An example of using a partial model is calling a project innovation when it is focused solely on inventions even though the invention does not address market values. Such a project results in an unwanted product, like the one shown in Figure 3.13, and is not an innovation.

According to Bessant (2020), the pitfall of innovation management is to only work on a part of innovating, resulting in work without reward. Other aspects to develop could include the technology, company process, business model, and position concerning the environment (Aulet, 2013).

Innovation is a broad topic, so its management must be multi-faceted. This critical view of innovation specifies the role of innovation management, it should balance all the parts that make up the innovation process, to be not only inventive but also effective. Success for an Innovation Manager is about following through and getting from the idea stage to something that creates value (Swiss Learning Exchange, 2021). Sometimes companies have innovation or creative events, but without follow through it is just a theatre. The concern that designs are lacking in completion, and fail to become innovative also applies to critical design projects and exhibitions.

It is common to have a deep and personal connection to the innovation project. It can feel as though the success of the project reflects your abilities. It can be daunting to try and make something which you want to be deep, intelligent, complete, empowering, elegant, sustainable, and more.

Figure 3.13. Sinclair C5
An electrically assisted pedal tricycle, designed by Sir Clive Sinclair in the 1980s to revolutionize the personal vehicle market with a low-cost and eco-friendly design solution. Despite the sleek and well-intentioned design, the product failed because it lacked practicality and failed to meet user needs. Image from Getty Images

For this reason, Kawasaki (2014) argues the need to let go of pride and allow the product to be crappy and polarizing. This somewhat fatalistic view on product launch helps to keep the innovation process moving. By not giving in to the temptation to postpone product launch, a more dynamic innovation process is born. In such a process the idyllic breakthrough innovation does not stand alone, but rather on the shoulders of a supporting portfolio. To this end it can be valuable to execute multiple projects simultaneously within one innovation direction, the added cost is paid back in the reduced risk of failure (Kawasaki, 2014).

Impactful Innovation

To succeed, innovating must have an impact. But what does that mean, and when can you say you have achieved impact? The impact can be achieved in many different forms. To structure all the types of impact, this thesis considers the metaphor of an object hitting the earth, representing the impact of a design project (Figure 3.14). A big enough impact, at the right place could permanently change the landscape. Such an impact would make a project innovative.

Cultural projects are typically effective at reaching a wide audience, because of their great storytelling, appeal, and relevance, but they don't penetrate as deeply as industrial solutions can do. So, to deepen the impact, cultural projects will need to develop into something more industrial. Fillip Studios has stated to desire a deep impact on how the Dutch restores its nature to let society sustain itself.

1. **Aim**
   The object is aimed at Earth. If the aim is off there will be no impact, or reduced impact as Earth may be only grazed by the object. Similarly, if the aim or vision of an innovation project is not defined and communicated correctly, the impact could be less than envisioned or missed all. Note however that the aim may shift during the process.
2. **Accuracy**
   The object is aimed at a specific point in one of Earth's oceans. If the accuracy is off, the impact area may become unpredictable. The object might hit an unexpected location, like a city or population centre, spawning disaster. Likewise, accuracy is the control the innovator has over the trajectory of the project. If poorly managed, unexpected or unseen impact may lead to pointlessness or a disastrous (or in rare cases an unexpectedly amazing) outcome.
3. **Momentum**
   The object has speed, which is the result of the energy put in by the thrower, and the pull of the earth. Momentum can be increased by working skillfully and collaboratively. The pull can increase by exposing the project to the media. Momentum can also be lost to internal or external friction and momentum is lost over time. Momentum can increase the impact of the project but also risks reducing the accuracy.
4. **Impression**
   After impact, the object leaves a crater on the earth. The shape of the impression indicates the type of impact that the project achieved. The impression could be broad and shallow, meaning that little has changed overall but a large part of society is made aware of the innovation. Cultural projects often have this type of impression. A narrow but deep impression relates to impact which has completely changed a small aspect of society, most technological projects this type of impression.

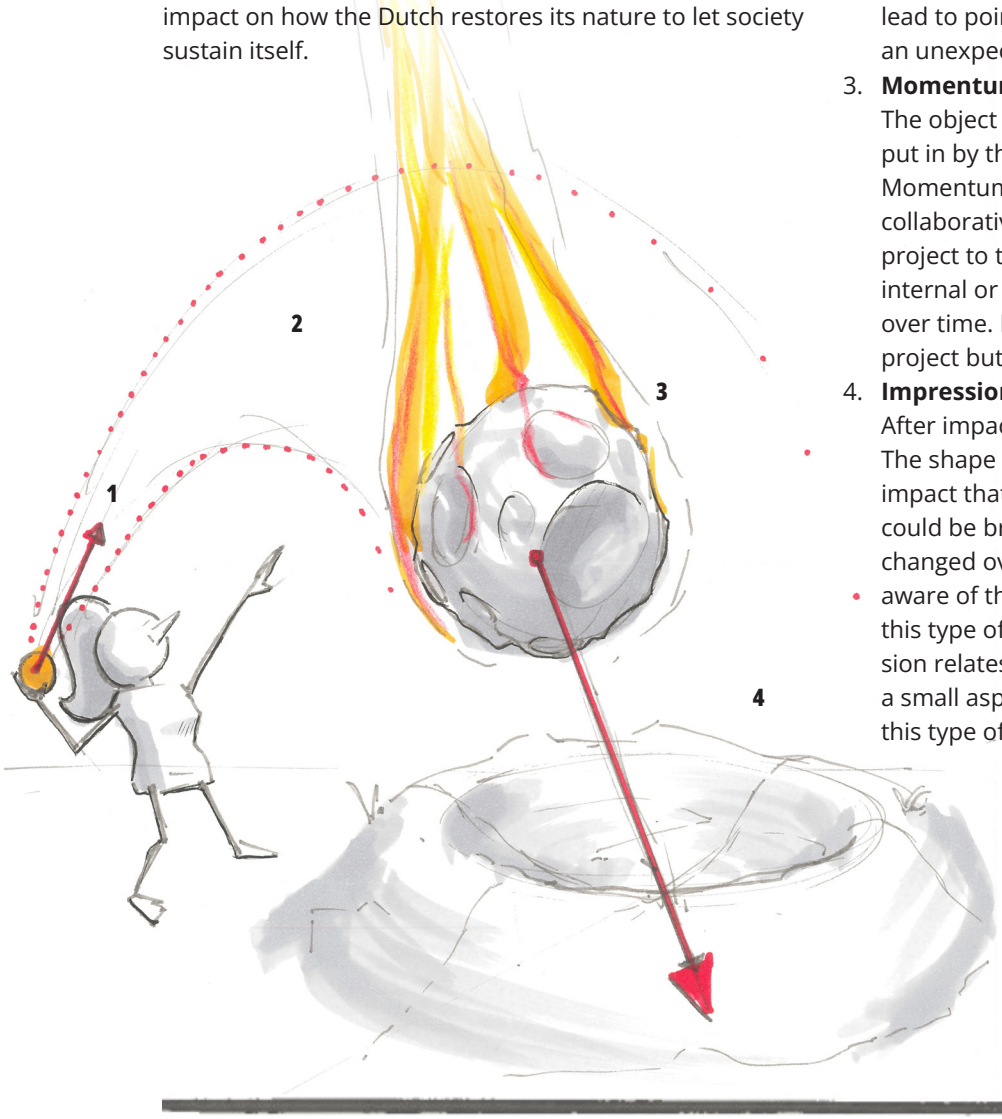


Figure 3.14. A visual metaphor for impact.

The Envisioned Impact of MAACQ Oase

MAACQ Oase can impact the nitrogen problem in multiple ways. It could make an impression as an early adopter of circular resources from the sewage, which could open new markets for new materials. It could make a deep impact by fully offsetting the nitrogen effects locally, which would allow for the preservation of biodiversity.

The approach in Figure 2.19 on page 29 illustrates how Omlab and Fillip Studios view the road to impactful design. By beginning with a conversation piece, they are not inhibited by their limited production capacity and team size, they reduce project drag. Even though the impact on the nitrogen problem will be negligible, there will be a significant increase in knowledge of proprietary ideas and techniques. So, the aim of the conversation piece is much different than the aim of the netting product—the fourth stage MAACQ Oase in which companies can buy off their nitrogen emission. This difference also gives Fillip Studios creative liberty, the first concepts to market are absolved from a requirement to repair our climate.

By making the early goals of MAACQ explicitly artistic in nature, Fillip Studios is also playing to its strengths as a company. This art-first innovation strategy would not work as well for a company in the high-tech sector.

By formulating these intermediary goals as products, each with its own goal, design brief, development, and product launch, it also becomes easier to connect the development to the external world. The DIM model illustrates this.

Setting out to create a series of products subverts the assumption that you need to get the innovation 'right' from the start. By exposing it to the world through public works and exhibition events new connections and meanings can be found. The Pedestal can be a jumping-off point, elevating a project (Figure 3.15).

Competing countermeasure techniques

According to (Verganti, 2009), when a design holds a novel meaning that is distinct from the design that dominates the market, it makes customers convert and buy the innovation. So, an understanding is needed from the current market and the meanings of the designs therein to learn how to make the meaning of MAACQ Oase distinct. There are a few comparable and competitive products and techniques.

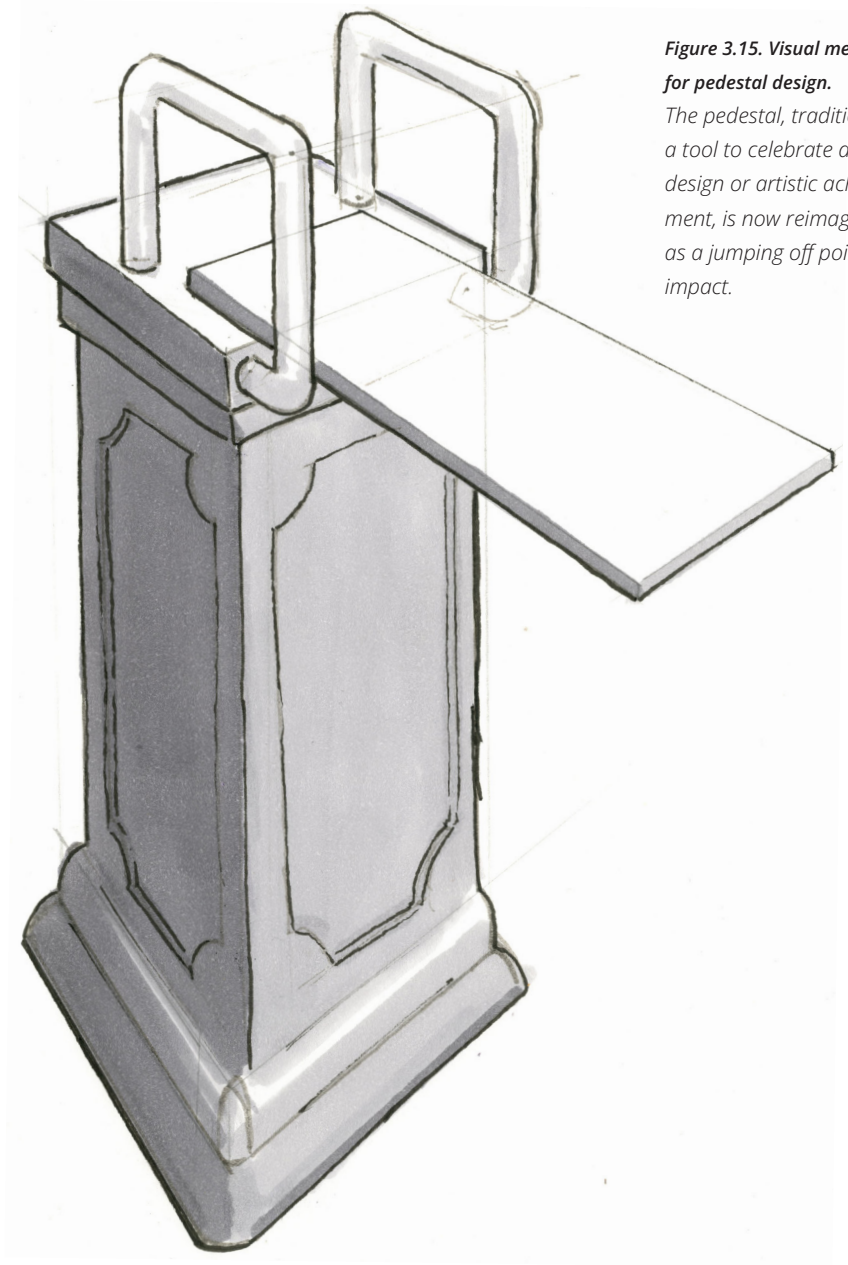


Figure 3.15. Visual metaphor for pedestal design.
The pedestal, traditionally a tool to celebrate a great design or artistic achievement, is now reimagined as a jumping off point for impact.

Product Styling & Meaning in Innovation

A product always has a styling, the styling concerns the form of the product and its interaction with the human senses, even if it is designed for optimal functionality. In incremental innovation, there is a previous version on which you can base the appearance of your product.

However, in radical innovation, there is no such example. As Verganti (2009) notes; radical innovation does not always conform to beauty standards, because often there is no standard.

The model for communication by Crilly et al. (2004) shows that the product communicates the intentions of the designer through a channel to the senses of the consumer, as depicted in Figure 3.16. Even if the product is not made just to be pretty, a gentle appearance will help communicate a message to its audience more effectively. This is because, by stylizing, the designer spends additional efforts on crafting the message that the product sends to the consumer (van Everdingen, 2020). Or, as Norman (2004) put it "Attractive things do work better".

Sight is a very dominant sense in the design domain, but weight, texture and smell can also influence the response of the consumer. In general, when it comes to radical innovation, it is best to keep the message a simple cultural reference while balancing novelty (expectedness) and typicality (difference).

The MAACQ Oase is not based on any specific product, there are no biobased sculptural products in the market for soil deacidification. But without a point of reference, it can be difficult to base the appearance on anything other than personal taste.

The styling of MAACQ Oase might not be able to transmit the primary function of deacidification, to the layperson. But as a sculpture conversation piece, the MAACQ Oase may be expected to feature an explanatory signpost, which can help explain what the product is doing.

This deferral to the signpost opens the opportunity to express secondary ideas with styling. For example, it might express subtlety, in contrast to the brute action of dumping stone flour from a helicopter. Alternatively, it could communicate positivity towards the wicked problems that plague our society. Finally, it could communicate a new relationship between products and nature, for example by attracting wildlife to interact with the sculpture.

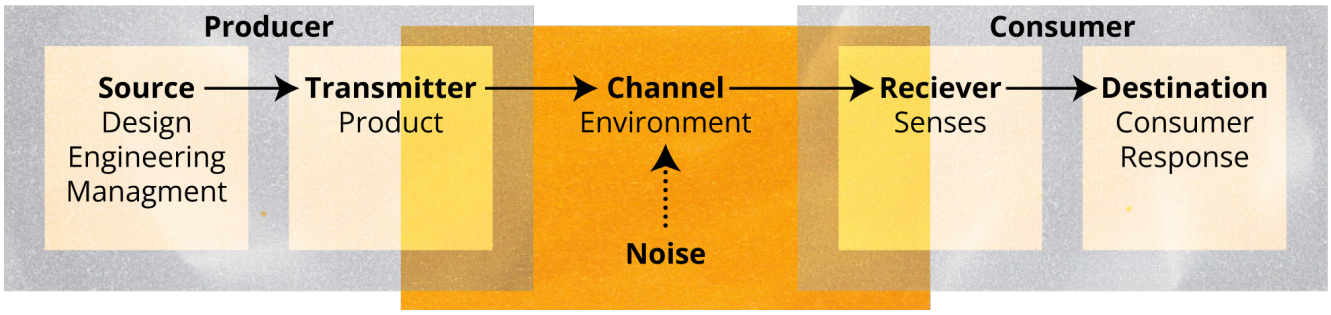


Figure 3.16. Communication model.
Figure adapted from Crilly et al. (2004).

Case Study

Photo by Ainur Khakimov

Part II

In PART one, ideas on how critical design is positioned and how innovators conduct themselves were brought closer together. However, to answer the research questions, in PART two specific research was done on the interaction between these topics with a case-study.

Case Study Method

To gather new insights on how critical design work is approached in SMEs in the cultural and creative sector, a case study is held on the MAACQ Oase design process. This chapter will explain why a collaborative research-trough-design method was chosen.

Collaborative design

The first half of the case study concerns design work performed collaboratively, which led to a new modular design concept called OAAS. The concept choice for OAAS prompted a re-evaluation of the case study scope. This chapter will conclude with a new method description for the second half of the case study.

Some of the collaborative work was leading up to the material testing approach and setup. The timeline of the testing plan was moved outside of the scope of this thesis because there was no direct need for results to achieve the goals set out in the project and time pressure from other projects put the tests lower on the priority list. The design process of this topic can be found in Appendix 2 – Degradation Test Plans.

Birdbead

The second half of the case study concerns individual design work on one design-research module called Birdbead, which was developed into a prototype and featured at the exhibition of 4TU at the Dutch Design Week 2023.

Grasshopper

Over the course of the entire case study the parametric CAD Modelling software Grasshopper was used. The insights on gained on modelling with this software are of interest to Fillip Studios. Furthermore, the application of this software is relevant to the objective of this thesis, because it has elevated the technological development of MAACQ Oase. Which was found to be a key part of the process towards making impact with critical design.

4. Case Study Method

There is an academic, political, and economic interest in increasing the number of cultural projects that are developed into innovation (Cousijn, 2022; European Commission, 2016; Malpass, 2013; OECD, 2021; Ysabel Nauwelaerts & Iris Hollaender, 2012). However, there is a lack of documented knowledge on how designers or artists in such projects behave, and whether the conditions in such projects are conducive to making a deep impact. It is also clear that the MAACQ Oase project is an example of a project that is in the intermediary phase between a cultural project and an innovation project. To find a deeper understanding of the workings of impact-oriented design projects from the cultural and creative sector, this case study was conducted on MAACQ Oase.

By presenting findings on this topic this thesis strives to inform Fillip Studios, and other designers on activities and structures conducive to a future increase of impactful projects from the cultural and creative sector.

Case-study approach

In the project planning, presented in Figure 1.3 on page 15, the expectation was set to create a new design framework based on the analysis findings and apply the framework in a solitary case study on MAACQ Oase. This approach was focused on adapting the design to industrial applications as a future vision. After familiarisation with Fillip Studios, MAACQ Oase and literature study in the analysis phase, it became apparent that working individually and iteratively on both a MAACQ Oase redesign and a new innovation framework would not be an effective approach.

Innovation is always a team effort and is aided by involving real stakeholders. It was decided that to research the specific context of impact-oriented critical design from the artistic sector, the better case-study approach is to work collectively as a part of the Fillip Studios MAACQ Oase design team. This shift enables a direct study of impact-oriented design. This entailed meetings every other week where results and ideas were pitched, and new tasks were set for the next meeting.

The method of inserting oneself into a new design context to gleam research outcomes from the process of designing falls into the category of “research through design”. By joining in with the MAACQ Oase design team it is possible to experience the process of ‘further designing critical design’ from up close. This goes beyond observing the trajectory of the project and interviewing its designers.

The following sections will explain the design team roles, which is a pragmatic company-oriented view of the project. This will be followed by a section on research through design, which will go further into the methods used to research the impactful critical design phenomena.

Design Team Roles

The goal of the design team is to come up with the next form of MAACQ Oase. Roos Meerman is the team lead of the design team; she is directly involved in the day-to-day design process as well as the decision-making making process. The designers are Niels Stuiver and the author, who are responsible for formulating and executing design activities together with Roos to produce design proposals. The designers have significant input in qualifying ideas, but they do not make decisions. Project decisions are negotiated among the company leads of Fillip Studios and Omlab: Tom Kortbeek, Roos Meerman, Huub Looze, and Margreet van Uffelen.

Research Through Design

Research through Design (RtD) embraces the idea that design practice can be employed as a means of conducting academic research, which can be done in a variety of ways (Stappers & Giaccardi, 2024). This case study will be inspiration-based (Sanders, 2005), and the design process of Fillip Studios will be followed 'naturally'. Inspiration-based RtD is explorative and invites ambiguity and surprise, it allows this project to make use of the knowledge and experience of Fillip Studios as an authority on further developing artistic projects. This differs from some other RtD approaches like usability testing and ethnography, which are more investigative and planned out.

RtD closes any gap between the processes of thesis writing and company activity. This enables the opportunity for active engagement with relevant stakeholders. Getting involved with the stakeholders during the design process could provide rich insights and understanding of the contextual nuances that help shape the design solutions. This participatory approach enhances the real-world applicability of the research outcomes.

Through designing together with the MAACQ Oase design team, research will be conducted on the following three topics.

Firstly, *how does an organization in the cultural and creative sector organize the redesign of impact-oriented projects?* From the design experiences parallels can be drawn to models for design and innovation. Furthermore, a statement can be made on how fitting the ideas presented in the literature analysis are to a company in this sector.

Secondly, *how can generative CAD software be used to model a product for the concrete 3D printing process?* A digital prototype will be made using the Grasshopper software. Fillip Studios can use work in Grasshopper to build up a library of proprietary knowledge. Furthermore, developing the MAACQ Oase in CAD can provide new insights into the process of supporting artistic and critical projects with technological development. The production of scale models, or any physical prototypes, is assumed to fall outside of the scope of the case study.

Thirdly, *what are the possibilities and limitations in designing with 'Itbettermatter'?* Omlab has knowledge and experience with these designs, as the material and processes are improving. By engaging with this stakeholder new insights can be gained on future design directions.

By choosing the RtD method the research becomes focussed on a single project. The downside of this is a loss of overview and objectivity. As the research results become reliant on the processes specific to the MAACQ Oase project, they may not be fully transposable to other impact-oriented designs from the cultural and creative sector.

5. Collaborative Design

Sensemaking

In this initial phase of the case study, work was done in the form of scenario sketching and Grasshopper exploration. This work deepened the understanding of the MAACQ Oase project beyond the documentation provided in chapter 2. This phase was needed because at the onset of the design process it was unclear what the objective and scope of the design work were beyond 'further designing' the MAACQ Oase in the broadest sense.

The 'MAACQ Oase story' had to be revisited. This was done by formulating a plan of requirements, some were already established in the MIT documentation. A meeting with Omlab reestablished various aspects of the design. Furthermore, these ideas were discussed again in the MAACQ Oase design team, in this way the ideas of what MAACQ Oase **is** and **could be** were exposed. The resulting ideas are captured in a 'mental model' and 'future vision' sections.

On top of that, scenarios were sketched to explore ideas surrounding the MAACQ Oase, these scenarios were in part based on discussion but also functioned as an ideation process. The scenarios uncovered some weak points of the mental model resulting in a critical reflection of the requirements.

The 'Mental Model'

This thesis will contribute foremost to the development of the first of the four future versions of MAACQ Oase shown in chapter 2. Fillip Studios already has ideas about what the next MAACQ Oase will be like while also realising that some aspects of the design are still undetermined. This mix of ideas is a 'mental model', an understanding of the project outside of the company and its project documentation.

To communicate the mental model, a visual impression was made (Figure 5.1), accompanied by a list of requirements and wishes. These represent the MAACQ Oase at the beginning stage of the thesis project.

None of the features of the mental model are set in stone, but Fillip Studios has expressed the desire to keep as much of this the same as possible during the concept generation phase.

Fillip Studios Future Vision for MAACQ Oase

From the analysis chapter, it is clear what the common goal is of all stakeholders in the MAACQ Oase project, to address Nitrogen Acidification with a Biobased Circular design solution. However, it is important to also consider the intentions of Fillip Studios from their company perspective, to understand their opinions on the design direction.

Fillip Studios has an entrepreneurial perspective, aiming to make an impact while also expanding its business. They have a desire to expand their portfolio in the direction of citizen science and parametric-generative design.

By incorporating citizen science Fillip Studios is trying to keep true to their mission statement, Impact through wonder. Citizen science could make people feel incorporated in the problem-solving process, which might help freeze an all-too-common fear of our climate future.

By incorporating parametric-generative design Fillip Studios is trying to reduce risk in decision making, which future-proves the design. Enabling it to adapt progressively to new research findings while ensuring a continuation of the project's original vision. They expect these parameters to relate to the weight of the MAACQ Oase, the recipe of the printing paste and the local nature. Fillip Studios also believes that knowledge of parametric design could prove useful in future projects.

Figure 5.1. The mental model of the MAACQ Oase.
A visual summary of what the conversation piece will entail.

Form

1. The shape and colouration of the MAACQ Oase will resemble a rock structure.
2. It will intentionally have an uncanny synthetic appearance.
3. It will be roughly 3 cubic meters.
4. Animals and insects will be able to make a house in the MAACQ Oase. It is uncertain whether animals will burrow their hole, or it is part of the print.
5. The shape of the MAACQ Oase's underside, height, and mass will be parametrically determined based on measurements made at the placement location.

Production

6. The MAACQ Oase will be a continuous-line planar print made with a modified industrial 3D cement printer on a robot arm.
7. The layers will be all in the horizontal plane. After printing no post-production is needed.
8. It might be printed on-site or transported there.
9. If needed, structural additions can be implemented. These must be circular and fitting to the local environment.

Material

10. The MAACQ Oase's material will roughly be based on 'Itbettermatter', with changes made to the material composition based on the precise location.
11. It might have embedded seeds of flora lost or deprived by the nitrogen acidification that belong to the area where it is placed.

Use

12. It will erode over roughly 3 years.
13. The first will be placed in the Utrecht Ridge.
14. Citizens will play a role in monitoring the activity and changes around the MAACQ Oase and tracking the erosion process.
15. It must be safe, without risk of collapse due to weather, animals, or humans in, on and around the MAACQ Oase

Management

16. Down the line the stakeholders expect to set up a new business entity that is responsible for producing the MAACQ Oases for other sites.

Critical Reflection of MAACQ Oase Through Scenario Sketches

The clear mental model of what the MAACQ Oase should become functions almost like a requirements list. However, there is a lot of unknown about what a MAACQ Oase would behave like if it were produced. Ideally, the material would weather away, enriching the surrounding soil with calcium while the rock slowly shrinks. This was expressed by Fillip Studios in their scenario sketch shown in Figure 5.2.

Figure 5.2. Degradation process.
The scenario of MAACQ Oase weathering over time and sprouting an Oase of biodiversity, made by Fillip Studios in 2021.

However, since it will be out in nature for 3 years it is to be expected that the MAACQ Oase will have many different types of influences and interactions. By sketching out scenarios with and around the MAACQ Oase it is possible to speculate about the sheer amount and varieties of interactions that the MAACQ Oase might have. The following four scenarios will explore interactions with degradation, humans, weather, and nature. In these scenarios the MAACQ Oase is displayed in many different shapes and sizes, to represent various permutations of the mental model. These interactions are not inherently problematic, but they shine a light on the complexity of designing for nature and public spaces. To concretize the ideas of each scenario they have been written out in Appendix V – MAACQ Oase Scenario Descriptions.

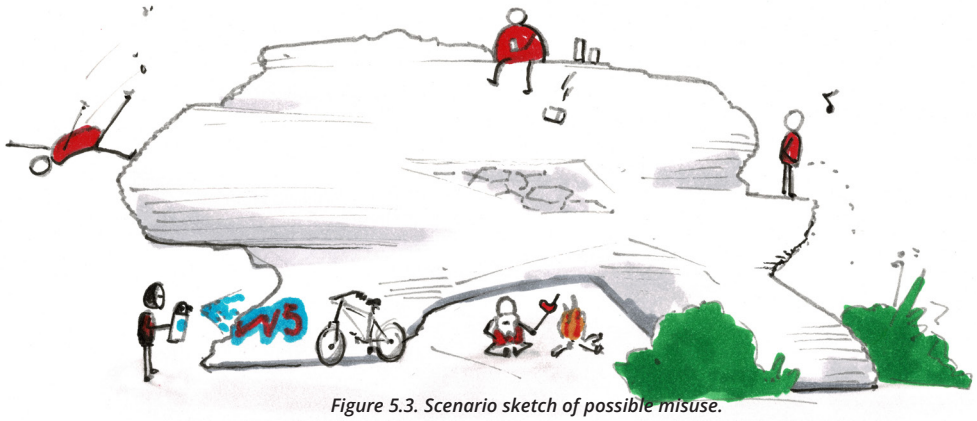


Figure 5.3. Scenario sketch of possible misuse.

Degradation

Because of the scale of MAACQ Oase, there are many ways in which the degradation process could cause the shape to deconstruct. This unpredictability could make the MAACQ Oase dangerous. A variety of possible scenarios are explored in Figure 5.3

Human influence

The MAACQ Oase will be placed in sight of people visiting the nature reserve, as it should elicit ideas about our climate crisis and design interventions for nature. However, a boulder-sized and shaped art piece may result in other behaviours as shown in Figure 5.4.

All products in public spaces are at risk of vandalization through violence or graffiti. People might feel invited to scale, but the MAACQ Oase's rough texture makes it an inviting challenge for bouldering enthusiasts. The structure could provide shelter, which could attract people to camp in or under the MAACQ Oase. General human activity could result in trash or excrement accumulating around the MAACQ Oase, doing additional harm to the soil instead of healing it. The presence of humans in general could reduce or altogether obstruct interactions with wildlife.

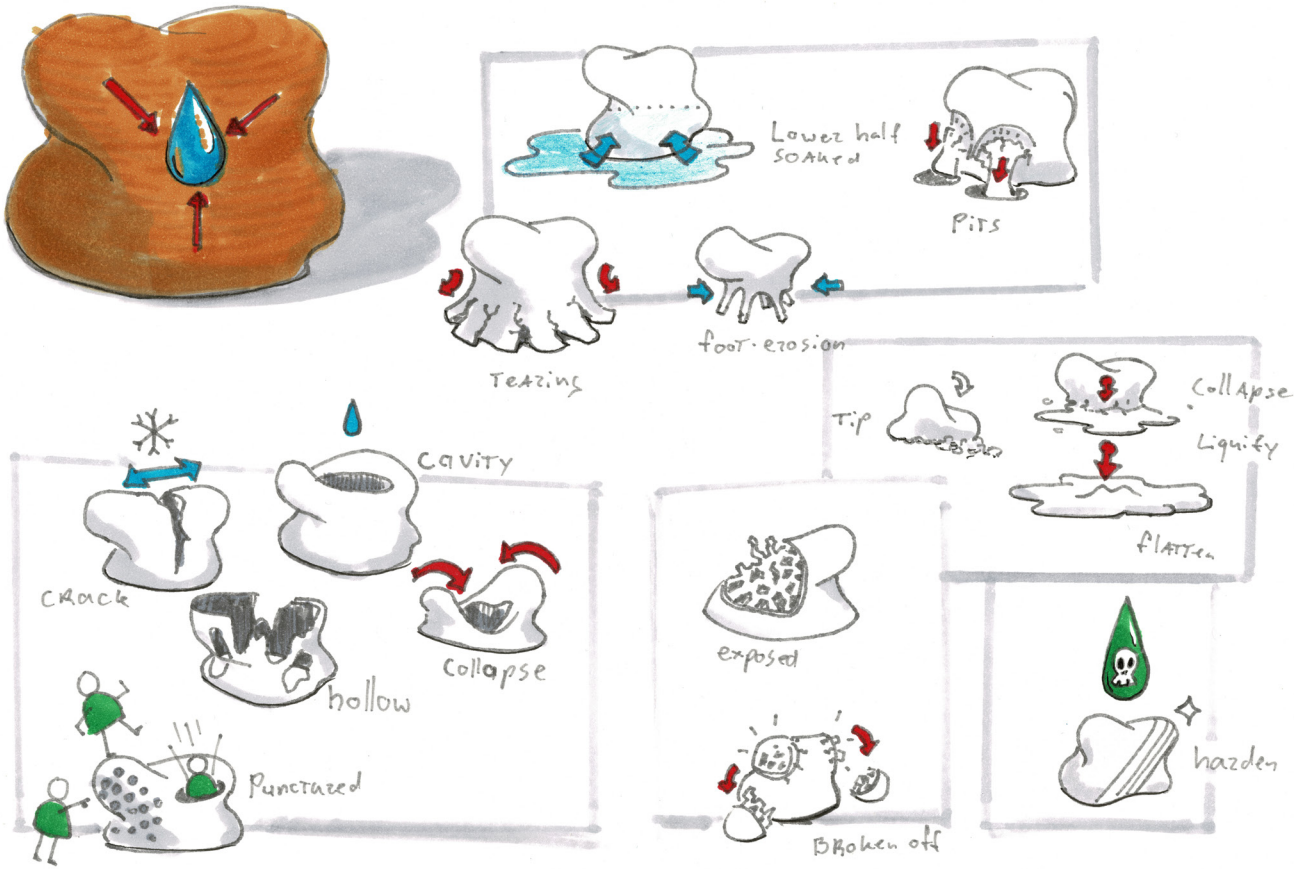


Figure 5.4. Scenario of collapse.

Weather influence

The MAACQ Oase uses the weather to degrade and disperse its minerals back into the soil. However, our weather can be fickle and intense as shown in Figure 5.5.

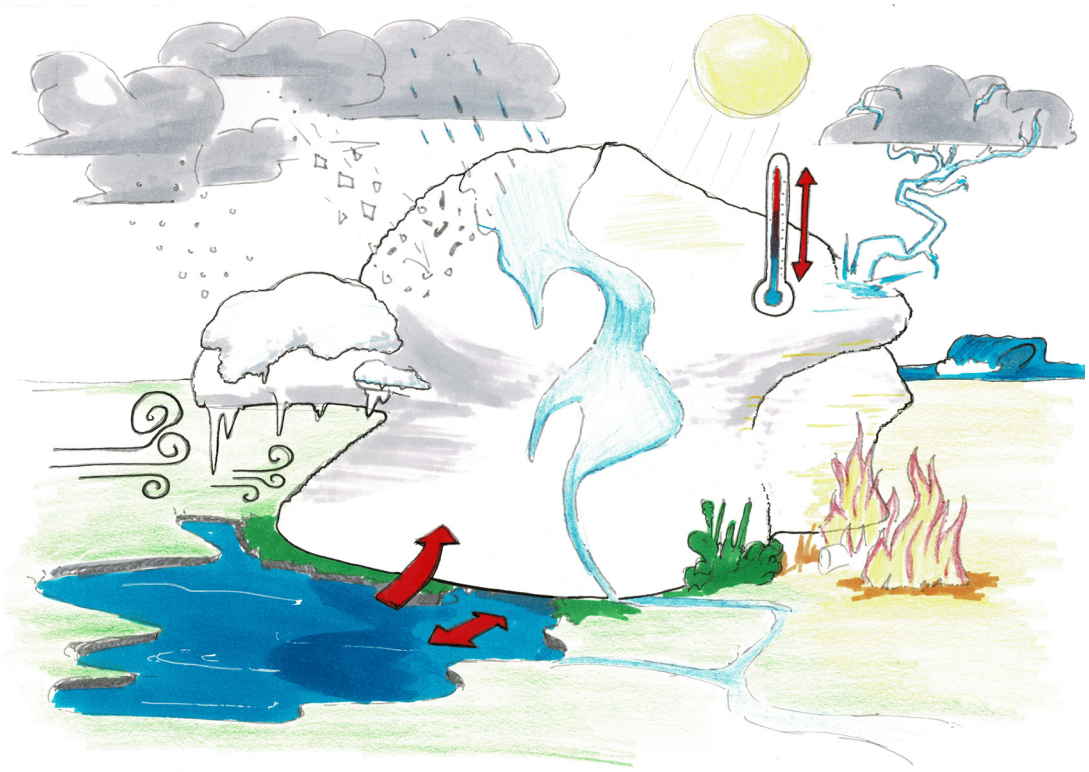


Figure 5.5. Scenario of interactions with weather and events

Flora and Fauna interactions

The MAACQ Oase is supposed to enhance biodiversity and introduce calcium back into the food chain. However, it is unknown what kind of attraction or repulsion the object will have on different species (Figure 5.6). Attraction of different species could result in a change in the natural balance. Furthermore, the objective of MAACQ Oase to interact with nature is at odds with its objective to be in sight of the public, because human presence disturbs natural wildlife behaviour.

Scenario sketching conclusions

Considering all these scenarios together, four conclusions can be drawn.

Firstly, the possible interactions with the environment are vast, rendering it impossible to design something which accounts for every possible use case.

Secondly, multiple possible scenarios could enhance one another, which could lead to spontaneous unpredictable behaviour of the MAACQ Oase. This could pose a risk for the project, as damage caused by the MAACQ Oase on nature, animals or people would reflect poorly on Fillip Studios and Omlab. For example, if the forming of puddles weakens the structure, causing it to collapse when a boar scratches its hide on the rough surface.

Thirdly, the needs of wildlife are not compatible with the role of MAACQ Oase of being in sight of the public. The presence of human activity undermines the potential of MAACQ Oase to become part of the natural environment, but without human observers, it cannot deliver its message about the nitrogen crisis. Both are key functions in the current concept.

Lastly, because of the ambiguity of a rock shape, MAACQ Oase is not more effective at managing any issue that could occur. Choosing a more specific design would make these scenarios more manageable.

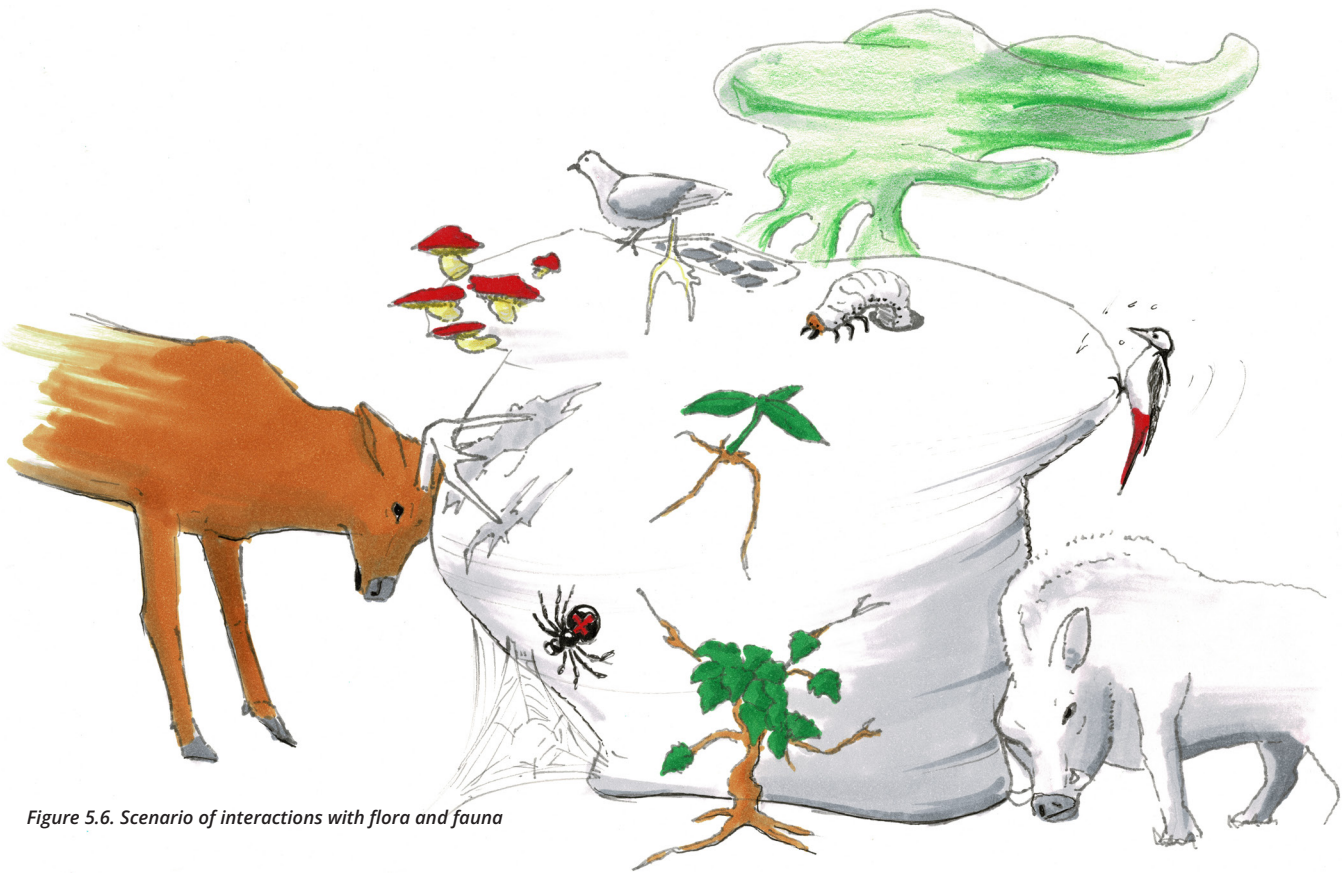


Figure 5.6. Scenario of interactions with flora and fauna

Exploration of parametric software

In chapter 1, the project objective is to design a MAACQ Oase using parametric tools. There is one software available which embodies the parametric approach like no other, called 'Grasshopper', a visual coding language which runs within the Rhinoceros 3D CAD software.

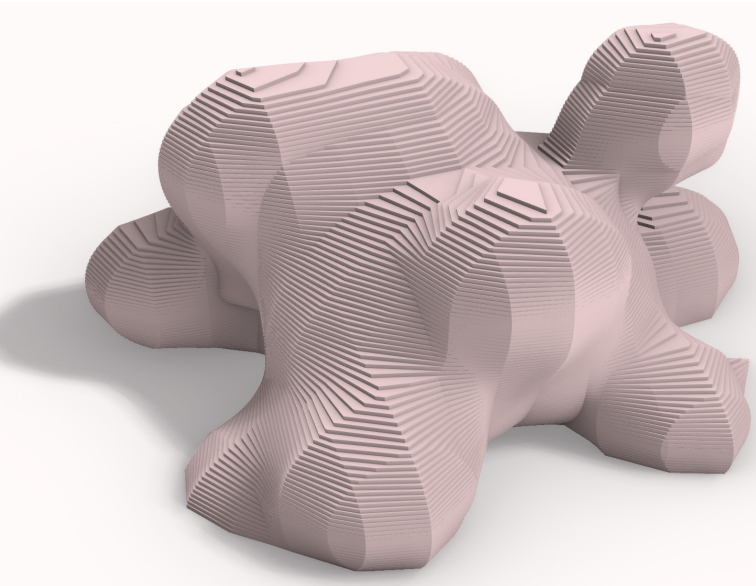


Figure 5.7. A 3D model for a rock structure.
Generated with Grasshopper.

Artists use the software to create generative art (example) as well as structural engineers and architects and does not require the user to learn a programming script. By interlinking the in- and outputs of coding components the user can create not only 3D geometry but also algorithms for physics simulations, audio-visual material, textual and haptic applications. Some users affectionately say the mantra; 'you can do almost anything with grasshopper'.

Knowing that this expansive software would be used later in the development phase of the design, time was allocated to become familiar with the program. After only a few tutorials and trials it was already possible to make an algorithm which generates complex layered rock-like structures akin to the MAACQ Oase DDW21 prototype, Figure 5.7 shows a possible model for MAACQ Oase.

This exploration provides a clearer view of what it will mean to design anything for MAACQ Oase parametrically. Designing something simple already takes more time in Grasshopper than in other CAD software, since the user must create an algorithm from scratch every time. However, the benefit is also clear. With a single, well-defined algorithm for MAACQ Oase, Fillip Studios would be able to create many products, see for example Figure 5.8 which shows the variety of shapes which can be generated by a single algorithm.

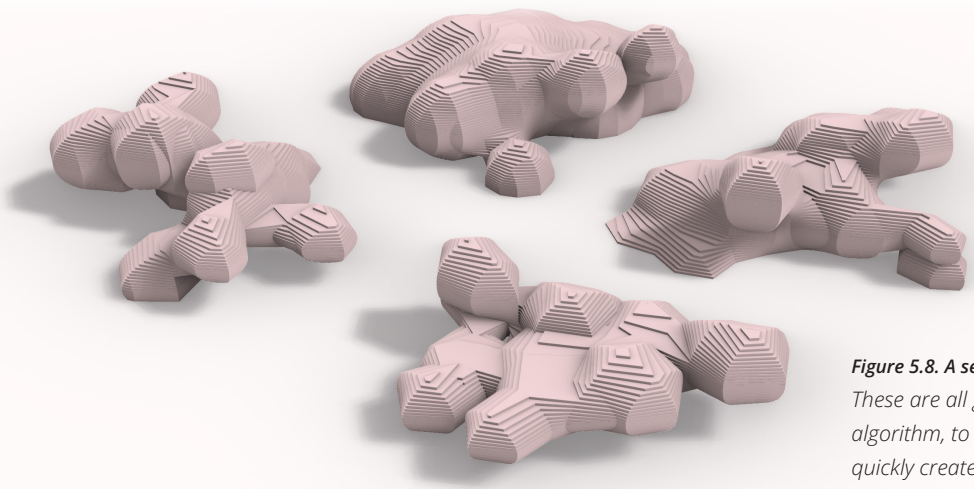


Figure 5.8. A set of 3D models of rock structures
These are all generated with the same algorithm, to illustrate that one algorithm can quickly create a variety of designs.

Inspiration

Having determined that the MAACQ Oase project will be more than a rock shape, the design team must find a new direction for the project. To do so individual tasks were made to collect inspiration images as preparation for a meeting in which they were presented to the team and verbally explained. This work was grouped per designer. This was followed by a second inspiration round where additional images and text were added into the 'cloud'. Following this second collection step the images from all the designers were clustered to find common topics, these topics were given a title. These titles dictate general idea directions for the project. The clustering was further cleaned up and translated for use in this Thesis as Figure 5.9, a textual description of the idea directions is provided in Appendix VI – Inspiration Cluster Descriptions, concluding the inspiration round.

The inspiration phase gives insight into the breadth of ideas which are being considered. In the analysis phase, the MAACQ Oase appeared to have a very clear project direction. However, the discussions in the design meetings make it clear that Fillip Studios is prepared to overhaul most of the shape language and metaphors in the concept. In this initial phase of the design process, there is a big focus on the appearance and meaning of the MAACQ Oase, and ideas are pitched without accounting for producibility, scale and functionality.

There are many advances towards exploring the differences between organic and geometric shapes. Which can be expressed as a crash, glitch, infection, or contrast. This dominant direction appears to focus on conflict, nature flourishes in erratic and irregular shapes while the geometric shapes convey a cold, deathlike and desolate feeling of industrial production.

A different viewpoint is that the MAACQ Oase creates harmony between the processes of nature and industry. By representing and imitating natural processes, like meteor impacts and dispersing MAACQ Oase dust like tree pollen. Biomorphic designs which blend natural shapes fit this category, as well as a more functional design like a bird and insect house.

Lastly, the design could also be more sculptural, where the use of organic and geometric shapes are representations of things we already know, a still life of an animal for example.

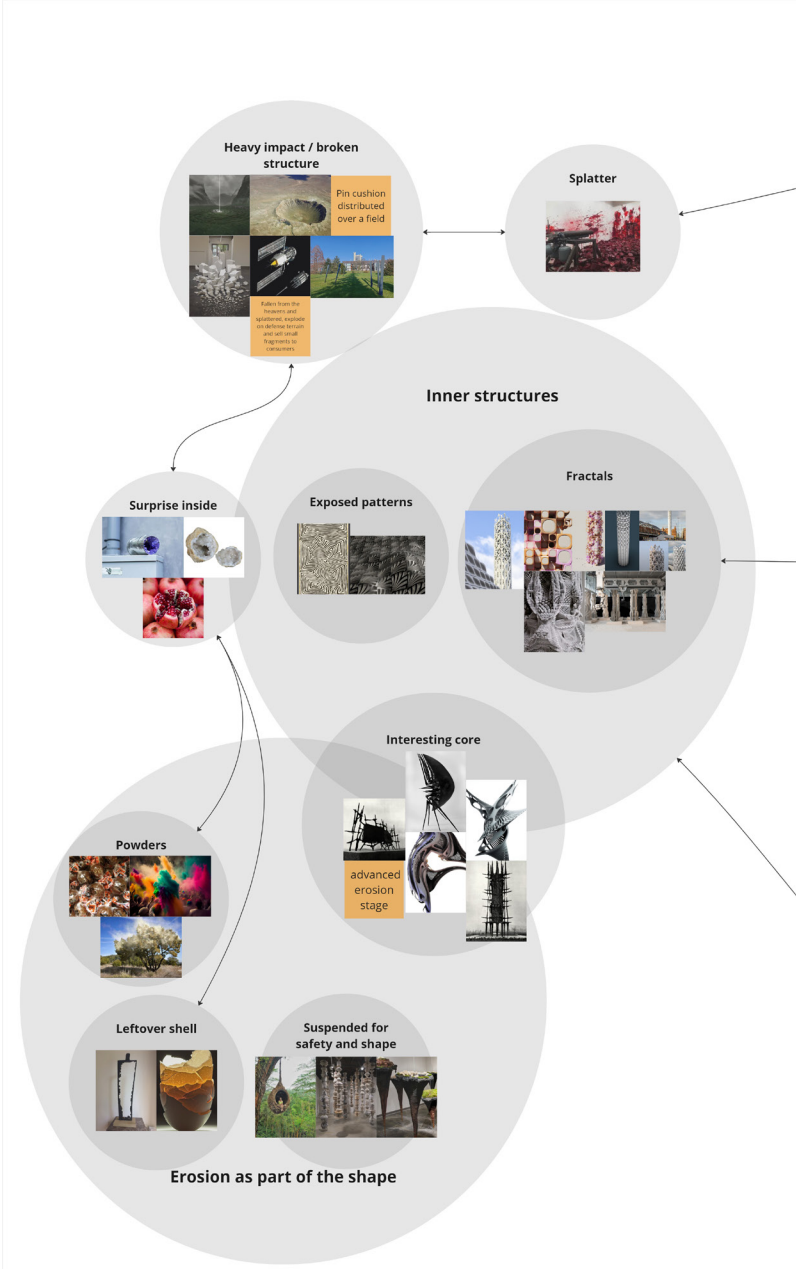


Figure 5.9. Idea inspiration clustered.
The sub-images were collected primarily through Pinterest.com.


Organic open structures
Natural shape inspiration
Natural erosion and hardening of sand
Root and fungus structures
Still life of viscous materials
Biomimicry
Biomorphic appearance great for drying process
Topological connections based on mechanical functions
Built up out of layers
Diverse printing directions are possible
Itero
Single line algorithms
Organic closed structures
Pressed together shapes
Housing
Potential holes for animal strongly visible
Sick or infected
Clear example of unnatural man-made help to nature
Clash or combine organic and geometric
Stone or Cubism meets organic shapes
Erosion could diminish the effect quickly
Let nature grow out of the rough side
Repeating patterns
Infinitely repeating
Printed houses
Modular elements
Earth layers
Real-life glitches
Infill based structures
Twisted box designs
Hotels for insects and birds
Coral
Generate new species of plants
Assembly of small prints
Gobstopper
Control erosion with layer hardness
Compensating Landscapes
Generate shape based on data
Strangeness by color use
Stratification

Ideation

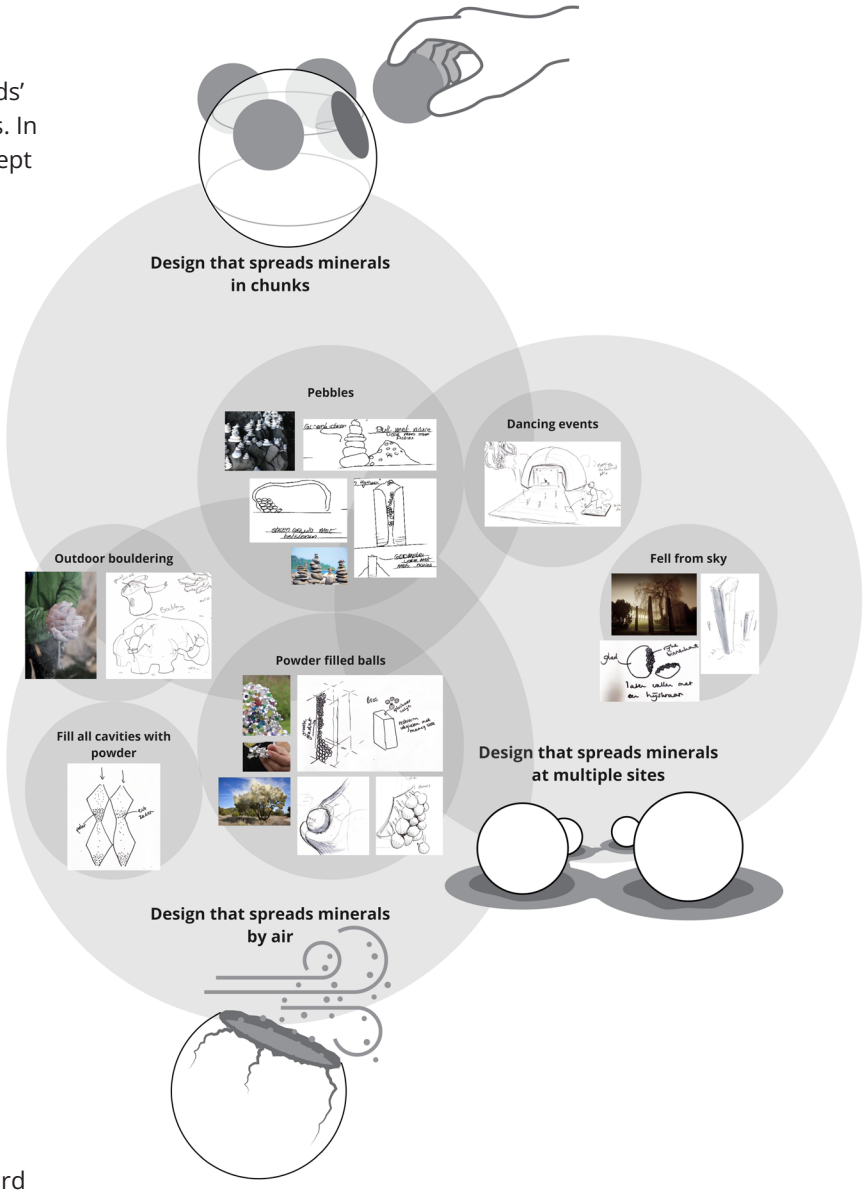
Having collected a generous bank of inspirational images and determined some general idea directions, an ideation phase was started. In this phase, the objective was to generate diverse ideas. Work was performed in a similar structure to the inspiration phase. Designs are made individually in a batch and are then presented in design meetings. Here ideas are bounced off each other, and the process is repeated. The 'design rounds' were finished by creating a clustering of similar ideas. In the ideation phase, there were 3 rounds until a concept direction was found.

Design Round 1, Sketching Part Ideas

This first, and largest, design round was aimed at coming up with novel design directions, loosely inspired by the previous phase. Two batches of sketches were made by the design team which were free from requirements, so they did not need to address all aspects of the MAACQ Oase concept. In this way, they are all ideas for parts of the design, which might be combined with other part ideas at a later stage.

Following the creation process of this design round, a discussion was held about the commonalities between the ideas. To characterize the idea directions, a set of icons was designed to represent the ideas, called 'design-archetypes' which can be seen in Figure 5.10. By making these archetypes it is made explicit that the design team could combine some aspects of different part ideas. They also create a more even playing field for idea directions, it is made easier to distance opinions about the project from the appeal or ambiguity of certain sketches. All the sketches, together with the design archetypes were clustered, as shown in Figure 5.11.

Following this first design round the decision the following conclusions were made: Firstly, the design directions related only to aesthetics, emotion and meaning were discontinued. Secondly, moving forward the concepts should be driven by their method for spreading minerals, or feature shapes that evolve because of erosion. These soft cuts are made to converge the design process, to focus more on certain topics than others in the upcoming design round.



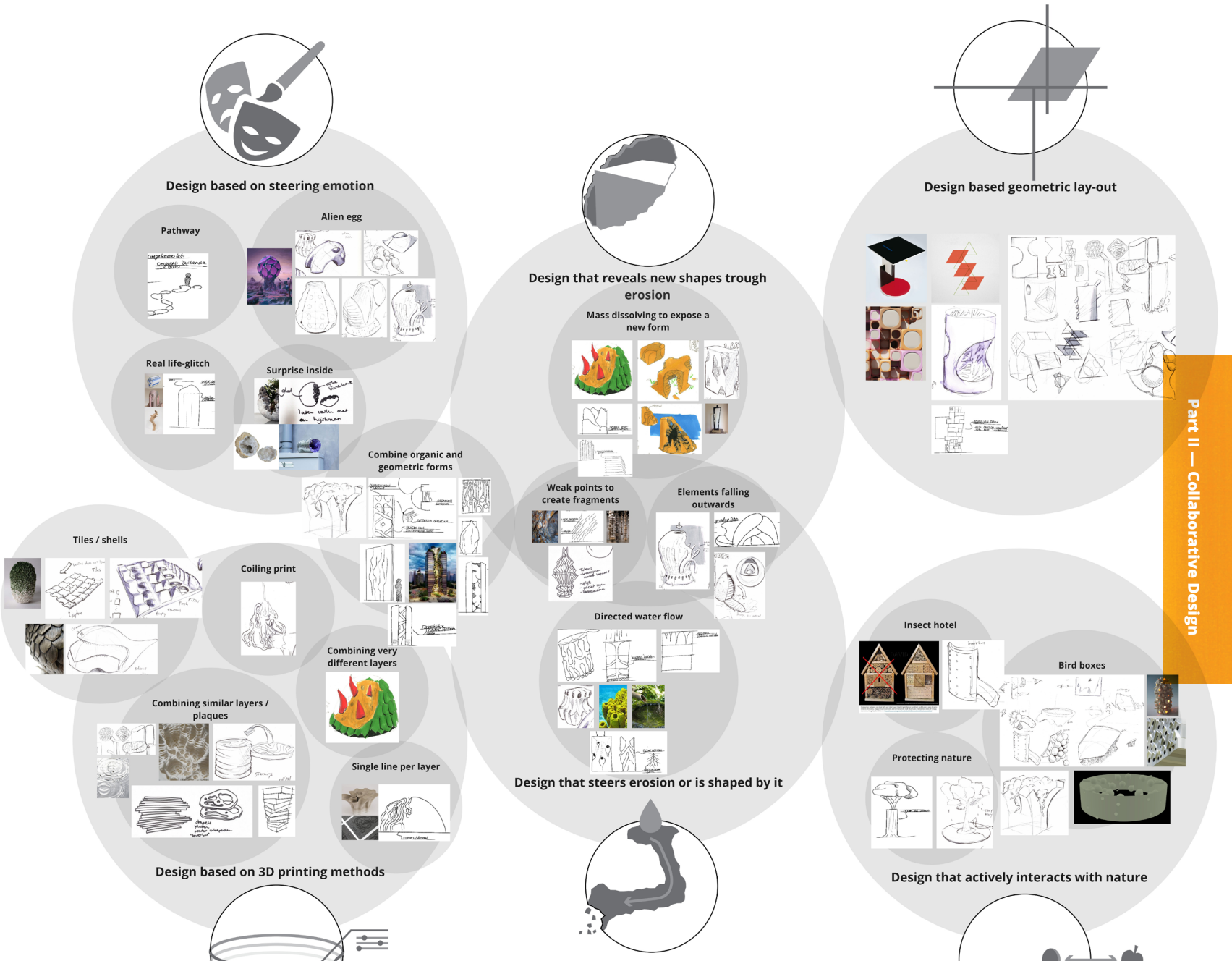


Figure 5.10. Design direction archetypes illustrations

Figure 5.11. Clustered Ideation sketches.

The design team made ideation sketches, these were sorted into categories, assigned an archetype, and then associated with various images from the inspiration cluster and Pinterest.com.

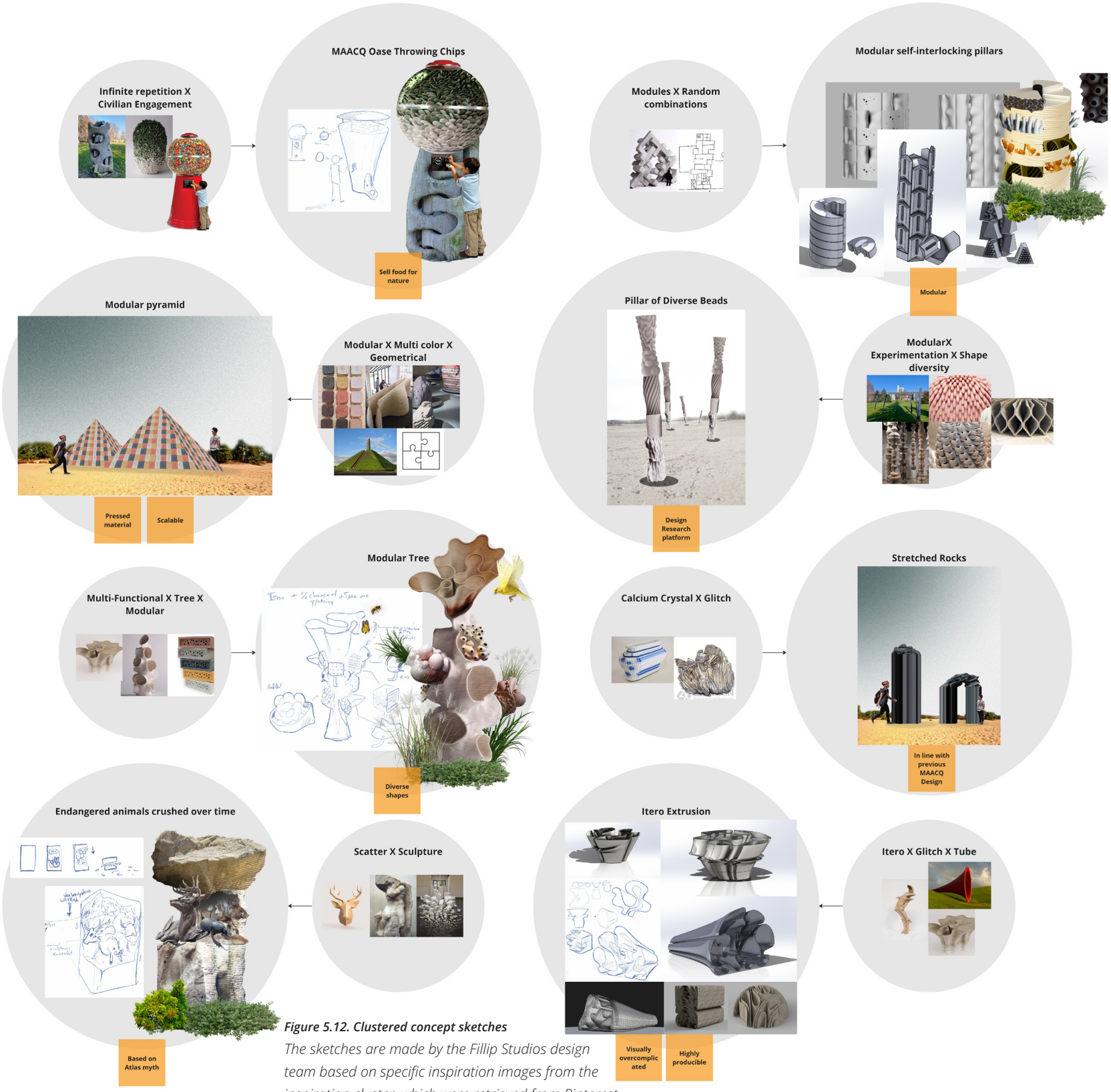


Figure 5.12. Clustered concept sketches

The sketches are made by the Fillip Studios design team based on specific inspiration images from the inspiration cluster, which were retrieved from Pinterest.com.

Design Round 2, Ideas

From the design archetypes and the ideas, they represent, it became apparent that in this design round, the focus should lie on three main topics: The shape refers to the appearance of MAACQ Oase and the meaning instilled in that. The production, how the prototype is produced, be that pressed, 3D printed, modular elements or something new. The spreading, gaining control of the erosion process and steering the spread of calcium minerals.

In this phase, the concepts also had to be of a higher fidelity. They should integrate multiple part-ideas presented in the inspiration and first ideation step into a sensible and understandable concept. In this phase, new sketches were made, but to make the concepts more evocative the concepts were expressed as photo-edits and rough 3D models.

This process resulted in eight idea directions, each with its inspiration images, visualizations, and name, they are presented in Figure 5.12.

Due to the timeline of the project, there is a need to select a concept direction and begin developing that into something marketable. The original production plan was to use a modified industrial 3D cement printer on a robot arm to create a large sculpture.

By creating and discussing the ideas of the second design round one key insight was gained. The time and financial investments needed to set up a design for a robot arm printer do not fit into the timeline. So, the next version will have to be produced with the machinery that is currently available at Omlab. This new course allows for more accurate prototyping since no new machinery is introduced at the end of the design phase. This decision also does not limit the concept selection, since all concept directions can be printed in multiple parts, possibly modules like in the pyramid and pillar concepts.

Concept Selection

Up to the second design round the progression of the MAACQ Oase project was confined to the Fillip Studios design team. To determine the best concept direction to move forward a meeting was held with the management team of Fillip Studios and Omlab. The strongest concepts were presented by Fillip Studios using Figure 5.13 alongside the proposal to use the Omlab machine as-is. The outcome of this meeting was two decisions.

Firstly, to move forward with the vase-pillar concept, see Figure 5.15. This decision was based on certain key strengths of the vase pillar not found in the other concept directions. The vase-pillar concept supposes that a pole is mounted in the garden of a customer, on this pole multiple vases are skewered. As they degrade, they slink in size, when the height is significantly reduced a newly designed vase can be added on top. The use of varied small shapes would allow for a flexible development process, where different vases are designed over time. This makes the creative process more procedural, allowing for more experimentation and progressive development of shape language associated with MAACQ Oases.

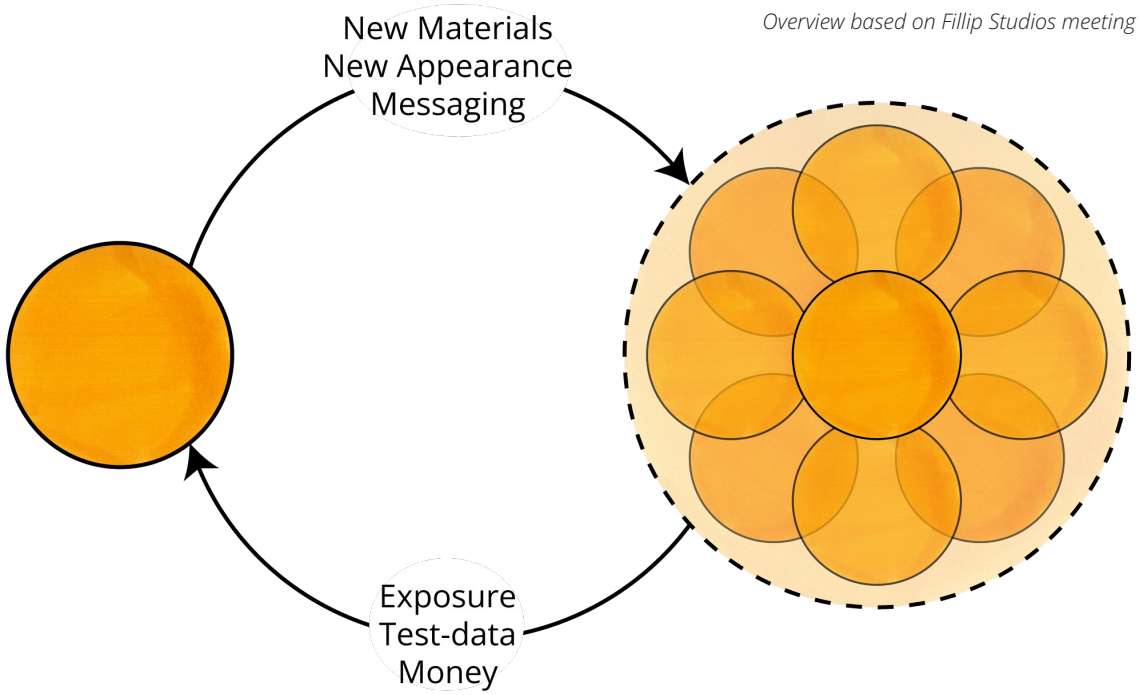
Figure 5.13. The concept selection.
Presented to Omlab at a project organization meeting.

Secondly, to reframe MAACQ Oase from a product into a service, called OAAS (Oase as a Service). The service aspect of OAAS also pairs nicely with the original development strategy as presented in Figure 2.19 on page 29. As a modular product, the proof-of-principle has the potential to prepare the conversation piece as well as the consumer product. A schematic overview of the OAAS concept is provided inFigure 5.14. Being a service also makes OAAS a more reliable source of income.

To a customer, the appeal of the vase-pillar OAAS would be that they have more variation and novelty, as new elements are added over time while also being able to express their participation in anti-nitrogen solutions for longer.

Moving forward the design team intends to consider different approaches to designing stackable modular 3D printed elements with the Omlab printer. To define a 'platform' from which to stylize and develop individual vases.

Figure 5.14. OAAS Concept Overview.
Overview based on Fillip Studios meeting minutes.



Modular MAACQ Oase elements

- Maximum size producible in current machine
- Adaptable shape per iteration to reflect updates in design & region specific dataDesign

Research System & Service

- Multiple field tests at multiple sites
- Degrading and enriching the soil over time
- Delivering new modules as a service for continuous revenue

Figure 5.15. OAAS concept direction.

On the left, is the concept selected, made by Niels Stuiver. On the right inspiration images following the concept selection relating to the OAAS.

Case study method update

One of the key deliverables of the thesis set in chapter 1, is a parametric CAD model made in Grasshopper. The concept direction of the OAAS opens the possibility of doing that kind of design work in one vase of the OAAS, or bead, as they were called in the design team. Until now the graduate and Fillip Studios design team have been working collaboratively on the concept level. Because of the concept selection by the MAACQ Oase management, the project has become more concrete. This prompted a revaluation of the position of this thesis relative to the MAACQ Oase project.

The following section will outline what changes are made to the method and how the second half of the case study will be structured.

Redefining the design-research scope

The functions of the other beads are still open for interpretation, but they could be the subject of design research projects into the makeup of modules in the OAAS. The scenarios in the Sensemaking section give a good overview of the kind of interactions that modules could cater towards. The inspiration board shown in Figure 5.15 was made invent bead designs. Some beads might just look appealing and tell a story, others may explore interactions with birds, insects, plants, and beasts.

The decision was made to make a bead for housing birds, called 'Birdbead'. Birdbead will primarily be a design-research effort on how OAAS modules can be modelled and produced with Grasshopper. After this point in this thesis, the focus will be on the technical execution of one bead by the graduate.

The Fillip Studios design team will continue to iterate on the structure of OAAS. So, there is an understanding that the OAAS concept may develop into something that does not accommodate the design of Birdbead. Nevertheless, the outcomes of designing Birdbead will be beneficial to all stakeholders. By limiting the scope of this Thesis to one bead, it can contribute a technology deep-dive to the MAACQ Oase project, while getting directly involved with the research topics of further developing critical designs. Figure 5.16 provides an overview of the work done and planned in the project and the outcomes of that work.

Birdbead design approach

Birdbead is a design project nestled within OAAS, which is nestled within MAACQ Oase. To come up with a concept for Birdbead a design brief will be formulated, followed by an analysis of the central topics of Birdbead; birds, 3D printing with concrete and clay-like materials, and parametric design. Following this analysis, the ideation on different possible Birdbead forms will be presented, resulting in a concept definition. A design exploration phase will discover how to express the chosen concept in Grasshopper. When a proof-of-principle is achieved this concept will be developed into a Grasshopper algorithm for 3D printing. The grasshopper design approach will be presented last, to give a cohesive explanation of how the algorithm is built.

Scale prototyping at Fillip Studios with PLA is possible, but at the starting point of the Birdbead design process, it was unclear whether prototyping in itbettermatter was an option, as significant efforts and costs are involved for Omlab to realise a print.

Following the design exploration, an opportunity was presented to apply for participation in the Dutch Design Week through the University of Twente, as part of the 4 Technical University Federation Design United research centre. Using the images in Figure 6.7 Birdbead was signed up to participate. Aside from the general appeal of exposing this design and all its stakeholders at one of the biggest design events in Europe, this opportunity also meant the prospect of receiving sponsorship from the University of Twente for prototyping Birdbead on a 1:1 scale. Something which was previously outside the scope of the project.

The outcomes and implications of the full design process, both collaborative and individual, will be discussed in a results section.

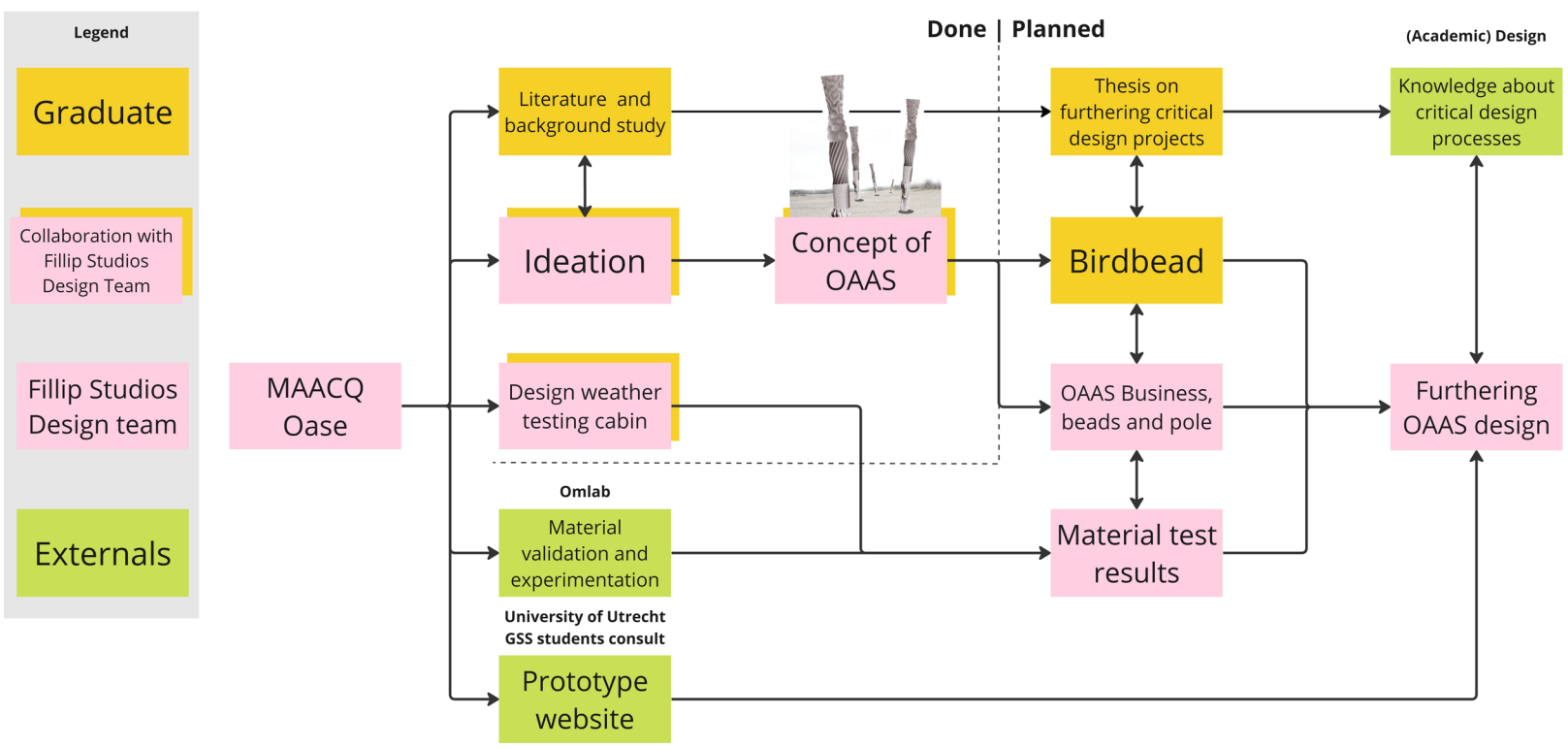


Figure 5.16. Overview of work done and planned.
The work items are separated into work done collaboratively, individually, and externally from the perspective of this thesis. the outcomes on the right.

6. Birdbead

Birdbead Concept

In this section, Birdbead concepts will be explored. Given the context of the OAAS, a design brief could be set up for Birdbead: Design a parametrically defined stackable birdhouse around a central pole with an organic and functional aesthetic for a clay and concrete-like 3D printing process with a single line per layer. The appearance should fit the Fillip Studios style of purposefully generated shapes with a specific application for outdoor use.

Bird Analysis

Since 1990 there have been 70% fewer wild animals in the Netherlands, this reduction is mostly in the populations of birds, reptiles, small mammals and insects (NOS Nieuws, 2020). Making a birdhouse out of 'Itbettermatter' brings together multiple aspects of the nitrogen problem in a marketable product. Tests in nature have shown that taking calcium directly available to eat birds directly impacts the well-being of forest birds (Vogelbescherming, 2021). The great tit is one of the most recognisable and common types of forest and garden birds in the Netherlands, (Figure 6.1) their population decline is therefore very noticeable to the public. Perhaps for this reason that the great tit is often the face of nitrogen acidification victems, as shown in Figure 6.2. Therefore, Birdbead will be designed with the Great Tit as a target species.

The Great Tit and many similar birds are suffering directly from climate change and nitrogen. The warm springs misalign the bird's breeding cycle with the natural peak of insects in spring (Vogelbescherming, n.d.-b). The lack of calcium in insects, as a result of nitrogen, also complicates the breeding process, as the eggshells are thinner and the chicks have bone growth impairment (Meijers, 2020; Vogelbescherming, 2021; Vroege Vogels Radio, 2017). In this way, the nitrogen problem goes from the roots to the leaves, to the insects, to the birds.

Birds find places to nest naturally, in the case of the great tit they find cracks in rocks and tree cavities (Vogelbescherming, n.d.-a). However, because of the general degradation and reduction of nature, it can be very helpful to place birdboxes. Placing birdboxes invites birds into an area where people can appreciate them, like in their private gardens.

Birdboxes are divided into nesting boxes and roosting boxes, which target the needs of birds in the different seasons. The nitrogen crisis has the most impact on young birds, so the focus will lie on nest boxes. It is well-documented how a birdbox can be designed so that it is safe and helpful for birds (Essens, 2022; Nestwatch, n.d.), and slight changes in design can attract different species of birds. These requirements for board boxes are as follows.

Figure 6.1. Great Tit.
Photo by Petr Ganaj

Mees. © Dreamstime

De koolmees legt het loodje door kalkgebrek

Zeldzame vogels in gevaar door stikstofvervuiling

Door Jeanet van Zoelen
Medewerker Vogelbescherming

Stikstof: simpel

Geplaatst op 7 oktober 2022

Figure 6.2. Headings of newspaper articles on nitrogen.
Image left from kro-ncrv.nl. Image middle from vogelbescherming.nl. Image right from AD.nl.

Design requirements for birdboxes.

1. Correct insulation for managing the temperature.
   Roosting boxes need insulating features, like thicker walls or material that is unconducive to heat. Nesting boxes need sufficient ventilation to prevent overheating.
2. Ventilation is needed to prevent condensation, but it must not draft.
3. Hole size must be appropriate for the species of bird.
   Sources report 28mm to 35mm holes for the great tit (Vogelbescherming, n.d.-b)
4. An opening at the bottom is needed for ventilation and drainage of excrement.
5. Overhanging the roof to prevent in-raining.
6. Appropriate floor and volume shape
   For the Great Tit this volume should be around 3.5 Liters and relatively tall, because the great tit makes a high nest, and young need to learn how to climb before they are allowed to fly. Some birds prefer a flat floor or a more bowl-shaped floor. For example, woodpeckers have an oval shallow dimple. Great Tits do not seem to have a strong preference.
7. Installation must consider the shadow direction; the entrance should be north-pointing to allow birds to fly in and out in the shade and prevent the box from overheating.

Additional helpful design features for birdboxes.

1. Features which deter predators.
   A perch exposes the bird and enables larger birds to stalk smaller species, so it is best left out. A collar or baffle can prevent climbing predators from reaching the nest.
2. A way for humans to clean out the nest, otherwise no new birds will come to the nest. One box can cater for 2 nests per season.
3. Features for exiting the bird nest from inside like groves.

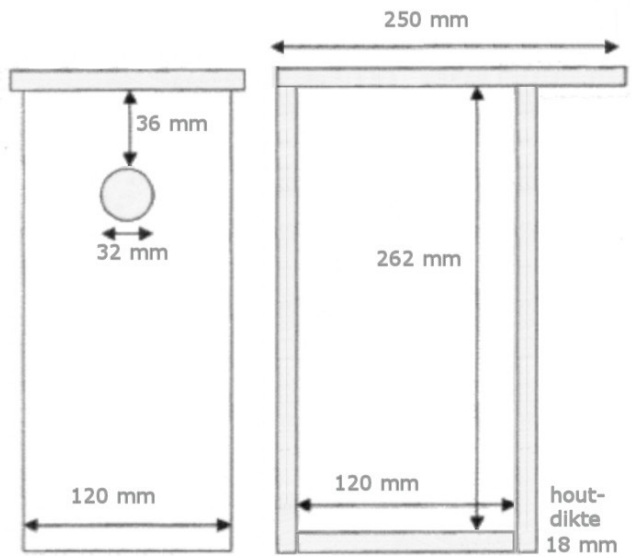


Figure 6.3. Reference schematic for Great Tit birdhouses.
By Madelèn Essens retrieved from mezen.madelen.nl.

3D printing Itbettermatter Analysis

Despite the limited availability of material test results, there is already information available about how to design with Itbettermatter. Some limitations and opportunities can be learned from Omlab directly, or from observing their portfolio. Figure 6.4 shows the shapes, 3d printing patterns and styles which have already been proven.

Since Birdbead is a technology deep-dive, it should increase the perspective of future projects. Therefore, in designing Birdbead the considerations and limits of the 3D printer should be engaged with and pushed to their reasonable limits.

Weather

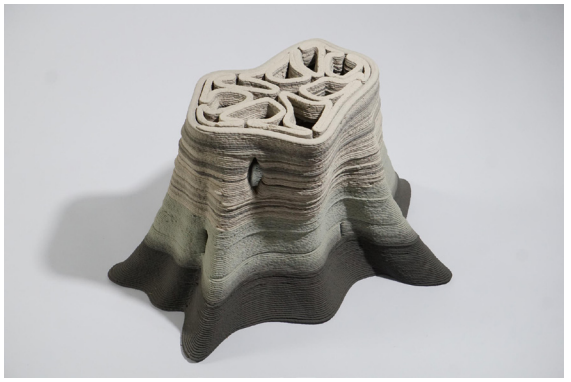
Itbettermatter is made to degrade and waste away over time, it is assumed that the biggest influence on the degradation process will be rain since itbettermatter is somewhat water absorbent.

When installing Birdbead, the opening should be north facing, to provide a shadow for the birds' flight-path. Since Birdbead is designed for the Dutch climate, this means that rain will predominantly fall from the southwest, as this is the dominant wind direction, based on Figure 6.5.

This knowledge can influence the shaping of Birdbead, to steer water away from parts of the design that are crucial and allow less important features to degrade first. Considering the opening of the bird nest to be the front of the design, means that extra attention should be given to wind and rain hitting the back-left area of the design.

	North	North-East	East	South-East	South	South-West	West	North-West
January	3	10	9	10	19	31	11	7
February	5	10	8	10	17	27	14	8
March	8	12	10	9	11	23	17	9
April	13	14	10	9	13	18	12	12
May	15	15	10	7	7	19	13	14
June	13	11	5	7	8	25	17	15
July	9	9	6	5	8	29	19	13
August	9	7	7	9	11	29	17	11
September	7	11	8	11	15	25	13	10
October	4	10	10	13	22	25	10	6
November	4	6	8	14	26	26	10	6
December	4	10	9	9	21	31	12	6

Figure 6.5. Table of dominant wind directions.
The wind direction per month in the Netherlands expressed as a percentage in the period from 1991 to 2020, showing a primarily South-West wind direction. Adapted from weerplaza.nl.



Design considerations with Itbettermatter

1. Manage the risk of condensation and rot.
   The cellulose is biodegradable, when the product is in use it should self-ventilate, otherwise it can become a breeding ground for rot.
2. Aeration during drying
   After printing the material must be dried, this is done in a drying chamber where warm air is pulled through the model by heating the top with infrared lights and sucking air away from the model.
3. Single line per layer
   Multiple lines per layer mean that the nozzle needs to make jumps. This makes printing much slower and can cause quality issues.
4. Variable nozzle size
   There are multiple nozzle sizes available, from 5 to 10 mm. A wider nozzle gives a more stable and safe print but increases the time and cost of printing.
5. Overhang limit
   The material is heavier and less self-adhesive than plastic prints. Because of this, unsupported overhangs can be no steeper than 25 degrees.

Figure 6.4. Proven design
This mock-up OAAS showcases the possible colours and shapes for Birdbead, photos retrieved from Omlab.nl.

Concept Definition

Birdbead's design process should provide new insights for future MAACQ Oase designs. From this objective, through ideation two concept directions were derived that fit the design brief, presented in Figure 6.6. The first concept sets out to research how water might be steered to give direction to erosion. By printing channels and funnels the water comes less into contact with the two functional elements: nest chamber and pole. The second concept's base shape strives for simplicity, making it possible to develop it faster, making it feasible to generate form variation and implement an iterative prototyping approach.

In a design meeting the first concept direction was chosen because it relates more closely to the research questions of the MAACQ Oase project and prototyping in the Itbettermatter material is likely outside of the scope of the budget.

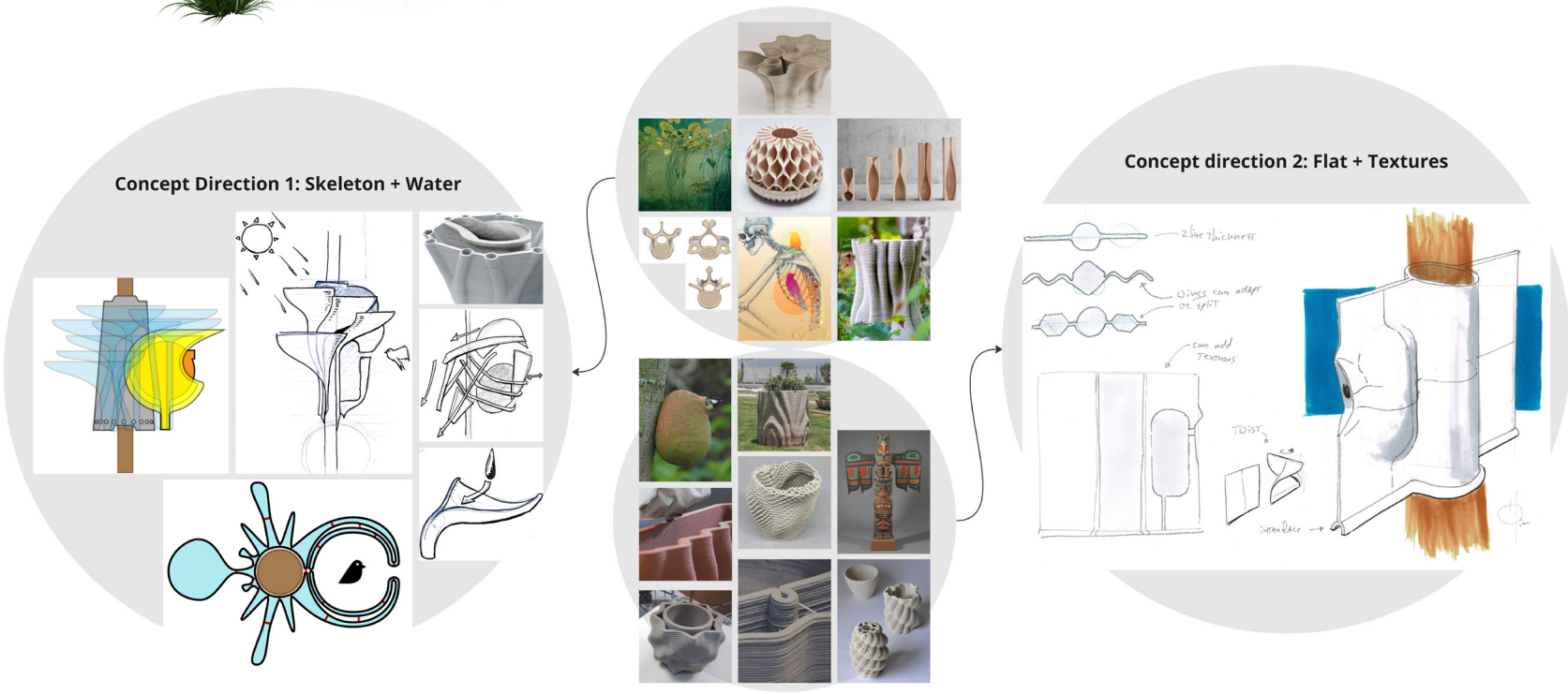


Figure 6.6. Birdbead concept sketches.
First inspiration images were collected, which were made into two concept directions.

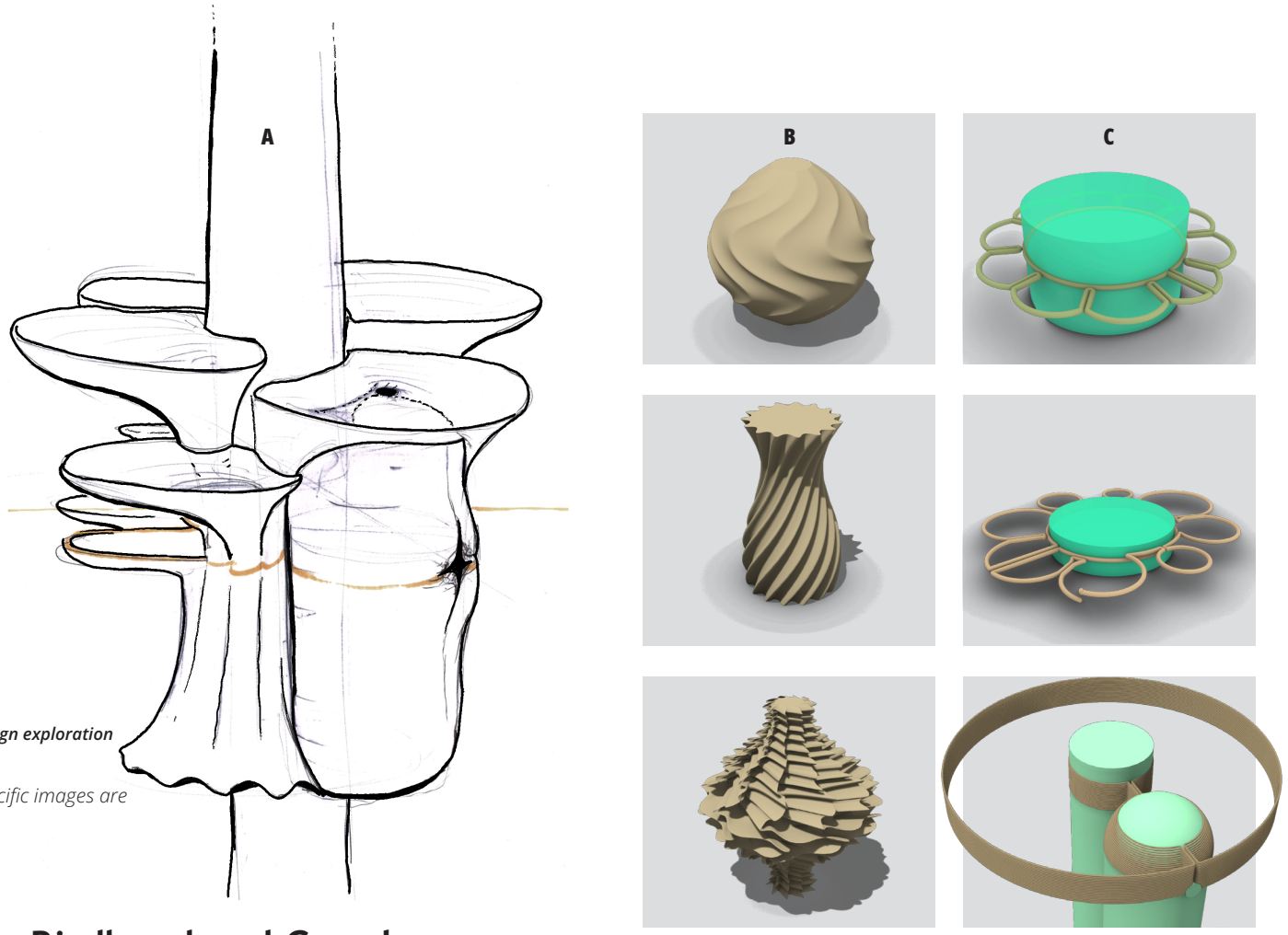


Figure 6.7. Collage of the design exploration phase visualisations.
Refrences in the text to specific images are marked by a letter.

Birdbead and Grasshopper Design Exploration

Having chosen a design direction, the first step was to explore how this design direction could be realized. At the concept selection, direction 1 was visualized across multiple partial sketches. To solidify the Birdbead design a **concept sketch (A)** was made to function as a guide for the remaining design process, as shown in Figure 6.7.

To make the design 3D printable with a continuous print a 3D model will have to be made which results in a single loop at any horizontal cross-section. Given the open-endedness of designing in Grasshopper, many different small definitions were made concurrently to address parts of the Birdbead. By exploring various shape-generation approaches, knowledge on how to design with Grasshopper was expanded until a proof-of-principle could be made.

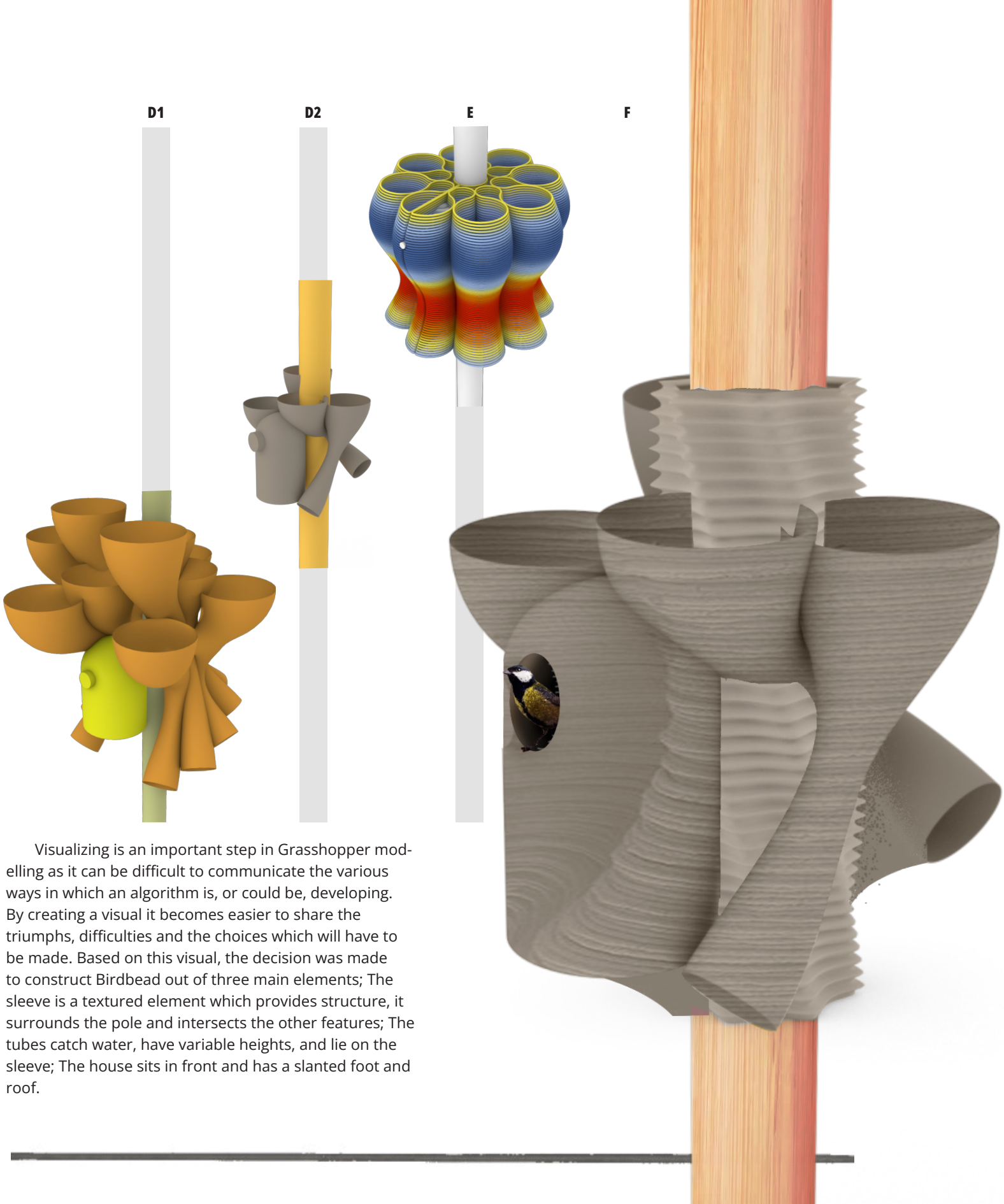
By making **twisted vases (B)**, knowledge was gathered on how to create flexible closed forms which don't self-intersect.

By experimenting with **wrapping curves around volumes (C)** an understanding was gained of how continuous line prints will function.

By creating a **visual approximation (D1&2)** of the concept sketch in 3D shapes more understanding was gained on how all the planned features can be laid out in 3D space. It became apparent that the number of tubes shown in the concept sketch would create a very complex design.

A **first proof-of-principle (E)** was made showing varying-sized tubes built up out of continuous lines with a birdhouse nestled inside.

The exploration phase was concluded by making a **layout visualization (F)** of Birdbead using the 3D model and photo editing to communicate the vision of the project and discuss the structural elements of Birdbead.



Visualizing is an important step in Grasshopper modelling as it can be difficult to communicate the various ways in which an algorithm is, or could be, developing. By creating a visual it becomes easier to share the triumphs, difficulties and the choices which will have to be made. Based on this visual, the decision was made to construct Birdbead out of three main elements; The sleeve is a textured element which provides structure, it surrounds the pole and intersects the other features; The tubes catch water, have variable heights, and lie on the sleeve; The house sits in front and has a slanted foot and roof.

Birdbead Design Phase

Following the exploration, the next goal was to work towards a 3D-printable version, Figure 6.8 shows all the design steps described in this section.

Having defined three elements of sleeve, tubes and house a **3D layout (A)** was constructed where all three shapes intersect. The tubes on the left side of the model are shaped to drain the heaviest incoming rain away from the house.

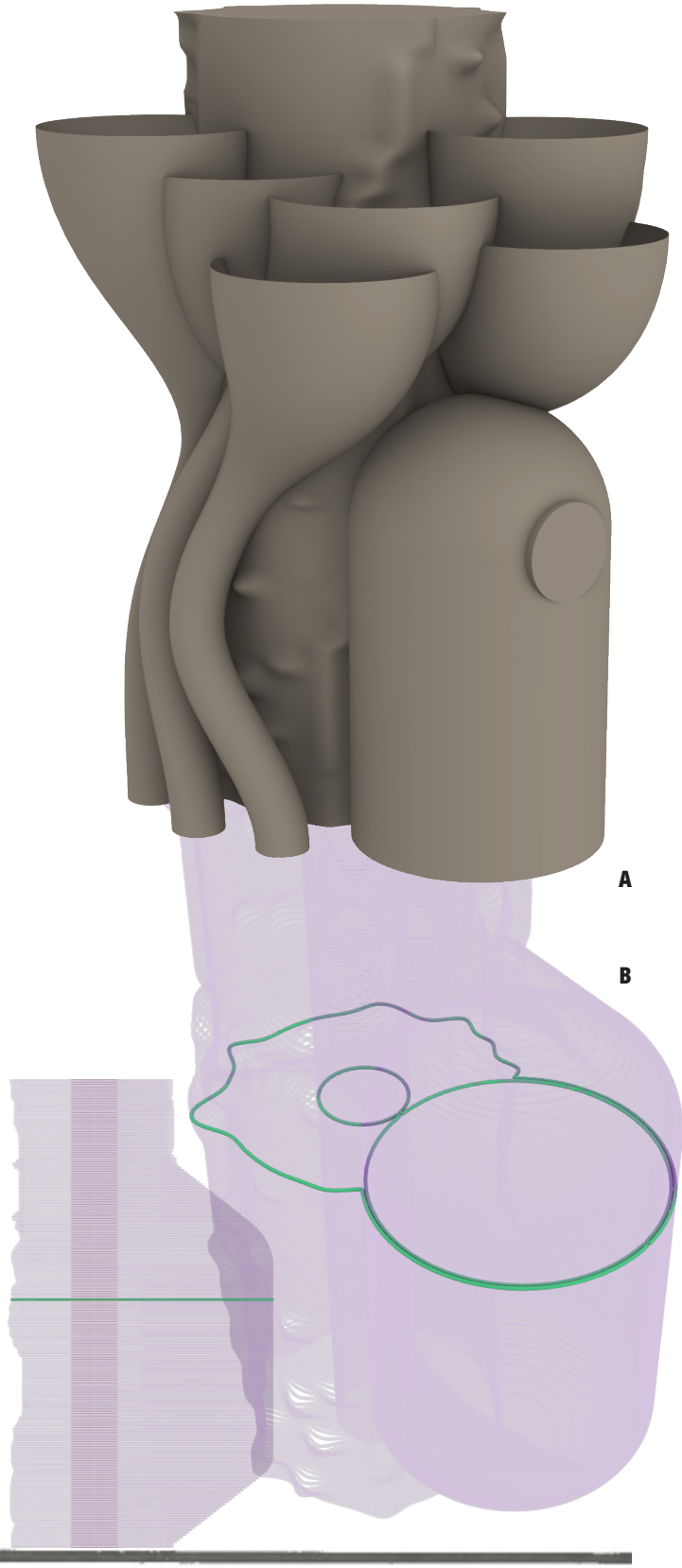
Having concretized the layout a more robust continuous line **cross-section method (B)** was made for the sleeve and birdhouse.

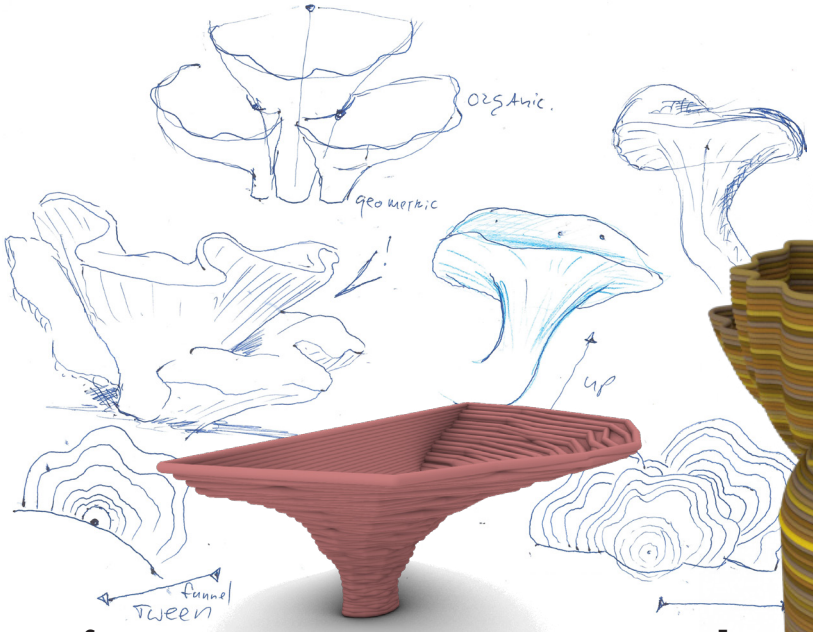
Simultaneously experimentations were made on how to generate the tubes in a functional-organic appearance. Inspiration was found in the shapes of **turkey tail (C)** fungi that grow on dead trees. They too enrich the soil by filtering out toxins and their growth pattern is comparable to 3D printing lines.

To make the **sleeve textured (D)** an image input was designed. This makes it easy to create visual variation between Birdbead iterations, it should after all be generative. A series of trials were made to find a suitable direction. For the Great Tit Birdbead, it was chosen to use a very fine, irregular, and bumpy texture based on an image of mountain ranges. This contrasts the relatively smooth sleeve and house.

To showcase the progression of the project towards a full-size 3D printable solution a **second proof-of-principle (E)** was made, combining all insights gained in the design phase thus far. Making this stage of the project visual and sharable helped with convincing the UT sponsor to admit Birdbead to the DDW and finance the 1:1 scale prototype.

Also, a 1:4 **scale prototype (F)** was made using an Ultimaker 2+ printer. The relative measurements of this printer are different from the Omlab printer, so it was not possible to simply scale down the model. Instead, a function was built into the algorithm to switch between the two printer settings. The scale prototype solidified the design and concluded the design phase. Among the biggest hurdles at this phase was visualizing the texture of printing with 'Itbettermatter', the proof-of-principle shows tube-like print lines, but the real model will have much wider lines, as shown in Figure 6.4.





C

D

E

F

Figure 6.8. Collage of the Birdbead design phase visualisations.
Refrences in the text to specific images are marked by a letter.

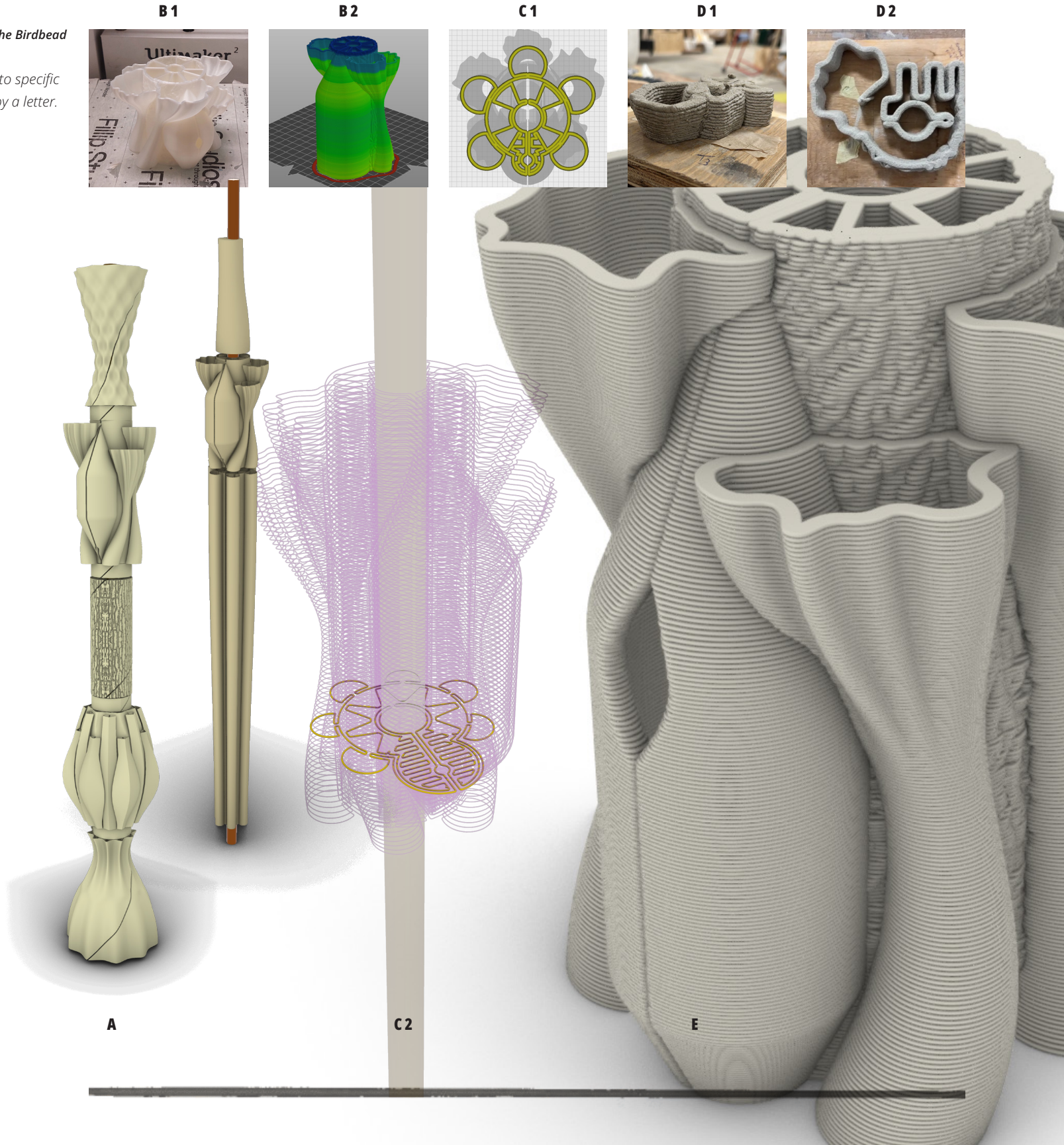
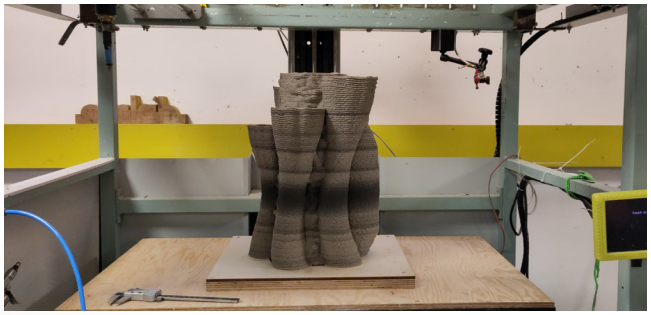


Figure 6.9. Collage of the Birdbead development phase.
Refrences in the text to specific images are marked by a letter.

F1

F2



F3

Birdbead Development Phase

In this final phase of the case study, the design was realized into a prototype (Figure 6.10), Figure 6.9 shows all the design steps described in this section.

With the realization of the 'first prototype', the original objective of the graduation assignment had already been mostly achieved. The DDW participation made it possible to go further with developing the algorithm, to make it capable of producing a full-scale prototype. During this phase, the algorithm was continuously improved to make it calculate faster and to make the design more structurally sound. The details about development in the algorithm are discussed in a separate Grasshopper section.

To make the full concept of an **OAAS pole design (A)** more explicit several other beads were designed by re-using parts of the existing algorithm. The result was visually very complex, so an alternative simpler sketch was made to highlight Birdbead.

To make the concept of parametrically designed birdhouses more explicit extra test prints were made showcasing **alternative houses (B 1 & 2)** that could be made. The first is a Wren birdhouse, this bird prefers a spherical house. The model was based on the design and research behind the Spherical Wren House 1ZA by Schwegler (n.d.). The second is a bat-box, bats prefer to be able to fly in from below and climb on a rough surface.

Up to this point the model of Birdbead consistsed of the sleeve, the tubes, and the house. It was lacking in some key structural elements needed for printing in Itbettermatter. So, a fourth element was added, a **support structure (C 1 & 2)**. This shape cups the birdhouse with ridges and anchors the sleeve to the pole. This inner structure is essential, but adds a lot of material to the print, increasing weight and print time.

Omlab communicated a hard requirement during this phase. The print needed to be done in one workday, otherwise, the material would harden. On top of that, the project would go over budget if multiple days were needed, so printing in parts was not an option. This meant that the printing time needed to be at six hours, at this time the model was estimated to take eleven. To nearly halve the material needed, the model was optimized to remove redundant elements. Furthermore, several concessions had to be made.

The number of tubes went from seven to five. Furthermore, the model was shrunk, from 500mm to 400mm in height, this shrunk the birdhouse to 2.5L, which is quite small for a Great Tit. This concession was accepted as this model was made for exposition and possibly water degradation tests later. Live animal testing would not be within the scope of any tests done with this model.

Two test prints (D1 & 2) were made in Itbettermatter to test the measurements in the model. Viewing the test print gave new insights into the design of the Birdbead. Firstly, the prints showed that the layers underneath the active printing layer move and shift along with the nozzle. This impacted the design of the tubes to be designed with greater clearance and less wobble. Secondly, the material shrinks after printing, which informed the design of the hole for the pole. Thirdly the texture on the sleeve could be tested to find a most appealing setting.

Because so much time was spent on optimizing the algorithm, new insights were gained on structuring the file and modelling in Grasshopper. This made it possible to organize the algorithm to make it more legible for Fillip Studios colleagues and possibly other Grasshopper designers. Furthermore, it became possible to create a 3D model with the right path shape, **enabling accurate digital visualization (E)** of the print's appearance, and showcasing the real width of the printing path.

All the work of the project thus far culminated in one critical **print day (F 1, 2 & 3)**. The budget provided by the sponsor accommodated only one attempt. After hand mixing the material, drawing and laser cutting a build plate, and making some on-the-spot decisions on the colour the print could commence. The process required constant surveillance, tiny errors in the definition of the sleeve texture caused material to bunch up around the nozzle. One error in the machine code nearly caused the print to fail, as the extruder settings were not called correctly in the code. After four corrective attempts, a dangerous but ultimately successful 'mid-air' restart allowed the print to finish. The six-hour print took a nine-and-a-half-hour workday, which provided a new perspective on scaling up the MAACQ Oase project going forward. The model was dried out in Omlab's oven, the foot had some drying problems resulting in more time spent in the oven upside down. The difference in shrinkage caused the centre front seam to unintentionally split open (see Figure 6.10).

Figure 6.10. Birdbead prototype. *Printed and dried Birdbead model with a split in the front, Photo by Huub Looze.*

Showcasing Birdbead

To prepare for exposing Birdbead at DDW several presentational materials were produced, including summaries, explanatory texts, website articles and high-quality visualizations. Furthermore, meetings were held about the design of the stand and the story of the DDW presentation. Video interviews with the University of Twente and Design United were made to promote the DDW and its participants. In Appendix 4 –Presentational Materials, these texts and images can be found. To enrich the exposition beyond the prototype with explanatory text, a hand-sketched poster was made, shown in Figure 6.11. Visually explaining the erosion process and soil enrichment function of Birdbead, the full poster can be found in that same appendix.

The plastic prototypes, poster, test prints and Birdbead full-size prototype were all presented at DDW in the Klokgebouw Figure 6.12.

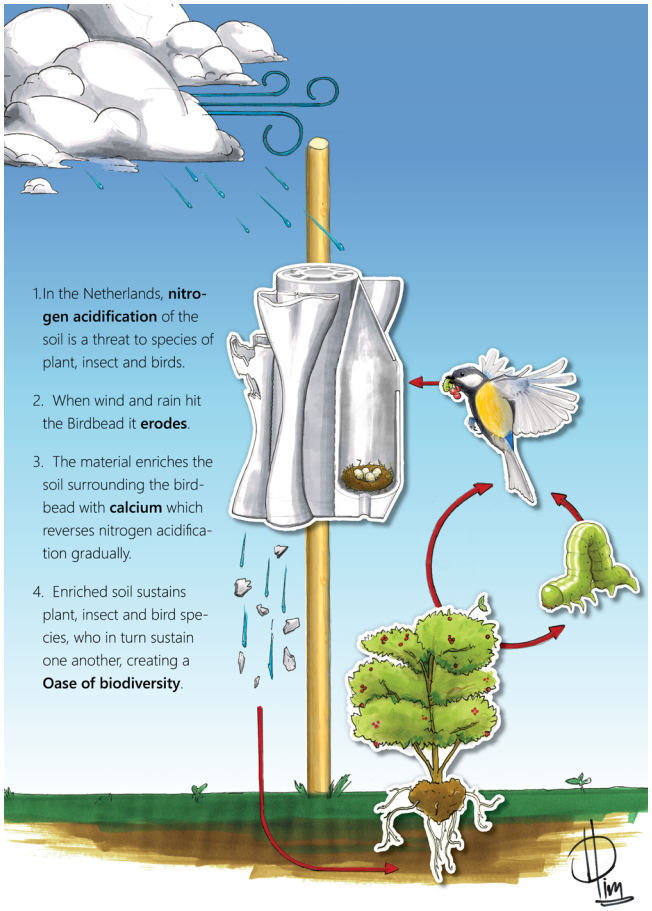


Figure 6.11. Hand drawn poster
Showing the interactions with nature in the form of weather, soil, plants, insects and birds.

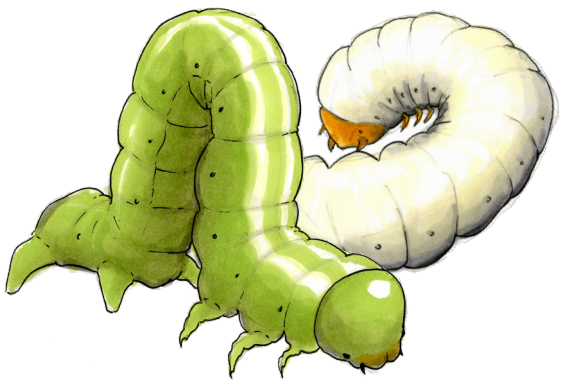
Feedback on Birdbead

It was possible to personally accompany Birdbead for five out of the ten exposition days. In that time many discussions were held with exposition visitors. These shone new a light on the associations the public has with the shape language of Birdbead. Some see the product as a jet engine, and others assume that it will be printed around a live tree. Multiple visitors assumed that the product would be for underwater use, likely because of other 3D printed bio-art they had seen in Eindhoven from Urban Reef (2023), Resting Reef (2023) or Xenofossils by Peters (2023), which all relate in name, shape or function to the marine biome.

Most visitors appreciated the greyish, rough, and monotone appearance of Birdbead. The calm and cool tone offset the complex shapes. From speaking with visitors about this it was found that sustainable objects with a louder appearance can feel too much like green-washed signalling.

Unexpectedly, the iconic stuffy smell of Itbettermatter was no cause for rejection, some associated it with old potatoes or a gutter smell but almost no one was repulsed. Overall, the public affirmed that Birdbead, as-is, would be marketable to bird and nature enthusiasts. Furthermore, people were generally excited about the prospect of contributing to design research into nitrogen acidification reversal products.

Aside from the general audience, Birdbead attracted the attention of 3D printing enthusiasts and professionals. A journalist from the newspaper Telegraaf publicized an interview about Birdbead with a photo (de Jong, 2023) (Figure 6.12). The full article can be found in Appendix IV –Presentational Materials.Birdbead was presented for numerous tours, including visually impaired visitors, Vattenval employees, and some members of the European Commission.



DE TELEGRAAF
WOENSDAG 25 OKTOBER 2023

NIEUWS VAN DE DAG T7

INNOVATIE VAN 'DICKPIC-PHOTOBOOTH' TOT VOGELHUISJE UIT HET RIOOL: DUTCH DESIGN WEEK TREKT DUIZENDEN ONTWERPERS

'WAAR KIJK IK EIGENLIJK NAAR?'

In de schaduw van industriële loodsen is het regenachtige Eindhoven dinsdag het toneel van high-tech innovaties en creativiteit. Dutch Design Week 2023 is aangebroken en lokt duizenden ontwerpers en bezoekers van over de hele wereld naar de Brabantse tech-stad. Allemaal hebben ze één gezamenlijk doel: zich onderdompelen in de toekomst.

door **Rosanne de Jong**

Het grootste designevenement van Noord-Europa maakt de tongen los onder de aanwezigen. „Waar kijk ik eigenlijk naar?", klinkt het, als de glibberkunstwerken, artificial intelligence-briefjezers, buisjes vocht en kartonnen Formule 1-auto's boven tafel worden getoverd.

Met een glimlach van oor tot oor stalt de 24-jarige Pim zijn stellage uit in het Klokgebouw. De technische student van Universiteit Twente vertelt over het profijt dat we kunnen hebben van fouten van machines. Hij wijst naar een 3D-printer, die staat te sputteren alsof zijn leven ervan afhangt. „Het doel van een 3D-printer is om zo goedkoop mogelijk resultaat te geven. Daar dat lukt niet altijd. Als gevolg van die fouten kun je er in de ruimte geen vervangende gaatjes hangt.

Met grote ogen luurt de 45-jarige Bart naar een lichtgevend 'monster' van auto-onderdelen in een donkere zaal dat de naam Manifestations draagt. „Waar kijk ik eigenlijk naar?", vraagt hij. Bart is docent van een groep studenten die dinsdag rondloopt om hopelijk wat op te steken voor de minor-opleiding Design aan Hogeschool Fontys. „Het is belangrijk om die vraag vaak te stellen, voor de bewustwording." Hij verwijst naar

Clim (25) zorgt met zijn ontwerp voor het nodige gegiechel.

Pim (24) met zijn vogelhuisje gemaakt van afval uit het riool.

Caido (25) brengt in zijn kunstwerk de oude vorm van film samen met de nieuwe vorm van film: TikTok.

FOTO'S RIA IMMINK

heidendaagse gewoontes waarbij mensen eindeloos lang op sociale media scrollen. „Dan kijk je niet echt."

De Britse Zain (39) en Alice (33) zijn op vakantie in Nederland en voor het eerst bij Dutch Design Week. „We vinden het heel indrukwekkend. Maar de boodschap is zoiets direct zichtbaar en vaak niet heel concreet. Dat vind ik wel jammer. Je moet als bezoeker ook wel creatief kunnen kijken", aldus Alice.

Met ruim 350.000 bezoekers dit jaar ten opzichte van 295.000 in 2018, kan geconcludeerd worden dat Dutch Design Week blijft groeien in populariteit. Creatief directeur Miriam van der Lubbe is grondlegger van het eerste maatschappelijke boodschap prioriteit voor in kwaliteit, dat vind ik het belangrijkste. De ontwerpers die hier staan, dragen echt bij aan een betere wereld met een maatschappelijke boodschap."

Ze stelt kritiek zoals die van Alice goed te begrijpen. „Ik zou zelf ook het liefst direct weten waar het over gaat wanneer je naar iets kijkt. Maar soms is die boodschap erachter niet zo makkelijk om te verbeelden." Van der Lubbe, die zelf ook ontwerper is, verslikt zich bijna in haar koffie als ze de vraag krijgt wat haar favoriete kunstwerk is. „Heel veel!"

Boodschap

Het overtuigen van een maatschappelijke boodschap blijkt prioriteit voor veel ontwerpers, tot grote vreugde van een groep vrouwelijke scholieren uit Tilburg. „We moeten een schooljapon hier uitvoeren, omwijs leuk! We hebben al heel veel ontwerpers gesproken over hun boodschap."

Een van hen is ontwerper Clim (25), die voor aardig wat gegiechel zorgt bij de tieners met zijn felbegeerde 'dickpic-photobooth'. De naam doet al aardig vermoeden wat zijn ontwerp moet voorstellen. Clim: „In dit hok kun je een polaroidfoto laten maken van je geslachtsdeel. Hiermee hoop ik dat mensen gaan nadenken over de vraag: wat betekent mannelijkheid tegenwoordig nog? Valt of staat dat met een dickpic? Een foto van het mannelijk geslachtsdeel, red.)."

Neemt bij hiernee bekende koppen als *The voice*-bandleider Jeroen Rietvrouwelijke schoolieren uit Tilburg. „We moeten een schooljapon hier uitvoeren, omwijs leuk! We hebben al heel veel ontwerpers gesproken over hun boodschap."

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Neemt bij hiernee bekende koppen als *The voice*-bandleider Jeroen Rietsteen en voormalig Ajax-directeur Mark Overmars op de hak? Zij lagen begin vorig jaar onder vuur vanwege vermeende dickpics „Een beetje. Maar het gaat me ook om de boodschap."

'Data-verkeer'

Terug in het Klokgebouw zijn ontwerpers Jort (31) en Olaf (32) druk in de weer met hun ontwerp, bestaande uit ballen en platen van staal. „We simuleren hier het volledige proces wanneer je iets koopt in een webshop", legt Jort uit. „Er ontstaat zó ontzettend veel data-verkeer bij een online-bestelling, daar zijn mensen zich helemaal niet bewust van." De heren vinden het belangrijk dat deze onwetendheid afneemt. „Het gaat namelijk wel over gegevens van mensen."

Grappen, een maatschappelijke boodschap of een potentiële innovatieve doorbraak: ook dit jaar is de Dutch Design Week rijk aan artistieke creaties. De 21-jarige Bram uit Drenthe is al onderzoek over wat we in de toekomst zullen terugzien: „Die Formule 1-auto van karton, daar moet Max Verstappen in rijden."

MAATSCHAPPELIJKE BOODSCHAP IS BELANGRIJK IN EINDHOVEN

Figure 6.12. Visual summary of the Dutch Design Week exposition.
The top three photos of the 'exposition' are taken by Janjaap Struis (Photography_by_jjs on Instagram). The newspaper publication is an excerpt from the entertainment and culture section in the Telegraaf of 25th October 2023, written by Rosanne de Jong. The sections relating to Birdbead are marked in yellow.

7. Grasshopper

Birdbead was designed using Grasshopper, a software for visual coding and modelling. The case study was held primarily to gain insights into the way of working in Grasshopper for MAACQ Oase. The following section will report on insights into the Grasshopper design process.

Breps

Boundary Representations, or Breps, are the 3D shapes used in modelling Birdbead. They are either a volume or surface which is defined with algebra. This differs from some other modelling software which uses meshes for example. Using Breps generally allows for greater shape control and lossless design. This comes at the cost of needing very precise definitions, which take time to develop and generally make it more difficult to create organic shapes.

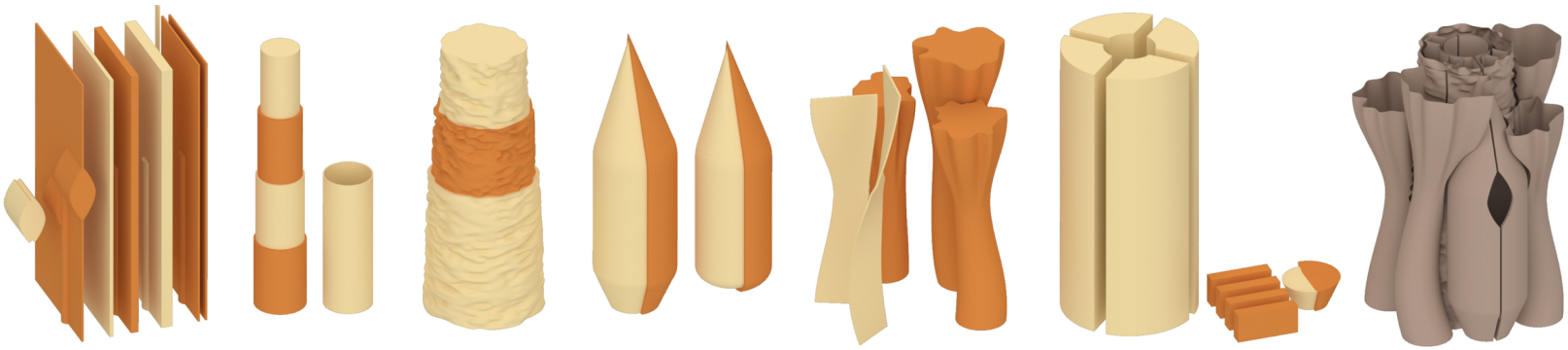
Modelling with Breps has two downsides. Firstly, it easily can happen that two Breps with a similar definition end up with colliding surfaces. Such collisions are a source of unexpected errors when using Boolean operations. One not-so-elegant solution is to 'nudge' Breps. Secondly, Breps cannot have cavities in watertight models. Having a cavity requires a definition which pierces the shell of the model. This aspect can make it difficult to model a closed shape with a custom infill, which is a very common shape for 3D printing.

Algorithm optimization

When working with Grasshopper, some steps take up more time than others. To keep the algorithm working smoothly the designer should try to set up their definition such that the slower steps happen later in the algorithm. Generally, everything 0,1 or 2D like numbers, lines and curves processes fast, while 3 or 4D like geometry, volume calculations and simulations processes slowly. Birdbead currently consists of 26 Breps, as shown in Figure 7.1. These all need to be assembled using Boolean operations, to keep the algorithm usable these operations are clustered together near the end.

During design, it is desirable to work non-destructively. This means that no data is lost by for example simplifying the shape. However, sometimes due to operations on data, more control points are added than needed, over defining a shape or dataset. By carefully identifying and culling unneeded data the calculation time per iteration can be reduced by a matter of minutes.

Figure 7.1. Line-up of Breps that make up Birdbead.
Similarly shaped Breps are presented in alternating colours, and in the pole, sleeve, house and support they intersect one another. In total 26 Breps are used.



3D printing Workflow

In the development phase, several prints and visualizations had to be made to assess and communicate the project. For this multiple software were used to model, export, slice and visualize Birdbead, shown in Figure 7.2. When Omlab would print, the 3D model was sent by email and sliced with their Cura settings.

This method made it difficult to control the slicing process since Cura has a lot of options on how to interpret a 3D model. Furthermore, settings differ between users and are not easily copied over.

To visualize the model that will be printed the Cura G-code can be viewed in the software, but not exported for processing in a rendering software like Rhinoceros or Blender. Another slicing software, Prusa, was used to make this possible.

This process is functional but has a few downsides. Firstly, the possible miscommunications about Cura settings. The number of files generated can lead to version control issues, especially when communicating with another company. The visualization process lacks accuracy, which will be explained in more detail in the following section. The last downside is that in Cura, since it is developed for Plastic FDM printing, very specific printing path optimization features are not provided, which would help with optimizing the print for meeting Omlab their time constraints.

In the second half of the OAAS Birdbead development phase, the decision was made to build the slicing, the generation of G-code, and the visualization into the grasshopper algorithm. The following sections will explain these features in detail.

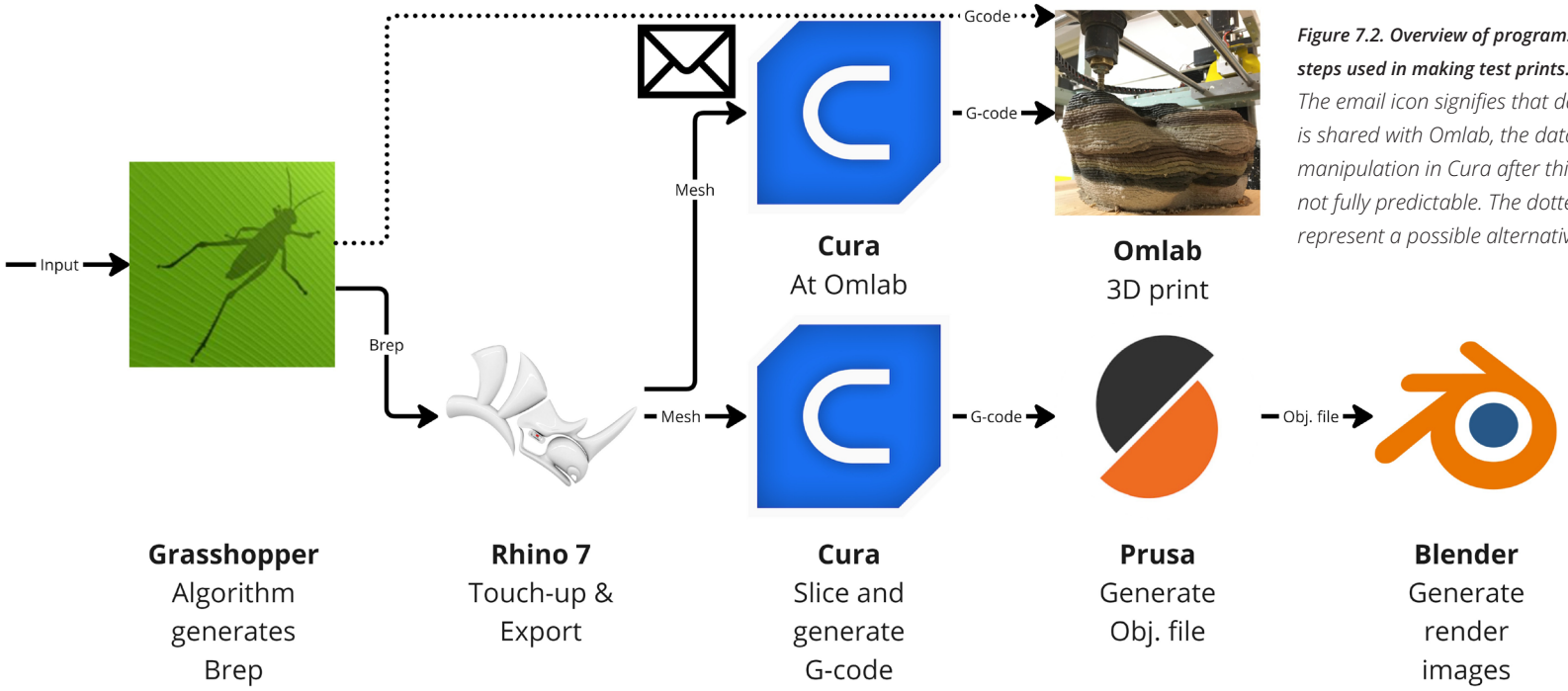


Figure 7.2. Overview of programs and steps used in making test prints. *The email icon signifies that data is shared with Omlab, the data manipulation in Cura after this step is not fully predictable. The dotted lines represent a possible alternative route.*

Realistic Visualization

By visualizing the printing path with Prusa, a Rhombus shape is drawn around the printing path. This method for visualizing did improve upon the Path to Pipe method used during modelling in Grasshopper. But it was not yet close enough to the way a real path looks. Because the path has insufficient width, as it does not account for the expansion of the material after leaving the nozzle. The differences between these path cross-sections are explained in Figure 7.3.

A realistic visualization solution was found in Grasshopper. Drawing a four-segmented profile along a simplified printing path, decreases the computational weight, as it calculates surfaces rather than volumes. Overall, a balance was struck between precision and computing time. One possible point of improvement would be to account for the reality that the nozzle follows the path and deposits the material a bit underneath it.

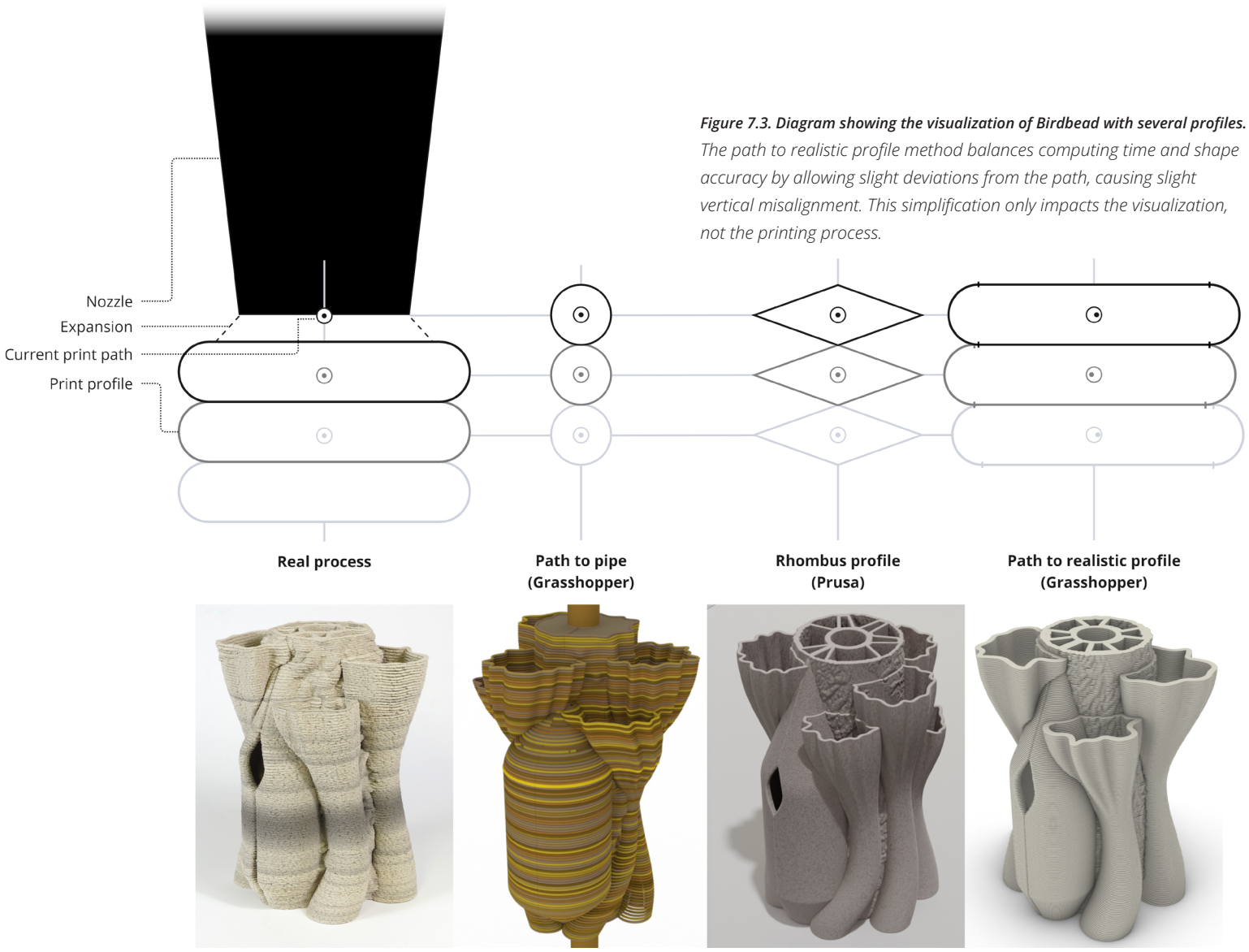


Figure 7.3. Diagram showing the visualization of Birdbead with several profiles. *The path to realistic profile method balances computing time and shape accuracy by allowing slight deviations from the path, causing slight vertical misalignment. This simplification only impacts the visualization, not the printing process.*

Printing Path Optimization

The initial reason for moving from Cura to Grasshopper for slicing the Model relates to the printing path optimization. In the design phase of Birdbead, the model was looped, when this is the case, it does not matter where the 3D printer moves to the next layer, often one vertical line is chosen called the 'seam'. In Figure 7.4 a simplified example of options for printing Birdbead is shown.

However, in meeting the time constraints of Omlab a lot of redundant elements could be removed by turning the loop into an open curve. In Cura, and most other slicers, the software will move from the end of one curve to the beginning of the next one, resulting in diagonal travels. From the onset of designing for MAACQ Oase, the goal had been to have continuous line printing, as travels reduce the quality of the print. By generating the G-code in Grasshopper the direction of every other layer can be flipped to effectively have two seams.

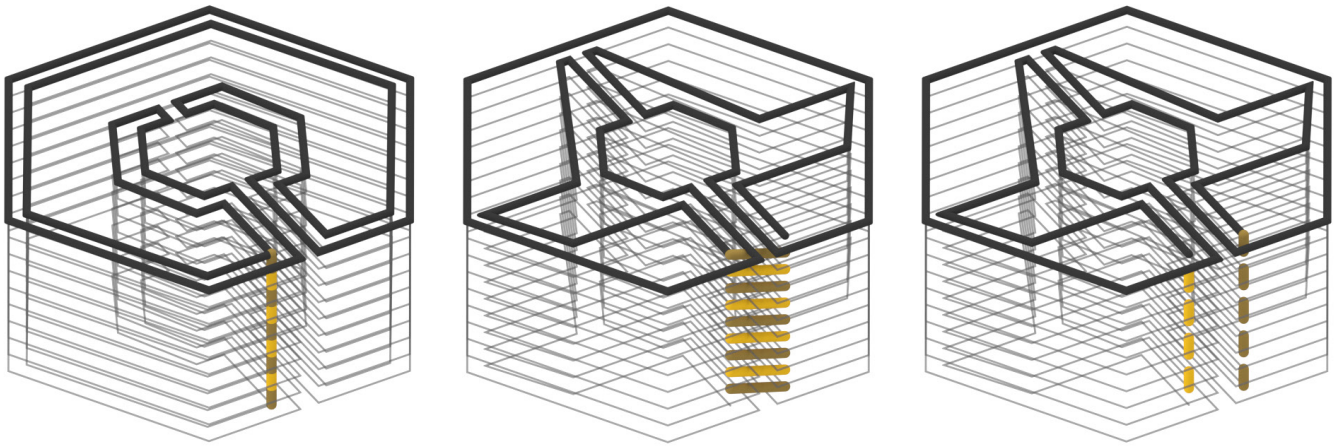


Figure 7.4. Printing path options for printing Birdbead.
On the left is a looping curve per layer with 1 seam, alternatively this path could be spiralized. The middle shows how Cura would print open curves. The lines cross the previously printed layers, introducing either intersections or travels, both of lower print quality. The right shows the optimized method with two seams.

Algorithm Structure & Generating G-code in Grasshopper

From online tutorials and the book by Cuevas and Pugliese (2020), it was already known that it is possible to slice models and write G-code with Grasshopper. They showcase that, to make G-code you only really need the X Y Z values of all the points the printer needs to move to during printing. Extracting that information from either a mesh or Brep and pasting the values into a standardized line of machine code can be done using Grasshopper. The workflow is explained visually in Figure 7.5

The total algorithm of Birdbead ended up with a very similar structure as shown in Figure 7.5 with the addition of design-specific intermediary steps, Birdbead algorithm structure is laid out in Figure 7.6. The bulk of the algorithm is dedicated to flexibly defining the Breps shown in Figure 7.1. The algorithm expands upon the model of Cuevas and Pugliese (2020) in four significant ways.

Firstly, the algorithm has multiple inputs, for printing with multiple 3D printers, the ultimaker2+ can be used to create quick prototypes at 1:4 scale in plastic.

Secondly the addition of visualization as a separate output. This output gives an impression of what the 3D print will look like, this feature helps to communicate about the direction of the project and enables the designer to do visual checks while modelling with the algorithm.

Thirdly, features have been added that analyse parts of the algorithm, enabling the designer to get a quick impression of bugs, mistakes, and glitches in the algorithm. These analysis tools now serve as indicators, prompting the designer to reconfigure the settings of the algorithm. Theoretically, they could be used for a fitness gene pool, a looping feature which optimizes the settings of the algorithm. For example, by shifting settings to meet a certain overhang requirement in the model.

Fourthly the algorithm is set up to add one travel in the printing process of Birdbead.

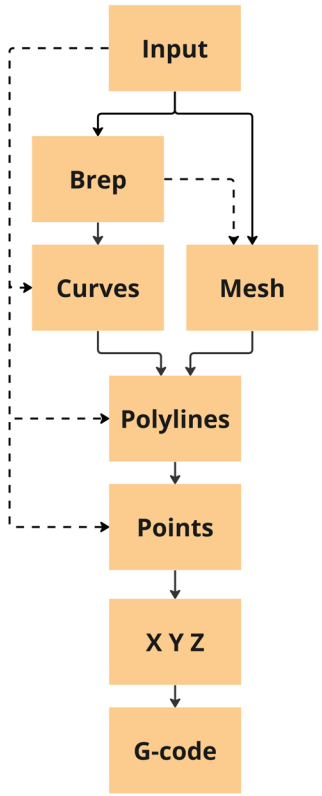


Figure 7.5. Overview of grasshopper 3D printing.
Adapted from figures in the book of Cuevas and Pugliese (2020), an input step was added.

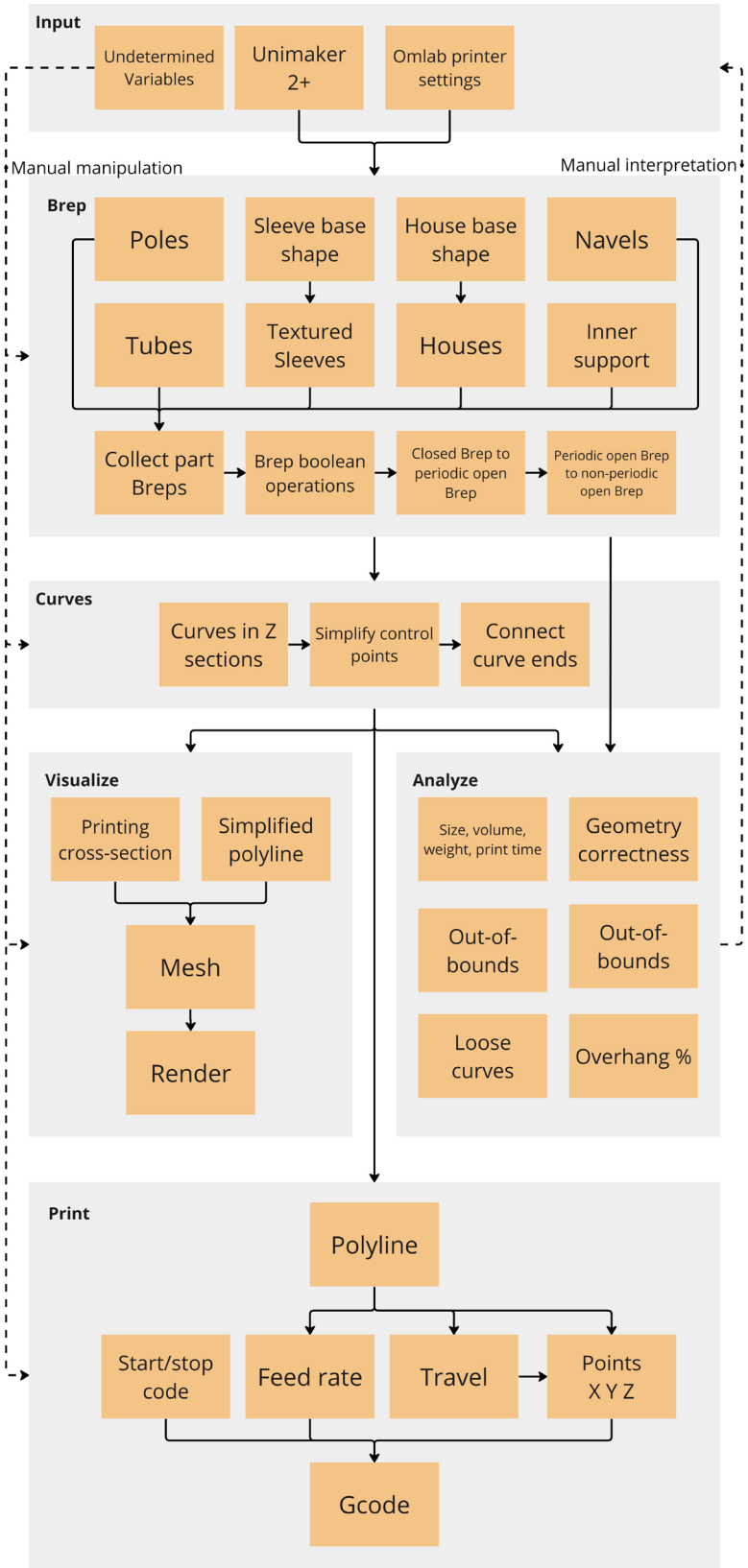


Figure 7.6. Structure of Birdbead algorithm.
The dotted lines represent actions performed by the designer.


Results

Part III

In this third Part of the thesis the case study results are laid out in a lessons learned chapter, and considered next to the analysis to find answers to the research questions in a synthesis chapter.

Lessons learned

The case study was finished when the Birdbead was presented at DDW23. This chapter summarizes what has been designed and expands these insights into future visions for the MAACQ Oase project. This chapter is concluded with recommendations towards Fillip Studios.

Synthesis

In this chapter the insights from PART one and PART two are concretized. Following this, they are brought together one illustrated framework to showcase what this Thesis has discovered.

8. Lessons learned

Through applying a research-through-design approach this case study has two types of results. Firstly, this section will discuss the design results, comprehensively describing what has been made and outlining how Birdbead could structure future MAACQ Oase designs. Secondly, the research result will be discussed, the case study holds answers to the research questions of this Thesis. In this results section, also new ideas will be presented on how Fillip Studios could structure their parametric-algorithm projects, and project management in the future.

Case Study Result

Birdbead is a design research object for testing interactions between biodegradable calcite-rich 3D printed sculptures and weather, wind, plants, and animals. Simultaneously, Birdbead also researches novel approaches to algorithm-based 3D modelling and printing. Like all MAACQ Oase products, Birdbead initiates conversations about the nitrogen issue and the things we design.

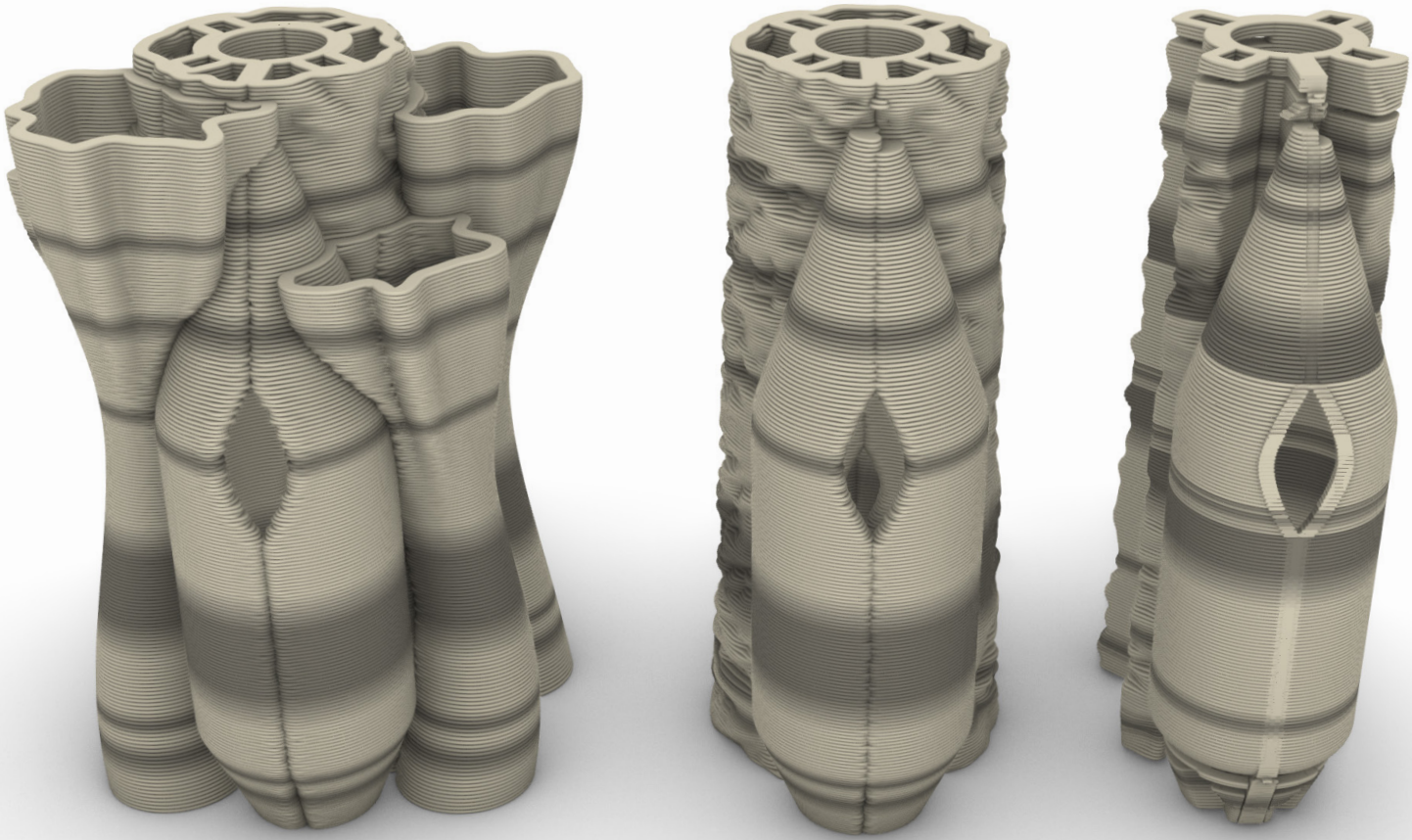


Figure 8.1. Degradation stages of Birdbead.
On the left, is the full model with no erosion. In the middle, the tubes have eroded first, as these catch rain. On the right the outermost layer has eroded, the house is double-walled, and the inner wall is now showing. Erosion beyond this stage would expose the house to the elements, rendering the sculpture ruinous.

Birdbead sculptures create a calcium-rich sanctuary for soil, plant, and animal species threatened by nitrogen acidification. It is made from a biobased circular material called 'Itbettermatter' which will degrade over time when exposed to weather, revealing new textures and shapes, and restoring the surrounding soil with calcium. The tubes will degrade first, revealing the underlying texture. When this layer is degraded a geometric core is revealed. Lastly, the birdhouse becomes ruinous, and it falls from the pole, this hypothesis for the degradation process is shown in Figure 8.1.

One instance of Birdbead has been produced as a Great Tit nest box shown in Figure 8.2. The nestbox is 400mm high, was printed using a 6mm nozzle and has 200 layers, and it was printed in two continuous parts. It has a slit opening to mimic natural nest spots, and the nestbox has a hole at the bottom for ventilation and drainage, as shown in Figure 8.3. The sculpture can be mounted on a 45mm round pole. The nestbox is protected from rain degradation by the tubes, which have been shaped to represent turkey tail mushrooms. The object is styled to look both functional and organic.

Figure 8.2. Studio photo of the Birdbead prototype.

Figure 8.3. Underside of Birdbead. *This view shows the tubes, sleeves, support, and pole features of the Birdbead and shows how all parts relate to a continuous printing line.*

Using the Birdbead algorithm habitats for other animals can also be made. To illustrate this scale prototypes for a Wren Birdbead and a Bat Birdbead were made and shown in Figure 8.4.

Developing a product that is safe to implement in nature requires extensive knowledge about the natural processes. Therefore, Birdbead is made to enable research into the interactions between nature and future MAACQ Oase products. Birdbead addresses the acidification issue by bringing together the key elements of the ecological processes: water, minerals, and biodiversity. Birdbead positions itself between the envisioned climate future of Fillip Studios and Omlab and the current technological possibilities. The limitation of the 3D printing technology to produce a single product at a time allows for variation and exploration. In this way, Birdbead demonstrates how small-scale development facilitates innovations in the cultural and creative sectors.

Figure 8.4. The 1:4 scale prototypes of alternative Birdbead configurations. *From left to right; Batbead, Wren Birdbead and Great Tit Birdbead.*

Future Vision

The next step within the Birdbead case study would be to place the Birdbead outside and observe the interactions with water and the degradation process. This kind of testing could shed light on the real relationship between designed shape and degradation. Additionally, it is vital for prospecting buyers to have information on the degradation time, nearly every visitor at DDW wanted to know more about this.

Following the Dutch Design Week and the analysis of the Grasshopper algorithm, new insights were gained on what the future of MAACQ Oase could look like. Initially, Grasshopper was one tool used in the process of making MAACQ Oase. However, the process of integrating functions of various software shown in Figure 7.2 into Grasshopper resulted in a fully controlled and customizable environment for generating Birdbead visualizations and prints.

The Grasshopper algorithm is as much, if not more, the design at the heart of this case study.

The power of using parametric algorithms is that multiple types of inputs can be bundled. In the current model, the only external input is that of 3D printing machine settings, all other variables are set by the designer based on their interpretation of the other stakeholders. Some decisions are based on aesthetic preference, like the texture of the sleeve. Others are based on desk research, like the shape of the birdhouse. However, theoretically, some of the inputs set by the designer could be set by external experts.

This thesis proposes a future vision for Filip Studios as a shape-developer for MAACQ Oase, where the Grasshopper algorithm is developed to be a tool capable of combining more input streams of a variety of stakeholders. This role is expressed in Figure 8.5.

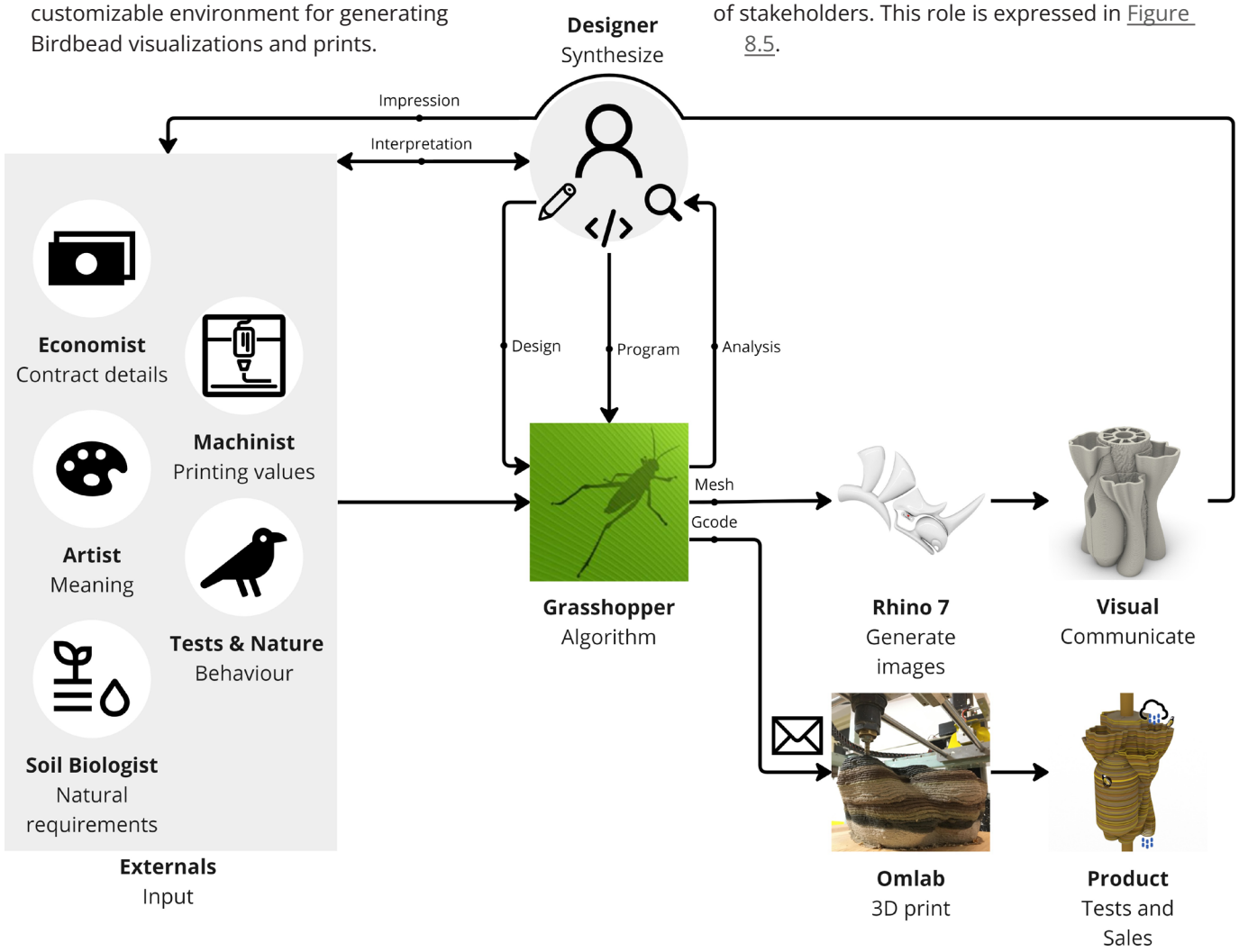


Figure 8.5. The future vision for the Grasshopper.
The grasshopper algorithm supports the designer in synthesizing the inputs of stakeholders into product offerings.

Future Vision Scenario

Consider for example a scenario where a contract is being set up for a long-running service between MAACQ Oase and a nature reserve. The algorithm could be used to adapt the design to the input of different stakeholders, authorities, and measurements.

The input of economists could be in the form of contractual details which must be met. In the OAAS concept, a client likely agrees to a certain amount of MAACQ Oases, which are meant to deliver a set amount of minerals. Grasshopper could inform the designer about how much time and printing material they are allowed to incorporate in a bead.

The input of a machinist could relate to machine settings, like nozzle size and layer height. But could also relate to the printing approach, like non-planar printing and updates in the G-code formulation. Furthermore, the algorithm could provide the machinist with a worksheet on where to add certain colours and minerals to the mixture, which in turn could be determined by the results of a soil biologist their findings.

The input of artists could challenge the model to express new forms, for example, the texture of the sleeve could be a custom design relating to the placement and meaning of the OAAS pole. Even the results of tests in nature could be measured and used to change the settings of the algorithm. For example, the rate of degradation of one bead could be measured to inform the nozzle size or treatment of a later bead.

Advantages of Developing the Algorithm

By developing not only the bead's shape but also the analysis tools for the bead, a designer balances all those stakeholders' various inputs. This is like a system engineering approach, where budgets are set not only for money but also for time, size, safety and more. So, the algorithm can be a product itself that Fillip Studios could continuously develop. Advanced future versions could be integrated, allowing for increasingly complex in and output. A stronger algorithm could even make it possible to partially automate the design process.

This makes it also possible to keep the project closer to the current stakeholders. Since the preparation and observation of the print only require the grasshopper programmers the first few times. Keeping the production process largely the same means that there is no need to pull in large investments for a production facility.

Figure 8.6. OAAS concept sketch.
On the left the design research pole featuring beads like Birdbead. On the right is the smooth plate pole OAAS Concept sketch by Fillip Studios

Research Results

The case study was started to research the innovation process in the creative sector. The process was divided into clear diverging and converging cycles, indicative of a design-driven approach. The design process quickly became open-ended and inviting to new directions. This artistic freedom in the design exploration came as a surprise, considering the pre-existence of the concept of MAACQ Oase. The concepts were not required to explicitly meet the production limitations previously established.

This prior knowledge was reincorporated in Birdbead after a concept decision was made. This 'concept first, technology second' approach made the development phase feel purposeful and educational since there was still a lot that needed to be learned and solved. The case study shows that; creative work can provide a foundation for a project which can be presented on a pedestal. Furthermore, the case study shows that the process of building that concept into an implementable solution adds additional value to the project owner as well as the exposition audience, this step amplifies the impact of the project.

The Fillip Studios design team continued to develop the concept after the Birdbead was designed. The pole concept was kept, but the form language of the pole was made much more holistic.

For this thesis this new OAAS concept direction is titled Smooth plate pole, while the Birdbead operates in the Design research pole, both are shown in Figure 8.6. This new direction makes the OAAS into a more unified artistic concept, instead of a totem pole of design research artifacts.

Art and Industry in Project Management

Plotting the route of the MAACQ Oase project on the space between art and industry shows a pattern (Figure 8.7). When Fillip Studios is working on the project it has an open and artistic character, but in their collaborations with students and communication towards investors, the project has a more technical and industrial character.

When asked about this, Tom and Roos made clear that this is no coincidence. They intentionally avoid collaborating on the artistic concept with externals and base that decision on past experiences. Tom also connects this separation to Aristoteles praxis, the concept of setting tasks where the end goal is the activity. For example, use sketching as a design tool because you enjoy drawing. Fillip Studios wants to keep doing the type of work that they enjoy doing the most. Knowing what your praxis is requires introspection and a developed sense of purpose which fits well into the artistic sector.

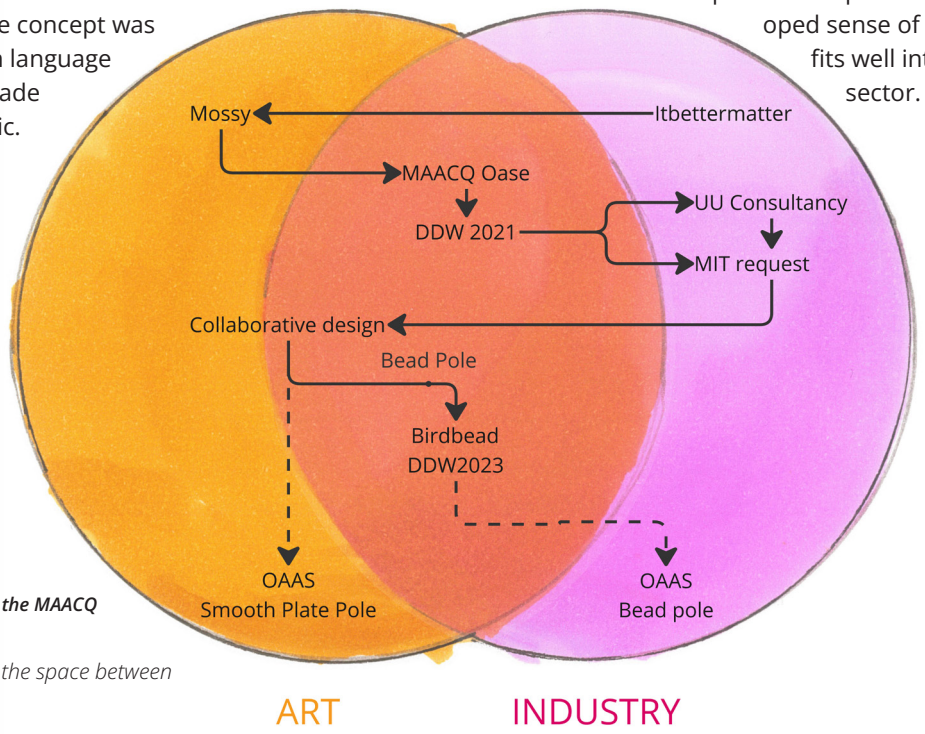


Figure 8.7. The route of the MAACQ Oase project.
Trough the model for the space between art and industry.

This path is comparable to other Fillip Studios projects shown in Figure 3.7 on page 36. Projects have a start at the right, are made artistic followed by some technological development. The Birdbead is more industrial than the current design direction of Fillip Studios.

This insight shows that a designer may have a certain vision for their innovation, without wishing to develop all necessary aspects themselves. Furthermore, as the continued progression of the MAACQ Oase project shows, they also don't have to do that. Aligning the design work with the personal desires and ambitions of the team members cultivates not only motivation but also a convincing concept.

In the section Letting Go of Taxidermy-Based Classification in the chapter Literature Analysis – Critical Design, the argument was made that the classification of a project should be up to the designer. This view can be expanded to incorporate the designers' intent about their personality, strengths, skill development and collaborations. *To further develop critical design projects, not only steps from innovation management are needed, but also an introspective step.*

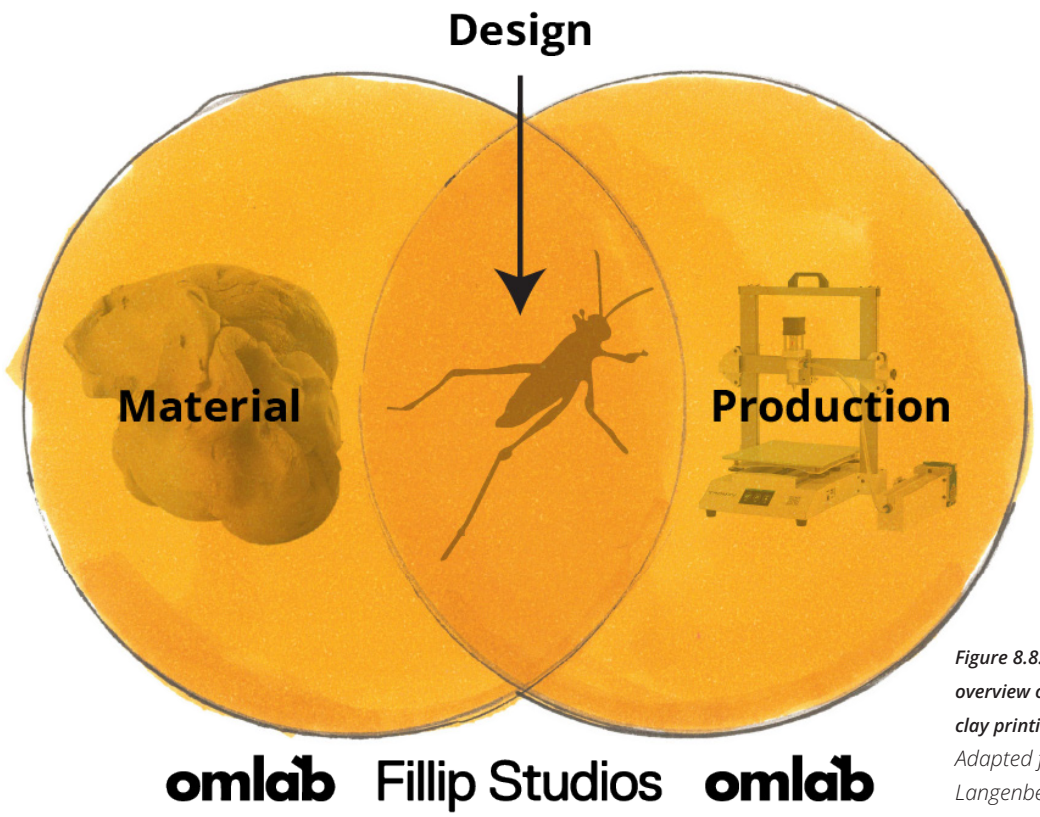


Figure 8.8. Process overview of designing for clay printing
Adapted from a slide by Langenberg (2023).

Recommendations

Moving forward I would recommend Fillip Studios to intentionally collaborate with open-minded technically oriented stakeholders like structural engineers.

As the project moves forward with the smooth plate pole, I would also recommend Fillip Studios consider the benefit of setting up a design research pole as a platform for experiments and collaborative design. As the project moves forward prototyping will become more common, and a design research pole could attract collaboration and provide serendipity in the project input.

At a symposium, Langenberg (2023) showed that design happens in the overlap between the affordances of the material and the possibilities of the production machine, replicated in Figure 8.8.

Under the current project construction, the design work of Fillip Studios is bookended by Omlab's development process. The project could become more innovative if the development of the material was separated from the development of the printing machinery. There already are interesting techniques for clay and concrete printing which could open design opportunities. Such techniques include dual extrusion, printing on curved moulds, coiled and unwoven printing, printing without cartridges, printing with local soil and more. A triad of collaboration would allow the parties to challenge one another and add secondary collaborations, as shown in Figure 8.9.

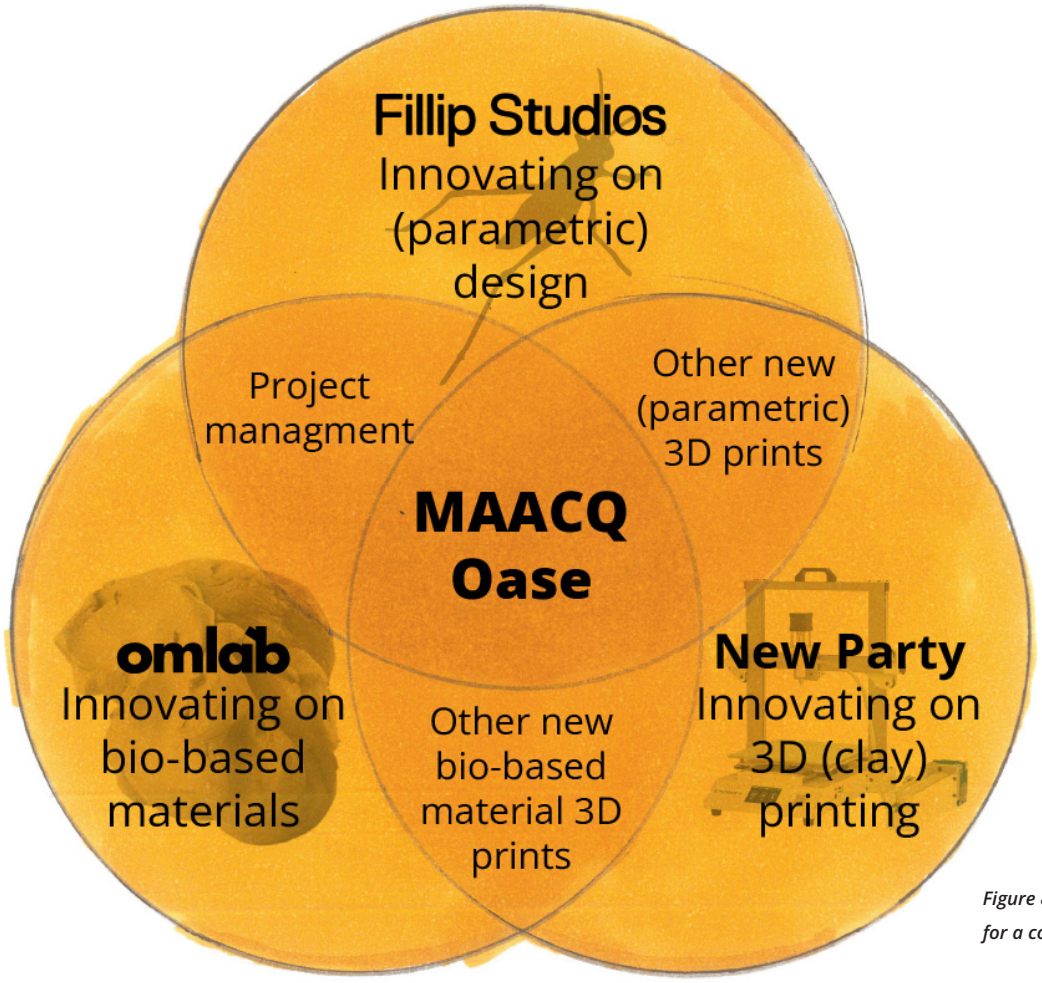


Figure 8.9. Recommendation for a collaboration structure.

9. Synthesis

In the original project planning, shown in Figure 1.3 on page 15, the goal was set to draft a framework for critical design innovations and to base the design phase on the framework. Following the analysis, the decision was made to employ research through design methodology in the form of co-designing the MAACQ Oase with Fillip Studios. This removed the need to develop a framework concurrently with the design process. Nevertheless, a framework can provide a good overview of how the insights and experiences of the case study, and the literature analysis relate to each other. This chapter will make the the insights from chapters 2, 3 and 8 explicit. They will be brought together into one illustrated framework.

Insights

This section will summarize the ideas presented troughout this thesis and make their relationships explicit.

Using the Field Between Art and Industry.

The design discourse surrounding critical design projects has been evolving over the years. In the beginning, the ideas were very novel; using design and critique as a new lens for design research; more playful than activism; and fast enough to concern relevant topics. Since the critical design field is a source of relevant and provocative projects, this thesis set out to find such projects and structure a road to innovation for them.

However, this thesis has found that identifying critical design projects and their value is not something that can be done well. Critical design projects are intentionally disruptive and self-reinventing, making them elusive and difficult to pin down. To add to this, the concepts of critical design and innovation may be mutually exclusive to some people since Dunne and Raby invented critical design to challenge the design discourse, not to solve problems. This has associated the term with passive designs. Fillip Studios themselves opt not to use the critical design term as a descriptor for their projects for this reason, even though their projects do provide non-obvious solutions. Specifically, the MAACQ Oase project is a direct response to our society's lack of solutions for nitrogen acidification problems.

So, rather than wrestling with terminology, this thesis analysed what sets design projects that are comparable to critical design apart from other design projects. It was found that value is created by mixing influences from both art and industry.

The Fillip Studios portfolio shows a pattern of artistic projects which lead to design-research projects. This suggests that the cultural and creative sector can develop designs which reach other societal sectors by taking ideas relating to industry, working on those in an artistic way and then developing the resulting ideas towards industry. A C-pattern movement over the design space between art and industry can be observed (Figure 9.1), in which designers intentionally work on artistic development before industrial development.

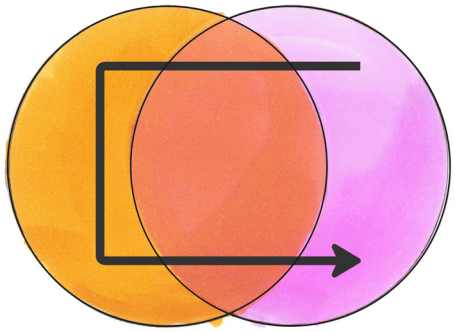


Figure 9.1. Observed movement.

Using the Pedestal as a Jumping Off Point

Just like any innovation process, projects from the artistic sector need to overcome hurdles by developing better solutions and convincing others of their value. Designs from the cultural and creative sectors are known to be presented on a literal or metaphorical pedestal. Critical design's relatedness to the artistic sector makes it fit very naturally on a pedestal. Furthermore, the process of getting a design ready for exhibition provides concrete goals which often must be achieved collaboratively with externals, resulting in a collaborative sensemaking process which develops the project and its meaning in

unexpected ways (Yaneva, 2003). This concretisation is especially beneficial for esoteric projects. Additional value is added to the project through interactions with the audience, gallery owners, curators, auctioneers, jury panels and journalists (Cousijn, 2023). However, the practice of placing designs on a pedestal is a source of criticism against critical design.

Placing design on a pedestal removes certain key aspects of design, like user interactions, market response and functionality. Designing with the intent to present on a pedestal can also motivate designers to create a 'Wizard of Oz' prototype, since on a pedestal, the design is distant from the audience. Even when physical interaction is allowed, the user must still imagine the implications of the design outside of the gallery context. This puts the critical design at risk of remaining a mostly intellectual exercise. Furthermore, a pedestal can be an endpoint for a project. So, the context of an exhibition can severely limit the impact of the design.

The Fillip Studios portfolio and the case study are proof that the pedestal can also function as a jumping-off point. Designers from the cultural and creative sector can choose to change the relationship between a project and the pedestal from an end-stage to a launch.

Using Innovation Management to Structure Impact-Oriented Critical Design Projects

Comparing the design-related innovation methods of DDI and the DIM each to the case study revealed two insights into the design from the artistic sector.

Firstly, DDI shows that to produce innovation, it is possible to develop meanings separate from technology or business. Critical designers find value in products that address the cognitive gaps in our society and their designs take a political and ethical stance. Therefore, projects from organizations in the cultural and creative sector are often aimed at radical innovation. To produce radical design innovations in small organizations, designers need to innovate on meaning first and technology second. This means that the creative work must precede ideas on how to industrially implement the innovation.

The 'C-pattern movement', which is Filip Studios' working method, can represent part of this process. Another key element of radical innovation is to allow interpreters into the design process. The development towards exposition and interactions with the audience in the pedestal design can embody this part of innovation. This thesis argues that DDI underpins the Fillip Studios working method.

Organizations in the cultural and creative sector are typically microscopic, and often run by a single person. The limited team size in small companies can be a limitation on their typical innovative capacity.

Secondly, the DIM determines that innovation is a circular process, see Figure 9.2, to innovate requires organizations to move through multiple innovation rounds. In each round, the project is redefined, redesigned, and launched. From both the literature and the case study, it became apparent that this launch is a vital part of making an impact, as it provides a designer with clear development goals and exposes the project to the environment, like the public or the market. Recontextualizing the DIM for the cultural and creative sector means that the pedestal can be used as a launching point again and again.

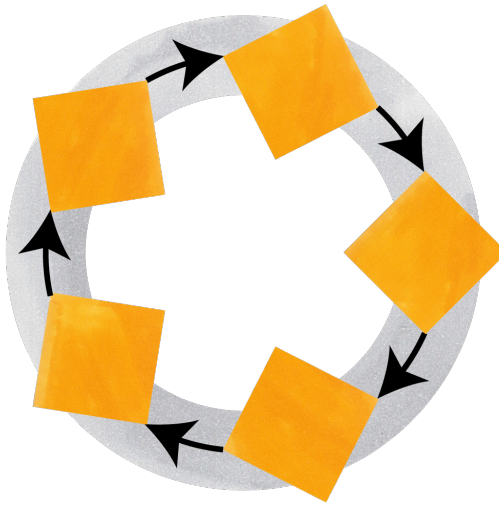


Figure 9.2. The simplified DIM

Modifying the Pedestal to Increase Impact.

Through innovation management research and the case study, it has become clear that critical design can be a source of positive innovation because of its inherently disruptive nature. Many critical designs are idealistic, altruistic and world-improving. If critical design work is done which holds potential for positive change, then choosing not to develop it into impact wastes the effort and research that went into the design. So, both the designer and the user stand something to gain when critical design is designed for use. Through use, the critique is expressed and puts the change in motion.

Critical design must therefore hit society like a comet, penetrating deeply and cutting to the core of the wicked problems that plague us. By combining critical design rhetoric and innovation management approaches, it is possible to greatly increase the impact of projects (Figure 9.3). This is achieved by allowing projects to find connections across societal sectors. Within the pedestal metaphor, this means that: through artistic work, designers can increase the height of the pedestal; through innovation management, the launch can become more accurate; and through functional development of the design the splash the project makes can become bigger.

For artistically minded designers, it is important to initially focus on creative processes to create a high pedestal and a strong foundation. Subsequently, by utilizing industrial tools and innovation methods, they can discover the appropriate meaning and context for the work, thereby amplifying the impact of the project.

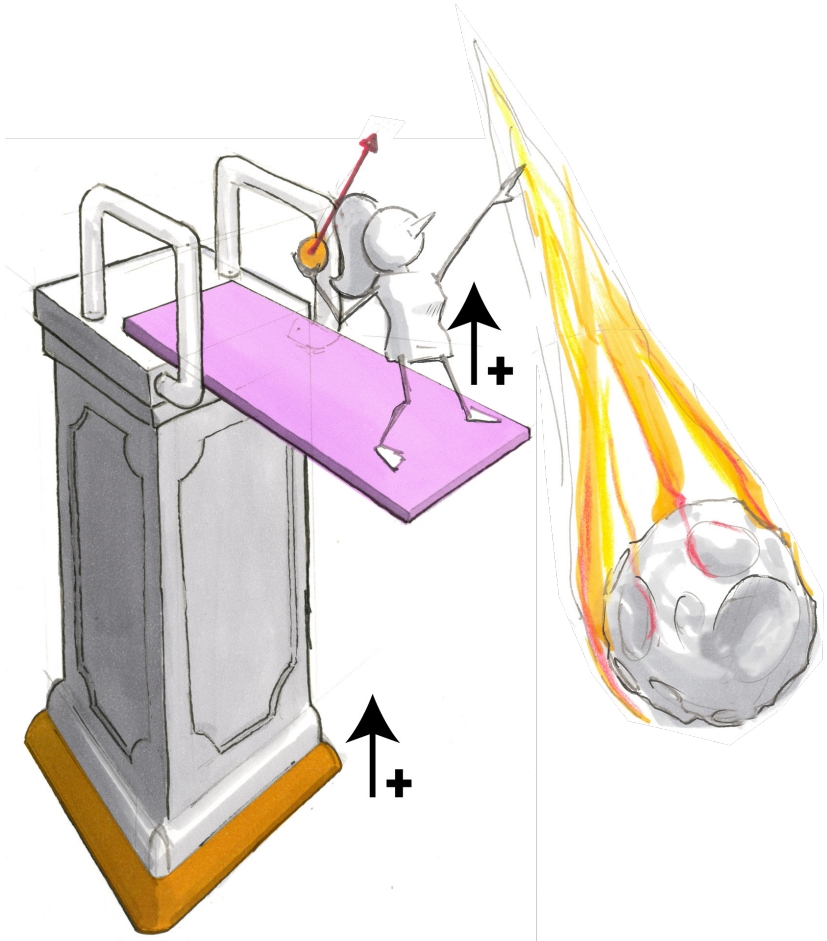


Figure 9.3. Intergrating insights into the pedestal metaphor

The colours from the model for the space between art and industry are used to show how these influences come together in impact making. The pedestal can be made higher with artistic development (orange). The launch can be improved with industry-related project development (pink). To make an impression projects need aim, accuracy, momentum, and impression (comet).

Lastly, the innovation management perspective underpins the need for critical design projects to be structured as continuous innovation processes. The designers make use of the process of designing for an exhibition to chain the development cycles of a project and create structure. By jumping off the pedestal not once, but repeatedly, the impact can compound. Each time the next project is re-exposed, the interactions with others can inspire and help the designers to interpret the next step in the radical innovation process.

Introspection in Impact-Oriented Design.

Impact-oriented design research is not a necessary next step for all the projects in the critical design field. This is dependent on the contents of the project, as well as the intention of the designers. For one, the original critical designers Dunne and Raby explicitly state that they will keep their designs fictional to preserve their creative freedom and explore undesirable futures (Dunne & Raby, 2007). Through the case study with Fillip Studios, it became clear that introspection is a key activity for designers in the cultural and creative sector.

Over time, projects gravitate towards practicality and technical development, which can change the nature of the work done by the designer. If the project pulls in additional talent, the designer could find themselves phasing into a management role over time. This can lead to dissatisfaction, and the prospect of a change in working style might even deter designers from pursuing entrepreneurship.

The designer must reflect on the project's course and their role therein (Figure 9.4). This self-reflection on the desires and intentions of the designer is not represented in the studied innovation management methods.

By sketching a new framework for impactful design targeted at the

The artists and designers behind these projects do not need to become innovation managers. Rather, they could outsource these aspects of the project. An external innovation manager can also assist a smaller team with identifying and filling those gaps, either by doing that work or by finding the right resources to do it for the team.

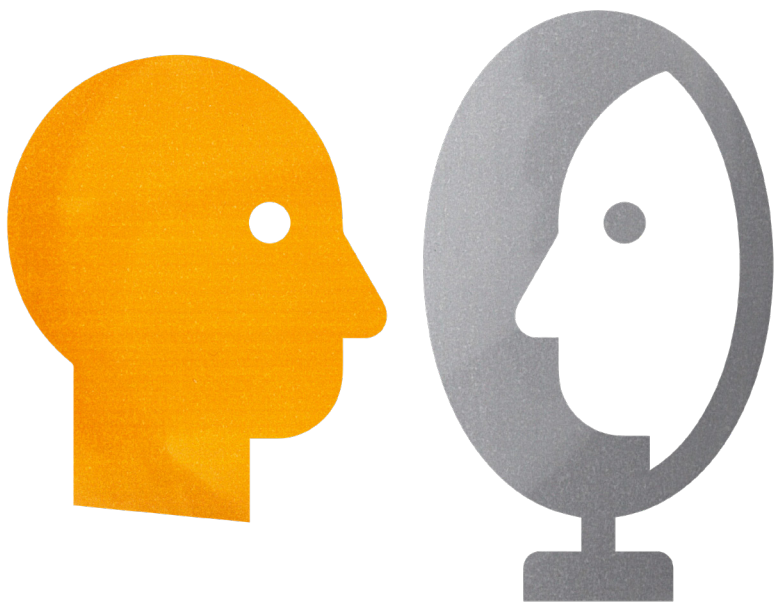


Figure 9.4. Self-Reflection of the designer.

Framework for Creative Innovation

The framework, Figure 9.5, is made to motivate designers to develop their critical designs into applied solutions to societal problems. It is meant to communicate insights on the processes of further developing impact-oriented design. The frameworks are made to express that artistically minded designer can make an impact without needing to sacrifice their preferred way of working. For critical designers to sustain the process of developing strong, disruptive products, what it is they make and how they go about making that, matters equally.

Walkthrough

The framework is visualised as a circular journey where a project makes an increasing impact by jumping from the pedestal—which represents any type of exposition event where the project is shown and shared but not commercially traded. The SME in the cultural and creative sector is personified into a character to express various stages and actions in the impact-making process.

From the observed C-pattern movement through the space between art and industry (Figure 9.1) it is determined that to make an impact artistic designers should work on the creative concept first, and industrial development second. This is expressed as **heightening the pedestal (A)**, which could mean that the project is more attractive, meaningful, and noticeable by the convincing power of the project. Furthermore, the type of pedestal chosen to present the project can change, for example, the Dutch Design Week or Arnhem Innovate.

Incorporating industrial development steps into the prototype of the artistic concept works **to amplify the launch (B)**. The jumping-off point of the pedestal is represented as a diving board which can be elongated by adding for example by displaying functional parts, new materials, new market values and new production processes.

By standing on the pedestal, the project becomes elevated, from this position new oversight is gained as the designer gets a better view of the project. From this vantage point, it is possible to **survey and strategise the launch (C)**. This relates to how the project is chosen to be portrayed at an exhibition. For example, the presentation of Birdbead was open about its materials and intended function, but it did not openly share insights on parametric modelling.

From the pedestal, using the springboard, the project is launched up to new heights. This gives the project exposure. The impact of this launch is represented by **making a splash in a pond (D)**. In this moment all the aspects of impact-making come together, which is expressed as a comet. This launch does introduce momentum which can be a risk. A well-aimed impact with an accurate launch in the right pond can make a big splash.

The splash causes flowers around the pond to blossom and flourish, these represent the inspirations and connections that present themselves in response to the project. These flowers all ask for attention, the designer can **pick and collect (E)** these for the journey ahead. This is represented by packing two suitcases, one full of artistic inspirations and connections like associations, shape language and alternative interpretations of the presented work. The other is full of industry-related inspirations and connections like investor interest, feedback, and alternative solutions. These flowers can wilt over time, so engaging with these opportunities is important. Furthermore, as repeated splashes are made, the garden available to pick from will grow fuller and richer, representing a strong networking position for the organisation.

Having packed the suitcases full, the designer passes a mirror. This step represents the introspection stage, here the **designers reflect on their role in the project (F)**. Decisions can be made on the roles in the project moving forward. Through the intense development process, there is new clarity about what the project will require to be further developed. Do the suitcases fit the journey to the pedestal again, or a different journey?

If the pedestal is visited multiple times, its height and springboard size increase as the suitcases are used to expand upon the previous visits **(A & B)**. This does not mean that the splash must be bigger every time. A small splash could be the result of faulty aim, a weak launch, or a small pond **(C & D)**. This should not be considered an outright failure, as through repeated journeys the impact will compound, causing the baggage to grow **(E)**, and the reflection will become clearer **(F)**.

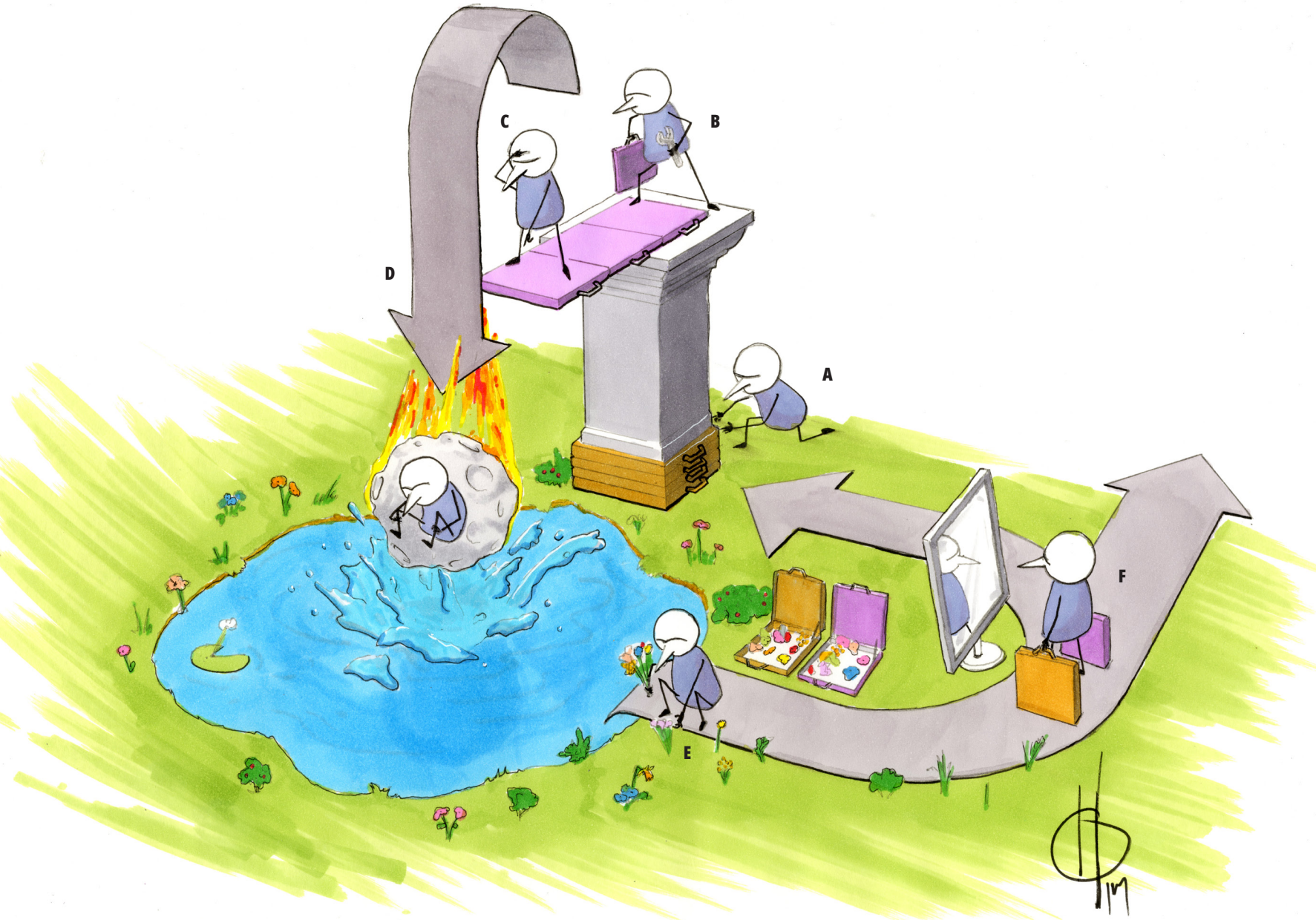


Figure 9.5. Exposition to Innovation framework

10. Reflection

The discussion will reflect on the approach taken in this thesis and make the limitations of that approach explicit. Following a critical reflection on the research question and the achieved results, a future work section will propose possible next steps in the research of this thesis. The thesis is finalized with a conclusion, which summarizes the thesis and its findings.

Discussion

This thesis does not directly answer its research questions. The questions are repeated here for clarification. This discussion will reflect on the approach taken towards finding research answers. Then this section will reconsider the research questions to find out why the questions were not answered in full and consider possible future work.

1. *To what extent can innovation management strategies be used to identify where and when critical design projects made by SMEs placed in the cultural and creative sector have value in other societal sectors and what design activities can be performed to achieve design with a deep impact?*

2. *What are the functional and non-functional requirements that the MAACQ Oase must adhere to for it to deepen its impact on society while reflecting the strategic position and the design vision of Fillip Studios?*

Approach

Desk research discussion

This thesis relied primarily on the input of desk research in the form and design work, limited use was made of the other research methods described in APP1 like interviews, structured observations, and statistical analyses. While this approach afforded a deep dive into new subjects, it limited the scope of the research.

The views expressed in the sections in the innovation research rely heavily on the interpretation of the books on DDI and the DIM while the experiences with innovation are limited. These views should be discussed with experienced practitioners of innovation management.

Design work

In the research through design method, a lot of time is spent on one project. Besides limiting the scope of research, this also introduces bias into the results, by spending time and effort on the project the designer becomes affectionate towards the design and convinced of its value and meaning. In the design approach, there is also a big reliance on the views held in Fillip Studios' design approach. To Tom's admittance in Appendix 3 – Interview, Fillip Studios is stubborn. The close collaboration with Fillip Studios may have amplified the affection bias in research findings.

Following the research presented in this thesis, the next step should have a wider scope and more objective approach. To achieve this a method must be developed for identifying and connecting to critical design projects, additionally, further research introduces tools which help to objectively contextualize and validate the findings based on designing critical design projects.

Findings

This thesis its findings are not an altogether discovery. The value of mixing art and technology is increasingly well-known. Every year there are hundreds of design projects presented at DDW with the express goals found out by this thesis. Considering the kinship in goals set by other designers, future research should engage in semi-structured interviews with DDW and critical designers. These people could be a more credible source of information concerning the statements made in this thesis.

The specific combination of the artistic mindset, critical design and the technical development of algorithm-based designing in this case study can serve as a well-documented example of what goes into a Dutch Design Week exposition. This could be a valuable reference point to contextualize future research.

Research Question 1

The objective of this thesis was to develop the MAACQ Oase project further strategically for greater impact. This was achieved, by having been able to develop a new MAACQ Oase product and present it at the DDW while introducing new layers to the design.

The research objectives outlined in Chapter Introduction were intended by the author to concretize the MAACQ Oase project, which to the author appeared to still be in the 'fuzzy stage'. During the desk research phase, it happened all too often that when the author discovered new methods or viewpoints, some permutation of that idea had already been done by Fillip Studios in the past. In time, it became apparent that the design process in companies is more loosely informed by academic models than previously expected. Efforts by the graduate to use those existing models for innovation to predict, or coach the MAACQ Oase project ended up feeling tone-deaf and unhelpful. It was learned that organizations do not follow a model for the model's sake. Rather, it sensibly makes decisions based on what would be best for the project and the company. In the case of MAACQ Oase, its 'fuzzy stage' was not a problem that needed solving, but rather a vehicle for exploring new opportunities.

In this way, deciding to collaborate with Fillip Studios on design was the right decision for this research. The initial approach of trying to single-handedly explore alternative avenues for MAACQ Oase assumed that it was possible to 'know better' than the Fillip Studios knew themselves. However, what the project needed was more work in the trajectory Fillip Studios already was moving.

This insight leads to the conclusion that research question 1 is not formulated in a way that is constructive to the objectives for Fillip Studios, and by extension, SME's in the cultural and creative sector. An improved question for future work would be: How can an organization in the cultural and creative sector develop artistic and critical design projects towards impactful innovation using innovation management techniques? Which more accurately describes the relationship in organizations between tools, projects, and methods.

Research Question 2

In the second question its formulation lies an assumption that, if MAACQ Oase is defined and designed in a particular manner, it will directly correspond to its ability to make an impact. Through the case study and literature review, it became apparent that for radical innovation the path towards impact is inherently indirect. To make an impact, organizations must not develop one project to a 'perfected' state. Through the literature review, it was learned that organizations must set up an innovation cycle which spans across multiple product launches. At the beginning of this thesis, the author tacitly believed that MAACQ Oase was a product, through the case study it was learned that it is a project. For future work, the question will have to be reformulated to reflect the process-oriented perspective on impact found in this Thesis.

Conclusion

This thesis has shown trough a case study that by combining critical design and innovation management strategies the impact of design from the cultural and creative sector its impact on societal problems can be increased.

During the process of working on the case study, the design approach opened up from a goal orieneted research project. Trough phe participation in the design process at Fillip Studios a new openended frontier of freedom presented itself. This artistic approach was fertile ground on which to start chipping away at a problem as wide and wicked as the nitrogen crisis. New oppertunities and ideas developed.

The pedestal became a jumping-off point, enabling the continued inspired development of a project, this process enables the designer to make an impact.

After analysing the results of the research through design approach, connections were found between what literature described and what was experienced. From this it was determined that to make impact, organizations in the cultural and creative sector should adopt a repeating innovation approach which makes use of the artistic sector its availability of pedestals as a launching point as well as employing industrial techniques to develop prototypes towards implementation. In this process, artistic designers must initially and purposefully distance the project from the industry before implementing industrial techniques to preserve the radical character of critical design, which is needed for building a strong basis for the project.

This provides a partial answer to the research questions, Innovation management strategies do align with the development of impactful design from the cultural and creative sector, but those strategies fail to address the unique aspects of designing from the cultural and creative sector. A new framework was made which includes introspective steps taken modulating the type of design activities.

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Appendices

Part IV

In this third Part of the thesis the case study results are laid out in a lessons learned chapter, and considered next to the analysis to find answers to the research questions in a synthesis chapter.

Lessons learned

The case study was finished when the Birdbead was presented at DDW23. This chapter summarizes what has been designed and expands these insights into future visions for the MAACQ Oase project. This chapter is concluded with recommendations towards Fillip Studios.

Synthesis

In this chapter the insights from PART one and PART two are concretized. Following this, they are brought together one illustrated framework to showcase what this Thesis has discovered.

11. Appendix I - Project plan

From Exposition to Innovation, MAACQ Oase case study

Student, Pim van Everdingen
University Supervisor, Dr. Ir. Wouter Eggink
Organisation Supervisor, Tom Kortbeek of Fillip Studios

Introduction

Fillip Studios is an art and design studio in Arnhem that creates tangible objects and experiences that evoke a sense of wonder by combining art, science, technology, and social issues. Their work is in part for research and in part for artistic exposition. The studio creates independent works and runs collaborative projects with universities, institutions, museums, and companies.

Fillip Studios is currently collaborating with Omlab on the development of 'MAACQ Oase' (Figure 11.1), a 3D printed structure made entirely from cellulose, Kaumera and calcite obtained from residual flows of water treatment facilities. MAACQ Oase is a sustainable solution that protects nature from the harmful effects of nitrogen acidification by releasing calcite (a base) as it erodes, neutralising the nitrogen. A proof of principle prototype showcasing how a filament can be produced and printed in various earthy colours has been made and displayed.

Figure 11.1. MAACQ Oase. *(left) a photo by Omlab of a multi-coloured MAACQ Oase prototype, (right) a visualisation by Fillip Studios showcasing the envisioned erosion and integration of the product in nature.*

Objective

In its current form, MAACQ Oase is most effective as a critical design object for exposition: it helps people to spark new ideas, brings people together and challenges people to rethink their conceptions about nitrogen acidification. Other projects are comparable to the MAACQ Oase like furniture pressed out of coffee grounds(Jans, 2022) and clothes made from roots(Holloway, 2022). Such projects are presented at events like the Dutch Design Week, which can be the end goal of critical designs. However, as is the case with MAACQ Oase, many projects hold further merit than exposition. In my research, I want to investigate how SME product owners create value in the cultural and creative sector and how to apply that value in other sectors to deepen the impact of their products on society.

The MAACQ Oase project has the potential to make an impact on how Dutch society restores its nature to become sustainable, as there is a clear need for solutions that can counteract the nitrogen problem. Because the project has an innovative character, and improving the nitrogen levels is part of a wicked problem the

design decisions on the product's functionality, shape, target group and production scale need to be carefully considered and fitted. Currently, more can be learned about the process and impact of the erosion of the product. Researching these topics will provide structure and answers on how to develop this specific project strategically further but will also provide a model on how other critical design projects could be managed. So, it will be the goal of the assignment to design a structured approach on how to further develop critical design projects and to apply that approach in a design case study resulting in a producible MAACQ Oase design that will have a deeper and more effective impact on the Dutch ecological health, and the societal view on the Nitrogen problem.

Assignment description

An analysis of preconditions (past and present client projects, literary study, industry comparisons, academic models) shall lead to a substantiated framework detailing the activities that can be performed to further develop critical design projects and products from the cultural and creative sector into applied and impactful innovation in other societal sectors.

The framework shall be tested, evaluated, and redefined in tandem with a case study, in which a proposal for an industrial design of the MAACQ Oase will be developed. Culminating in a proposal for the product's implementation approach and a digital prototype showcasing a MAACQ Oase design that is fit for industrial production, as an adaptive parametric CAD model made in the software Rhinoceros 3D written in the Grasshopper language.

As part of this case study, through an experimental and explorative material study, the influence of the designed form on the product features 'erosion speed', 'erosion steerability', 'integration with nature' and more will be researched.

The assignment deliverables and the intermediary steps are represented in Figure 12.2.

Academic topics

3D Printing, Critical Design, Demand Driven Design, Author Driven Design, Design Driven Innovation management strategy, Design Management, Conceptual Design Methods and more.

Research questions

The project will have 2 research questions, the first has a broad perspective on critical design projects and aims to underpin the framework under development, and the second relates to the specific project of Fillip Studios and aims to underpin the design decisions relating to the MAACQ Oase design, formulated as requirements.

1. To what extent can innovation management strategies be used to identify where and when critical design projects made by SMEs placed in the cultural and creative sector have value in other societal sectors and what design activities can be performed to achieve a design with a deep impact?

2. What are the functional and non-functional requirements that the MAACQ Oase must adhere to for it to deepen its impact on society while reflecting the strategic position and the design vision of Fillip Studios?

Sub questions

The sub-questions are formulated to dig deeper into the emboldened elements of the main research questions, and they are presented in the questions column of Table 1. After formulating the questions several approaches were devised to answer the questions which are presented in an abbreviated formulation in the approach column. Table 2 provides a legend for the abbreviations.

Table 1. Subresearch Questions

#	Questions	Approach
A	**Innovation management**	
1	What are established and dominant methods for managing innovation?	Literature
2	What management activities are related to innovation?	Literature, interview
3	What design activities are related to innovation?	Literature, interview
4	Which models of technological- and design innovation apply to start-ups and critical design projects?	Literature, interview, ideation
5	What innovation management strategies can be implemented by Fillip Studios and other SMEs to develop a critical design concept most effectively further.	Literature, interview, ideation
B	**Critical Design Projects**	
1	What other design fields are synonymous or comparable with critical design and is critical design a suitable term for the focus of this project?	Literature
2	When is a design or art project a critical design project?	Literature, interview,
3	How big is the demand for a framework that supports critical design innovations?	Literature, interview, statistical analysis
4	What qualities are critical designers looking for in design methods?	Interview
5	What is currently inhibiting critical designs from growing their impact on Dutch society?	Interview, observation
6	What are examples of (critical) design projects from the creative and cultural sectors that have made an impact on society?	Literature, interview
7	What pitfalls and opportunities can be learned from B6?	Interview, observation
8	What factors determine whether critical designs have (potential) value outside of the cultural and creative sector?	Literature, interview
9	Are there examples of critical design that are already being developed outside of the cultural and creative sector?	Literature, interview, observations
10	How do the design categories of Demand Driven Design, Author Driven Design and Innovation Driven Design express and differentiate themselves in the critical design field?	Literature, interview, observations
C	**SMEs / Fillip Studios**	
1	What are the inherent opportunities of SMEs impacting the design process	Interview, observation
2	What are the inherent constraints of SMEs that impact the design process?	Interview, observation
D	**Societal sectors**	
1	What are the different sectors of the Netherlands	Literature
2	When is impact achieved?	Literature, interview
3	What forms of societal impact are critical designers aiming to achieve?	Literature, interview
4	What forms of impact are SMEs in the cultural sector good at achieving, and what forms do not?	Literature, interview, observation
E	**MAACQ Oase**	

#	Questions	Approach
1	What are the current stakeholders in the MAACQ Oase project and ownership?	Documentation, interview
2	What are the potential audiences for the MAACQ Oase outside of the cultural and creative sector?	Documentation, Interview, Ideation
3	What are the qualities should Fillip Studios weigh when making decisions on approaching, selecting, and rejecting investors?	Literature, interview
4	What functionality and meaning lie at the core of the MAACQ Oase concept?	Documentation, interview, observation, ideation
5	What alternative or additional functionalities could the MAACQ Oase support?	Ideation, collaboration
6	What 3D printed forms and (post)production steps can influence the erosion speed variably throughout the product?	Material experimentation, ideation
7	Can the MAACQ Oase hold a volume of water?	Material experimentation, documentation
8	Can organisms grow on the MAACQ Oase?	Material experimentation, documentation
9	What forms, if any, of maintenance does the MAACQ Oase require?	Material experimentation, literature, interview
10	What processes and outside influences could obstruct the MAACQ Oase's functionality?	Scenario, ideation
11	Is styling applicable to a product intended to protect nature, and if so, What form language should the MAACQ Oase display	Literature, ideation, interview
12	What is the 'Itbettermatter' material made from?	Documentation, interview
13	What are the unique aspects of printing with 'Itbettermatter'?	Documentation, interview, material experimentation

Abreviated aproach	Full approach
Collaboration	Organized workshops where other designers/design students elicit ideas as creative input, or as a testing ground of the designed framework.
Documentation	Review of the Fillip studios documentation of the MAACQ Oase project.
Ideation	Generation of perspectives, views, requirements, and designs through the ideation process.
Interview	Transcribed qualitative semi-structured expert interviews or quantitative and qualitative survey forms

Abreviated aproach	Full approach
Literature	State of the Art Literature review of books, journals, periodical articles, and web content.
Material experimentation	Observations made specifically through experimentation with the 'Itbettermatter' material.
Observation	Observations at expositions, public sites, and Fillip Studios' internal processes.
Scenario	Written or illustrated description fabricated by the designer to reflect a future scenario.
Statistical analysis	Statistical analysis of publicly available information on demographics and economic key figures.

Table 2. Legend of abbreviations used in Table 1.

Activities

The research questions will be answered in a stepwise approach through 4 phases, Analysis, Design, Development and Testing. These phases are described in a flowchart (Figure 11.2), visualizing how the activities of the project interconnect to achieve the assignment description. The activities of the Testing phase depend on the level of physicality of the prototype and the designed form; therefore, they will be chosen later in the project.

Value of the project to its stakeholders

The student will gain valuable insight into the workings of a multidisciplinary art & design studio and expand skills in CAD modelling and practical testing and prototyping. Allow for broadening of knowledge of product management strategies and approaches.

Fillip Studios and other SMEs in the creative sector will benefit from the development of a concrete approach to progressing critical design into innovation projects. Because the approach will be fitted to the company's existing process there is an opportunity for Fillip Studios to employ more effective planning and reflection on the most efficient, economical, and strategic solution.

Academics will value the novelty of developing models that are sensitive and responsive to creativity-driven design practice. Furthermore, bridging the fields of critical design and innovation management will open possibilities for closer collaboration between arts and academics in the Engineering field.

Results

A framework for classifying critical design projects and selecting activities for structured development.

An expanded MAACQ Oase concept that is adapted to have the right impact for the right target with the right form, based on the developed framework.

As part of the OASE concept, a set of five or more design features that reflect the adapted OASE concept that be applied to a Rhino Grasshopper script as parameters.

The deliverable will be a product proposal with the following features:

- The geometry is defined by a parametric CAD script.
- The product matches the Fillip Studios brand,
- The design is accompanied by an outline of the production process and a cost overview.

Preliminary planning

The master assignment consists of 1260 hours of work, which translates to 8 months of full-time work (Figure 11.3). Taking the Academic calendar as a work schedule comes down to 70 free days. The 'Korean holiday' uses free days taken out of the summer break. The summer break will be coordinated with the closed days of the Fillip Studios office.

Start date: 28 / 11 / 2022.
End date 13 / 09 / 2023.

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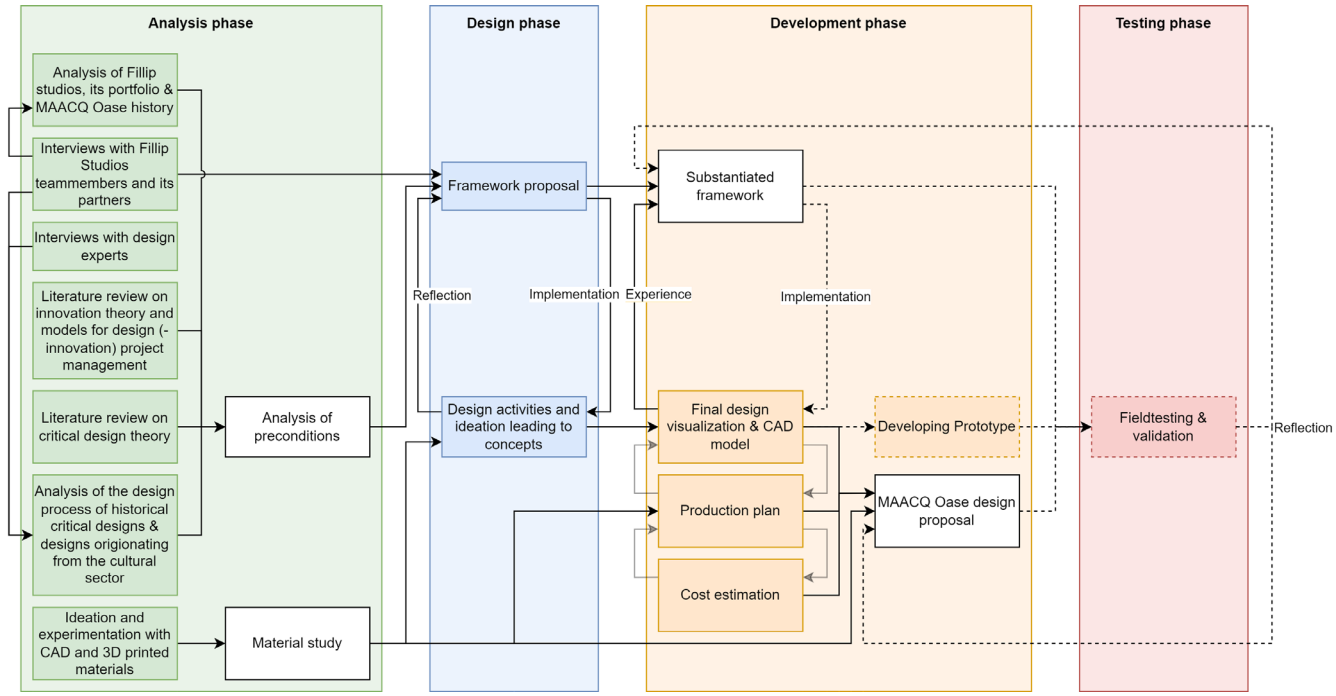


Figure 11.2. Flowchart of the project.

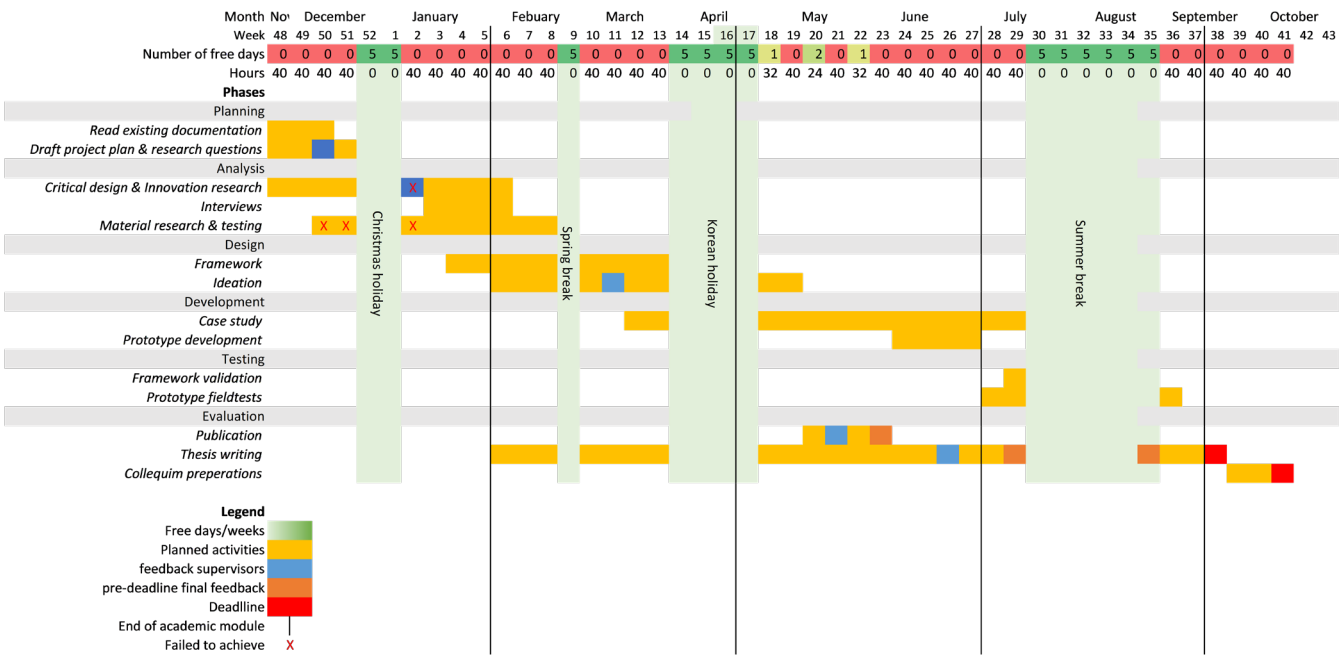


Figure 11.3. Project planning overview by weeks.

12. Appendix II - Degradation Test Plans

Itbettermatter material study

The project is based on the new material 'Itbettermatter', Omlab is experienced in printing with this element and is confident in restoring properties. However, many of the mechanical properties are still unknown. Omlab is collaborating with several researchers to make measurements relating to the material and its application in construction projects, this includes hardness and flammability.

For the intentions of the MAACQ Oase project, some knowledge is needed on the material and its behaviour in a natural setting. As displayed in the analysis chapter, there are many conceivable scenarios on how interactions with nature and different types of degradation could play out. Within the project, it is not feasible to test every scenario, but it would be good to get a feel for how the material might behave.

To gain this knowledge the Fillip Studios MAACQ Oase design team was tasked with drafting a low-cost testing setup. Because of budgetary constraints and other influences, the testing setup was never implemented within the time frame of the thesis, severely limiting the information gathering for the material-study goals of this thesis.

This appendix will document the work performed, as it is part of the research through the design process.

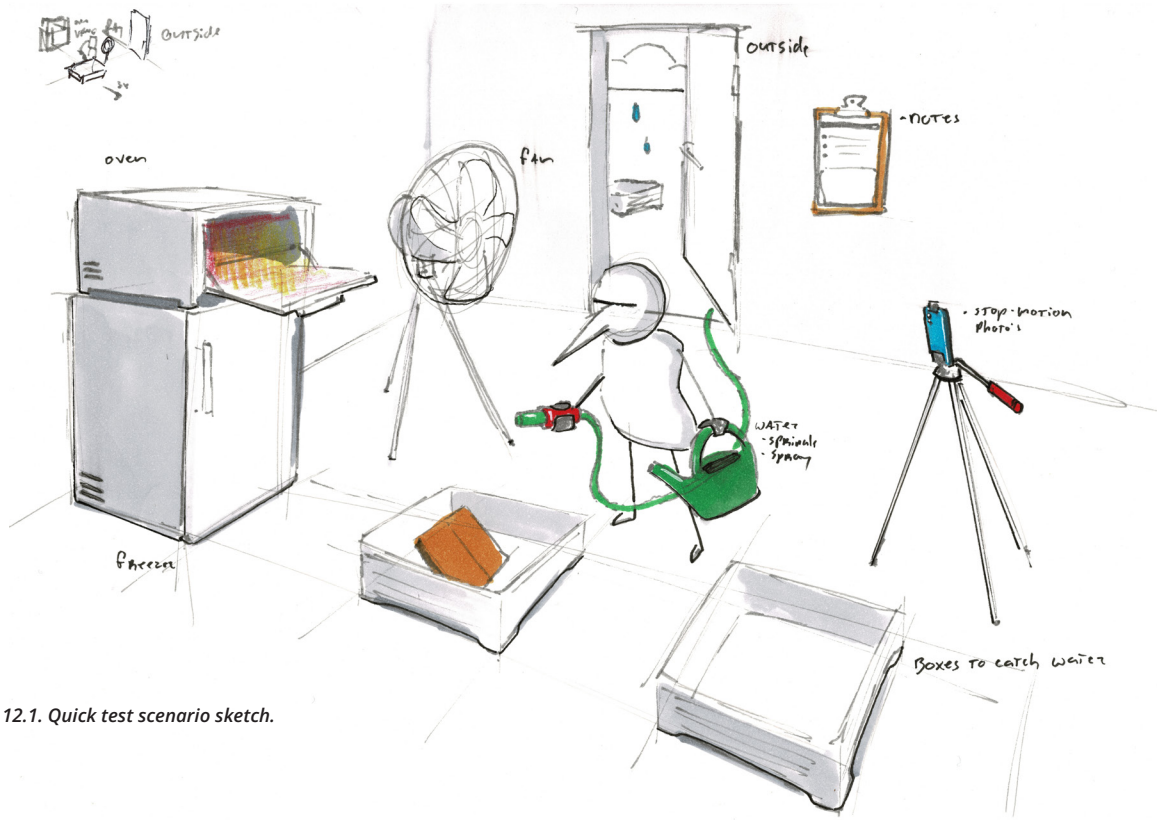


Figure 12.1. Quick test scenario sketch.

Testing approach ideation

Much of the design process was executed in the form of sketches. The first of which was a testing scenario (Figure 12.1). To communicate to Omlab, and set internal expectations, a scenario was made to illustrate on what level Fillip Studios was planning on doing material tests. The goal was to circumvent the time-consuming process of rigid scientific testing and instil material experience in the design team. However, it still should be a well-documented, repeatable setup with results that could be shared with future colleagues. To achieve this the testing setup would be made mostly from material already present at Fillip Studios on relatively simple 3D-printed blocks.

To summarize the scenario, it would focus on extreme interactions with weather, by simulating temperature fluctuations with oven and fridge, wind exposure with a fan, rain interactions with a hose or watering can. For documentation, a form would be filled in and a camera would film a timelapse of the degradation. To validate the quick tests some of the prints could be placed outside to compare the high-intensity tests to regular natural exposure.

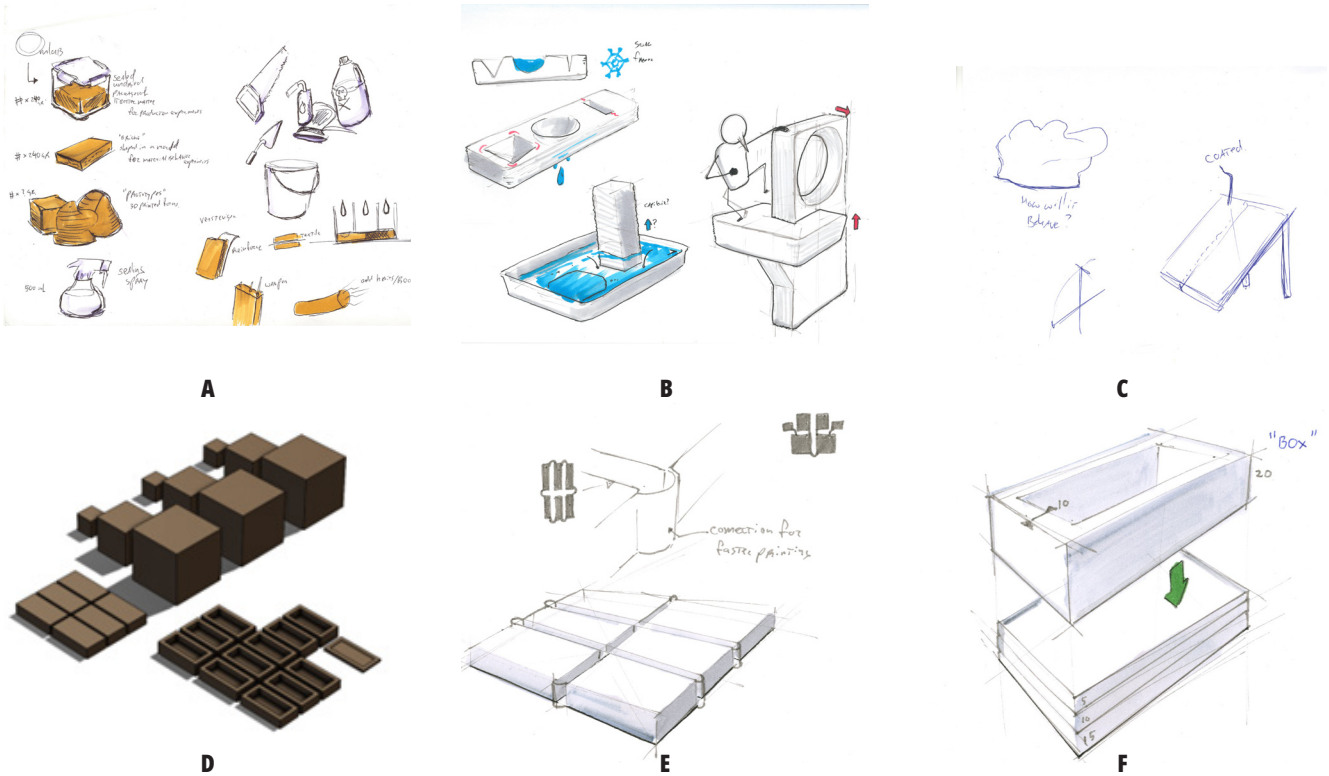
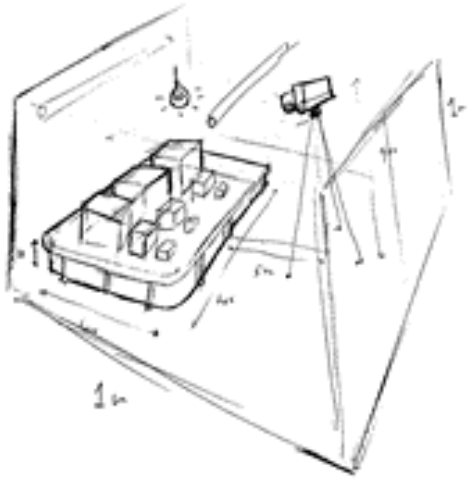
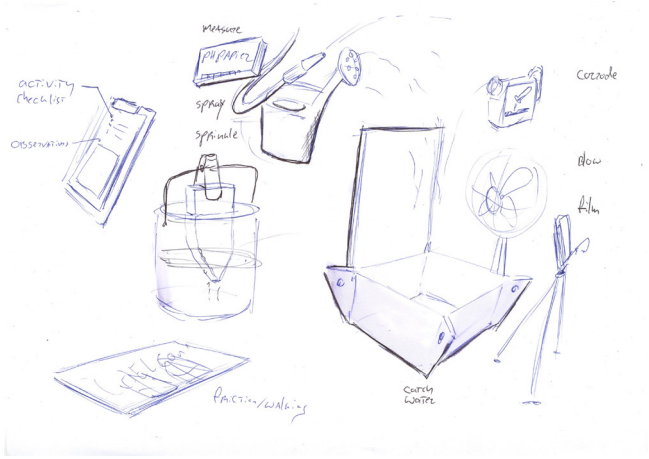


Figure 12.2. Collage on the ideation of the test blocks. *Element H, and I by Niels Stuiver*

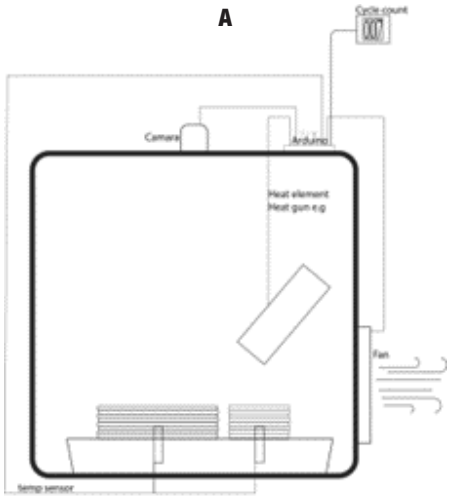
Following this scenario, many deas were gathered on how the test blocks should be shaped (Figure 12.2), what the testing setup could look like and what the expected test outcomes would be. The decision was made to use simple shapes which can be quickly produced and to focus the testing effects on simulating rainfall. Therefore, the final shapes were squares with various infill patterns.

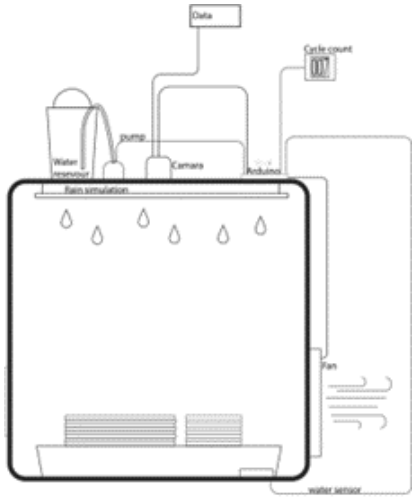
Besides the test block, a testing setup had to be built (Figure 12.3). The decision was made to attempt to create a high-quality stop-motion video from the tests. This video had to be suitable for publication on the social media of Fillip Studios, this way the company would be able to communicate its design research character.





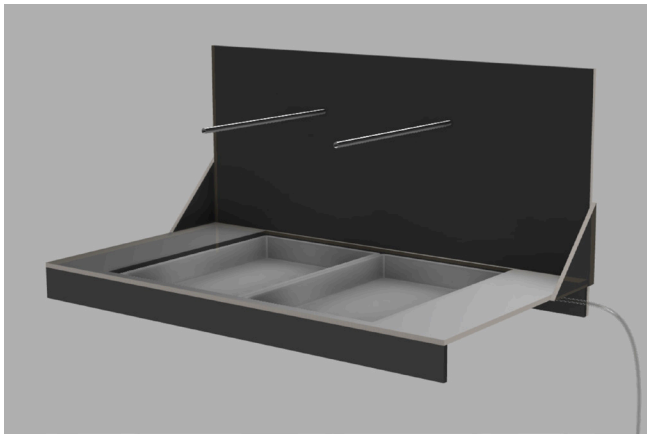
A

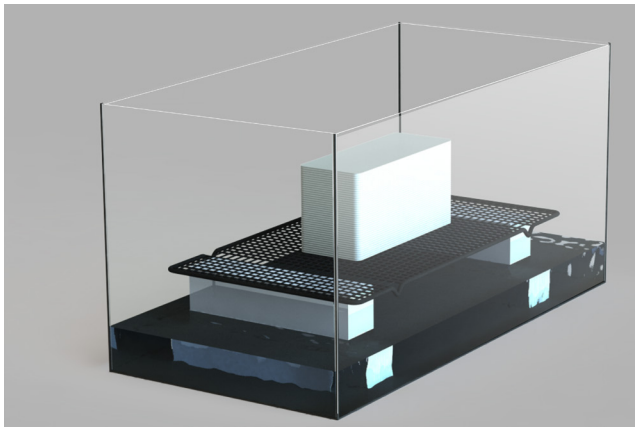




C

D

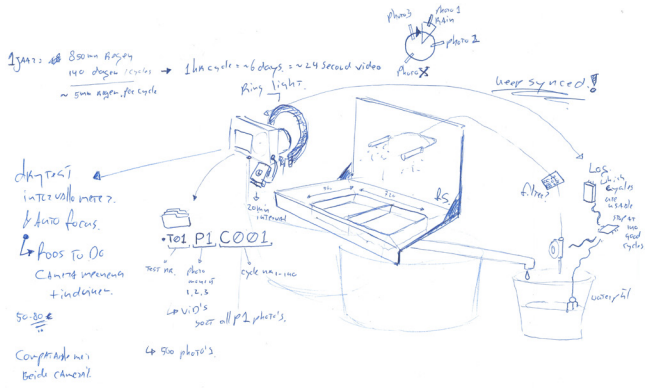




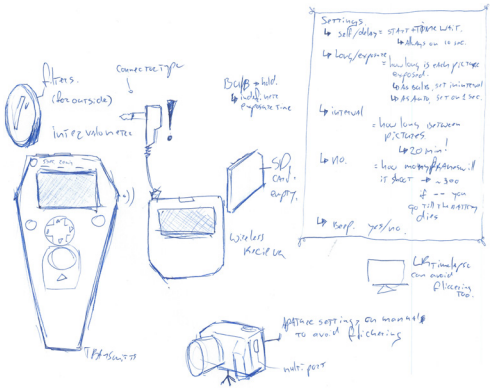
E

F

Figure 12.3. Collage of the weather cabin design process.
Elements c, d, and f by Niels Stuiver.



A



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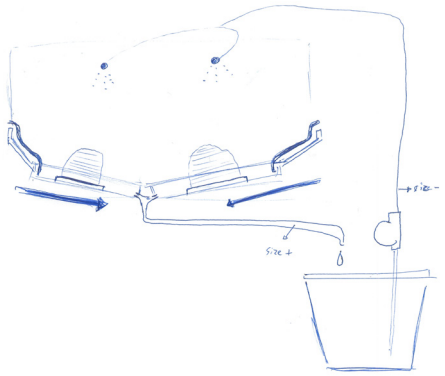

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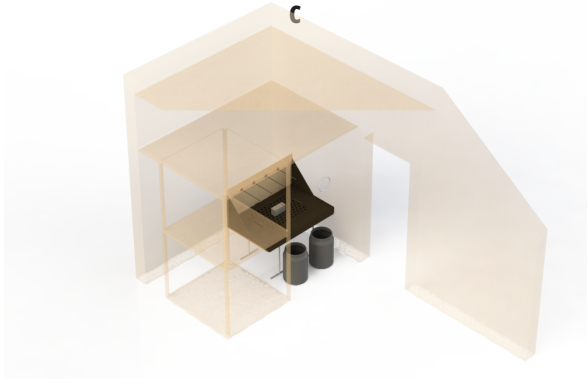
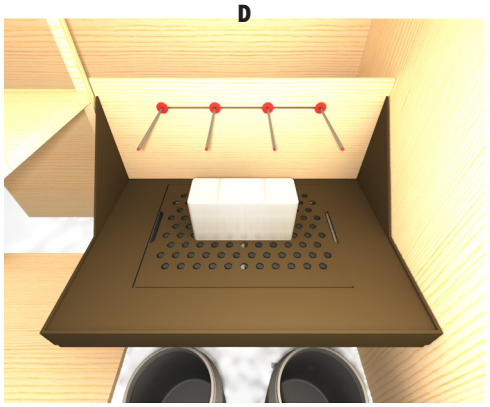


E



F

Figure 12.4. Gallery of visualizations made of the testing setup.
Element c retrieved from Amazon.com.

To achieve this a test setup had to be made which could run for at least 1 week with consistent weather simulations and illumination for photography (Figure 12.4). The testing setup had to be able to hold water, so several solutions were considered, in the end, a concept was devised which could be filmed during operation. To simulate rain a 3D-printed nozzle is used and to create the video an intervalometer add-on was bought for the company camera. A digital version of the testing setup was made in the context of a 3D model of the backroom it would be placed in. In this way, several lighting setups and camera positions could be tried out before buying new equipment.

The setup (Figure 12.5) was built by a colleague and installed in the Fillip Studios backroom. This setup can use the intervalometer and its signal to the camera as a timing device to turn on the water pump.

Figure 12.5. Figure 12.8. The realized test setup.
Built by Niels Stuiver.

13. Appendix III - Interview

KozieMe Tom Interview

Questions

The interview setup is a semi-structured interview consisting of 2 parts, (A) the story of KozieMe followed by (B) reflective questions. The interview will be held in Dutch.

The reason for the interview is that I intend to use KozieMe as a subject for structuring and modelling the 'exhibition to innovation' framework. For this I want us to sketch out a visual representation of the ' KozieMe story' during the first part of this interview and use the second part to reflect on the KozieMe and 'other critical design projects', like the MAACQ Oase project.

I would like to record this interview, to craft a transcription for the appendices of my thesis. I also intend to use an AI software to transpose the audio file into English text.

Pt. A KozieMe Story

1. Could you please tell me about the design process and contexts leading up to the international exposition of the adaptive orchestra?
2. What functionality and meaning lay at the core of the adaptive orchestra concept?
3. How would you categorize the Adaptive Orchestra concept? Is it critical design? Is it a product, or an art piece?
4. Could you describe the original intended audience and function of the adaptive orchestra? How was this changed when it became KozieMe?
5. Could you please tell me about the process and contexts leading up to the series fabrication of KozieMe, when and how you came to realize the alternative / additional functionalities and audiences that the adaptive orchestra could support?
6. Do you consider KozieMe a commercialization of the Adaptive Orchestra concept?
7. What are the current stakeholders in the KozieMe project and ownership?
8. What qualities did Fillip Studios weigh when making decisions on approaching, selecting, and rejecting investors for the KozieMe?
9. What forms, if any, of maintenance does the KozieMe project currently require from actors in the Fillip Studios organization?

Pt. B Project Management Analysis

10. What opportunities/benefits/funds did you make use of in the financing and development of the KozieMe project?
11. What setback/gatekeepers/unforeseen (financial) obstacles restricted or endangered the development of the KozieMe project?
12. Is KM an example of a (critical) design project from the creative and cultural sector that has made an impact on society?
13. Is KM a successful innovation?
14. What pitfalls and opportunities can be learned from developing the KozieMe?

Consent

Using the following form Tom Kortbeek provided his informed consent to be interviewed and for his voice to be analysed and translated using Artificial Intelligence tools. For a signed version of this form please contact the author using the contact details provided in the colophon.

CONSENT TO TAKE PART IN RESEARCH

- I, Tom Kortbeek, voluntarily agree to participate in this research study.
- I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
- I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.
- I understand that participation involves disclosing business details of Fillip Studios and KozieMe.
- I understand that I will not benefit directly from participating in this research.
- I agree to my interview being audio-recorded and AI-assisted transcription and translation.
- I understand that I will receive a copy of the interview documentation for review within 2 weeks and that I can withdraw permission to use data from my interview within four weeks after the interview, in which case the material will be deleted.
- I understand that all information I provide for this study will not be treated confidentially.
- I understand that in any report on the results of this research, my identity will not remain anonymous. This will be done by changing my name and disguising any details of my interview which may reveal my identity or the identity of the people I speak about.
- I understand that extracts from my interview may be quoted in a master assignment thesis and an academic publication.
- I understand that signed consent forms, original audio recordings and a transcript of my interview will be retained in possession of Pim van Everdingen, the University of Twente Library and Fillip Studios Google Drive, indefinitely.
- I understand that under freedom of information legalization, I am entitled to access the information I have provided at any time while it is in storage as specified above.
- I understand that I am free to contact any of the people involved in the research to seek further clarification and information.

BSc. Pim van Everdingen, Industrial Design Engineering master graduate,
Dr. Ir. Wouter Eggink, assistant professor at the University of Twente and academic supervisor to this graduation research

Research participant

Signature: _____

Date: _____

Researcher

I believe the participant is giving informed consent to participate in this study
Signature: _____

Date: _____

Transcript:

The conversation, held in Dutch, was recorded using a Samsung voice recorder. This file was transcribed using the AI transcription tool Descript, this software is unable to handle Dutch, but it does recognise voices and adds accurate timestamps. Using the Descript file as a starting point a transcript was made by hand, which was subsequently translated to English using Google Cloud Translation. Upon request, the author can provide the Dutch version, for contact details see the colophon.

Pim van Everdingen: [00:00:00] I have a consent form drawn up. I do know not whether you are there through want to go, but I have one you then sent and is on my computer. And that would be my normal print out. And then you must everyone in duplicate sign so that we both a copy to have.

Tom Kortbeek: Oh yes do you have that me? emailed, okay then I 'll just sign it and forward. But that can also afterwards However?

Pim van Everdingen: Yes, well, it comes down to this that you in facts also during the day and right after the interview because of the things you said have back at to take.

Tom Kortbeek: Yes, okay great, me can't do it find.

Pim van Everdingen: I sent him in your chat.

Tom Kortbeek: oh yes, all right. I just make one task on for myself.

Pim van Everdingen: I it would too interesting find to _ hear what you think of the concentrate form finds it, and whether it has it useful will find on this one way. And I 'm also planning on getting one external software too use to edit the transcript translate and possibly also together at grasp. Gives you there also permission for.

Tom Kortbeek: yes, that's fine.

Pim van Everdingen: And to the and then the interview? Could you do something for me? talk about the design process and the context in which you are working _ _ were up to and including. The international exhibition of the adaptive orchestra.

Tom Kortbeek: Yes, the Tactile orchestra. Yes, because that's what it is something different from Kozie, that is this go really about the process up to the artwork you mean?

Pim van Everdingen: Yes. So, for one thing a bit on the chickens of What was that process? How does it look that out? And of course, there's Link [00:02:00] with Kozie.

Tom Kortbeek: Yes. Well, one nice anecdote that is at the beginning Rose and I during the day our first date having this project invented. Because it is an was a combination of two things Where We both working on it loosely goods. On one _ side was Rose concerned with how to make textiles, fabrics, etc others experience could just give _ to feel. I was interested in one Others experience of music, which is music go usually from A to Z, linear experience. But how can you do that on a non- linear experience yourself guiding interactive experience just saying. Over there we were talking about and when we came up with those things, we must combine. [00:03:00] And that is how Tactile Orchestra was born, namely you touch something On, and you feel not only you also hear something, and with that you get the opportunity to have one piece of music on one Others way together with others at experienced. Well, that was ours first date in august 2014, and when we are further along with that idea to go to develop. When one came _ chance from odd stream, who had an open cabbage for makers from Gelderland, who had an open amount for good ones works of art to develop. And that became well directly also exhibited in both drift for to _ dancing, that's a dance festival here, and in Italy. That was in June 2015. Then to have made two at once because they are at the same time explored had to become. And those goods of two large ones [00:04:00] boxes of standard plate size. From 1.44 by 2.22 and then 40 centimetres thick, very heavy also, a lot at heavy. All kinds of stuff goods over there still wrong. _

Pim van Everdingen: That was the first time that you physically _ to have made?

Tom Kortbeek: Yes. Yes. We have it too welded, another 6 weeks trouble on had ultimately, sleepless nights. In the end it was too much big drill in the car to go to Italy to go. When has Someone milled it in half on their own with a metal thing. Yes, and he has it there on the spot, in half, because it was the border of-

Pim van Everdingen: Because of you at to help?

Tom Kortbeek: Yes. Yes, that was a joke - one nice anecdote because that was a lot of hassle, apparently it is without us. Because it didn't fit on that bus that was going to Italy go, and finally could it fit in then? thought we 're like, well, okay, apparently it is Good gone. So, we crossed the border into Slovenia by plane. [00:05:00] When we got there and everyone watched us very strange to, because we said, we are from tactile orchestra, oh you people are from tactile orchestra? We already thought why do everyone so crazy in return for us. Because then pale so that guy was on his own that whole work of art in half sharpened with a grinding wheel. And when on sight there again with one Slovenian to put that together again to be welded.

Pim van Everdingen: Well, what one party.

Tom Kortbeek: Then we got that at here in the taxi to the hotel. It was _ A heart attack. But it went well. That was the first thing work of art, it has on several places in the Netherlands when also. And when We received the funny question via email enough, because they had us found, googled. The Cooper Hewitt, Smithsonian Design Museum New York, Manhattan, or we Tactile Orchestra their A special one version for their wild ones to make [00:06:00]. And that question came so 2016-2017 we are in March 2018 we are going there gone to install. That was a Next level version of the original artwork.

Pim van Everdingen: That's that photo you took couple time sees of the great hairy wall.

Tom Kortbeek: Yes, 6 meters long by 3 meters high with a curve in it. Because we are also in one certain niche _ placed, then we could follow that niche nicely with that curve, then you really got the feeling that you were surrounded by the black wall and that you are that musical experience yet more could experience. That has six months in New York that the people of Denmark from the Trapholt museum saw it there again. _ _ And they have us ask the artwork also in Denmark We will be going there in the summer of 2019 gone. Over there has it until mid-2020 has it there stood, a while closed been because of the first part of Covid. [00:07:00]

Pim van Everdingen: It looks very Covid friendly.

Tom Kortbeek: No, no. That is, post-covid it really is A work of art which is not so easy can still be exhibited again. Yes, that is A bit of the timeline, I have not so much talked about the process. Do you want there? yet want to know more about it?

Pim van Everdingen: Yes, true I curious to ben, is, you had already talked about the functionality; it on be able to touch, and the meaning thereby; the self be able to make non- linear one's music. That process up to and including all those exhibitions is there, yet a lot of change been in that part (the meaning of) the concept?

Tom Kortbeek: Yes. [00:08:00] Yes. We have on several places and various ways looked at how best to do this could work. If you like the music looks, we looked, what exactly should be included? Should we? yourself or should we do it together? to work? We found that it is from high level had to are, therefore we are to go together working with. Zep for? that's a string Quartet. And they have a performance in Bakhuizen Amsterdam, and we recorded it multi -channel, all instruments apart. That was a live set of three quarter in which she improvises. So are to start Ordinary at to play. No- sorry, five quarter improvised with each other. There's everything there out came. And we all have those lines, tracks be able to hide in the wall. And which was very nice for that that's

us iron music fits very well with the touch. Because you are too yourself must stroking it fits very well in that movement.

Pim van Everdingen: Because it controls the volume becomes (makes pushing hand movement). [00:09:00]

Tom Kortbeek: Well, more also just the actions (general) that you perform on a certain way one intuitive logic is that you do belongs instead of a _ trumpet, which blows. That's one signal sound, and this is a lot more A sliding, one way or another way that fit Good. That's the music, on the other side there is the material choice. Over there we have a lot of tests done with it. High pile, hard, soft, different to colour. And even with thermos chromic ink.

Pim van Everdingen: I know that not.

Tom Kortbeek: Thermochromic that is ink that on one certain temperature changed colour. _ Or it will be transparent. Practical it becomes transparent, so you post A colour with an others colour over it in that ink, like you it touches will be the top one colour transparent and you see the bottom one colour.

Pim van Everdingen: Yes, like those hot wheels.

Tom Kortbeek: Yes precisely [00:10:00], and you can also fine- tune it that way that it is at body temperature go. So, when you touch it that it is in colour changed. Finally, we opted for black _ at to hold so you get that visual sense became checked so that you focus on the music. And all your attention there to go. So, we finally got it simplified. The same we have too done at the interaction, we have a lot of looked Unpleasant different gestures, we checked whether your volume and speed and other ways (makes sliding and rotating hand gestures), but because the moment of experience relatively is short in such a museum, and the learning curve of gestures, yes, then you ask quite a bit of people. So that worked absolutely purl. So, we have finally also elected for simple touches, touch is unmuted, and not touch is mute [00:11:00]. And with one _ _ nice fade-in, fade-out so it makes sense sounds. In those areas, music, materiality, and interactivity we have a lot of stuff tried, and there the choice for made as we have it made.

Pim van Everdingen: Would you like one? bit be able to set that, because you know that it will end up in a museum at to stand that you are a certain set _ expectations and goals have so that you can design Unpleasant And certain human experience? So that you are working on experience design?

Tom Kortbeek: Hmm, yes … and on that additional, but that's also its A link Unpleasant Kozie, that's why we have Tactile Orchestra and Kozie out each other drawn. Because at Tactile orchestra our personal vision and opinion as artists, that is leading been [00:12:00]. Unlike Kozie _ _ Where more Real just the user experience and the target group are the people with dementia and multiple limits guide the choices made _ become. That's really the difference between Tactile Orchestra as artwork and Kozie as applicable product.

Pim van Everdingen: How could you the Tactile Orchestra concept and her multiple versions classify. I had three options written down, is that design, is that art, is it a product?

Tom Kortbeek: Me have it _ Real seen as art [00:13:00]. We really see it as an artwork.

Pim van Everdingen: Despite that it is A design-like process to it has it been art?

Tom Kortbeek: Yes, but the search is real read to what we the best there for would find to work. We have not worked with user groups or tested it (with public). We wild one's A certain experience see or give. And look, us are another kind artists than twentieth century, the most individual expression of the most individual emotion of the artist. And I am a theatre maker, so you have always with an audience at making, that's intriguing, you're always busy with that. You always are thinking about that perception or experience you want to give must well experience be able to become. So, you go think about how that happens. And I think that maybe A painter and visual artist over there may be less concerned with that know I not so well [00:14:00]. The fact that We think about how something happens is inherent to the species artists that we are.

Pim van Everdingen: Yes. That the audience, that audience, you would be that for me be able to describe for the tactile orchestra. How to saw you that original audience for you? e

Tom Kortbeek: That is still well different, with the first one Gilders Kol, from odd stream of Nijmegen. They had A kind program in which they are works of art as fringe programming at dance festivals. So just saying A kind culture audience, at festivals it was a bit younger than in museums, where the audience is a bit older. In general, it was the audience [00:15:00].

Pim van Everdingen: And that changed Naturally when it was KozieMe became, then it was very specific people with a certain limit.

Tom Kortbeek: Yes, that initial one target audience goods people who have dementia had in such further advanced stage they do not more at home be able to live. And later that is supplemented with people with a multiple limitation for the same rode not at home be able to live.

Pim van Everdingen: Yes, now that we are talking a little more about Tactile orchestra you could do something now talk about the process and the context in which you that led to the multiple products of KozieMe?

Tom Kortbeek: Yes, the moment we made Tactile Orchestra, we already had the idea, well we are literally making now A unique product, a one-off [00:16:00]. But it would also Nice are if, in a general sense, we understand the knowledge we develop also be able to apply to impactful one's innovations. So therefore, we had already turned off that scope, that radar. Tone, we met the ZZG group from Nijmegen. That's one healthcare institution for below other people with dementia saw the work of art and thought, what you do with that touch, that to call we multi-sensors concern. We are very much looking for Unpleasant products that do that kind things (care). be able to take.

Pim van Everdingen: How did that happen? that contact, they were there an exhibition been?

Tom Kortbeek: Yes, yes, me think according to me at Innovate, a previous edition or something, 2016?

Pim van Everdingen: [00:17:00] What kind of an exhibition is that? It is standing over there and you are not there, or were those moments that and more trade fair-like setting?

Tom Kortbeek: Innovators are real A kind of scholarship indeed. Over there we were not always at, but the contact is still there one or the other _ way bee us came. That there are tickets layers or something, there are always flyers and such.

Pim van Everdingen: It's real an event in which the object is in a context of; hey, think about it after, as this next _ step would be able to are for someone here on this one floor, then here is contact information. While in the museum it does not say ' in front of it more information email to ___'

Tom Kortbeek: That know I not. We have innovators in 2016 too Ordinary seen as something cool, from cool makers Arnhem. I know not so sure how _ first contact has now been established honestly said honestly said. Anyway _ touched it _ A kind of ' this would a concrete lead are according to what we already wanted ', it is applicable to make [00:18:00]. When we are step for step bee them on the floor to go see how we do that artwork would be able to adapt Unpleasant An application. So, we have the first one A table made of, a quarter standard size, 60 by 1.20, with a trestle underneath, then you could put it on the table lay. He was still whole _ black and dust, then we got one nice anecdote, a remark. That people were like 'oh there the coffin is carried in again '. That was not exactly the connotation we wanted to have So when there are more of us to colour to go to work. When we have too A kind of a roll-out mat that we put on the table could lay [00:19:00]. With the same once again sounds and then with others sounds tried. Step for step also came the individual, everyone is different, everyone has completely different one's musical needs just saying. We sat then very much in one kind of ' elderly ' love Piet or something 'but people who grew up are as fans of the rolling stones and Beatles are now also 80, which is of course very diverse. That individual one need so to speak, your feeling of what your home is, ' you're feeling of home ' is ultimately also became the tag of Kozie. That has made that we thought, okay, it must be done A kind to kiss come with which you completely your own music in it can places.

That your family and friends not always nearby _ be able to be but want maybe to leave something behind or something record something like that person with dementia if she misses the grandchildren the voices can belong and can cuddle [00:20:00]. From there is the KozieMe to arise. So, to look to what is needed, what is the need and how can we do that implement in a product.

Pim van Everdingen: So, it's getting smaller and smaller and smaller become.

Tom Kortbeek: Yes, funny enough yes, and next to it is the KozieWe also developed. That is a 1 to 1 adaptation of the wall object that you put on the wall can hang. Where various sounds from outside at to belong such as the city or nature reserve. Because the people in healthcare institution pleasant outside come, because that practical not at organization, they can still get the feeling of being outside in one indoor setting to offer. That was the idea of the KozieWe. [00:21:00]

Pim van Everdingen: And A bit for my imaging; is the KozieMe and Who is really in production, how much are made? _

Tom Kortbeek: Right now, no, Kozie as company liquidated in 2021. It was natural and separate start-up, and we then we encountered _ all kinds So there are bumps in the road as a start-up We also Naturally. Things really started happening at the end of 2019 well, the sale, it came on, it was a good product that worked, that was nice. But then came Covid, and We worked in production side with a social workplace, distance to the labour market, because it is a social company was. We were working with chips from China, before Covid Chinese New Year's Eve was already very difficult because there is pre-financing was necessary [00:22:00]. The target group, the market goods healthcare institutions, we had a team of people on the street by healthcare institutions used to go. Immediately with Covid, all healthcare institutions were closed, so when we couldn't do anything to sell. To production _ side as sales _ side we totally could nothing more doing. And we had Ordinary not enough liquidity or perspective, because we don't know when it would to hold up. So, we could not to the financiers, which we also had, say how many postponements is necessary would fare for a forecast for next year. So, when we have together decided to _ fuses. The IP is now in one kind of safe in the Fillip Studios foundation, currently consists of Kozie as company not. [00:23:00]

Pim van Everdingen: Ah that way because the website exists also not Real more.

Tom Kortbeek: No, it is not more live, that is if you look for it you go to Fillip Studios.

Pim van Everdingen: Yes, I did _ seen. I would yet something more clarity want to have about certain things choices made _ be in the process. So, you said for example, back then you had your first date then it was invented, were you just left the schools off?

Tom Kortbeek: That was in 2014, in June it was Roos graduated, that is just graduated. I graduated in 2012, so just 2 years ago.

Pim van Everdingen: Okay, [00:24:00] your goods So yet Real young and had few experiences in this kind projects. Then you do that project on, and do you have that design process until it is successful _ exhibit. Are over there yet choices that come very much from that work context? Did you for example A physical location, or that yet not at some time?

Tom Kortbeek: You mean (to ask) or we things to have addressed because We also yet not knew how we did that had to doing etc?

Pim van Everdingen: No, me try it _ compared to how that shall be in other projects that also have their start through art. I think that the profile of a young someone who works of art tried to continue to develop that context maybe well more often for would come. That way on which you have gone to the Tactile Orchestra working towards. I am personal (with that process). not confesses, so I am curious to what for A resources you at your disposal had. [00:25:00]

Tom Kortbeek: Do you mean specifically in the artwork?

Pim van Everdingen: Yes, I _ try from the front (the beginning) to behind (KozieMe) through ' time to at scroll '. In other words, how you more and more maybe hands had them on stuff could work. You already said that at the end _ A social workshop with people who assembled. That had to so you at that point not yourself more at doing.

Tom Kortbeek: Yes, the very first thing artwork we totally have yourself made, we have six towards that deadline from 6 in the morning to 12:30 in the evening for weeks at a lot of work unclear done. We had also not Real a plan, we knew also not necessarily what we wanted that it would become. There had to be a lot of picked become, audios for example, which goes a lot now easier. So yes that _ kind hassle. That was trial and error, we had already here _ this workplace. Rose fed up here coincidentally with 9 other people they had one kind of co-working space. This workspace was already there available [00:26:00].

Pim van Everdingen: had you there to the other people there too sat. Was that ...?

Tom Kortbeek: No.

Pim van Everdingen: It was not A kind of group.

Tom Kortbeek: No, no. No. For we had this project there nothing On. We had well happiness, people did things, it was very nice and inspiring, but for that artwork had there nothing On. For the 2nd version we have for New York someone made the frame otherwise made, the fabric is plain purchased there _ we do have steps taken. _ Let's see, with _____ a lot more of it forward technical elaborated. That we a lot more knew how or what, that was already a lot more convenient. Towards the production of Kozie when we also have the design and development, we have a lot yourself done [00:27:00]. Setting up a business, setting up a design and A company, that we do that in your own hands wild ones to hold because we thought that that would have been easier or something. While a lot of other parties, industrial product design agencies _ to have offered for that for us at doing. While We thought Yes that costs us a lot of money, that's also true, but if you do that finally calculated backwards how many times and energy has been put into it while it too for A part Ordinary bee and company could have done. In that design process is our process now a lot better furnished, but we would also a lot of faster together working with others. Also, in the production process.

Pim van Everdingen: You could set that you were protective, like we do this yourself?

Tom Kortbeek: Yes, too stubborn maybe yes, yes. [00:28:00] If you do A type of general character traits looking for that kind companies that do this kind processes to engage, to be able to artists in principle also well stubborn are. What's good is what we do to have learned that you are very good know where you find yourself stake that you good know Where others be good / better at. And, for example, we to have yourself set up a sales team, we are yourself door to door gone, we almost did business to consumer. While that would I never again now doing. I would just look for retailers. Only buy so much, this is your margin and good luck with it.

Pim van Everdingen: You have for example and web shop with stuff for dementia people.

Tom Kortbeek: Yes there _ we also sold yes, dementiawinkel.nl, but that is a principle only A sale channel. He buys nothing in it, that offers no service, you must do it yourself doing [00:29:00]. They have just that URL and that's them revenue model. But there are A couple other parties such as Barry Emons or Nemko, they already produce themselves. I would be faster now saying; We to have an idea, eh you are percent and seller. Take this idea and start producing it and to sell and give us 5 to 10% of your turnover and good luck with it. But that we can now too easily doing because we are in other areas more stable revenue to have as company. With Kozie as separate BV we thought we had the margin for ourselves high had to keep it, but that pale cheap expensive at are [00:30:00].

Pim van Everdingen: Okay, interesting. You would put that the KozieMe is a commercialization of the Tactile Orchestra concept, may also be not Naturally.

Tom Kortbeek: Yes, yes, yes. _ _ Yes, and it has us helped in that process through as well really two names at think up for those different one's stuff. A lot in such a process wrong can go if you like those things precisely the same stays to call. Because that's what you're going to do artist too many opinions about the final product and your own perspective. It has the artistic Tactile Orchestra helped us a lot of mention, and there's our personal vision leading for. As artists about the work of art. And this is the product Kozie, and over there are things the target group

invites have leading for the choice we make in the product. And that's a perspective difference [00:31:00]. It has and has us helped, also legally, a product, a concept, and a name. That's a tip!

In that process becomes very similar to two languages at think up for the different one's stuff. Because I think that there is such a process there a lot of wrong go can go.

If you like those things precisely the same to stay to call. Because that's what you're going to do artist at a lot of an opinion have about or where clearly the product from your own perspective and that this want to us helped us all. Do himself also A work of art, a detector about talking. There's our personal vision. Lead to peace.

Can work as artists in healthcare and. This is the Cosi product. And over there are things that matter necessarily has. Suffering for the choices we make a product. And that's Bertie differs. And that has the same role in the two interchangeably to leave. Lily also in products as pseudonym. Each other thought that that's it.

Pim van Everdingen: Yes, so by one thing more as an inspiration source at to see for the other instead of a chicken and egg (the further development / growth of 1 artistic idea into a product)

Tom Kortbeek: Well, you have yes of that kind of 'accelerated' programs, such as 'bridge-the-gap' for how you … artists money can earn with your art. The danger that's what you say an attempt to do to Tactile Orchestra as such at marketing. Then you get one splits in which you meet one side Ordinary want to make what you already made because you think that that is good, and there is value in that. Then you go to publish and get their stuff bee to look such as user experience, market (safety) [00:32:00].

Pim van Everdingen: Then it feels too much pretend to express your creative side must sacrifice for …

Tom Kortbeek: … for commerce? _ Yeah so _ there's one there dangerous in, a field of tension. And precisely because of that each other at to cut and it as two things at sea, that one A link to have Naturally. But then it is clear, until here leads the artistic, and here leads the commerce. That creates peace, clarity, and that you can do it that way to address.

Pim van Everdingen: Where did you get that idea, to do it that way? at divide.

Tom Kortbeek: That know I no, it just is A kind of came about that way. Think I.

Pim van Everdingen: Did you foresee the stress of…

Tom Kortbeek: Well, that know I not that _ would very visionary _ sound as I that … (had already thought so).

Pim van Everdingen: When I think about it expected I that some people perhaps they are afraid that they think ' if it is commercialized now, what exactly will happen? ' There is ambiguity there, and that that So is exciting. I know not or that is visionary, it is possible also correct obstructive are, and that you might A solution searches for that obstructive feeling [00:33:00].

Tom Kortbeek: Yes, exactly. Yes, us to have then with a lot of various people Speaking of which, that idea (of splitting) gradually emerged.

Pim van Everdingen: Then question 7 is not more relevant. You mentioned before _ that there are investors were, you could do something talk about the qualities you had considered when approaching, but also when selecting and refusing to do anything investors.

Tom Kortbeek: We wanted to so much possible foreign assets inside get, so that We in principle owns all the shares _ kept [00:34:00]. It was structured with priority shares, because we want it to be social entrepreneurship first at to make. Content _ and impact first, and commerce on one second place. We have always sought to financiers in the form of loans, which is foreign assets of a bank, or a regional innovation fund with smooth loans without joint and several liability. So that We operationally owns the total _ would have. That is something other than that Yes, if you quickly start working with a venture capitalist, his money is worth it also as foreign assets in the balance sheet, but in addition in addition they want too shares capital to have. Influence and so operational [00:35:00].

Pim van Everdingen: So, control has about…

Tom Kortbeek: Yes, yes, there we have always watched over it.

Pim van Everdingen: Okay, why?

Tom Kortbeek: Because we don't wild ones that it is social character of the company lost would go, maybe also well stubbornness.

Pim van Everdingen: You went there from that an investor who owns the shares would want to buy that which is not perse the same one interests first would make.

Tom Kortbeek: No, he states return above, and who wants that maximize. Unlike a _ _ content-related driven innovation fund of the province, which will be Ordinary to assure that there is more gain made becomes in them geographical region. Then you make one appointment for A loan with a fixed interest rate, and if you like those Ordinary pays then that person has what that Re Ordinary meal On. How do you do that? for each other gets then it does not matter out [00:36:00].

Pim van Everdingen: Then I have I yet A question about the KozieMe section, what is the technology to have used, that is a patent?

Tom Kortbeek: No, we don't have a patent, an IP.

Pim van Everdingen: Still there technological … yes, new ways in? With touching or having you in facts purchased an existing product to use (the KozieMe). to use?

Tom Kortbeek: No, we have the printed circuit board itself developed, but with existing one's components. But the effect as is entirely copyrighted protects. We have before chose not to at patent because you do too public must to make. We have before chosen because there are on the designs is copyrighted, the brand has trademark rights, we have had the logos registered [00:37:00]. So that's that, on like that way we have also consulted with legal authorities' experts decided not to patent it _ _ to protect.

Pim van Everdingen: Because technology is one bit and dust touches and that a computer can do something with that and that there is sound comes true. Is that unique in the world?

Tom Kortbeek: No, that can everyone to make Naturally. A patent costs a lot of money, a global or even Benelux patent is already expensive, and then you have an active one obligation to comply. So, as I have a patent, and you If you 're going to do something with it, then you have to I active Unpleasant you are looking and then you have to I you go to sue just saying. And then you have to I also yet prove that you me have imitated, so you get yourself so much around the neck that it is not worth [00:38:00]. So, you can better just the worst strategy _ at have, and that we tried _ at doing.

Pim van Everdingen: We 're going to wrap up soon, I 'm still here well new curious to what for were there any setbacks? Mainly gatekeepers, which is an actor in the playing field who occurs that you see the progression makes what you wanted to make. What was there, what for? An obstacle there existed and have the KozieMe development at risk brought, or hindered?

Tom Kortbeek: I think that … that there are a lot of gatekeepers us bee ourselves layers. The way on which to which we are working retroactively power certain strategies to have addressed [00:39:00]. What we better not yourself had been able to do. It's Covid after all was the closing gatekeeper who did that Real has stopped. But also, the market / sector that we have chosen, the healthcare institutions and the way where the care is becoming financed made the scalable one selling the product is very complicated, we found out. That's because of the budgets year on year become calculates, an ongoing financing. The investment up-front, out of pocket, is very complicated. Because she's alone an exploitation structure to have. Would Kozie as a service, you pay monthly, then that was easier (KozieMe _ namely was in principle Ordinary a product that you use once purchases) [00:40:00].

Pim van Everdingen: Okay, so that's it a business structure that you not Real yourself had invented. That's more something driven _ became facts through the context A new one's industry.

Tom Kortbeek: Well …it's knowledge afterwards you know, so (the knowledge that) the way where the care financed and structured is one

is an obstacle. The way on which We over there initially for had chosen, to lead the sales of the product in the market at put, and the way on which We thought the design yourself at be able to make that has a lot of delay delivered. Because We there on one certain way for wired to be, to perfection at go, while you might could have entered the market faster with someone to go you know _ [00:41:00]? Then you would have gotten their faster revenue be able to make and being able to make a business take off, that are considerations are not necessarily setbacks or gatekeepers, but who at to have to behave to the development process. had We chosen to market that product for?

Pim van Everdingen: Do you think you have those character traits? shares with the kind people that also projects might make that would be able to become further developed.

Tom Kortbeek: I suspect so _ yes, I _ suspect so. _ The creative sector is led from the arts high schools, which is conceptual it must be strong are, the execution must well think out, the fineness. That are qualities Where I am very much behind, but they had also phased implemented be able to become. Instead of we love everything under the radar until it's perfect, and only then will things go well become [00:42:00]. Dan knows also no one of it.

Pim van Everdingen: Now and then then is a tweet, 'something big is coming ' but then we do not hear from you for a long time.

Tom Kortbeek: Yes, exactly that _ kind stuff. We have to us realize that a 'beta variant' too Good had been.

Pim van Everdingen: Okay, let's finish, then we can go having lunch. Thank you, it was great nice to belong.

Notes on the interview

At certain points we used 'adaptive orchestra', but it is called tactile orchestra. It started as a passion project on researching textiles to give them more experiences + non-linear music experiences combined during a date.

The project had an 'art phase', from 2014 until 2020 tactile orchestra was developed and exhibited internationally. In this phase there was an evolution on HOW the object performed, through material choice, colour, and experience design. Tactile Orchestra was based on a personal and artistic vision. Kozie was based on user experience and target groups, those were leading. In Tactile Orchestra there was a quest-like search for the object that matched the feeling and vision of Tom and Roos. There were no tests performed and an 'audience' is different from users, even when there is an interaction. An audience is subjected to the design and reflects upon it. Users are different, they use the design and live alongside it. The Tactile Orchestra was unique, but within Fillip Studios there was already a growing desire to morph/evolve that idea into impactful innovation. They had acquired new knowledge and produced something with a high enough fidelity that they knew that it could be applied in an impactful innovation, but they did not know what that was. On an innovation convention, the Tactile Orchestra was presented, and it caught the attention of people who have experience with dementia-aiding products. They approached FS.

Tom's strategy was to attract as many loans as possible without collaborating with investors, so bank loans, innovation funds and the like. This gave them a lot of space to develop in their way, and to keep the social goals of the project stable. They trade in shares or ownership.

Post conversation

After speaking with Tom, we had a lunch break, during this break we continued talking for a bit about the subject. I repeated Tom's statement that he (and Fillip Studios) share a character archetype of a stubborn, self-organizing agent with a focus on vision and a reluctance to relinquish/share ownership. Co-founder Roos agreed with this. I noted that this character influences how 'my model' should approach the problem. Roos told me that, in the setup of Adaptive Orchestra, the commercialization of Kozie and the founding of Fillip studios, they had seen, used, considered, rejected, and otherwise engaged with many different models and frameworks. This insinuated a sceptic question, what will one more model, based on this thesis, offer that all those others cannot?

Currently, I don't have a full answer to this question yet. The model should play into its specific audience; this is a balance, since every project is unique, and a model is a generalization. A. The model could provide concrete answers on what to do at what moment, concerning legal action and protection, finance, concerning design activities. B. The model could provide an unexperienced project owner with an overview of what could prompt non-intuitive actions, based on the character archetype. This means that the model could show the advantages of collaborating, sharing ownership, protecting vs secrecy, the development of a business surrounding a product, of the development of a product series rather than a singular failure/success story. The model could describe how successful startups end up organizing themselves.

14. Appendix IV -Presentational Materials

Explaining Birdbead to the public

The exposition of Birdbead at DDW 2023 consisted of the physical stand at Klokgebouw as well as two websites with additional information available to the public. These presentational materials will be documented in this appendix.

The process for making these materials was in part collaborative, all the texts had to be proofread, and at times edited by Fillip Studios and Omlab, as well as the people of Design United and their representatives and the organizers of Dutch Design Week. The DDW website is bilingual. The layout of the stand was designed by Lucas & Lucas, a Tilburg based design studio.

The physical stand

The stand consisted of the prototypes, an informative sign, and a video, shown in Figure 14.1. The prototypes were set on a table, with Birdbead presented on a pole. This setup invited visitors to interact with the prototypes and feel the material of the test prints for themselves.

Because Birdbead has a different kind of functionality than most birdhouses, it was assumed that the public would have difficulties understanding the message of this project. To compensate for this a poster was designed to illustrate the degradation process, shown in Figure 14.2. This poster was hand-sketched to make it look appealing and communicate that the project is not finished yet.

The video explains a lot of the process that went into making Birdbead, it shows the 3D printing, Grasshopper modelling and the hand-sketching ideation process. Furthermore, the video shows some natural footage of birds and rain associated with Birdbead. The video can viewed on the website of van Everdingen and 4TU (2023), captures of that video can be seen in Figure 14.3.

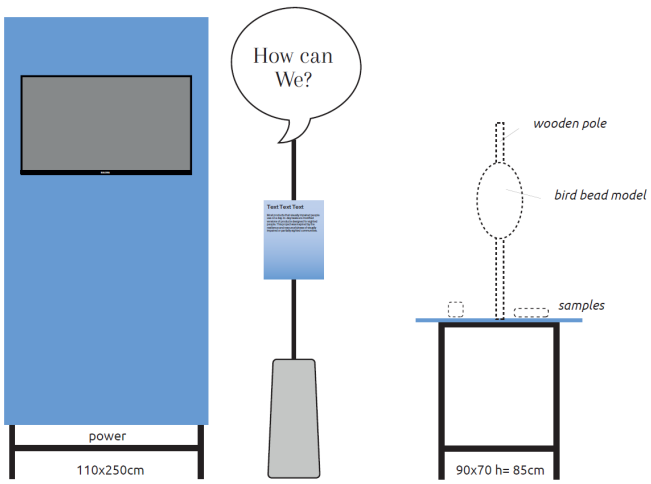


Figure 14.1. Layout of Birdbead stand.
On the left is the planned layout of the Birdbead stand, image and design by studio Lucas&Lucas. On the right is the realized layout in Klokgebouw.

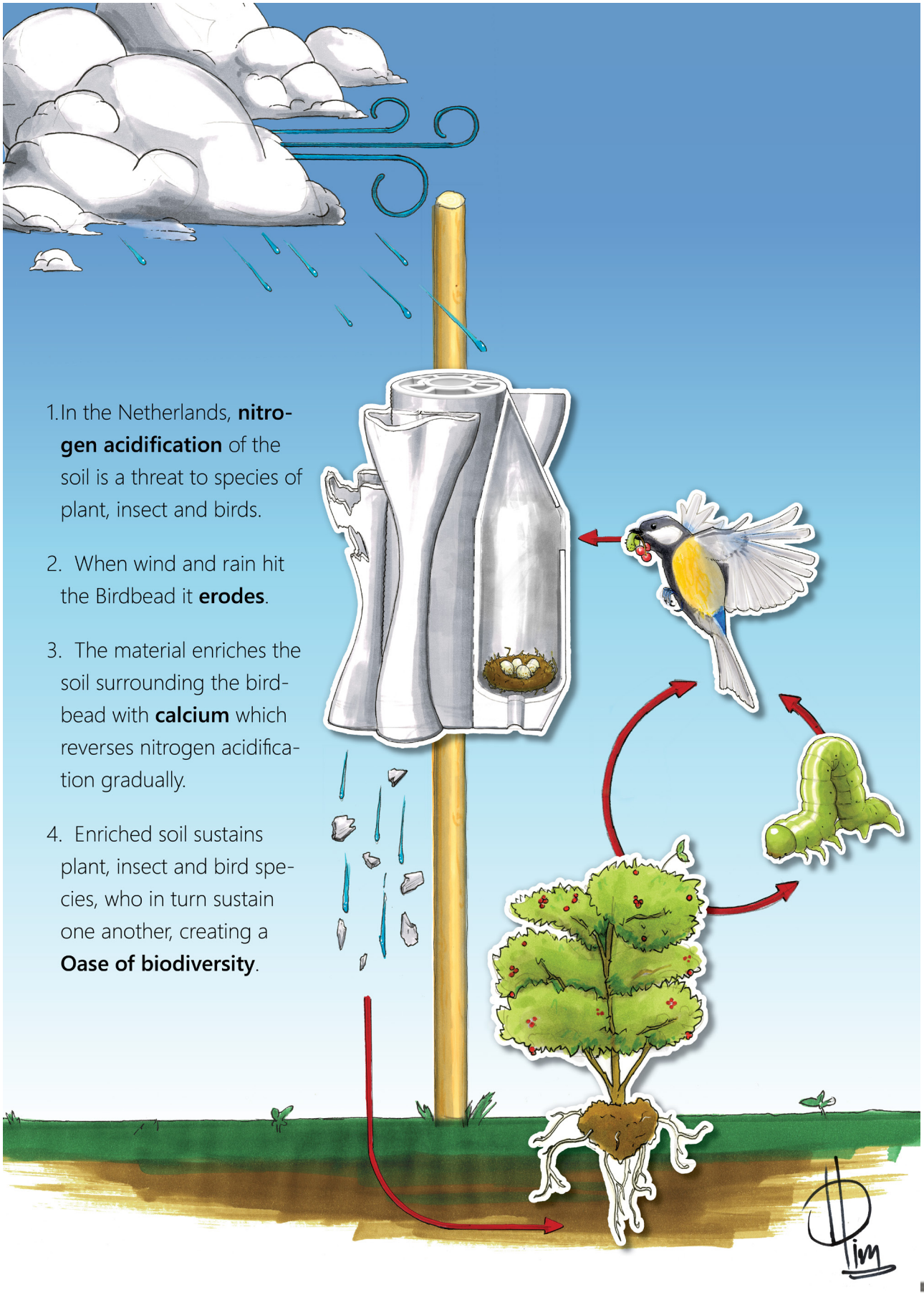


Figure 14.2. Hand Sketched poster. *Realized as a hardboard A2 Poster, as a visual explanation of the degradation function of Birdbead.*

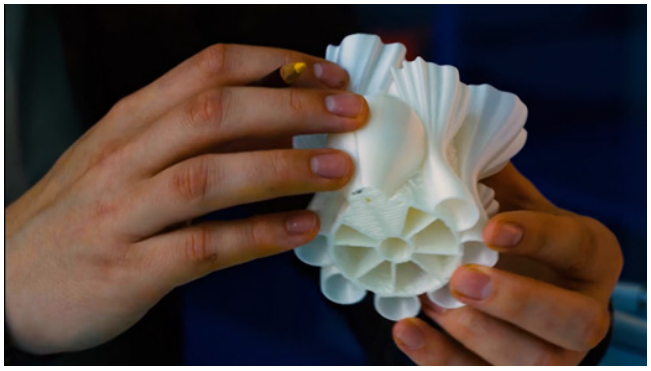


Figure 14.3. Captures from the DU video.
The video was shot by Pim van Everdingen, Marica de Michele and Laura Papke, and edited by Marcia de Michele.

Sign text

The sign text at the physical stand, visible in Figure 14.1, features a design question to attract interested visitors and a summary explanation of the design.

How can we help species survive our changing climate?

Birdbead is a nest box that creates a sanctuary for species threatened by nitrogen acidification. The design uses a parametric model which enables precise tailoring per species; the version shown is for the 'Great Tit' (Koolmees).

It is 3D-printed with a biobased circular material mixed from elements found in sewage and water reclamation. When exposed to the weather it degrades, revealing new shapes and textures while gradually restoring the surrounding soil with calcium.

The DDW website by van Everdingen (2023)

MAACQ Oase: Birdbead

A nest box which creates a calcium-rich sanctuary for our soil, plant, and animal species threatened by nitrogen acidification.

Birdbead is a 3D-printed nest box designed to address nitrogen-induced soil acidification. It is made from a biobased circular material which will degrade over time when exposed to weather, revealing new textures and shapes, and restoring the surrounding soil with calcium.

Addressing nitrogen acidification through Birdbead: A solution within the MAACQ Oase project.

Industrial nitrogen usage has made Dutch soil acidic, reducing its natural balance of minerals, particularly calcium. This poses a threat to the biodiversity of vegetation, soil, and various wildlife species. With the MAACQ Oase project, Fillip Studios and Omlab are working to develop a product which can nurture our fragile soil back to health.

The project is centred around the material used to print Birdbead called 'Itbettermatter', a biobased circular material composed of calcite reclaimed in drinking water decalcification and elements like cellulose collected in sewage treatment. This material is as strong as cellular concrete, and weathers slowly when exposed to water. When this happens, calcium is released into the soil around Birdbead. This technique is more effective at sustaining biodiversity than helicopter-based dissemination techniques used in Dutch nature reserves. By combining 3D printing and parametric design, the two companies strive to counteract nitrogen acidification, with solutions tailored to the local soil and species. At the same time, MAACQ Oase products should start conversations about the nitrogen issue and the things we design for it.

Bridging the gap between climate futures and technological possibilities.

Developing a product that is safe to implement in nature requires extensive knowledge about the natural processes. Therefore, Birdbead is made to enable research into the interactions between nature and future MAACQ Oase products. Birdbead addresses the acidification issue by bringing together the key elements of the ecological processes: water, minerals, and biodiversity. Birdbead positions itself between the envisioned climate future of Fillip Studios and Omlab and the current technological possibilities. The limitation of the 3D printing technology to produce a single product at a time allows for variation and exploration. In this way, Birdbead demonstrates how small-scale development facilitates innovations in the cultural and creative sectors.

Taking a new approach: The innovative design process behind the unique shape of Birdbead.

Birdbead is designed as part of the design research into interactions between 3D printed sculptures and weather, wind, plants, and animals. Simultaneously, Birdbead also researches novel approaches to algorithm-based 3D modelling and printing.

The objective was to design a pole-mounted nest box which could be printed in one continuous thick line. The shaping of Birdbead was inspired by turkey tail mushrooms because, like fungi, MAACQ Oase will enrich soil biodiversity in nature. The tubes and the inner structure are designed to guide rainwater away from the birds so that, despite eroding when exposed to water, Birdbead remains functional as a nest box for as long as possible. During the erosion process, the layers of Birdbead fall away to reveal new textures and shapes to make the sculpture dynamic.

In the algorithm used to design Birdbead, key measurements of the model can be adapted and tweaked to target the needs of a nesting animal; some birds prefer a specific nest box volume or shaped entrances. The prototype nest is configured to suit the needs of the 'great tit', which has been heavily afflicted by acidification.

Design United website by van Everdingen and 4TU (2023)

MAACQ Oase: Birdbead

The MAACQ Oase Birdbead explores new and sustainable ways in which we can use design to address nitrogen-induced soil acidification. With novel 3d printable materials, it is possible to craft tailored solutions that can throw nature a lifeline. As Birdbead degrades it releases calcium into the soil to create a local 'Oase' of biodiversity. How can we help species survive our changing climate?

The acidification of Dutch soil through industrial nitrogen usage is causing the degradation of biodiversity and threatens wildlife. Birdbead is part of the MAACQ Oase project of Fillip Studios and Omlab. These companies aim to use circular biobased 3d printable materials containing calcium to reverse the effects of acidification by printing sculptures. This material is mixed from calcium reclaimed in drink water decalcification (ontharding) and elements like cellulose sewage treatment.

Birdbead is designed as part of the design research process into the interactions between 3d printed sculptures with weather, wind, plants, and animals while also researching novel methods for algorithm-based 3d modelling.

Birdbead is a birdhouse that erodes when exposed to water. The tubes and the inner structure are made to guide rainwater away from the birds so that their home is the last feature to go. During the erosion process, the layers of Birdbead fall away to reveal new textures and shapes to make the sculpture dynamic. The gradual release of calcium is more effective at sustaining biodiversity than some of the helicopter-based dumping techniques used in Dutch nature reserves right now. The entire structure is developed so that it can be printed in one continuous thick line.

Like mushrooms, MAACQ Oase aims to enrich soil biodiversity nature, therefore the shaping of Birdbead was inspired by 'elvenbankjes'.

Birdbead is based on a shape-defining algorithm. In this algorithm, some key measurements of the model can be adapted and tweaked to suit the needs of different species. Some birds prefer a specifically shaped entrance for example. This nest is configured to suit the needs of the 'great tit' (Koolmees), which has been heavily afflicted by acidification.

Birdbead looks at the ecological processes disturbed by human influence and brings together key elements of the problem, water, minerals, and biodiversity. However, developing a product that is safe to implement in nature requires extensive knowledge about the natural processes. Birdbead enables research into the interactions between nature and future MAACQ Oase products. The design positions itself between the envisioned climate future of Fillip Studios and Omlab and the current technological possibilities. The limitation of the 3d printing technology to produce a single product at a time enables variation and exploration. In this way, it demonstrates how small-scale development enables innovations to arise.

"The adaptable algorithm allowed me to reframe the role of nature in design projects." - Pim van Everdingen

Exposure

The Birdbead attracted the interest of the Telegraaf, a national newspaper. It was featured in the general article on the DDW 23 (Figure 14.4). The article underpins that the breadth of design ideas presented is inspiring but can be disorienting to an audience. This leads to many people's first reaction or question when approaching a design to be; 'What am I seeing here?' This shared experience shows that the meaning of design work is often not visible at first glance, the same is true for Birdbead. Its appearance of a stony shape on a stick does not explain its function against nitrogen acidification.

The conclusion of the article states that the Dutch Design Week is a combination of joke projects, projects of a social character and a few innovations.

INNOVATIE VAN 'DICKPIC-PHOTOBOOTH' TOT VOGELHUISJE UIT HET RIOOL: DUTCH DESIGN WEEK TREKT DUIZENDEN ONTWERPERS

'WAAR KIJK IK EIGENLIJK NAAR?'

In de schaduw van industriële loodsen is het regenachtige Eindhoven dinsdag het toneel van high-tech innovaties en creativiteit. Dutch Design Week 2023 is aangebroken en lokt duizenden ontwerpers en bezoekers van over de hele wereld naar de Brabantse tech-stad. Allemaal hebben ze één gezamenlijk doel: zich onderdompelen in de toekomst.

door **Rosanne de Jong**

Het grootste designevenement van Noord-Europa maakt de tongen los onder de aanwezigen. „Waar kijk ik eigenlijk naar?", klinkt het, als de glibberkunstwerken, artificial intelligence-brieflezers, buisjes vocht en kartonnen Formule 1-auto's boven tafel worden getoverd.

Met een glimlach van oor tot oor stalt de 24-jarige Pim zijn stellage uit in het Klokgebouw. De technische student van Universiteit Twente vertelt over het profijt dat we kunnen hebben van fouten van machines. Hij wijst naar een 3D-printer, die staat te sputteren alsof zijn leven ervan afhangt. „Het doel van een 3D-printer is om zo glad mogelijk resultaat te geven, maar dat lukt niet altijd. Als gevolg van die fouten kunnen echter schoenen en onderzetters gemaakt worden", aldus Pim, die ondertussen een volledige schoen omhoog houdt – van inderdaad ribbelig plastic – die vers uit de printer rolt.

Favoriet

Het is een ander kunstwerk van hem dat wellicht favoriet zal zijn voor protesterende boeren op het Malieveld. „Dit vogelhuisje wordt gemaakt van afval uit het riool, waar veel mineralen zoals calcium in zitten. Op termijn breekt dit vogelhuisje af en verdwijnen de mineralen weer in de grond." Het gevolg? „Minder bodemverzuring door stikstofuitstoot", aldus de vrolijke student, die voor elkaar heeft gekregen dat er in de ruimte geen vervelend geurtje hangt.

Clim (25) zorgt met zijn ontwerp voor het nodige gegiechel.

Met grote ogen tuurt de 45-jarige Bart naar een lichtgevend 'monster' van auto-onderdelen in een donkere zaal dat de naam Manifestations draagt. „Waar kijk ik eigenlijk naar?", vraagt hij. Bart is docent van een groep studenten die dinsdag rondloopt om hopelijk wat op te steken voor de minor-opleiding Design aan Hogeschool Fontys. „Het is belangrijk om die vraag vaak te stellen, voor de bewustwording." Hij verwijst naar hedendaagse gewoontes waarbij mensen eindeloos lang op sociale media scrollen. „Dan kijk je niet écht."

De Britse Zain (39) en Alice (33) zijn op vakantie in Nederland en voor het eerst bij Dutch Design Week. „We vinden het heel indrukwekkend. Maar de boodschap is zelden direct zichtbaar en vaak niet heel concreet. Dat vind ik wel jammer. Je moet als bezoeker ook wel creatief kunnen kijken", aldus Alice.

Met ruim 350.000 bezoekers dit jaar ten opzichte van 295.000 in 2016, kan geconcludeerd worden dat Dutch Design Week blijft groeien in populariteit. Creatief directeur Miriam van der Lubbe is grondlegger van het eerste uur: „Het is vooral gegroeid in kwaliteit, dat vind ik het belangrijkste. De ontwerpers die hier staan, dragen echt bij aan een betere wereld met een maatschappelijke boodschap."

Pim (24) met zijn vogelhuisje gemaakt van afval uit het riool.

Ze stelt kritiek zoals die van Alice goed te begrijpen. „Ik zou zelf ook het liefst direct weten waar het over gaat wanneer je naar iets kijkt. Maar soms is die boodschap erachter niet zo makkelijk om te verbeelden." Van der Lubbe, die zelf ook ontwerper is, verslikt zich bijna in haar koffie als ze de vraag krijgt wat haar favoriete kunstwerk is. „Heel veel!"

Boodschap

Het overbrengen van een maatschappelijke boodschap blijkt prioriteit voor veel ontwerpers, tot grote vreugde van een groep vrouwelijke scholieren uit Tilburg. „We moeten een schoolopdracht hier uitvoeren, onwijs leuk! We hebben al heel veel ontwerpers gesproken over hun boodschap."

Een van hen is ontwerper Clim (25), die voor aardig wat gegiechel zorgt bij de tieners met zijn felbegeerde 'dickpic-photobooth'. De naam doet al aardig vermoeden wat zijn ontwerp moet voorstellen. Clim: „In dit hok kun je een polaroidfoto laten maken van je geslachtsdeel. Hiermee hoop ik dat mensen gaan nadenken over de vraag: wat betekent mannelijkheid tegenwoordig nog? Valt of staat dat met een dickpic? (een foto van het mannelijk geslachtsdeel, red.)."

Neemt hij hiermee bekende koppen als *The voice*-bandleider Jeroen Rietbergen en voormalig Ajax-directeur Mark Overmars op de hak? Zij lagen begin vorig jaar onder vuur vanwege vermeende dickpics „Een beetje. Maar het gaat me ook om de boodschap."

Guido (25) brengt in zijn kunstwerk de oude vorm van film samen met de nieuwe vorm van film: TikTok.
FOTO'S RIAS IMMINK

'Data-verkeer'

Terug in het Klokgebouw zijn ontwerpers Jort (31) en Olaf (21) druk in de weer met hun ontwerp, bestaande uit ballen en platen van staal. „We simuleren hier het volledige proces wanneer je iets koopt in een webshop", legt Jort uit. „Er ontstaat zó ontzettend veel data-verkeer bij een onlinebestelling, daar zijn mensen zich helemaal niet bewust van." De heren vinden het belangrijk dat deze onwetendheid afneemt. „Het gaat namelijk wel over gegevens van mensen."

Grappen, een maatschappelijke boodschap of een potentiële innovatieve doorbraak: ook dit jaar is de Dutch Design Week rijk aan artistieke creaties. De 11-jarige Bram uit Drenthe is al zeker over wat we in de toekomst zullen terugzien: „Die Formule 1-auto van karton, daar moet Max Verstappen in rijden."

MAATSCHAPPELIJKE BOODSCHAP IS BELANGRIJK IN EINDHOVEN

Figure 14.4. Article about DDW and Birdbead.
The newspaper publication is an excerpt from the entertainment and culture section in the Telegraaf on the 25th of October, written by Rosanne de Jong (2023).

15. Appendix V - MAACQ Oase Scenario Descriptions

Reframing MAACQ Oase with scenario sketches

For the first step of the design phase, sensemaking, various scenario sketches were made to collect ideas about surprising, undesirable, or unintended interactions that the MAACQ Oase could have if it were made. The following sections describe the intended meaning of each sketch in full.

Human influence

Figure 15.1, all products in public spaces are at risk of vandalization through violence or graffiti. People might feel invited to scale the MAACQ Oase, its rough texture makes it an inviting challenge for bouldering enthusiasts. The structure could provide shelter, which could attract people to camp in or under the MAACQ Oase. General human activity could result in trash or excrement accumulating around the MAACQ Oase, doing additional harm to the soil instead of healing it.

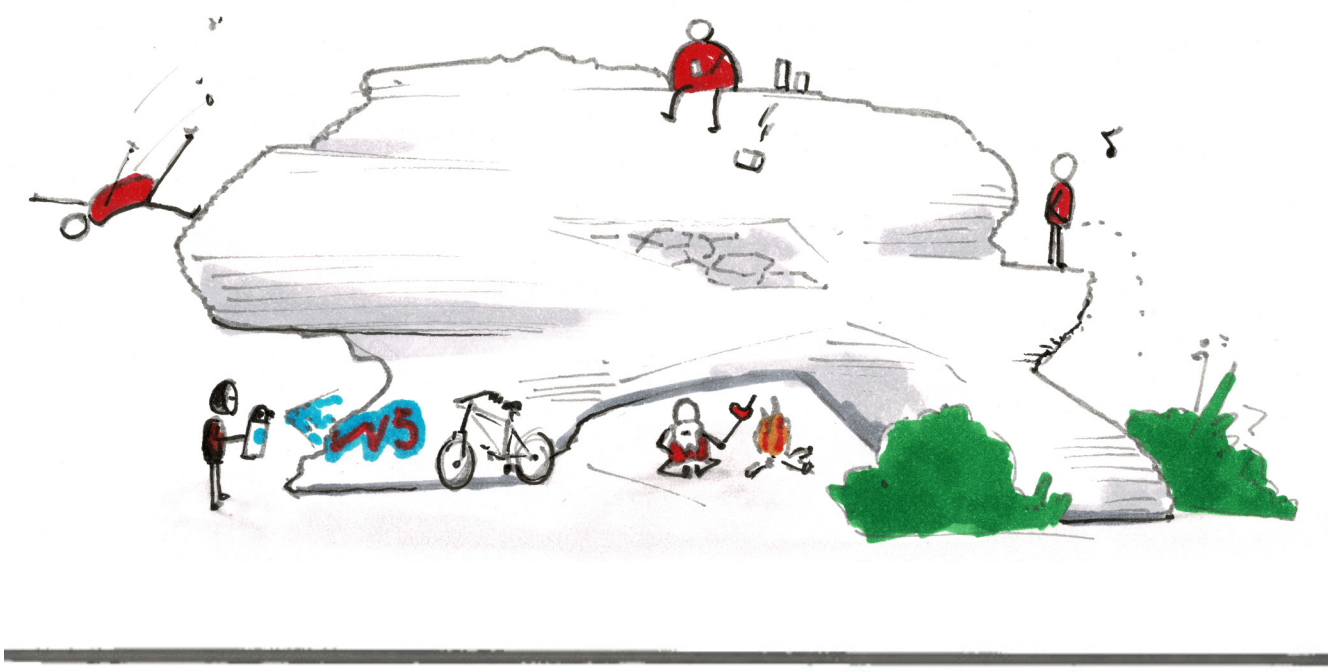


Figure 15.1. Scenario sketch of possible misuse.

Degradation

Figure 15.3, to summarize the scenario. If puddles and holes form around the MAACQ Oase, it might cause a disproportionately fast degradation of the foot. Possibly resulting in unstable structures, tears, or collapse.

- Water trapped inside the material itself or in pools on the MAACQ Oase's topside could cause various problems. For example, tears when it freezes due to expansion, or the support structure inside could degrade faster than the outside, resulting in a hollow shell. Such a shell could give the MAACQ Oase a false appearance of stability. Water could also make the material softer over time, enabling animals or humans to poke holes in the material or fall into it.
- If the outer shell degrades faster on one side than the other due to wind direction the jagged inner structure could become exposed, or this could cause overhangs to break off.
- It could happen that, due to long exposure to the weather the material liquifies, resulting in a pancake which suffocates the soil underneath, or the structure could accidentally roll over.
- Unexpected exposure to certain types of acid or oxidising elements could make the MAACQ Oase undesirably hard, halting the desired degradation process.

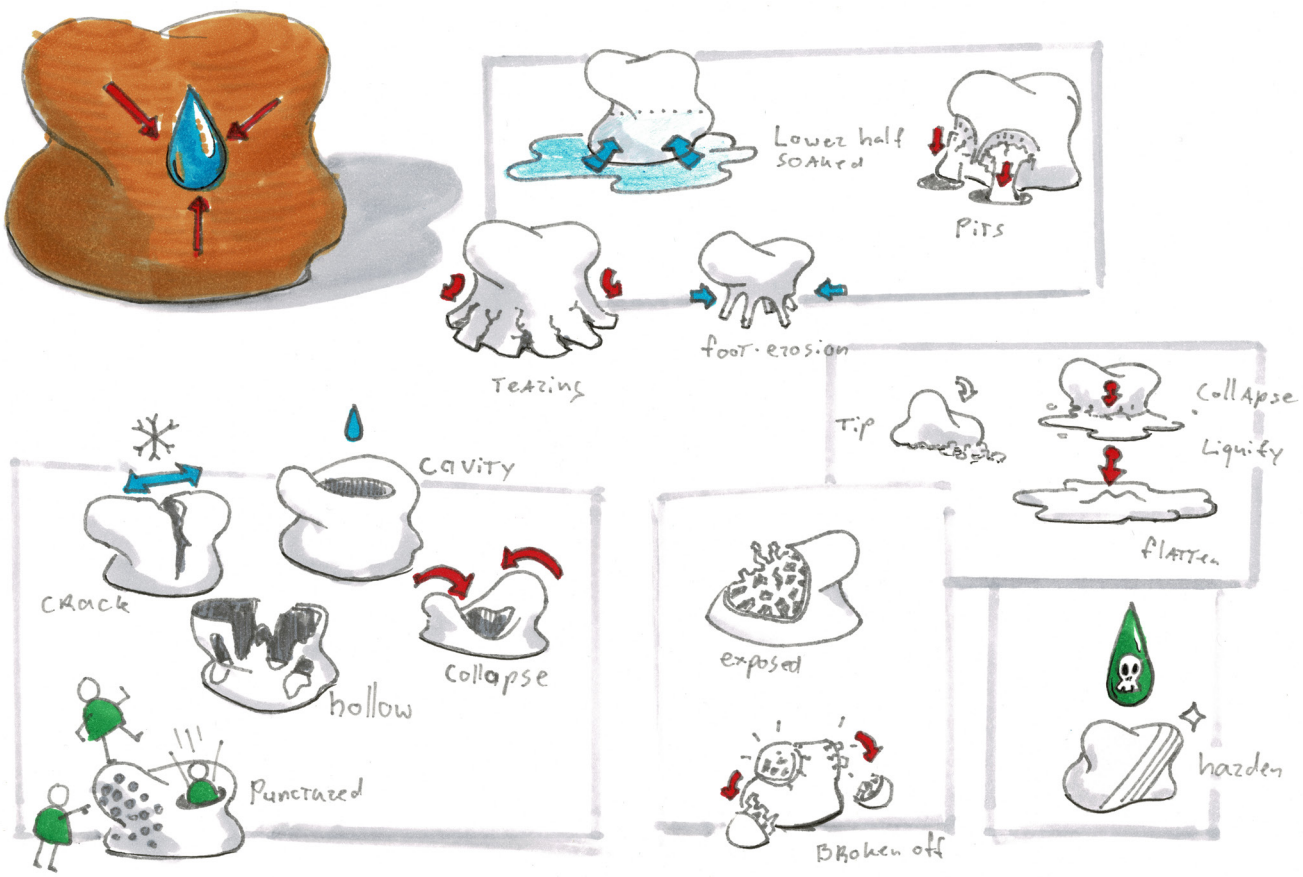


Figure 15.2. Scenario of interactions with weather and events.

Weather influence

Figure 15.2, there are many types of downpours besides rain. Snow could weigh down the MAACQ Oase, and hail could pelt or break it. Heavy rain could dig in paths for the water to follow, resulting in uneven wear. Similarly, puddles could form around and/or underneath the MAACQ Oase, which might soak the material unevenly throughout the MAACQ Oase. The wind could also cause erosion to form cavities or overhangs, at such places, icicles could weigh down parts of the MAACQ Oase. Fluctuations in temperature and sun intensity throughout the days and seasons could wear on the material as well.

Besides these regular weather events, the MAACQ Oase may also encounter rare events, like lightning storms, cold snaps, droughts, fires and even floods.

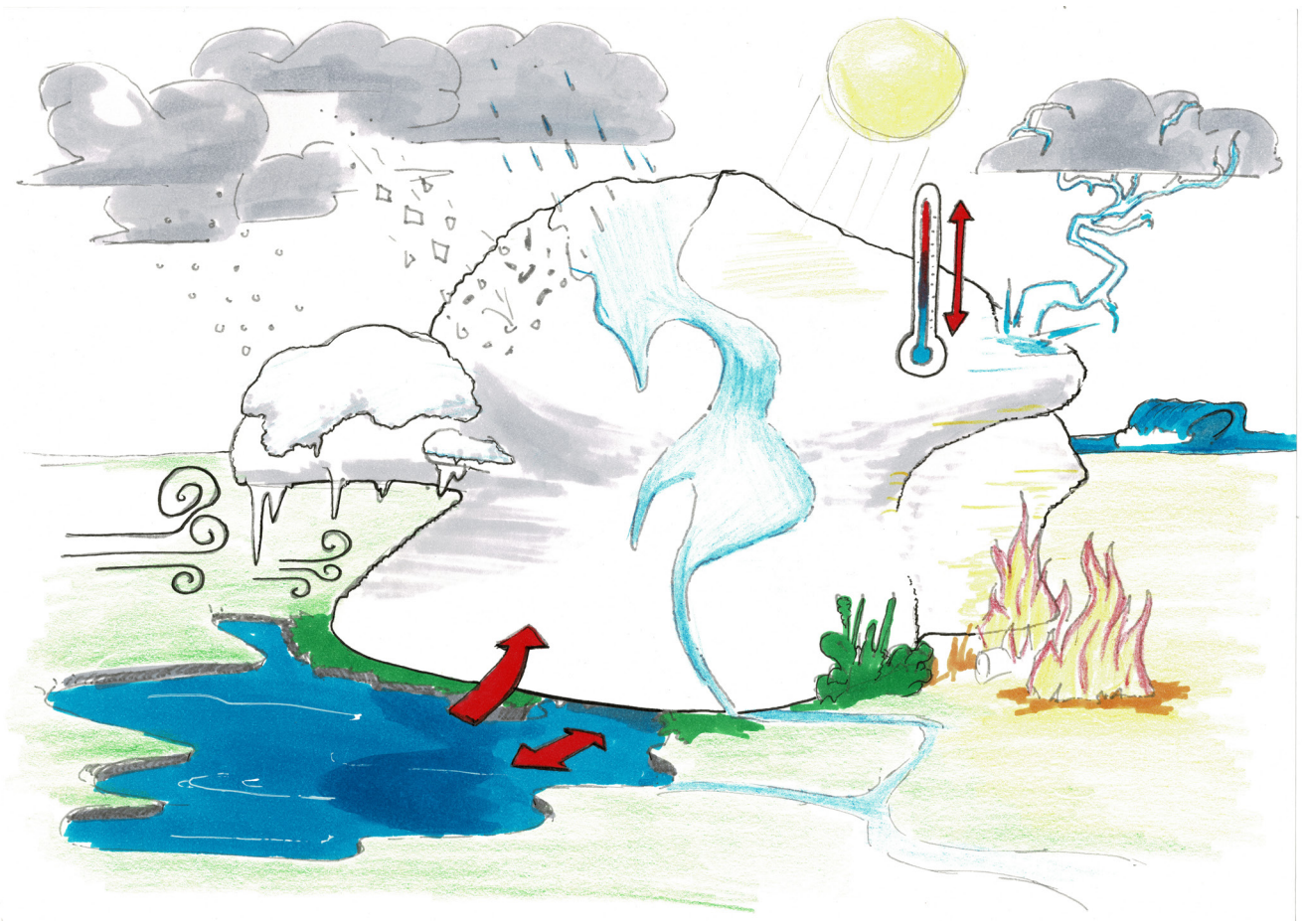


Figure 15.3. Scenario of collapse.

Flora and Fauna interactions

Figure 15.4, small fauna, like insects, rodents and birds might eat, burrow or nest in the MAACQ Oase, which could cause unexpected weak points to form. They might also leave behind excrement, webbings, and husks in the MAACQ Oase.

Large Fauna might choose to use the MAACQ Oase as a scratch post. Deer like something rough to scrape their antlers on and swine like to rub off mud, both these animals can be so rough that it permanently harm trees. Some predatory animals might choose to scent mark the MAACQ Oase to set their territories or use the MAACQ Oase as a hide-out.

Flora might grow in or on the MAACQ Oase, roots of plants like ivy could bind the material together or tear it apart. The inside of the MAACQ Oase might attract mushrooms if it is dank and dark inside.

Figure 15.4. Scenario of interactions with flora and fauna.

16. Appendix VI - Inspiration Cluster Descriptions

Expanding development directions of the MAACQ Oase project

The inspiration phase holds a lot of ideas which were influential to the design process of Birdbead, which were documented in a web of ideas, shown in Figure 16.1. This appendix describes in short statements the ideas and meanings of each set of inspiration images, from top left to bottom right.

Erosion as part of the shape.

- Powders which are released during erosion to increase the spread.
- A structure where the outer 'eggshell' is the last element to erode.
- Sculptures which hang from a wire, with safety benefits.
- Shapes with a surprise inside, like a geode or fruit.

Organic open structures.

- Natural shape inspiration, imitating nature with the design.
- Biomimicry, technical solutions generated like growing like topological and biomorphic design.
- Itero, loops generated with an algorithm which can morph.
- Build-up out of layers, can create infills which appear organic and dry well.

Designed inner structures.

- Fractal based shapes.
- Patterns, which become visible over time.
- Brutalist and futuristic inner shapes.

Splatter

- Products which appear to be dropped or shot at high velocity to be broken up.

Housing

- Shapes which have a real or fictional housing function for animals or humans.

Repeating patterns.

- Inspired by UT artworks, complex large shapes which repeat infinitely.
- Combining similar patterns can give the appearance of new plant species.
- Some patterns or units are based on infill solutions from additive manufacturing.
- Modular elements can combine into a variety of shapes. Using standardized blocks to create a complex structure.

Organic closed structures

- Combining cell-like shapes can make a geometric contour with an organic association.
- Shape language can refer to sickness, infections, and bloating egg sacks to give an eerie quality to a sculpture. Referring to an alien appearance gives a sense of danger and intrigue.

Glitches

- Shapes which appear to be made by a computer error, by stretching recognizable shapes and combining organic and geometric shapes irregularly.

Clash or combine organic and geometric.

- Using Boolean cuts, combinations of 3D models and base geometry, intentional breaks and planned plant growth can all signal a story about human intervention in nature.
- Displaying stratification
- It could degrade like a gobstopper, showing different layers as some parts erode faster.
- Like the first MAACQ Oase prototype, it can reference layers of the earth.
- The use of unnatural colours could accentuate the intervention that the MAACQ Oase is performing.
- Using data as input for the shaping can create an infographic landscape. A reflection of the climate damage that MAACQ Oase is combating.

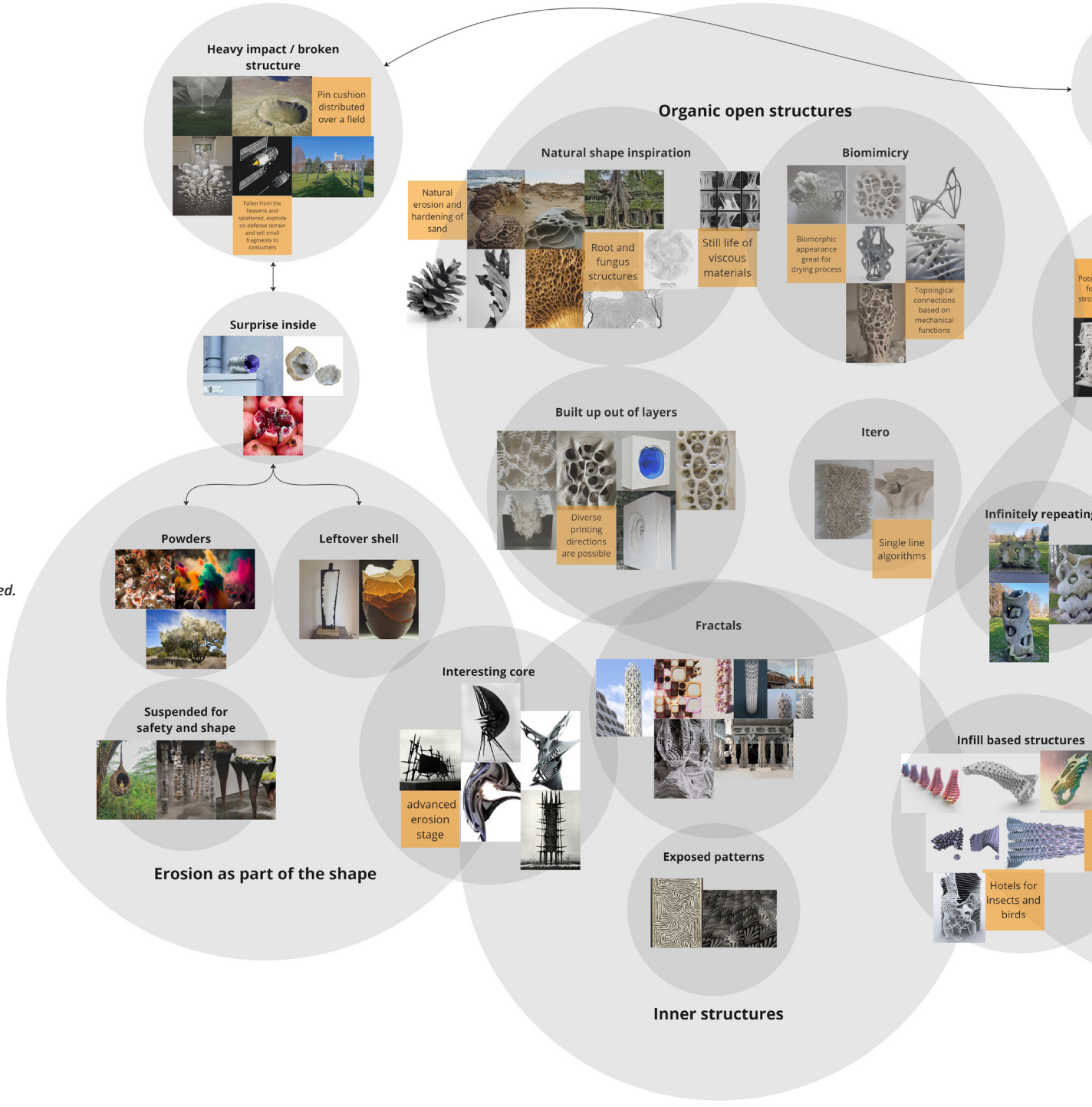
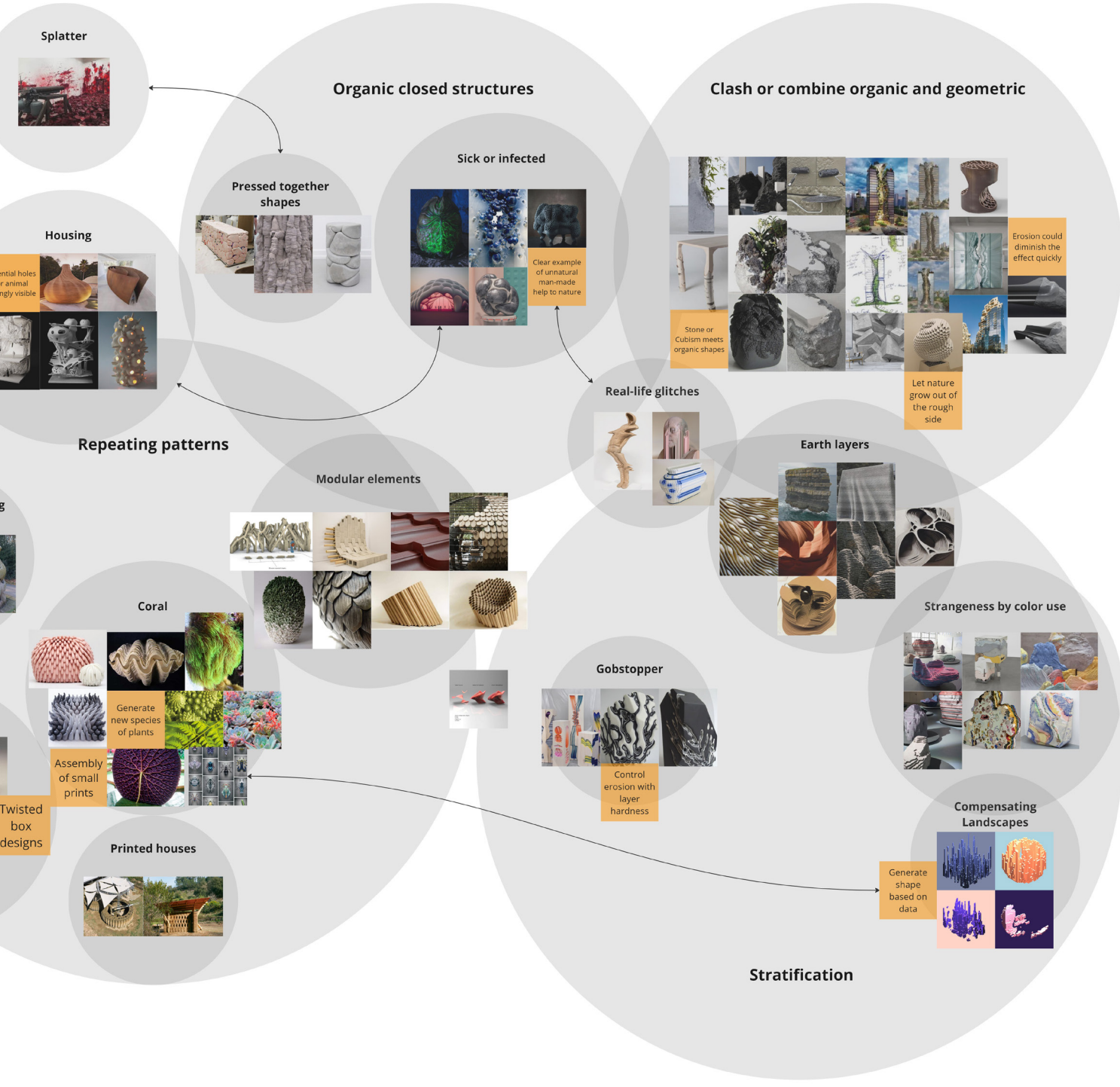


Figure 16.1. Idea inspiration clustered.


Splatter
Organic closed structures
Clash or combine organic and geometric
Pressed together shapes
Sick or infected
Clear example of unnatural man-made help to nature
Housing
Stone or Cubism meets organic shapes
Erosion could diminish the effect quickly
Let nature grow out of the rough side
Real-life glitches
Repeating patterns
Earth layers
Modular elements
Coral
Strangeness by color use
Generate new species of plants
Assembly of small prints
Gobstopper
Control erosion with layer hardness
Twisted box designs
Printed houses
Compensating Landscapes
Generate shape based on data
Stratification

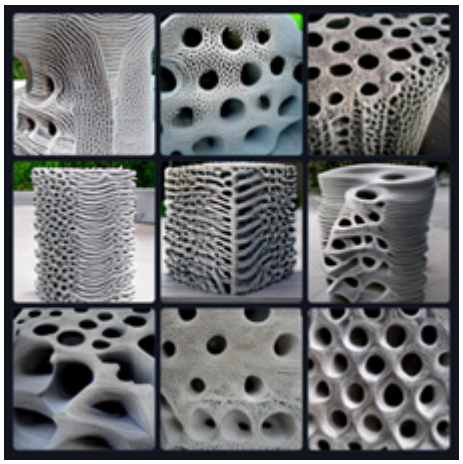
17. Appendix VII - AI-generated images

AI AS A SOURCE OF SHAPE INSPIRATION

The use of AI image generation tools was very limited in the design processes of this Thesis, other sources of inspiration were found to be more usable and meaningful, the AI-generated images were limited to inspiring the visual domain, and no new functions or meanings were gleamed from the AI tools. Nevertheless, these images were part of the inspiration process.

The images were made in three batches, shown in Figure 17.1, Figure 17.2, and Figure 17.3. The AI tools used for this are CrAIyon, a text-based image generator, and Hotspot, which can modify an image based on a text prompt.

1



2

3

4

5

Figure 17.1. Sculptural artwork images generated with CrAIyon. *The objective of using AI was to reimagine the MAACQ Oase through the lens of MAACQ Oase. These images were generated on 09/12/2023.*

Prompts used to generate the images in Figure 12.18:

1. A 3D-printed concrete art sculpture based on the layers of the earth and water that will save the Netherlands from Nitrogen acidification.
2. Artistic 3D printed concrete structure with a layered texture and with holes that many critters can live in, and plants can grow on.
3. Artistic 3D printed dark brown concrete sculpture with a layered texture and with holes that many critters can live in, and plants can grow on placed in a natural reserve park.
4. Bulky 3D printed sculpture with earthy colours and a layered texture placed in the Netherlands.
5. Artistic 3D printed earthy colours concrete sculpture with a layered texture and with plants growing out of it placed in a natural reserve park which erodes over time.

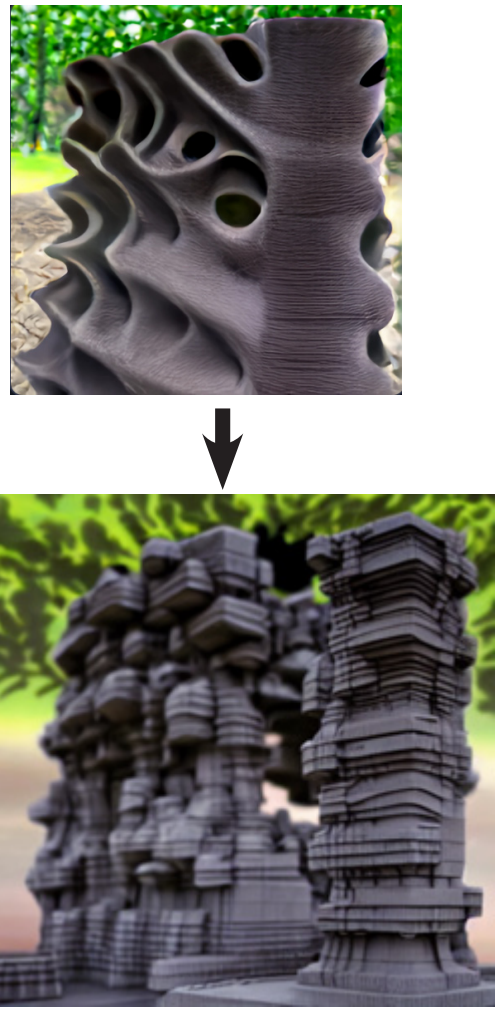


Figure 17.2. Image generated with Hotspot.
Generated on 09/12/2022, based on an image previously generated with CrAIyon.

The prompt used for generating Figure 12.19 was the same as Figure 12.18.3: Artistic 3D printed dark brown concrete sculpture with a layered texture and with holes that many critters can live in, and plants can grow on placed in a natural reserve park.

The prompt used for generating Figure 12.20 is 'Design a parametrically defined stackable birdhouse around a central pole with an organic and functional appearance.'

Figure 17.3. Birdhouse images generated with CrAIyon.
The objective was to gather inspiration for designing the Birdbead on 25/05/2023.

Thank you for reading