TU Delft

Thesis project
A.M.J. van der Wal

A Framework for the Agency of Sketching

Annemiek van der Wal
November 2023

Delft University of Technology
MSc Design for Interaction

Supervisory team:
Ir. Hoftijzer, J.W.
Ir. Haans, M.C.
Human Centered Design (HCD)

Faculty of Industrial Design Engineering

A Framework for the Agency of Sketching

Abstract

Previous scholars have advocated the significant value of sketching in design processes. This thesis project first explores how design sketching functions as an agent for design, building on insights derived from both theory and practice. Interviews with professional designers in the field reaffirm the functions and importance of sketching. Not only for designers themselves, but also for their clients and consumers. Given the value of sketching and the variety of stakeholders involved, this research then aims to structure the affordances of design sketching in a practical framework.

Considering that affordances must be discoverable and perceivable in order to be effective, this project subsequently proposes ideas for transforming the framework into a tool that will help designers to rediscover design sketching and unlock its benefits.

Keywords:

sketching; design drawing; visualization; interaction; affordances; agency

Executive summary

This thesis project aims to answer the following research question: “What was and is exactly the agency of design sketching with its affordances in the past, in the present and probably in the future?” To answer this question, the various roles of sketching in different design phases are studied, taking both a theoretical and practical perspective.

Following a general introduction to the themes, definitions and scope of the project, chapter 4 begins with a review of the literature to produce a cohesive theoretical foundation for the role of sketching in the design process. Existing literature in the field of design sketching often lacks a wider view on the human perception of pictorial representations in general. However, the perception of sketches by non-designers, such as clients, is increasingly important. Therefore, the rest of chapter 4 zooms out to provide a perspective beyond ‘design sketching’: the human psychology behind the perception of sketches and paintings. This leads to a better understanding of the interactive human role that is involved concerning the agency of design sketching.

Chapter 5 focuses on design sketching in practice. Firstly, it analyzes the development of design sketching from the twentieth century till now. Thereafter, to gain insights on design sketching in modern times, the results of interviews with five designers are presented. This offers crucial insights into the contemporary context of design sketching as well as knowledge of current approaches to upcoming trends that are appearing in this field and might shape the agency of sketching.

The interviews provide two observations. Firstly, there appears to be a decline in the sketching skills of young designers entering the work field. Secondly, designers tend to increasingly pay attention to the affordances of drawing with regard to outwards communication, rather than a focus on internal affordances. This might lead to an unbalanced practice of design sketching, in which some core affordances with regards to the design process are lost.

Hence, the situation calls for increased recognition of the significance of sketching in design. Chapter 6 aims to explain the key aspects of sketching for designers. The essential theoretical affordances of sketching are captured in a framework that reveals the agency of design sketching.

The Framework for the Agency of Sketching should be applicable in practice, with the following goal: to let designers rediscover design sketching as an agency and unlock its benefits. Therefore, chapter 7 provides a vision on realizing this. So, while the primary focus of this thesis project revolves around the development of the theoretical framework, its possible application in practice is briefly explored, leading to the proposal of two concept directions.

Table of contents

Theoretical perspective

Practical perspective

Converged

CONTENT VISUALIZED

1: INTRODUCTION

2: MAIN DEFINITIONS

3: PROJECT SCOPE

RESEARCH QUESTION:

"WHAT WAS AND IS EXACTLY THE AGENCY OF DESIGN SKETCHING WITH ITS AFFORDANCES IN THE PAST, IN THE PRESENT AND PROBABLY IN THE FUTURE?"

8: CONCLUSIONS AND DISCUSSION

7: APPLICATION OF THE FRAMEWORK

6: A FRAMEWORK FOR THE AGENCY OF SKETCHING

4: A THEORETICAL PERSPECTIVE: THE FUNCTIONS OF DESIGN SKETCHING

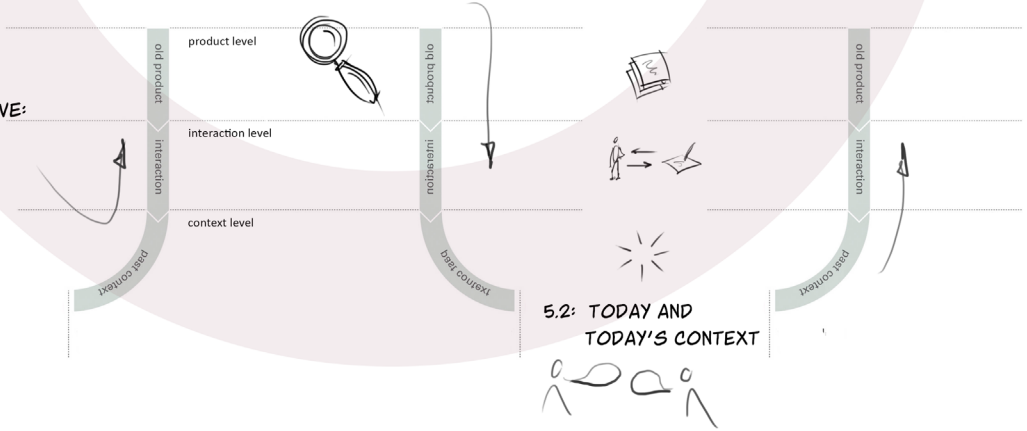
4.1: STUDIES ON DESIGN SKETCHING

4.2: BEYOND DESIGN SKETCHING: PSYCHOLOGY BEHIND PICTORIAL REPRESENTATIONS

5.1: THE HISTORICAL CONTEXT

5.3: TOWARDS THE FUTURE

5: A PRACTICAL PERSPECTIVE: DESIGN SKETCHING AS AN AGENCY



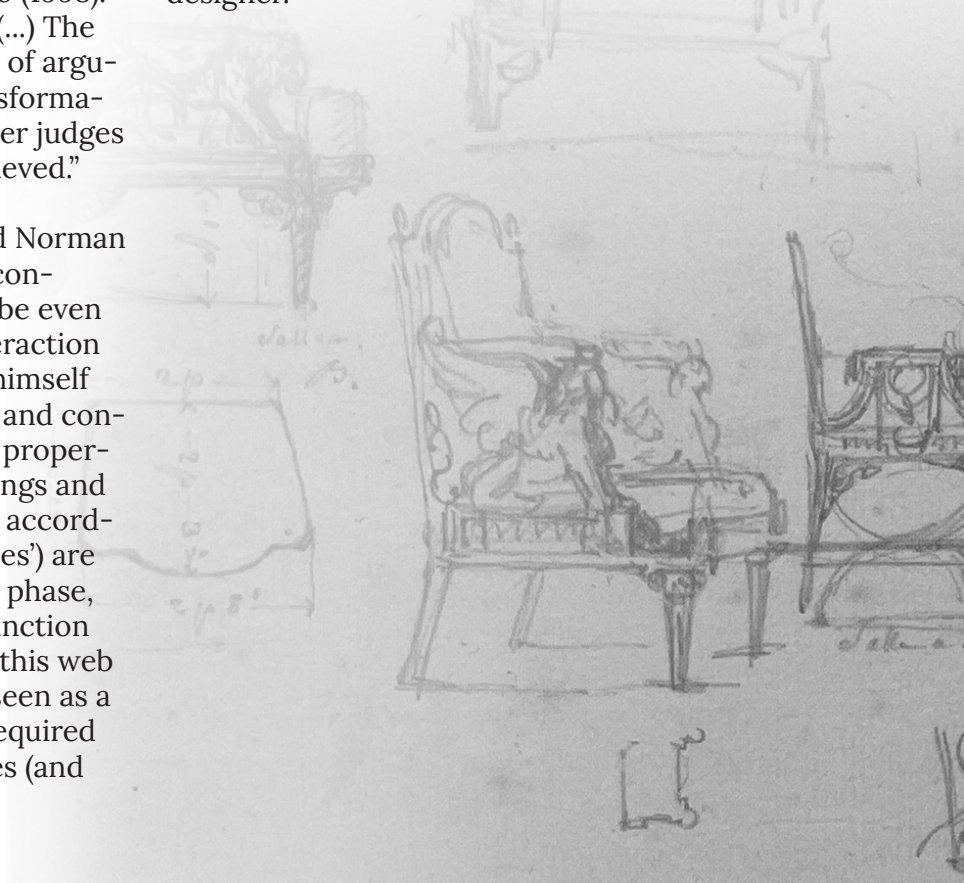
5.2: TODAY AND TODAY'S CONTEXT

1. Introduction

Sketching is a way to (re)organize and develop thoughts, arouse emotions, encourage action and cooperation and inform yourself or others, with which one can reflect (Tversky, 2011). It is inextricably linked to design, as the original Italian word 'disegnare' actually means drawing. Results of a study by Corremans and Vaes et al. (2018) show that students with better sketch competences are more likely to score higher for their product design projects. Drawing during the design process could maximize the conditions necessary for the reinterpretation of an image and the emergence of new ways of 'seeing it', according to Purcell and Gero (1998). Goldschmidt (1991) defines sketching: "(...) The dialectics of sketching is the oscillation of arguments which brings about gradual transformation of images, ending when the designer judges that sufficient coherence has been achieved."

When considering the theory of Donald Norman about affordances in design, we could contemplate the relevance of sketching to be even higher. I found that there is a lot of interaction between drawings, the designer her-/himself and other stakeholders, such as clients and consumers. The relationships between the properties of both the different kinds of drawings and the interacting parties involved (which, according to Norman, can be called 'affordances') are defined by multiple aspects (e.g. design phase, stakeholders involved, industry field, function of the final design, use of materials). In this web of influencing factors, drawing can be seen as a major agent for design; providing the required affordances. To be effective, affordances (and anti-affordances) have to be discoverable - perceivable (Norman, 2013). In this project, I will focus on that subject.

In order to do that, I will research how the interactions between design drawings and their different stakeholders have developed throughout the years and how sketching has functioned and functions as an agent for design. Design sketching has long played a role in cataloguing, in a commercial sense, and as a blue-print for production and consistency, in addition to its artistic value and its developing function for the designer.



The Design Museum of Den Bosch recently opened an exhibition that presents a collection of design drawings from the period of 1500 till 1900 (see book 'Process' by Reinier Baarsen), which shows a wide range of drawings with different functions, styles and purposes. Studying these historic and more recent drawings and a variety of literature studies that cover this field, like Tversky and Goldschmidt, sketching appears to have always been an agent for design and still is, affording the people involved to think, elaborate and reflect.

Given the various purposes of sketches and sketching, and given the various stakeholders involved, and given the varying contextual factors, this thesis aims to research and position these elements in a working model: a framework, in order to structure the gained knowledge and insights. Finally, a tool will be proposed, that will stimulate contemporary designers to experience the benefits of the agency of sketching in practice.

2. Main definitions

To provide clarity, a range of terms will first be defined. These terms are mentioned several times in this thesis report, wherefore a clear understanding beforehand is valuable.

2.1 'Agency'
In order to research and address design drawing as an agent for design, it is important to first clarify the phenomenon of 'functioning as an agent'. According to Oxford Languages, an 'agency' can be defined as an 'action or intervention producing a particular effect'. Like rivers can be carved by 'the agency of running water', one could say that design takes place by 'the agency of sketching'. An agent can be seen as a tool to achieve certain goals (Vertalen.nu). Reddy et al. (2020) even approaches agency as the emergent result of active and continuous (re) configuration, something interactive. Considering the fact that sketching, with all of its various purposes, interacting parties and influencing factors, provides us with multiple required affordances all the way through the design process (which will addressed in this thesis research), using this described definition of an 'agency' for sketching seems to fit.

2.2 'Drawing' and 'sketching'
Furthermore, an important note should be made about the (difference in) meaning of 'drawing' and 'sketching'. Etymologically, drawing means producing or tracing an image (someone or something) by making lines and marks on paper, while sketching is a preliminary depiction of something that is not concrete yet (Hoftijzer, 2018). Drawing and sketching are two forms of visualization that are very alike, apart from the subtle difference that sketches are more likely to be incomplete in comparison to drawings. However, the same could be said about drawings: "There is something technically and, even more importantly, creatively unfinished even in the most finished graphic works. This internal and external flux, this fluidity of the image, this incompleteness, is one of the characteristic dimensions of the aesthetics of drawing." (Graschenkov, 1995). Defining the differences between drawing and sketching seems to be hardly possible in an unambiguous way. Therefore, in this thesis the words will both be used, mostly meaning the same.

2.3 'Drawing' versus 'design drawing'
In this thesis, design drawings as well as other kinds of pictorial representations will be used, within certain explorations and explanations. Therefore, it is valuable to make a concise distinction between the drawings we make for the discipline of design and other kinds of drawings. Generally, the specific purposes behind the making of these drawings differ: design drawings may have a more specific function, e.g. communicating how a product should be build,

how the intended interaction with the product takes place, what alternatives can be implemented. However, all of these functions of the drawings lead back to an overarching aim of the artist: communicating. They do that by externalizing thought and, with that, informing both self and others (Tversky, 2010).

Hence, drawings have in common that they convey information. This can be abstract information, just to create a certain atmosphere, by the use of light, colours, certain stroke techniques, et cetera. It can also be information specifically about the characteristics of people, products or space. Every artist of a drawing or a painting chooses a subject with the purpose of communicating something to himself or to others. In fact, most drawings, including design drawings, have the same purpose. For that reason, not only design drawings, but also a variety of other kinds of drawings, and even paintings, will be addressed within this thesis project. The variety of visuals, so-called pictorial representations, will be involved for the purpose of theoretic reasoning and analysis; having relevance towards answering the research question.

3. Project scope

With regard to the set period of time concerning this graduation project, it's important to set a scope. Therefore, inspired by the exhibition of Design Museum Den Bosch with the time frame of 1500-1900 (Baarsen, 2023), I will focus both on the historical context and on today and today's context, with a larger focus on the latter. The research project, providing information for contemporary industrial designers, will have the following set-up.

3.1 Research question

"What was and is exactly the agency of design sketching with its affordances in the past, in the present and probably in the future?"

3.2 Sub-questions

To provide guidance throughout the answering process, the main research question is divided into the following sub-questions:

- What are the functions and purposes of design sketching in theory?
- What was the agency of design sketching in the successive period of the 20th century until now?
- What is the agency of design sketching in practice nowadays and probably in the nearby future?
- How can the affordances of the agency of design sketching be made discoverable/perceivable for contemporary designers in practice?

This report will respond to the sub-questions through its various paragraphs.

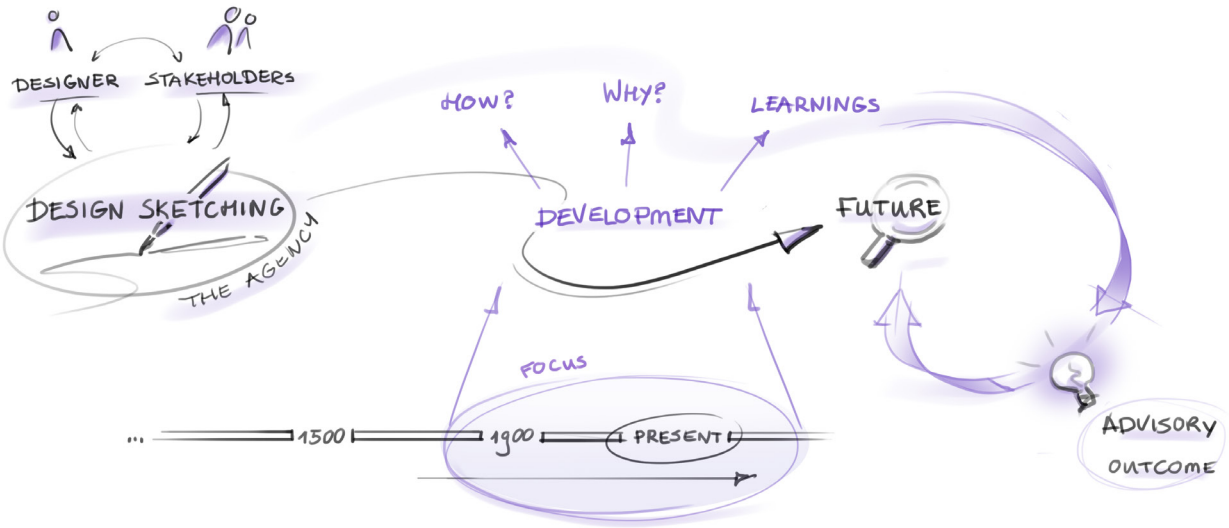


Figure 1: Overview of research area

3.3 Thesis goal

The aim of the project is to do research on the activity and purposes of design drawing and the involved stakeholders. The research outcomes will be utilized to create a framework, to serve as an advisory model for contemporary designers (e.g. a toolkit or method).

The theory of Donald Norman will be used and the VIP method will be considered to apply as a frame of reference, as well as literature, musea and interviews with designers. The final deliverable will be this report describing research findings and highlighting the most important insights. Additionally, inspired by Norman's statement "To be effective, affordances (and anti-affordances) have to be discoverable - perceivable", I will map out the affordances that are created by design drawing. I expect this to be a shaped model/framework, that involves valuable knowledge, functions, styles and context factors, that can be used by contemporary industrial designers or design agencies in general to see in what way, during the process of designing, we can use drawing to achieve the desired design goals. Therefore, the framework must be accompanied by a realistic vision of how this knowledge can be applied in practice.

3.4 Approach

To reach this goal, I will go through a loop of activities that together will provide enough information to answer the research questions and to create the described framework.

In order to do that, research will be done on both (design) sketching in theory and design sketching in practice. This twofold approach is visualized in figure 2.

First of all, a review of the literature will be provided to produce a cohesive theoretical foundation for the role of sketching in the design process. Secondly, I will zoom out to provide a perspective beyond 'design sketching': the human psychology behind the perception of sketches and paintings in general. This leads to a better understanding of the interactive human role that is involved concerning the agency of design sketching.

Thereafter, I will focus on design sketching in practice. Firstly, the development of design sketching will be analyzed from the twentieth century till now. In order to do this research in a structured way, the gained insights will be categorized, according to three levels inspired by the VIP method (Hekkert & Van Dijk, 2011): product level, interaction level and context level. The first will be about the characteristics of the sketches themselves (the 'products'), the second about the interaction between the involved people (like stakeholders) and the third about the influencing aspects of the surrounding context (e.g. the emergence of new technologies). Reflecting on these factors will provide insights on how and why sketching as an agency developed in past times, leading up to today and today's context.

Thereafter, to gain insights on design sketching in modern times, interviews will be conducted with five designers, particularly chosen for their active involvement with design and sketching in practice. Nevertheless, each serving a different field (cars, products, visual strategies) and each having a different professional position (company/independent/manager/employee). Of course, this does not pretend to cover the entire contemporary design sketching context, but it will offer insights into the contemporary context of design sketching as well as knowledge of current approaches to upcoming trends that are appearing in this field and might shape the agency of sketching.

Subsequently, the obtained theoretical and practical perspectives will lead to the creation of a framework, in which the most essential affordances of sketching will be captured to reveal the agency of design sketching.

Overall, the goal with this approach is to study what the agency of sketching was, is and probably will be in design. Inspired by the statement of Norman: "To be effective, affordances (and anti-affordances) have to be discoverable - perceivable", the approach will end with an exploration on how the theoretical framework can be applicable in practice.

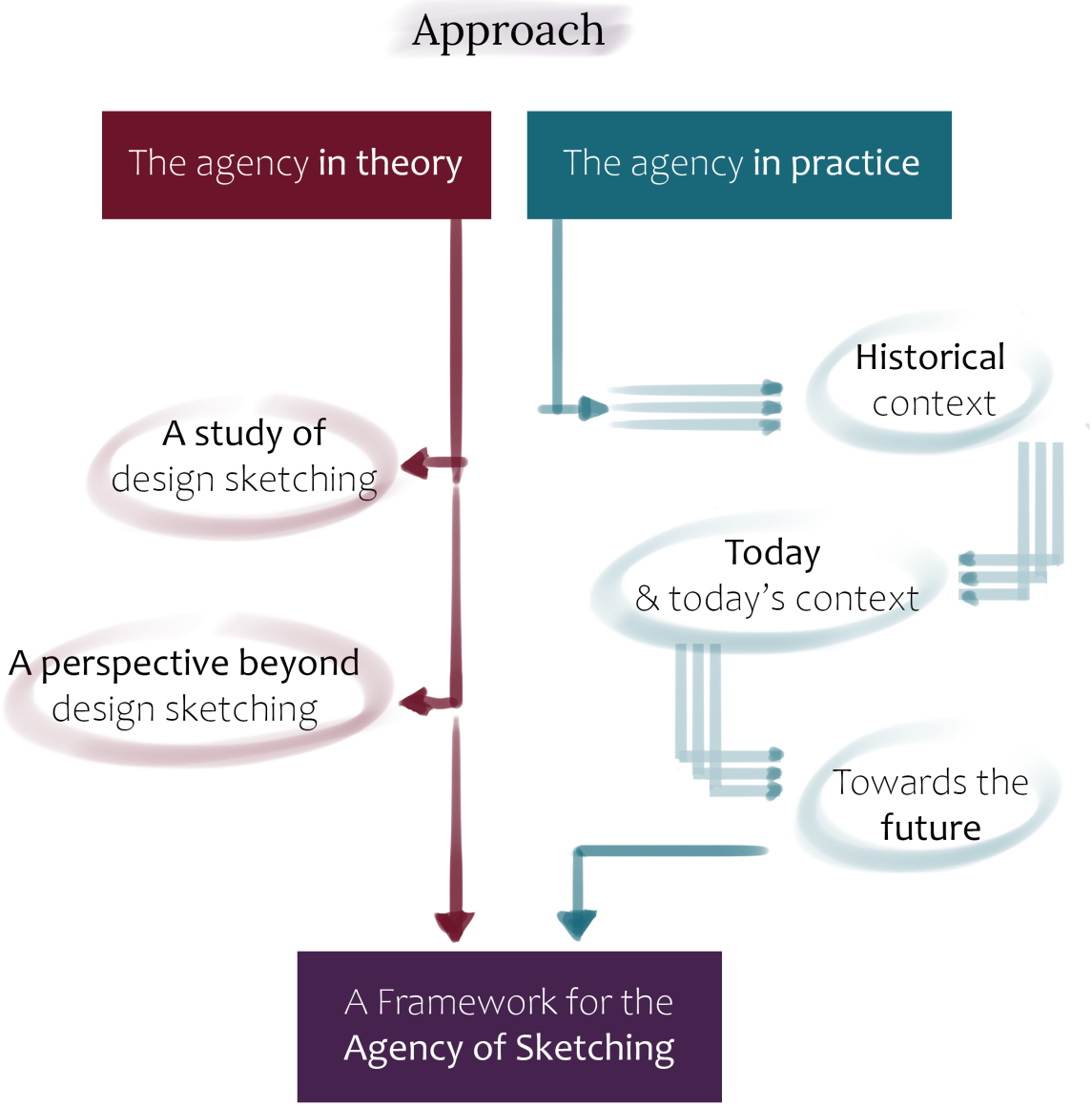


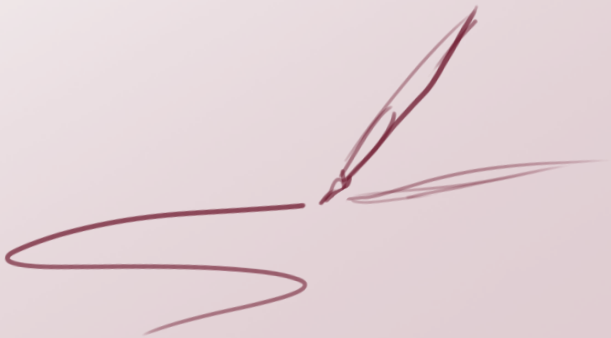
Figure 2: Overview of approach

4 A theoretical perspective on design sketching as an agency

Drawing: it is a form of communication used all over the world. We could see it as a language. A language that seems to be better understood than most written languages.

"Like language, visual communications abstract and schematize; unlike language, they use properties of the page and marks on it to convey meanings. The visual expressions of these meanings have analogs in language, gesture, and especially in the patterns that are created when people design the world around them." (Tversky, 2010)

As drawing is inextricably linked to design, this chapter concerns a theoretical approach to help getting a vision on how sketching works as an agency for design.



The chapter is formed by two parts:

1) Literature studies on design sketching (4.1)
2) A perspective beyond design sketching (4.2)

First of all, in 4.1, a variety of studies will be analyzed and connected, in order to deduce the various functions and purposes of design sketching. The gathered insights will contribute to the creation of the final framework.

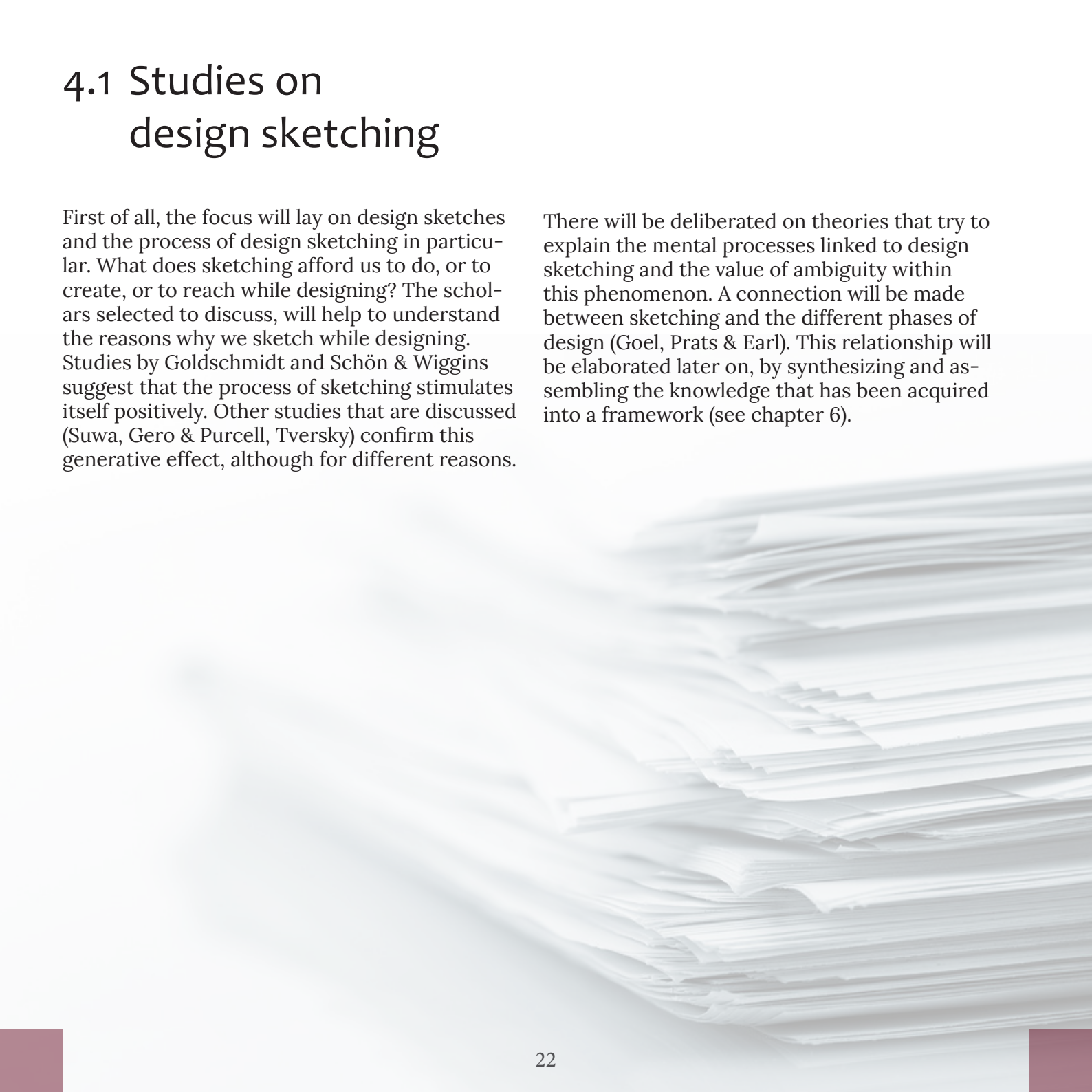
Secondly, section 4.2 concerns a broad view: a perspective beyond 'design sketching' in specific, to have a concise look at the psychology behind our perception of all sorts of sketches and paintings (pictorial representations in general). This section is added to help understand the human perception of sketches; by designers as well as by non-designers, such as clients, which is increasingly important in the work field (see chapter 5). Subsequently, the section aims to provide a better understanding of the interactive human role that is involved concerning the agency of design sketching.

Figure 3: Drawings evoking human interaction - designers at Granstudio in conclave (photo shared by Ewoud Luppens)

4.1 Studies on design sketching

First of all, the focus will lay on design sketches and the process of design sketching in particular. What does sketching afford us to do, or to create, or to reach while designing? The scholars selected to discuss, will help to understand the reasons why we sketch while designing. Studies by Goldschmidt and Schön & Wiggins suggest that the process of sketching stimulates itself positively. Other studies that are discussed (Suwa, Gero & Purcell, Tversky) confirm this generative effect, although for different reasons.

There will be deliberated on theories that try to explain the mental processes linked to design sketching and the value of ambiguity within this phenomenon. A connection will be made between sketching and the different phases of design (Goel, Prats & Earl). This relationship will be elaborated later on, by synthesizing and assembling the knowledge that has been acquired into a framework (see chapter 6).

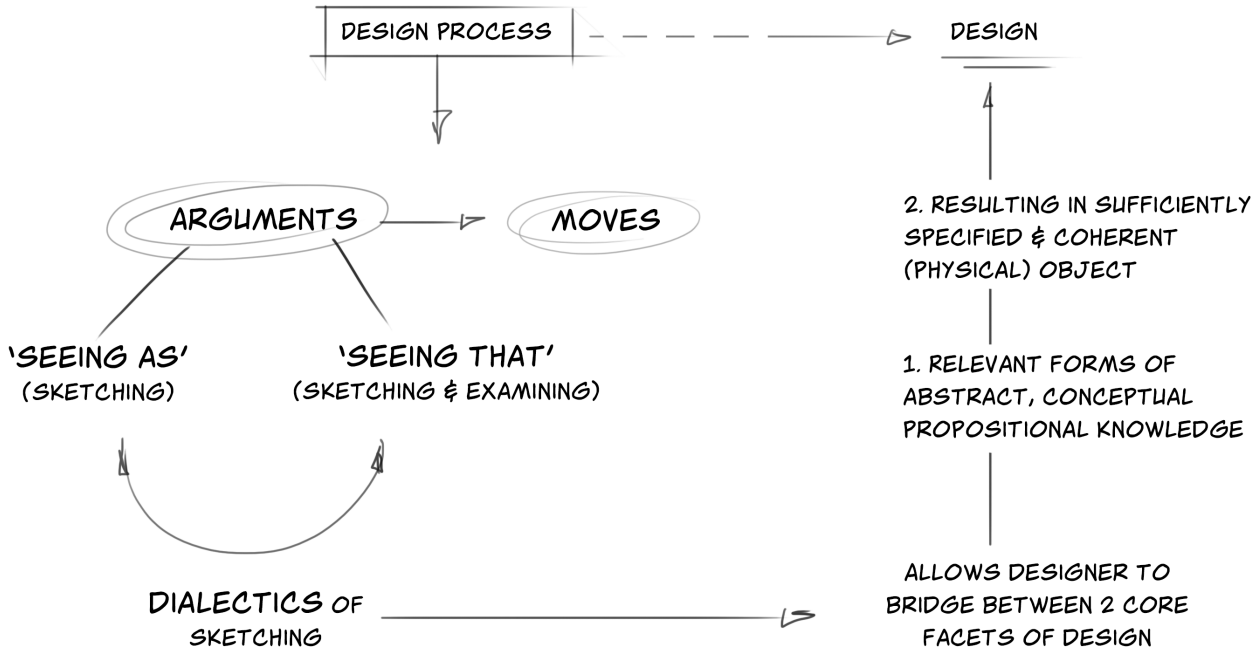


4.1.1 The dialectics of sketching

When we sketch, we visualize the things we imagine in our head. One could say that during this process of sketching, we are constantly bridging between thinking and seeing, which keeps determining our so-called movements. Goldschmidt (1991) therefore schematizes the design process, with particular emphasis on the activity of design drawing, into 'moves' and 'arguments'. Arguments, that determine the moves, can be of two types – 'seeing as' and 'seeing that': distinguished between interpreting figural properties during sketching (seeing as) and interpreting conceptual properties by sketching and examining (seeing that). This creates a generative dialogue that aligns the design process with both abstract, conceptual ideas and concrete object specifics, turning into a final design (see figure 4).

The described dialectics between 'seeing as' and 'seeing that' can be related to the four drawing purposes Cohen introduced in 1997: it trains one to observe (linked to 'seeing as'), make representational decisions and movements on the basis of motor skills, and to reflect (linked to 'seeing that'). According to Hoftijzer (2018), another step could be added, which is 'imagination': "Learning these four elements allows one to take the next step: imagining", he states (see figure 5). This ties in with the subsequent step Goldschmidt describes: observation of the imaginary will help to bridge between abstract knowledge and a specific outcome.

Figure 4: The 'dialectics of sketching' by Goldschmidt (1991): bridging between different kinds of arguments to determine our sketching moves and final design



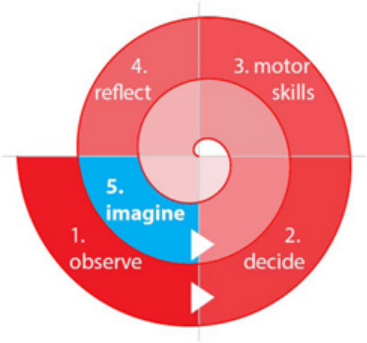


Figure 5: Model for learning how to draw (Hoftijzer 2018, inspired by D.J. Cohen)

4.1.2 Unintended consequences of moves

Next to these dialectics between 'seeing as' and 'seeing that', the movements are made. These can be done intentionally, but they can also be the unintended consequence of thinking, or, according to Schön & Wiggins (1992), seeing. They stress that the consequences of unintended and unexpected moves help to get more design knowledge into the consciousness of the designer. They contend that seeing unintended moves triggers the interconnectedness among different knowledge domains related to the design process and brings them into consciousness (see figure 6). They add that it is this level of interconnectedness that distinguishes experts from novices. (Purcell & Gero, 2006). This described process initiated by sketch moves, can result in the improvement of both quantitative and qualitative characteristics of idea development.

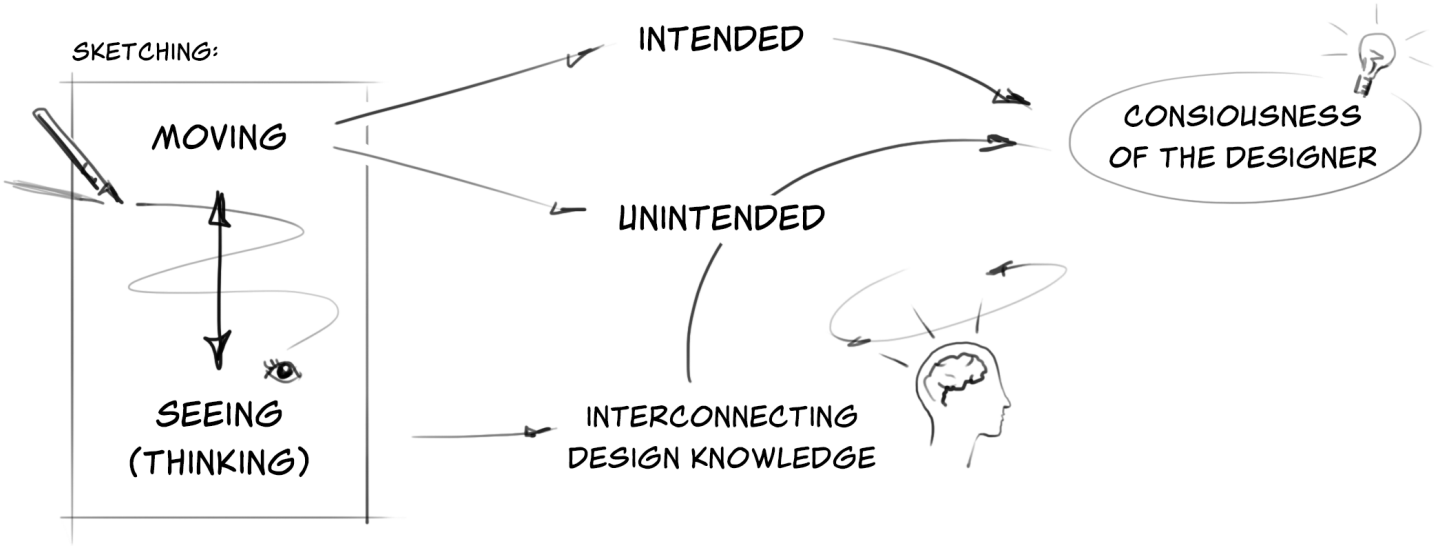


Figure 6: The consequences of unintended moves allow interconnected design knowledge domains to reach the consciousness of the designer, according to Schön and Wiggins (1992)

4.1.3 Transformations

Goel (1995) links the purpose of drawing directly to the different stages within the design process (figure 7). So, this act of seeing, moving and seeing, or the 'dialectics of sketching' that Goldschmidt mentions, is transforming during the problem-solving process. The sketches that are made during the preliminary phase of design, are less structured, precise and explicit. Furthermore, these sketches can be identified as lateral transformations: there is a movement from one idea to a different idea. Later on, vertical transformations can be identified: one idea is transforming into a more detailed form.

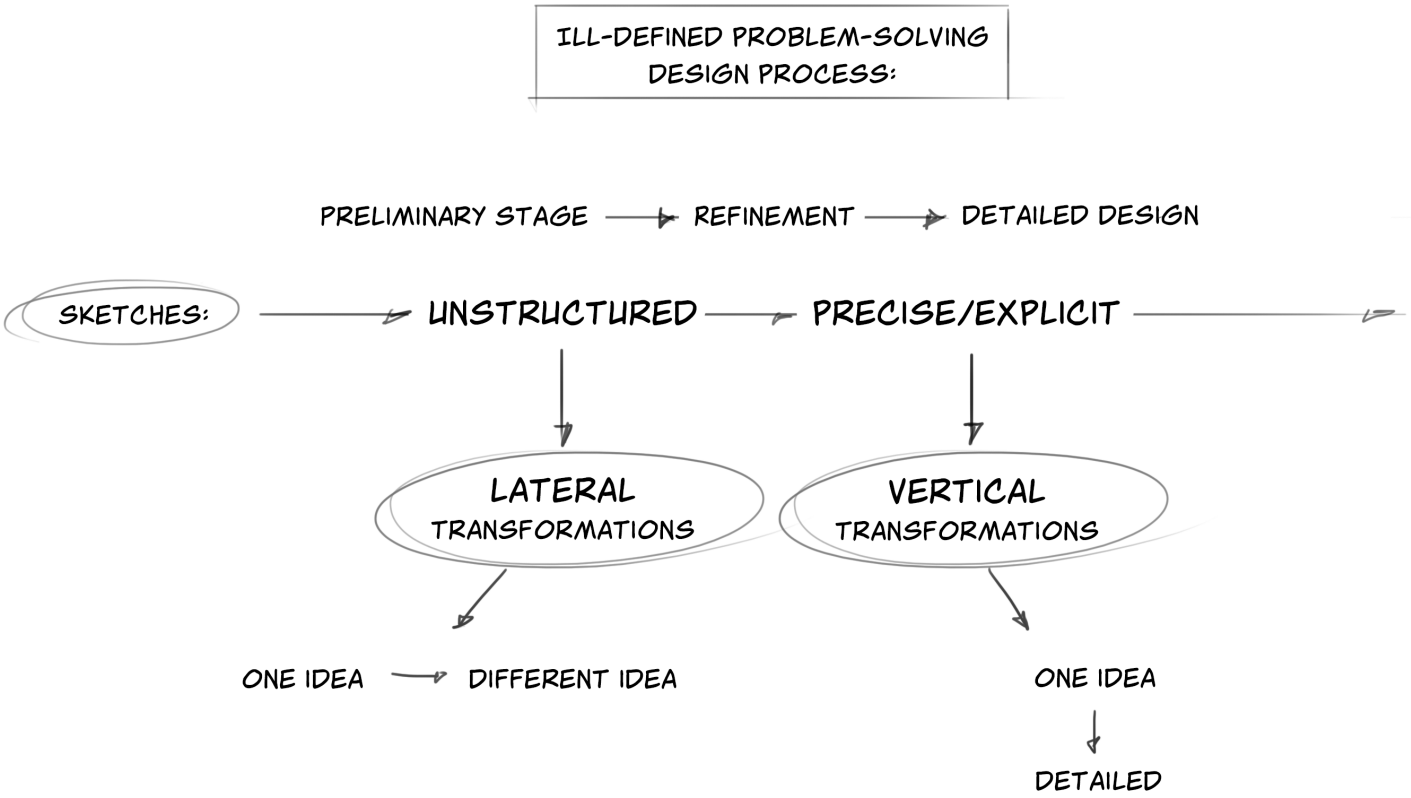


Figure 7: Transformations of sketches during the design process, theorized by Goel (1995)

If we zoom out, the two sorts of transformations that are defined by Goel can be related to the 'double diamond' model of the design process (British Design Council, 2005). While discovering and ideating, 'divergence' will appear: the designer is likely to come up with all sorts of ideas. However, during the moments of 'convergence', the designer will let go of most ideas and will work out one idea into a thought-out vision or concept. Subsequently, these movements of diverging and converging correlate with the lateral and vertical transformations of sketches throughout the design process (figure 8).

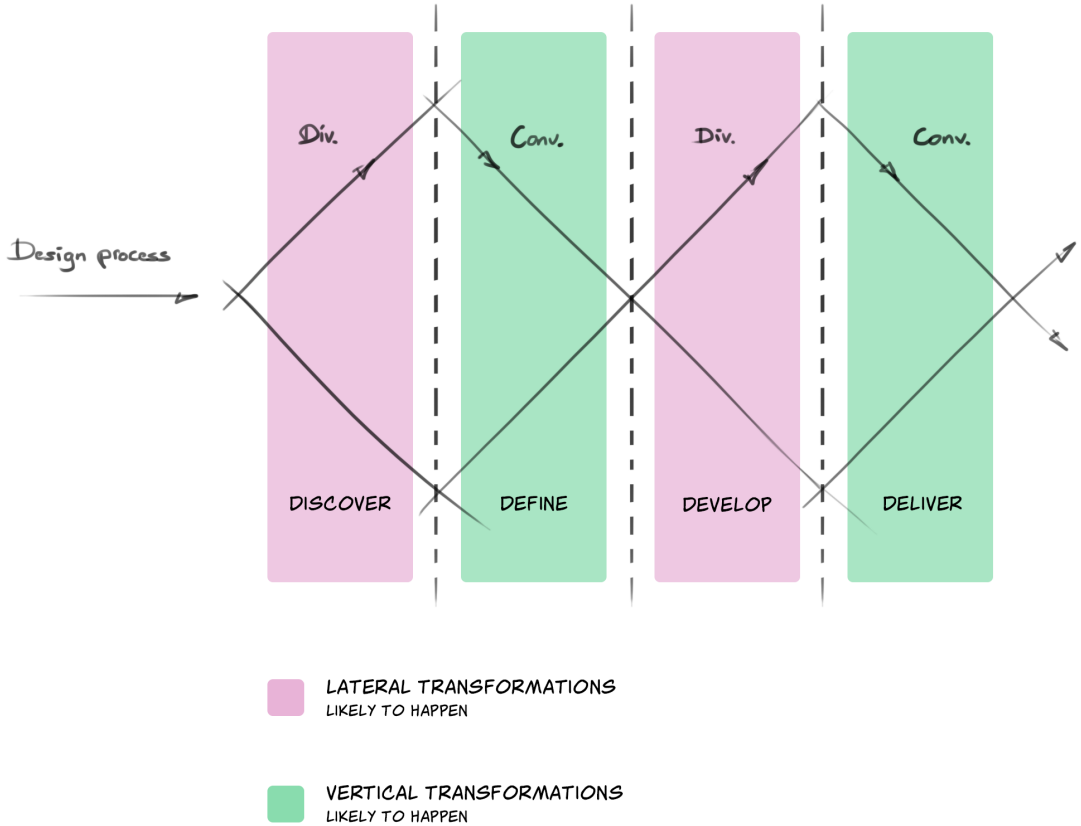


Figure 8: Transformations (Goel, 1995) throughout the design process of diverging and converging ('double diamond' model by British Design Council, 2005)

An important note to take into account, is that the identification of these transformations can not only be made by distinguishing visual shape modifications, but also by the designer's interpretation (Prats and Earl, 2006). For example, the dinner table in figure 9 may have undergone two possible changes in the design process. If only the dividing seam with hinges has been added, so that part of the table top can be folded in, this has been a form of detailing and therefore vertical transformation. However, if the right part of the table top was an extension of the existing body of the table, this can be considered as a movement towards a different kind of table, wherefore lateral transformation.

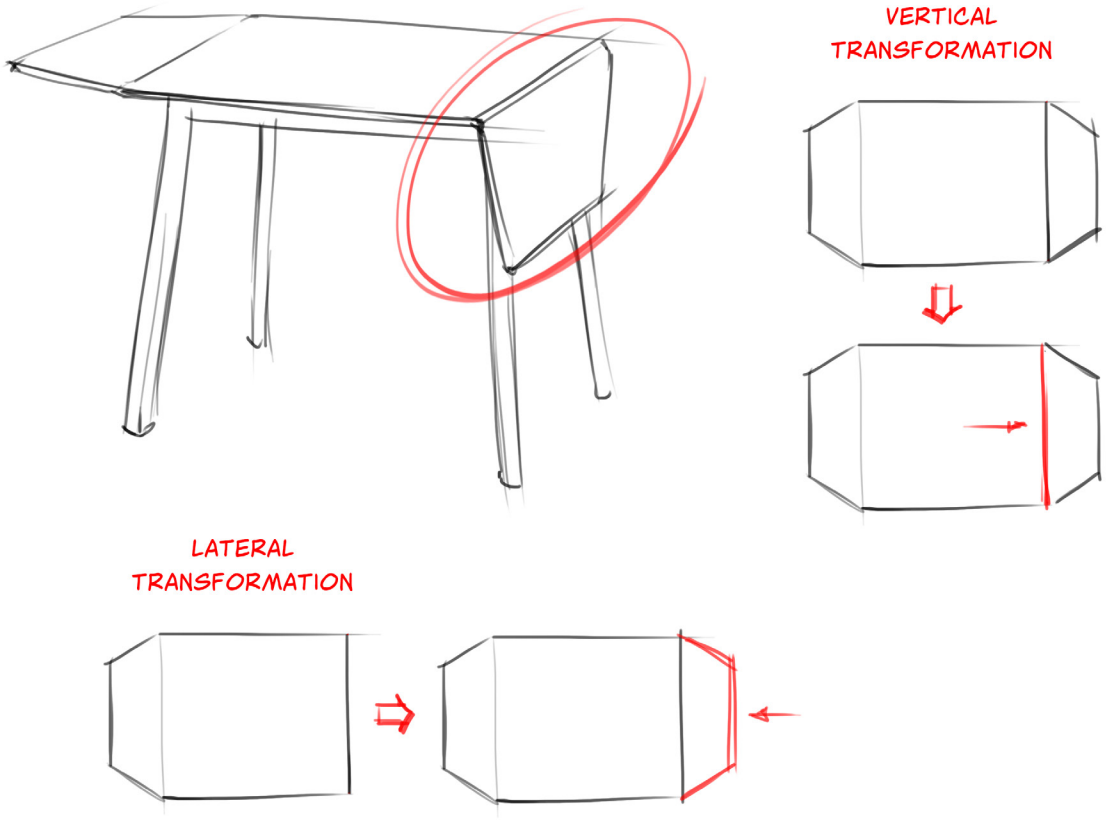


Figure 9: The sketching transformations depending on the order of construction

So, the kind of transformations within a sketch also depends on the designer's interpretation. This interacts with multiple factors on which the making of the sketch is based. According to Hoftijzer et al. (2018), each design sketch has a certain 'intention': "This 'intention' strongly correlates to specific factors that apply to a sketch. And, as emerged from the study (by Hoftijzer et al., 2018, red.), this intention highly influences the forthcoming sketch characteristics." The study referred to was done in collaboration with design agency Vanderveer, of whom the designers shared information that revealed certain factors that were decisive for the appearance of their sketches.

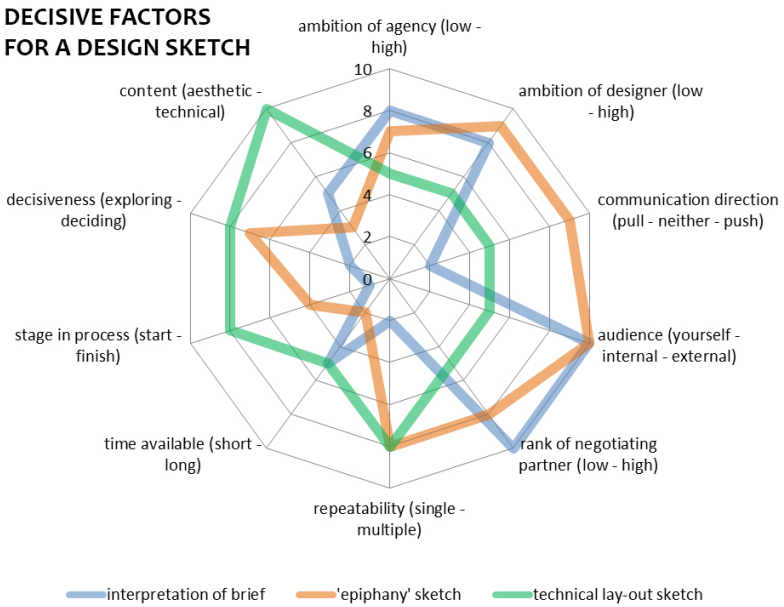


Figure 10: Decisive factors for a design sketch, model by Hoftijzer et al. (2018)

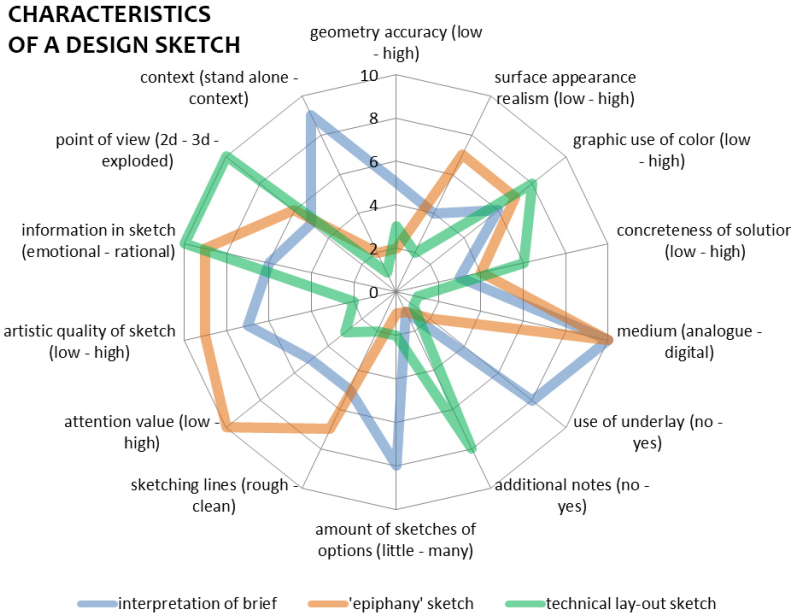


Figure 11: Characteristics of a design sketch, model by Hoftijzer et al. (2018)

In figure 10, the influence of decisive factors for three 'distinguishable' kinds of design sketches are shown.

The factors that are featured (e.g. the ambition of the designer, the audience, the stage in process, etc.) correlate with the aforementioned 'intention' of each sketch, which subsequently influences the characteristics of the sketches. The latter are plotted in figure 11 (Hoftijzer, 2018).

While the decisive factors of figure 10 are determined beforehand, the sketching process itself also influences the visual outcome. As a result of another study by Prats et al. (2009), that concerns the way designers transform shapes during the process of sketching, a list of general shape rules was proposed. Most modifications to the sketches reveal multiple shape transformations at a time, which is shown in the table of figure 12.

Observing these transformations can clarify how, during the process of design sketching, shapes can be reinterpreted and therefore trigger the discovery of emergent parts.

The discovery of emergent parts is, confirmed by the aforementioned scholars, characteristic to sketching. It enables designers to, through intended and unintended movements, develop new figural and non-figural ideas.

Researcher 1 Rules - ID	Researcher 2 Rules - Arch	Schema	Examples from sketches
Outline transformation	Bend Straighten Thicken Extend shape Change width/length		
Structure transformation	Flip Change angles Change direction Split (use both parts) Change position		
Substitute element	---		
Add element	Add a new shape Combine shapes		
Delete element	Delete element		
Cut element	Split (use one part)		
Change view	Change view		

Figure 12: Transformations of sketching shapes observed by Prats et al. (2009)

4.1.4 Discovering
The development of ideas could happen by the finding of 'unexpected discoveries':

> "*Unexpected discoveries are a form of perceptual interaction with one's own sketches. In other words, that is to detect hidden features of a visual/spatial representation.*"
>
> *(Suwa, Gero and Purcell, 2006)*

According to Suwa, Gero and Purcell, these discoveries can be categorized into three distinct ones: the 'relation-type', the 'visual-feature-type' and the 'implicit-type'. The first one happens when the designer, for example, suddenly notices the proximity between two elements. The second one appears when the designer attends to a new visual feature, for example the size or the shape of a certain element. Lastly, the 'implicit-type', refers to perception of figure-ground reversal, like what happens when we look at the well-known illustration of either two faces or a vase. A previous study by Suwa, Gero and Purcell (1999) provided evidence for the proposal that occurrences of unexpected discoveries have strong correlation with those of inventions of design requirements. Inventions of new requirements refer to the moment when the designer encounters new demands imposed on the design, not beforehand, but during the design process. Unexpected discoveries seem to trigger the generation of new design requirements, while in turn, new requirements encourage new discoveries.

So, for example, a backpack is to be designed: when sketching, the drawn curves of the hip belt give the designer the idea of adding a small storage within this belt, which subsequently brings about a new requirement: "it must be possible to store small stuff in the backpack, which is still within reach when the backpack is worn on the back". The invention of this design requirement slightly changes the perspective of the designer towards the current sketches, as a result of which new sketching ideas are likely to be triggered. Those can in turn lead to unexpected discoveries again.

A study in 2006, also by Suwa, Gero and Purcell, confirmed that the invention of design requirements, during the sketching process, is a conceptual driving-force that makes the aforementioned 'relation-type' as well as 'visual-feature' type of unexpected discoveries happen. Furthermore, the 'relation-type' also seems to have a another driving-force, a 'sensory' one: when a designer simultaneously pays attention to a set of previously-sketched elements that were not connected before, these kind of unexpected discoveries are likely to be made (Suwa, Gero and Purcell, 2006). This increases the chance of coming up with creative inventions.

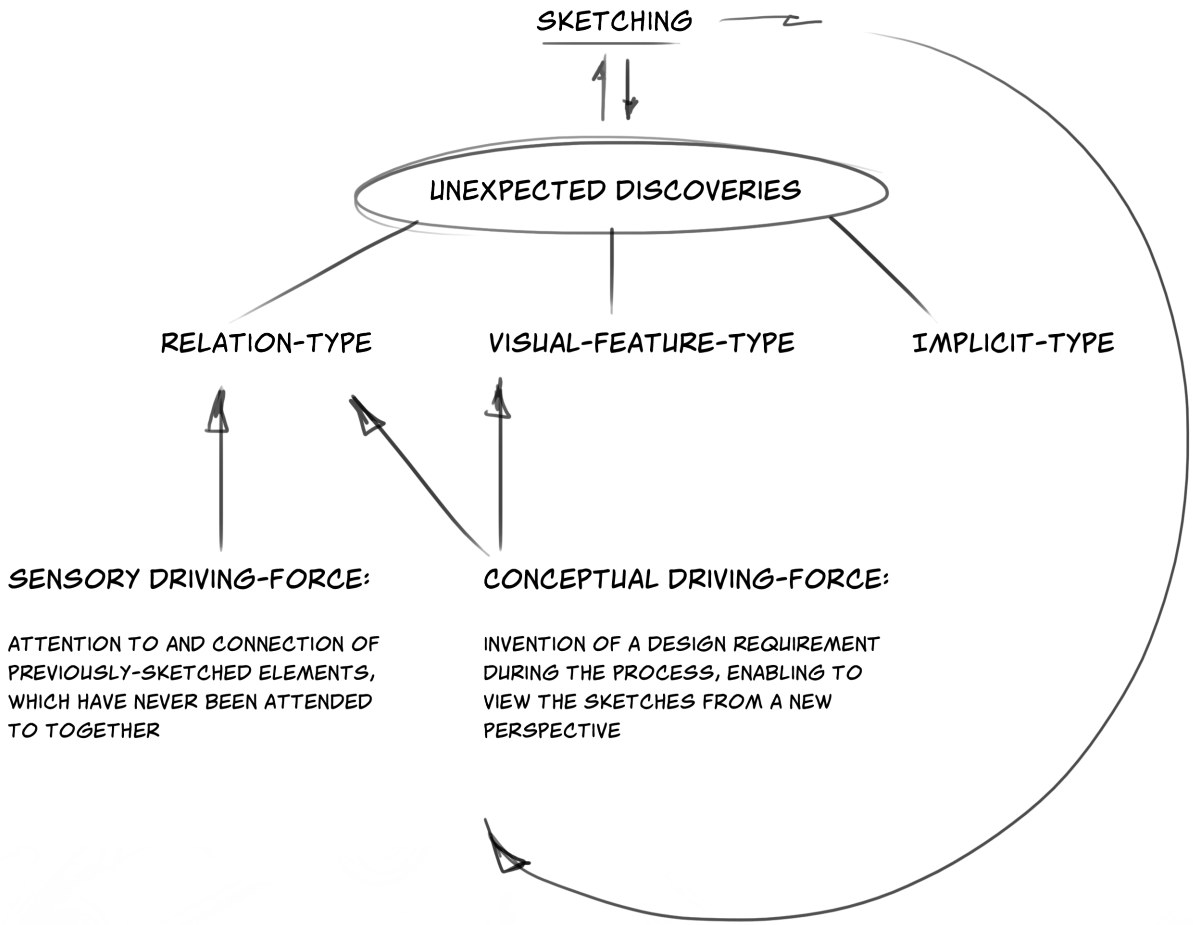


Figure 13: The interplay between the designer and the sketch can result in unexpected discoveries by emergence and connection of perceptual elements (Suwa, Gero and Purcell, 1998)

4.1.5 Ambiguity

The above mentioned are quite specific driving-forces within the process of sketching, that bring us to new ideas. However, this characteristic, immersive part of sketching goes further than that. According to Goel (1995), ambiguity created by unstructured sketches of varying ideas, referred to as lateral transformations, can be called essential for the design process. Considering the divergence and convergence stages clarified by the double diamond model of the design process (British Design Council, 2005), one could state that ambiguity in sketches, while encouraging lateral transformations to happen, positively influences the stages of divergence. Tversky (2010) aims that: "Ambiguity in sketches, just like ambiguity in poetry, encourages a multitude of interpretations and reinterpretations." Seemingly, ambiguity in sketches increases the chance of the aforementioned discovery of emergent parts happening, bringing about new insights, new ideas and new sketches, subsequently causing a generative loop (see figure 14).

This loop can be stimulated by the designer shifting focus between new perceptual figures and relations in specific and, by zooming out, new conceptual interpretations of the sketched subjects. These focus shifts, a phenomenon referred to as 'constructive perception' by Suwa and Tversky (2001, 2003), are allowed by the generative loop of ambiguous sketching and triggers thoughts about more complex visual and functional considerations. This relates to two reappearing occurrences in this section about design sketching: emergence and (re) interpretation during the sketching activity.

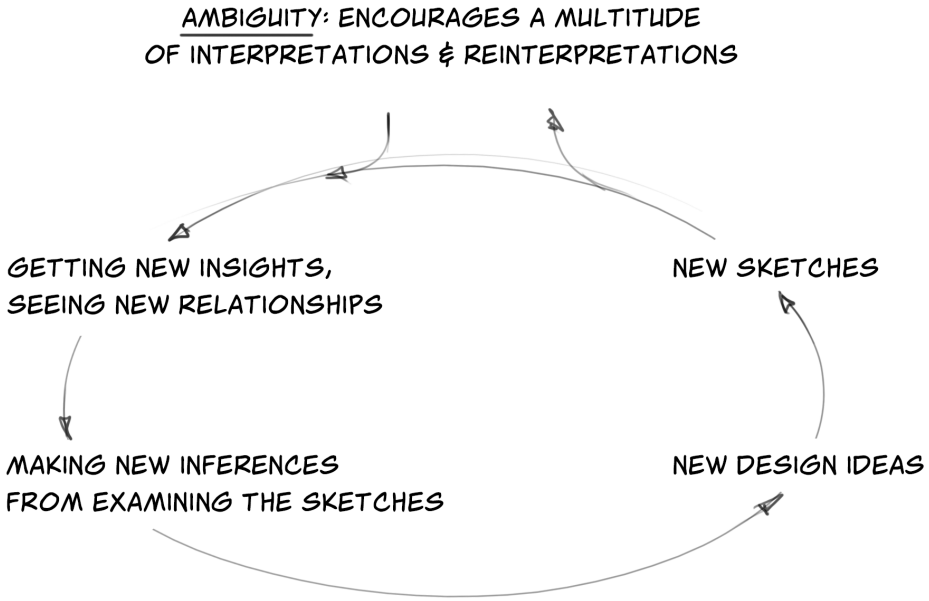


Figure 14: The positive role of ambiguity in design sketches, advocated by Tversky (2010)

4.1.6 Interactive imagery

Connected to this emergence and reinterpretation is de role of imagery and the connection of it all. Scholars have advocated that the use of imagery forms the basis of solving complex problems. According to C. Ware in Visual Thinking for Design (2010), "mental imagery can be thought of as an internalized active process; much as our inner dialogue is internalized speech, visual imagery is based on the internalized activities of seeing." This evolves with visual thinking, by the ability to recognize patterns depending on the brain's network of pathways, enabling us to link visual information with our existing knowledge and understanding (Ware, 2010). Goldschmidt (2003) has proposed that design sketching functions as an extension of imagery, introducing the phenomenon of 'interactive imagery'. This phenomenon concerns the activity of translating mental images into drawings that "express concepts in the visualgraphic modality using patterned schemas stored in a graphic lexicon that combine using 'syntactic' rules" (Cohn, 2012). Subsequently, within this lexicon there is the aforementioned emergence of unintended moves and unexpected discoveries, triggering new interpretations and mental images, which closes the loop of interactive imagery (see figure 15).

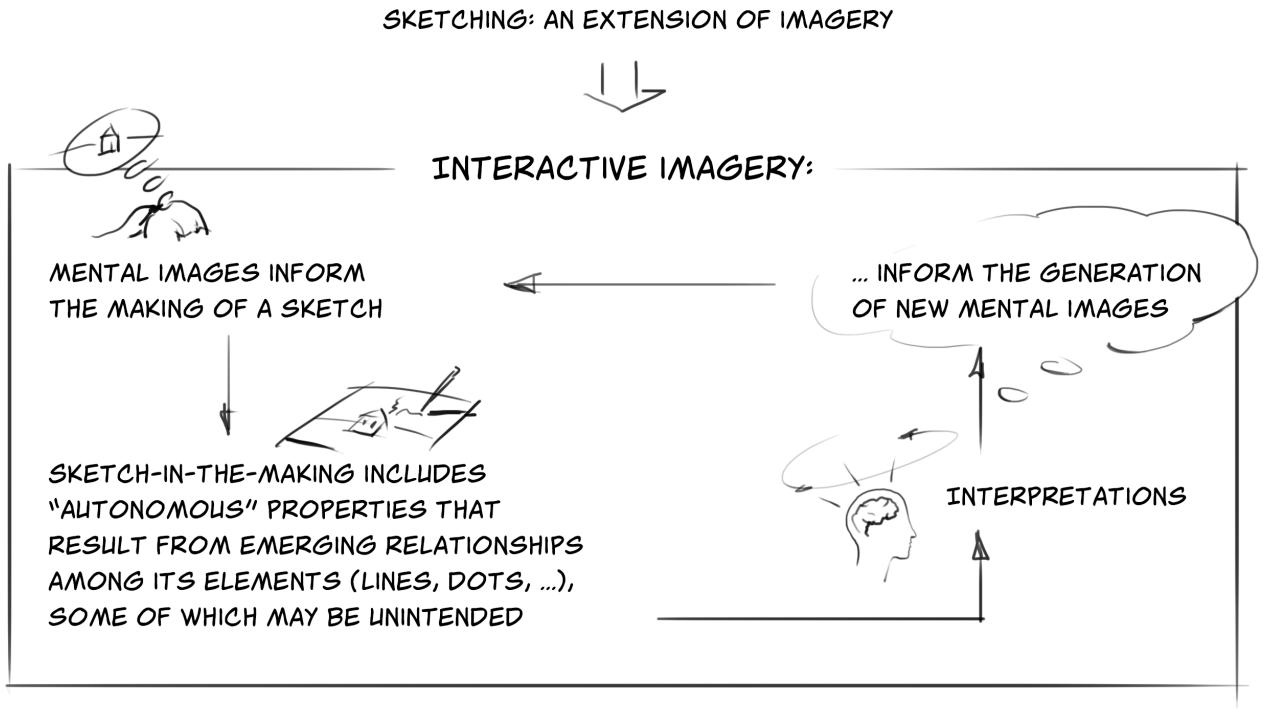


Figure 15: Design sketching triggers a generative loop of 'interactive imagery', according to Goldschmidt (2003)

This would suggest that sketching creates a way that reinforces visual imagery in a positive spiral, so that designers could keep coming up with creative inventions. Within this process, the key role of sketching, would not only be the aforementioned emergence of unintended moves and unexpected discoveries, but also to serve as an external memory aid. It allows us to access different types of knowledge in the long-term memory (Purcell & Gero, 2006). Sketches make (de)compositions of our mental images that can help us processing, structuring and reflecting on the information we see in our head. It reduces the load on our working memory by mental synthesis.

4.1.7 The mind's eye

In their paper 'Amplifying the Mind's Eye: Sketching and Visual Cognition' (1990), Fish and Scrivener recognized something similar to this:

"The important point is that what we are conscious of when we perceive sketches or real objects is not a static array of luminances and colours but a briefly stored, highly processed mental representation that is continually updated by the integration of meaningful fragments from a flow of directed glances."

(*Fish and Scrivener*, 1990)

According to them, sketches are 'assisting' the human mind to translate descriptive propositional information into depictive information.

They state that information in a description is 'extrinsic', by which they mean that the interpretation of it is strongly connected to externally defined rules (figure 16). Information in a depiction, on the other hand, is 'intrinsic', meaning that it is not represented explicitly but can be extracted without rules of interpretation by inspection (Fish & Scrivener, 1990). They claim that the mental translation and scanning by attentional processes bring out new and perhaps innovative descriptive information. This theory again leads us to a certain loop: one of the mental process of descriptive-to-depictive-and-back translations during design drawing. The more translations like this take place, the more thoughts and sketches are developing, which makes the process expectedly generative (figure 17).

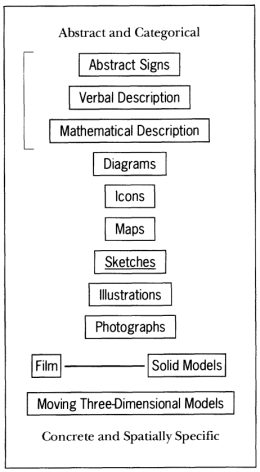


Figure 16: From descriptive (up) to depictive (down), Fish and Scrivener (1990)

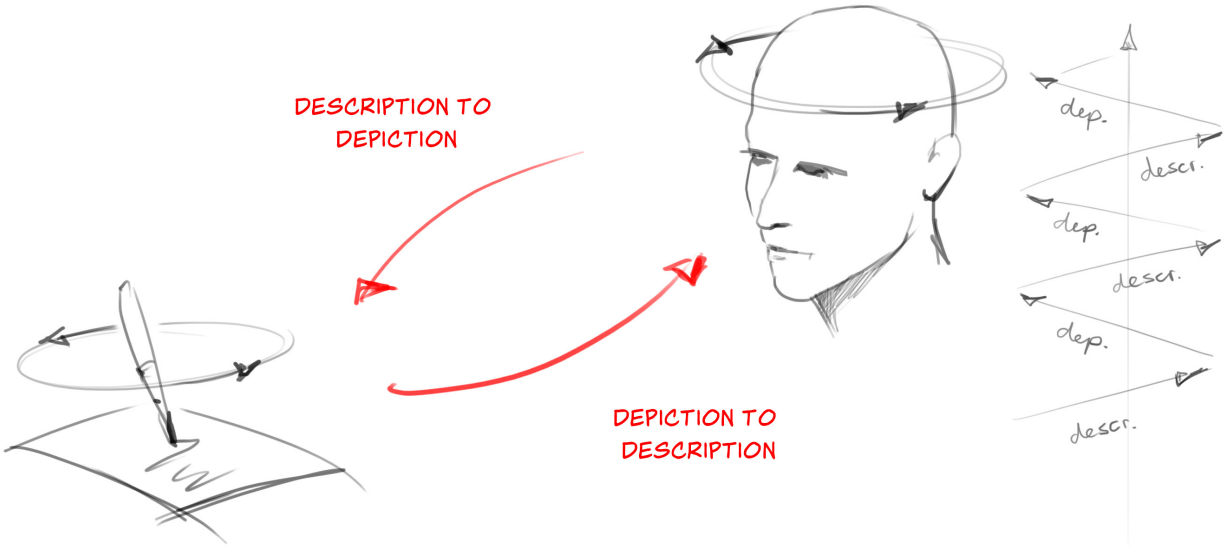


Figure 17: The generative process of translations advocated by Fish and Scrivener (1990)

Studying product design sketches, one will see that they communicate information including 3d information, visualization, representation, indication, lay out and a varying level of specification and rendering (Hoftijzer et al., 2018). Fish and Scrivener (1990) corroborate the communication of three dimensions and identified two more attributes of sketches, that are contributing to the process of description and depiction translations:

A. Sketches use abbreviated two-dimensional sign systems to represent three-dimensional visual experience

B. Sketches contain selective and fragmentary information

C. Sketches contain deliberate or accidental indeterminacies that are important to their function

To make these proposed attributes more clear, figure 18 shows an example of a design sketch with clues to the specific attributes described by Fish and Scrivener.

The line designated by A gives a suggestion of how the volume of the body must be: round with a notch. It is a two-dimensional sign, a so-called 'cross sectional line', that gives us information about what the body would look like in 3D.

At the points B, selective and fragmentary information is provided by the sketch. For exam-

ple, we see that the hose of the vacuum cleaner should be ribbed, although we don't know details, like how deep, yet. Furthermore, the wheel is not fully sketched, although that is not a problem for the viewer: he or she can imagine the part that is left out. In the sketch, leaving things out avoids attention towards unimportant components of the sketch. Furthermore, in other cases it can create space that triggers the imagination, leaving room for alternative ideas.

Finally, C is designating two options for the hand grip of the vacuum cleaner. Both would be too much, maybe even conflicting with other components of the product, but the sketch is providing the observer with both: these indeterminacies again leave room for alternatives.

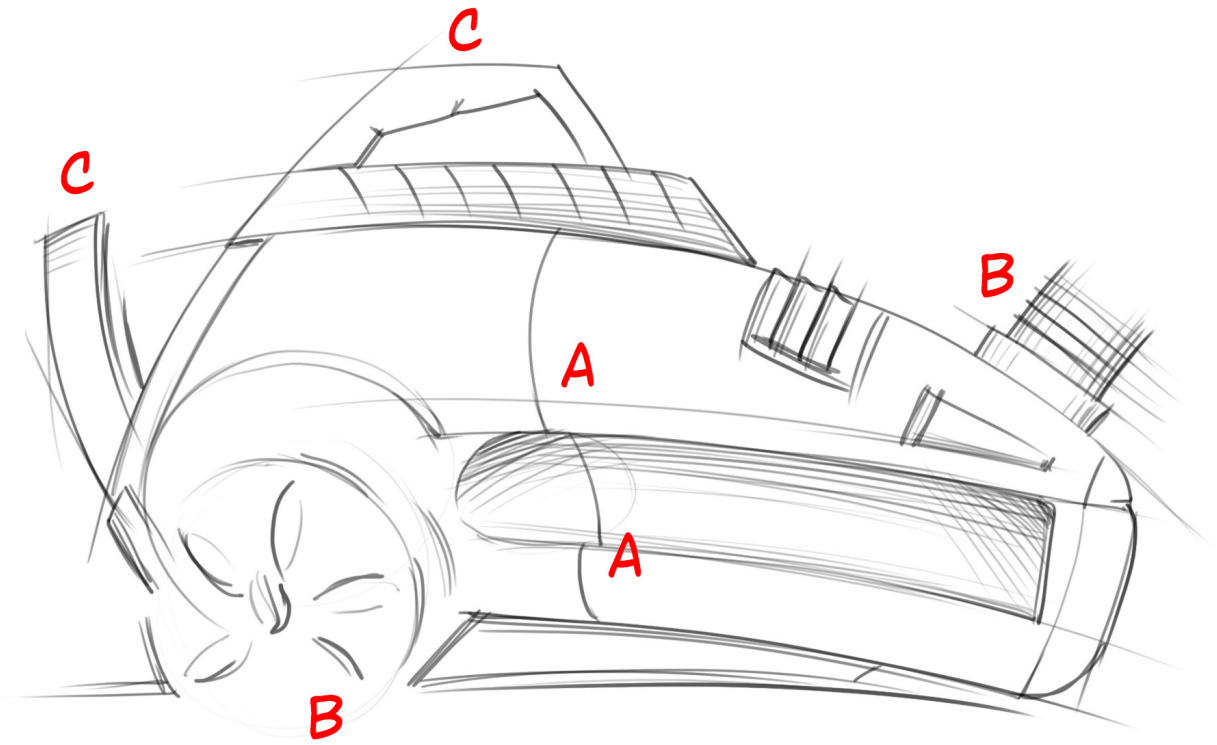


Figure 18: Design sketch of a vacuum cleaner demonstrating the proposed sketching attributes of Fish & Scrivener (1990)

The deliberate or accidental indeterminacies mentioned as attribute C by Fish and Scrivener can be related to the aforementioned '(un)intended moves' during sketching: "Commonly found are black spaces where the drawing fades away, multiple alternative contour lines, missing contour lines, wobbly lines, mysterious dark shadows, suggestive scribbles and smudges, energetic cross-hatching, blots, accidental flow patterns of paint or ink and even scratch marks" (Fish & Scrivener, 1990). Similar to these attributes of design sketches, art drawings use principles as deliberate indeterminacies: the drawing in figure 19, by Henri Matisse, shows an example of the intended absence of certain contour lines. Although there are only a few explicit lines, in our head it appears to form a whole.

Another example is the drawing of 'A stand of trees' from Leonardo da Vinci (figure 20). This seems like the opposite phenomenon, namely too many lines, but at the same time it also triggers our mental imagery. If we look at the drawing, despite the confusion that probably shows up, our mind automatically starts mechanisms that attempt to associate, recognize, complete and match together certain suggestions in the drawing. This leads back to the ambiguity of sketches: it generates a stream of imagery, which is especially interesting for designers.

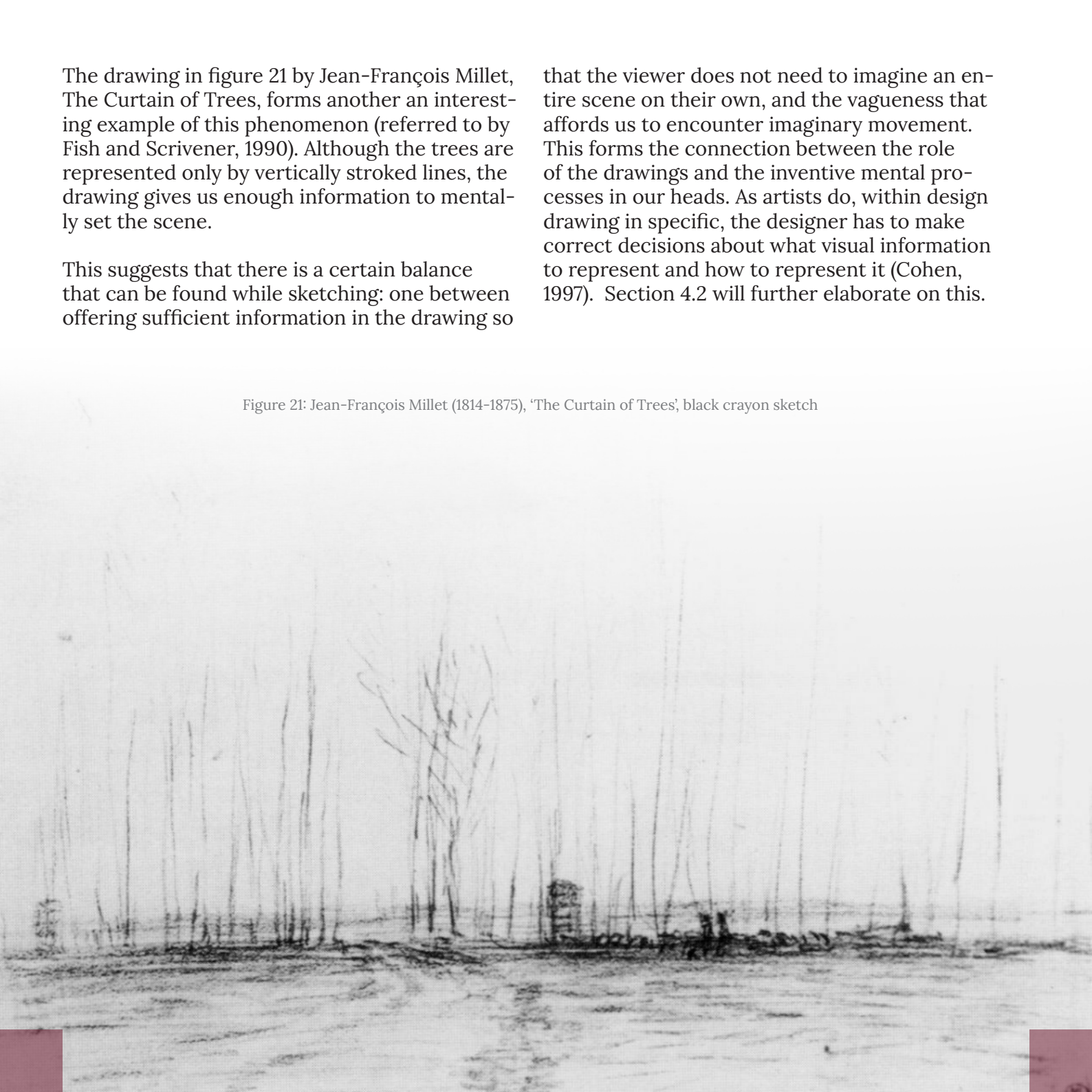
Figure 19: Henri Matisse, 'Nude, Semi-Abstract', 1901

Figure 20: Leonardo da Vinci, 'A stand of trees', ca. 1500

The drawing in figure 21 by Jean-François Millet, The Curtain of Trees, forms another an interesting example of this phenomenon (referred to by Fish and Scrivener, 1990). Although the trees are represented only by vertically stroked lines, the drawing gives us enough information to mentally set the scene.

This suggests that there is a certain balance that can be found while sketching: one between offering sufficient information in the drawing so that the viewer does not need to imagine an entire scene on their own, and the vagueness that affords us to encounter imaginary movement. This forms the connection between the role of the drawings and the inventive mental processes in our heads. As artists do, within design drawing in specific, the designer has to make correct decisions about what visual information to represent and how to represent it (Cohen, 1997). Section 4.2 will further elaborate on this.

Figure 21: Jean-François Millet (1814-1875), 'The Curtain of Trees', black crayon sketch



While (depictively) arousing imagination by fragments and vagueness seems to be the opposite of (descriptively) providing text, in some drawings artists and designers use both. Regarding this combination of description and depiction, 'A heath' by Millet (figure 22) is an example of a sketch that uses description in the form of written notations to stimulate the 'mental translation to spatially depictive imagery' (Fish & Scrivener, 1990). The extent to which the written notations are refined, makes it clear that its intention is to imagine a specific view in our head. This way, the drawing affords the artist to communicate information that is essential.

Figure 22: Millet, 'A Heath', pen and brown ink over black crayon sketch, through which written notations:

"Cleared patches, tillage, rye on the heights, roughly cleared land, most of the stones set up on top of each other, broom, green rushes, green, cleared and ploughed lands having a thoroughly Celtic look."

Regarding product designers, drawings can fulfill a similar role. This is, for example, the case in the design sketch of figure 23. The descriptive factor of the drawing (text and sketched features form a whole) affords the designer to communicate relevant, practical information about the construction. Subsequently, the description-depiction balance in (design) drawings can be used across a spectrum from conveying an atmosphere through to the literal explanation of the subject depicted.

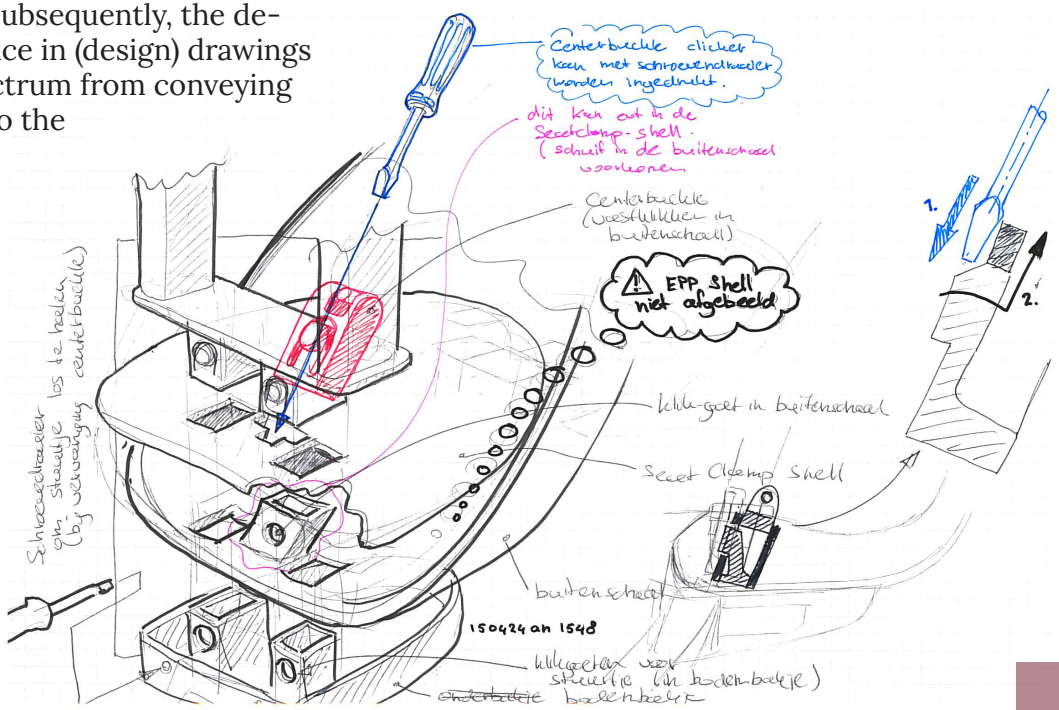


Figure 23: Design for a children's bicycle seat by design agency Modyn (formerly Van der Veer), 2020

4.1.8 Interplay between drawing, designer and stakeholders

Examining studies by Schütze, Sachse and Römer (2003), the role of design sketching in converging imagery by mental synthesis is confirmed: "The quality of solution concepts increases from entirely mental design problem solving without external support over partly supported to completely supported problem solving." As expected, subjects who solved a design problem supported by sketching achieved a significantly higher solution quality. Furthermore, Kudrowitz et al. (2012) found that the quality of sketches has a positive influence on the perception of the creativity of ideas, and Mulder-Nijkamp and Eggink (2016) found a significant correlation between the level of quality of drawings and the success of design outcomes in a brand extension industrial design project. Better sketchers are more likely to become better product designers, as proposed by Cormans and Vaes (2018). One could conclude that design drawing contributes to our 'visual literacy', meaning the ability to 'read, write and create visual images' (Harrison, 2022). This is apparently a valuable capability for designers themselves, but also a valuable aspect in the communication between designers and stakeholders.

For example, in his book Engineering and the Mind's Eye, Ferguson (1992) wrote about the value of non-verbal thoughts for engineers and how drawings play a significant role in the emergence of new inventions. Ferguson distinguishes three categories of sketches, as described by Brun, Weil & Le Masson (2015): 1) 'thinking sketches' made by an engineer looking for new ideas; 2) 'talking sketches' made when two engineers communicate; 3) 'prescriptive sketches' that are meant to please and

convince people outside of the design process. Emphasized by Brun et al. (2016), the different categories are in fact based on the distinction of the designer, stakeholders and other people outside of the design process. Tversky (2010) identifies four sketch purposes, three of which also involve interactions beyond the designer, with regard to communication, aesthetics and behaviour (see figure 24). In the communication with others, design sketches afford the designer to promote behavioural action and to convey literal information, e.g. measurements for manufacturing engineers, as well as to convey sensory information, e.g. by arousing emotions (Tversky, 2010).

The categories of Ferguson and the purposes of Tversky mark the interaction between the design sketches and industrial designers themselves, as well as with their stakeholders. However, existing literature in the field of design sketching appears to lack a wider view on the perception of non-designers, such as clients, on design sketches. Therefore, the rest of chapter 4 will study the human psychology behind pictorial representations, in order to better capture this human role with regard to the agency of sketching.

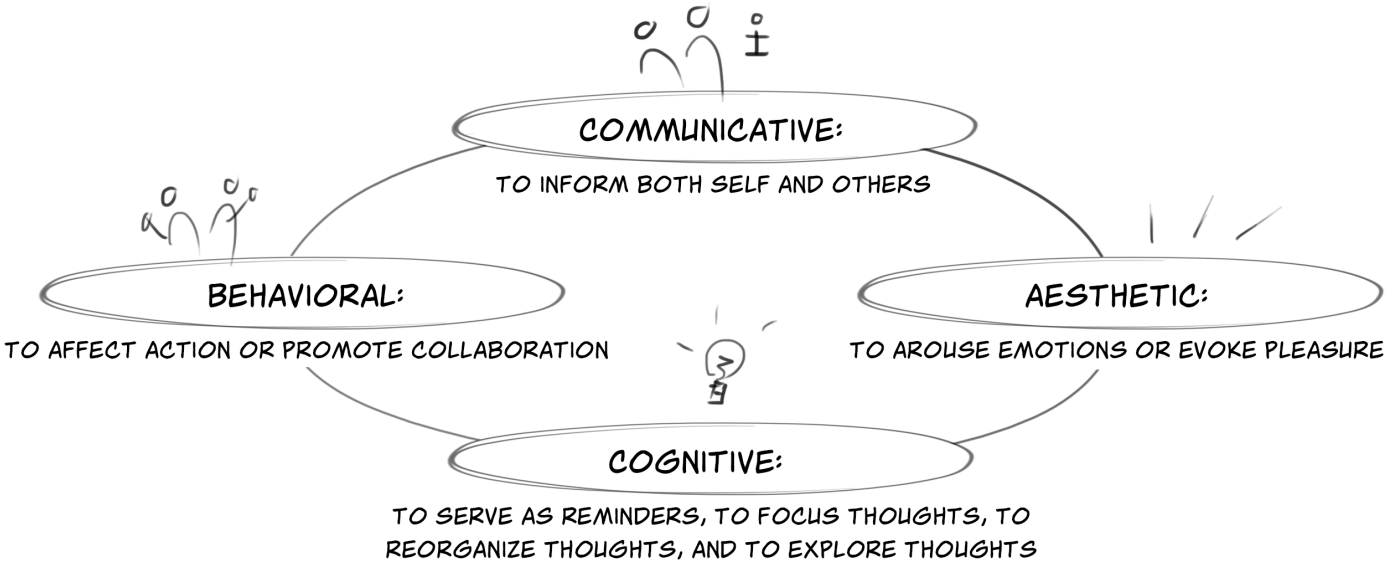


Figure 24: Four purposes of design sketching proposed by Tversky (2010), three of which concern the interaction with others

4.1.9 Discussion and conclusions

The discussed theories have provided evidence on and examples of functions and purposes sketching can have and simultaneously its affordances within the design field. Overall, one could state that design sketching can work as an intervention that

1) triggers emergence and imagery;
2) supports (re)interpretation and convergence;
3) increases the value and quality of the process outcome;
4) serves roles in the interaction between designer and stakeholders.

The agency of sketching triggered by the interplay between the designer and the sketched features, seems to affect the movements of the designer both during and between mental processing and physically acting. Studying the theories about the dialectics of sketching, the corresponding (un)intended moves and transformations during the design process and the emergence of new discoveries by driving-forces like ambiguity, brought us to the phenomenon of interactive imagery. By 'amplifying the mind's eye' and constantly changing between arguments and moves and descriptive and depictive information, our mental capability to come up with new design solutions is enhanced. Purcell and Gero put it the following way:

"Drawing during the design process could be performing the same function, which is of maximizing the conditions necessary for the reinterpretation of an image and the emergence of new ways of 'seeing' it."

(Purcell & Gero, 2006)

Seemingly, there is a balance between giving sufficient information and creating selective and fragmentary components or vague and ambiguous parts, leaving room for the imagination of alternative things or scenes. This resonates with Da Vinci saying:

"Confused things rouse the mind to new inventions."

(Leonardo da Vinci, quoted by Fish & Scrivener, 1990)

The constant loops that we seem to go through during the processes of design drawing, during the 'interactive imagery', have to do with reflection. We constantly reflect on our moves and arguments, on our unintended consequences of moves and on our new discoveries. Sketches make (de)compositions of our mental images that can help us processing, structuring and reflecting on the information we see in our head. It reduces the load on our working memory by mental synthesis and thus facilitates decision-making. It also stimulates the generation of a new stream of imagery and observation of the imaginary. Within this all, the designer chooses which elements to put in his or her sketch, depending on the most relevant information that the viewer must be given. Goldschmidt stated it as the following:

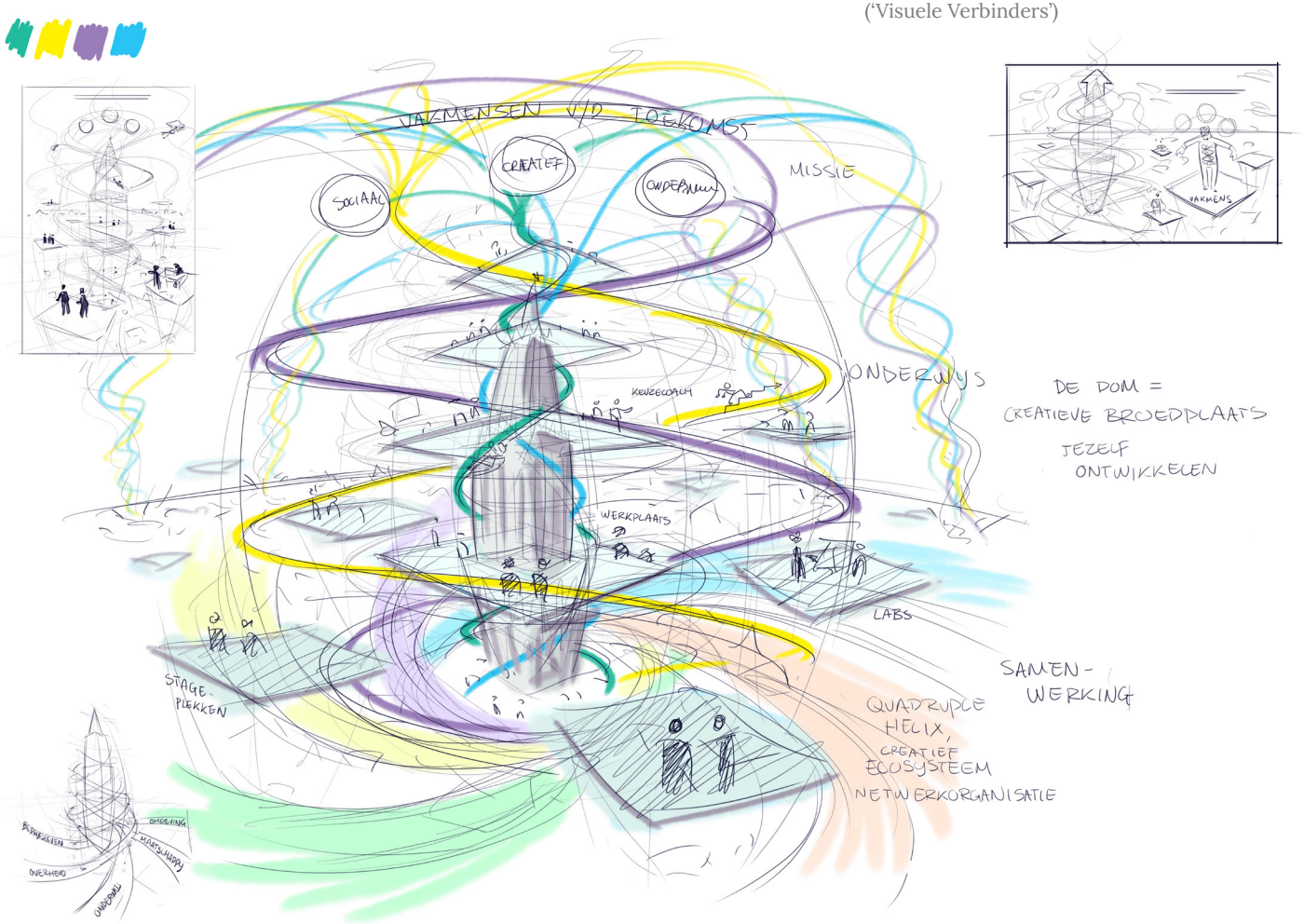
"The dialectics of sketching is the oscillation of arguments which brings about gradual transformation of images, ending when the designer judges that sufficient coherence has been achieved."

(Goldschmidt, 1991)

Observing these conclusions, one could state that the agency of sketching is initiated by setting the designers' internal communication in motion. Additionally, the resulting sketches serve varying affordances in the communication towards stakeholders.

Sketching appears to be a versatile, multidimensional kind of communication. Sketching is often referred to as a language. And just like in the case of a language: what it affords us to do, or to create, or to reach, is strongly related to human interaction. Keeping this in mind, section 4.2 will go ahead.

Figure 25: Sketch by Robert Oude Nijhuis ('Visuele Verbinders')



4.2 Beyond design sketching: the psychology of pictorial representations

Section 4.1 provided a theoretical view on the agency of sketching in the design process. However, considering earlier involvement of clients in the design process (see chapter 5), the perception of sketches by non-designers is increasingly important. The existing literature in the field of design sketching in specific, could use a wider view on the human perception of pictorial representations.

Therefore, the rest of chapter 4 zooms out to provide a perspective beyond 'design sketching', addressing intentionally also other than design drawings. With regard to the research question, a perspective that goes beyond 'design sketching' in specific helps to better understand the interactive human role that is involved with regard to the agency of design sketching.

Figure 26: Rembrandt van Rijn, 'Old Man Seated', 1631, chalk on prepared paper

4.2.1 Perception in art and design

When considering our interaction with visual stimuli, a sensory side of perception plays a crucial role.

According to philosopher Merleau-Ponty (1945), the indeterminate and contextual elements of the tangible world cannot be detached from a comprehensive understanding of our senses (Widewalls, 2022). Sensory perception represents a dynamic and interactive connection with the (visual) world, making it manifest to us as a familiar environment intertwined with our lived experiences. We imbue the perceived reality with personal values and interpretations that fundamentally relate to our own lives. Therefore, it is crucial to recognize that this reality is contingent upon the lens of these subjective values, and it does not inherently possess an absolute truth independent of our perceptions.

Subsequently, approaching something from a different background and with different perspectives can make the experience of art or a designed product or environment completely different for two people.

An exemplification of this is a situation described by De Botton in 'The architecture of happiness' (2006). The case took place in 1923, when architect Le Corbusier was commissioned to build houses for manual workers. From his modernist view, and certainly also because of his admiration for the industry, he created sleek, abstract, raw designs. However, as soon as the workers were in, the style was completely changed to the traditional side of the spectrum: they added wooden shutters, garden fences, floral wallpaper, et cetera. Although both parties clearly preferred a different style in this case, the logic behind it was the same. According to De Botton, both the modernist architect and the factory workers were "charmed with a style which evoked the qualities with which their own lives were inadequately equipped" (p. 184). Accordingly, as a designer, it can be of great value to understand the client's or users' way of perceiving the visual world around us.

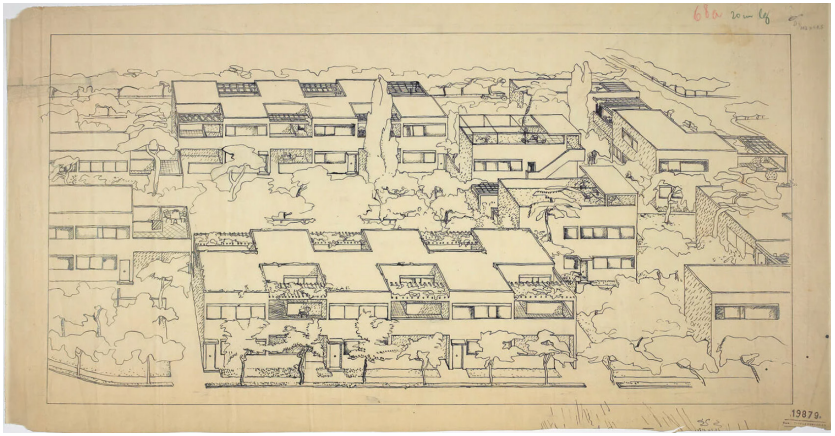


Figure 27: Le Corbusier, 'Cité Frugès' design for workers' houses

Perception seems to be strongly influenced by the contextual backdrop from which observation and evaluation arise. It is shaped by a multitude of factors, involving the realms of politics, society, culture, gender and race. These elements affect not only how we perceive visual stimuli and the meanings we ascribe to it, but also actively shape the process of artistic creation. Both the perspectives of the artist and the observers (stakeholders) contribute to the comprehension and the making of art and design, with neither being inherently more significant than the other.

4.2.2 Changes over time: ways of 'seeing' and interpreting

Looking at various historical changes in art styles over time, it becomes clear that perception significantly changes the meanings attributed to pictorial representations. This leads to shifting interpretations over time: while certain universal principles may endure, the majority of understandings are contingent upon the specific societal norms of a given era. Perception and our opinions are intimately intertwined. Artistic styles have undergone various transformations throughout history, reinforcing the aforementioned notion of a significant interconnection between our opinions and the perception of pictorial representations.

Although this thesis does not have the ambition to capture the entire history of 'pictorial' art, relevant to know about perception is the moment a significant change appeared that might still influence the communicative visual affordances of design drawings. Namely, with the advent of the Impressionists, heated debates arose, which got artists and critics actively engaged with the mysteries of perception (Gombrich in 'Art and Illusion', 1960). Until then, the painter's aim was to return to the 'unadulterated truth of natural optics'. As Vasari stated: "(...) Painting is no more than the simple portrayal of all things alive in nature by means of design and color as nature herself produces them." But, early in the eighteenth century, people began to see that 'looking at nature' was more complex than that. The changes in style were not only based on an improvement of skill, but were the result of different modes of seeing the world.

"(...) both see the same life, but with different eyes."

(Richardson in 'Art and Illusion', 1960)

Motivated by the ascendancy of science and the emphasis on empirical observation, the discussions regarding vision and perception kept on going by the artists and critics during the nineteenth century. In Modern Painters, published in 1843, John Ruskin still claimed that the "truth of nature is not to be discerned by the uneducated senses" and he paid tribute to Turner "for his correct view of the structure of clouds and waves, rocks and vegetation" (Art and Illusion, 1960). This extensive book is likely to be the last and most convincing in a tradition that began with Pliny and Vasari, where art history is seen as a journey towards visual truth.

Figure 28: J.M.W. Turner, 'The Passage of Mount St. Gothard', 1804

So, Impressionism and art styles that followed had a transformative impact on our perception of pictorial representations. Characterized by its emphasis on capturing fleeting impressions of light, color, and atmosphere, with its loose brushwork, one broke away from the traditional conventions of realistic representation: in a way, impressionism captured 'truth' better, though less a copy of reality. The emphasis on capturing the artist's subjective experience and emotions invited viewers to engage with art on a more intuitive level.

This change of perception might have broadened our view on design sketches too. Drawing freely and intuitively affords us to convey information that appeals not only to our reason, but also to our sensory side. This means that the ambiguity that triggers the imaginary, in section 4.1 discussed as an important affordance of sketching for the designer personally, can also be used externally: in communication with stakeholders.

Figure 29: Monet, 'Impression, soleil levant', 1872

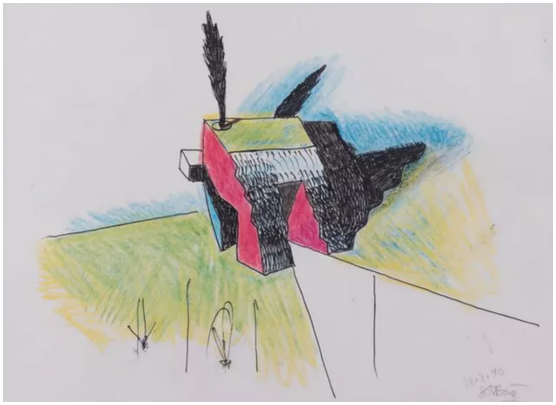


Figure 30: Design drawing by Etoire Sottsass, 1990 (source: Artsy.net)

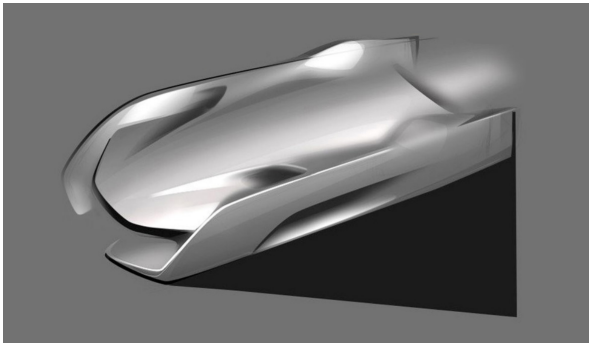
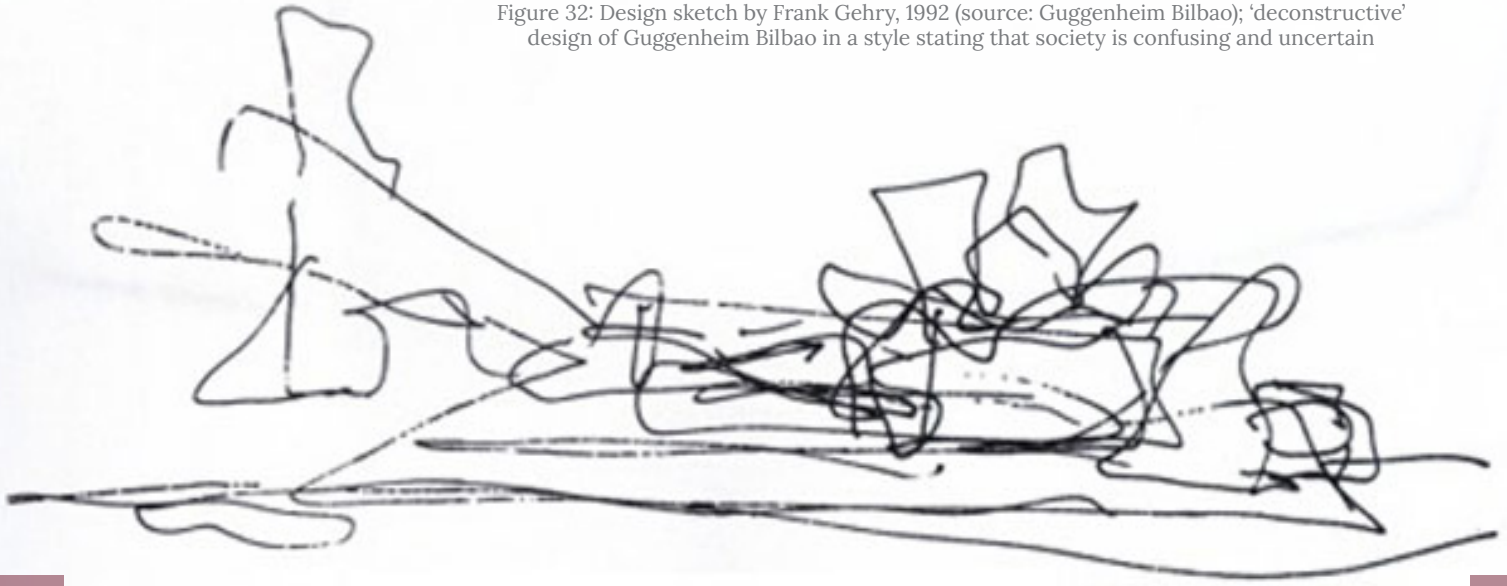


Figure 31: Design drawing for Drallara Stradale, shared by car designer Ewoud Luppens, Granstudio

This is particularly evident in the car design world. According to car designer Ewoud Luppens, interviewed in chapter 5.2, it is the emotionally attractive aspect of design drawings that plays a major role in convincing the design director. Figure 30, 31 and 32 show examples of design drawings that play with ambiguous communication.

Figure 32: Design sketch by Frank Gehry, 1992 (source: Guggenheim Bilbao); 'deconstructive' design of Guggenheim Bilbao in a style stating that society is confusing and uncertain



4.2.3 Dealing with perception: incentives in (design) drawings

Hence, our perception regarding pictorial representations is susceptible to change and depending on subjective values. This can make things complicated for artists and designers. At the same time, this subjectivity of visuals apparently affords us to experience the visuals in a broader sense: from perceiving literal information to sensory information. That can work out positively with regard to the communication from the designer towards stakeholders, providing that visual elements have been thoughtfully applied. That way, visuals can be powerful tools for persuasion. In order to do that, one may wonder the following: what are specific incentives to take into account, with regard to our versatile ways of perceiving pictorial representations? To study that, determining values in positively perceiving visuals will be discussed:

1) Perceiving positive associations;
2) Peace out of complexity;
3) Harmony of contradictions;
4) Perceptual tension.

These incentives, initially gathered from observation of (design) drawings by the author, show similarities with the Gestalt principles (Wertheimer, Köhler and Koffka, 1920s). These principles, concerning proximity, similarity, continuity, closure, symmetry and 'figure-ground', help explain how humans naturally organize visual stimuli, resulting in the recognition of patterns and structures with a definition. Given the fact that people are sensitive for these visual appearances, they naturally play a role in the discussed four incentives. In addition, different from the Gestalt principles, the incentives take into account that visual stimuli can be seen from diverse perspectives, e.g. bringing about associations, wherefore they can be interpretated differently. The incentives therefore take the influence of one's 'perceptual filter' into consideration, while exploring the intentional visual stimuli. 'Using' them the right way, like described in the following paragraphs, can ensure a high level of attention value and artistic quality; characteristics of a sketch that can trigger an 'epiphany' for designers (Hoftijzer, 2018) as well as touching a spark at other stakeholders. This will be demonstrated with the use of examples from both art and design, the latter of which in specific car design, to keep things slightly coherent. Studying the incentives that work positively on perception, can help to make the communicative affordances of design sketches towards stakeholders discoverable and explainable.

1. Perceiving positive associations

Next to the fact that contemporary politics, society and culture affect our perception, there is another aspect playing a role over time in our lives: associations. They shape our interpretation and emotional response by connecting the artwork to our own memories, experiences and beliefs. These associations can amplify or alter the intended meaning of the artwork, making it a personal and subjective experience.

There is a huge diversity of inner needs. This differs per person, but, to make it even more difficult, it differs also per moment. It is human nature to constantly switch in life between traditional and progressive, between tension and tranquility, between subdued and exuberant. Often people are in need of something that is not present in their life enough at that moment. The designed environment, especially speaking of the visual styles we choose, can compensate for this imbalance by providing what is missing (De Botton in 'The Architecture of Happiness', 2006). For example, if we work long hours in a modern, simplistic office, we are more inclined to go for a warm and friendly-looking interior at home. Or, more specifically in terms of pictorial representation: those who live in the busy city will be more easily entranced by a painting that shows a calm, French landscape.

Designers can make use of this in the field of aesthetics. For example, when car brand Vauxhall introduced its Velox and Cresta models around 1950 (figure 34 and 35), a lot of positive attention was caught: the style of the cars added futuristic, American glamour to a dowdy post-war Britain. The cars suddenly had a lot of shiny chrome, fins at the rear appeared and the glass was curved: esthetic aspects coming from chic American influences. This turned out to be a good timing: a period in which the British people appreciated some more glamour, opposing against the war. So, these cars were visually perceived well and lots of them were sold (Big Car, 2019).

Figure 33: Pissarro, 'Haystacks, Morning, Éragny', 1899

Figure 34: Flyer of Vauxhall Velox and Cresta

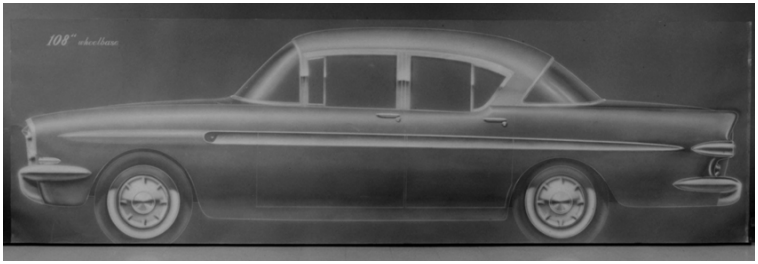


Figure 35: GM Design Vauxhall PA Series proposal full size rendering (GM Archive)

This case demonstrates that aesthetics are closely linked to associations, playing a role with concern to the agency of design visualization. If the designer manages to anticipate on the effect of associations and inner needs on how people will perceive a chosen style, like the designers of Vauxhall did, design drawings can afford the designer to let people be charmed or enthusiastic about a design, before they actually know the design in terms of content.

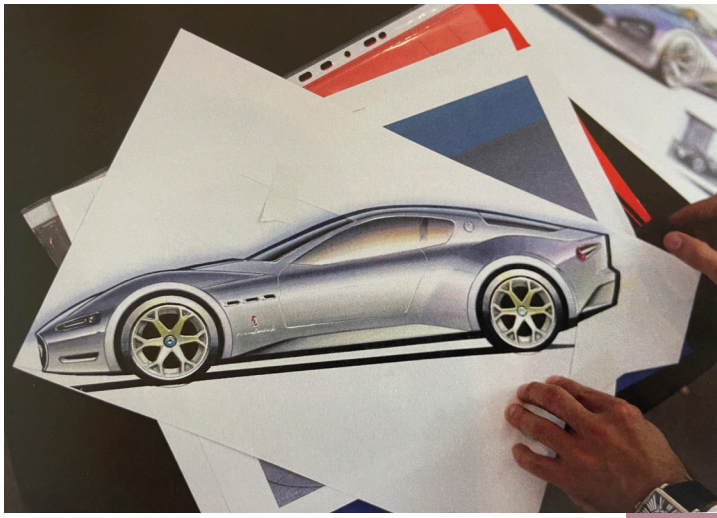


Figure 36: Design sketch of another car: the Maserati GranTurismo; associations with speed, incenting to be aesthetically pursuasive

2. Peace out of complexity

Another incentive for positive perception of pictorial representations is order. Because our lives can be unpredictable and complicated, order around us does a lot of good. De Botton makes an interesting comment: "We appreciate order mainly when it seems to go hand in hand with complexity, when we feel that a number of disparate elements are lined up (...)" (p. 207). Supposedly, we like it when it is clearly visible that various difficult matters are combined into one simple solution. While De Botton mainly refers to the designed products surrounding us, the same might apply for the pictorial representations that we create and that we choose to see. The design or object and the visualization of it merge together in this principle. In figure X, the drawing of an invention by Leonardo da Vinci illustrates this in a very literal way: we see an innovative, complex component, but a number of elements are 'lined up', compensating for the complexity with a calm space, which is visually pleasant.

Apparently, design drawings not only help the designer to achieve mental synthesis personally (see section 4.1), but the drawings can also convey this feeling of mental synthesis towards the client or consumer. The agency of sketching in this case concerns simplifying, structuring and composing graphically.

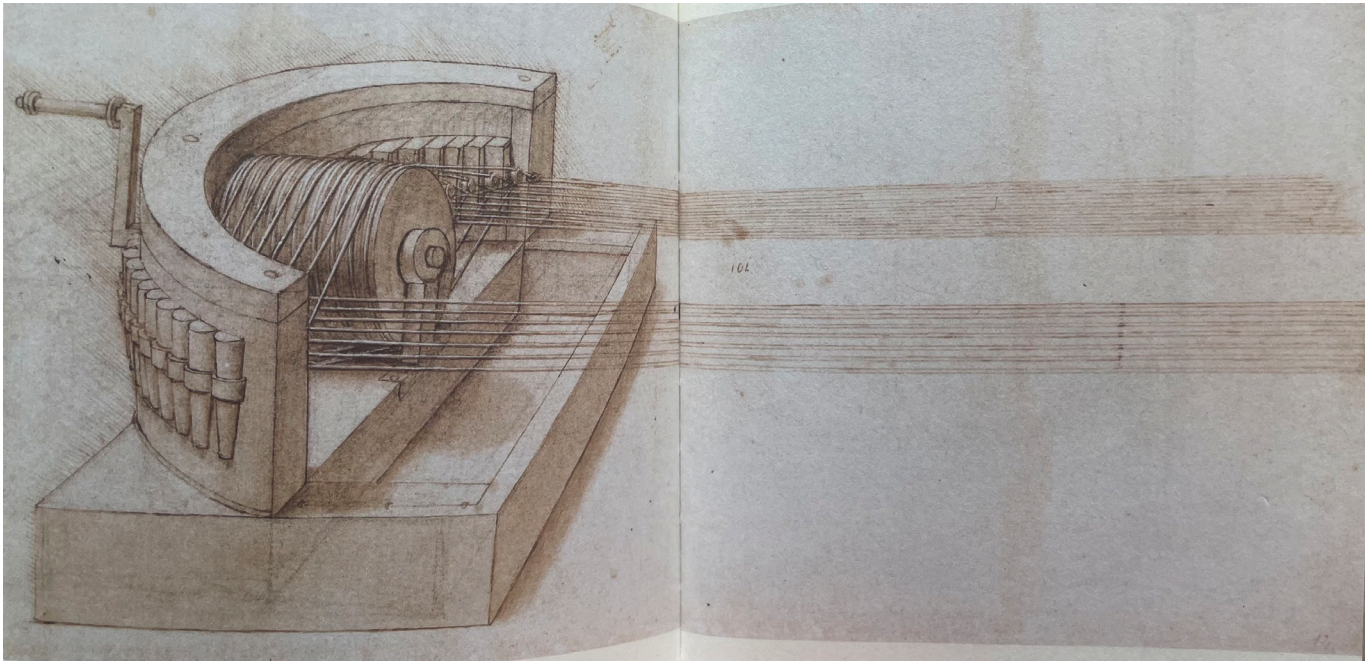


Figure 37: Drawing of a design by Leonardo da Vinci ('Leonardo da Vinci Schetsen & Aantekeningen', Suh)

Figure 38: Designer of Ferrari sketching for the LaFerrari model: an ensemble of orderly lines within the complexity of the design ('Ever since I was a young boy, I've been drawing sports cars', Lenaerts)

3. *Harmony of contradictions*

This comprehension suggests that not only human needs consist of contradictions, but that the beauty of the designed, visually represented world around us, can also be made up of contradictions. Complex and simplistic, classic and modern, fragile and robust: the art appears to be an interplay of various characteristics. An interplay of not necessarily an exact balance, rather an interesting consideration. A harmonious ensemble of opposing characters. Maybe because we ourselves are facing a complex set of characteristics and feelings, we also look for this in the designed, visualized world around us. For instance, this can be recognized in paintings that one perceives, in general, positively.

Example given, The Storm by Cot (figure 39), depicts a dramatic and atmospheric scene in which a young woman and a man are caught in the midst of a rainstorm. This painting exudes a sense of tension between power and fragility, created by the seemingly impending doom of an unescapable storm and the vulnerability of the naked depicted bodies. The contrast between light and dark, transparency and rough folds and even the difference in facial expressions all contribute to the interplay between extremes.

Figure 39: Cot, 'The Storm', 1880

Another example of the balance between contradictions, but more on the aforementioned 'order side', is the painting of figure 40 by Paul Cézanne. This painter developed his own colour theory, which he calls 'modulation' (Könemann, 2011). It involves colours progressively converging in terms of both hue and brightness, with distinct shades maintaining clear separation. This way, Cézanne modulated areas and positioned them by repetition of similar colour sounds in such a way that they reinforce the composition. In his representations, it creates order, geometry and rhythm. Nevertheless, contrast is distinctly noticeable, also created by the use of colours. Extensive use has been made of dull and radiant shades of blue and orange, two complementary colours. Here and there bright blue has been placed right next to the orange tones, resulting in the orange tones considered even brighter (Johannes Itten in 'Kunst en Kleur', 1961). However, a whole is created, by in a subtle way applying a few of the warm colours in the cold parts as well, even as applying cold colours (like the bright blue) slightly in the warm parts of the painting. We could conclude that with his modulation, Cézanne created a pictorial representation that is a harmony of ordered, contrasting elements. A balance that seems to work positively with concern to the perception of observers.

Figure 40: Cézanne, 'Mont Sainte-Victoire', 1902-1904

This phenomenon of contradictions in harmony can also be recognized in the more specific kinds of pictorial representations: design drawings. Figure 41, for example, shows a drawing of a car in which high contrast is being used between light and dark. The part of the car on the left, in the dark, is marked by highlights on the edges, while the right part of the car is defined by indications of shadows. Another contradiction can be recognized in the use of colours: just like in Cézanne's painting, there is decided on the application of the two contrasting colours blue and orange. Nevertheless, they run together to both sides of the horizontal frame and the light-and-dark contradiction is orderly arranged in a diagonal direction. This, in combination with the chosen view of a perfectly symmetrical form, makes the whole look like a unity.

4. Perceptual tension

Apparently, our perception is constantly influenced by our rich, personal context, the influence of the times we live in and our search for a harmony of interesting (contrasting) characteristics. The ambiguity that triggers the imaginary and the emotional attractive aspects allow drawings to create specific moods and evoke a wide range of emotions for their audience. But what is it exactly, within drawings, that affords them to let us experience the sensory side of our perception? If we look at the incentives discussed above (order/complexity, harmony/contradictions), the relationship, or maybe even a certain degree of tension, between the artistic elements within the drawing seems to be important.

Figure 41: Design for Masterati Birdcage by Jason Castriota ('Ever since I was a young boy, I've been drawing sports cars', Lenaerts)

This can be determined by the visual 'style' that is being used. According to Gombrich (..), a style can be defined as "any distinctive, and therefore recognizable, way in which an act is performed or an artifact made or ought to be performed and made". This characterized 'way of creating' encompasses the modulation of multiple artistic elements into one representation. Consequently, with the way of using color, composition, form, subject matter, and techniques, artists or designers can (intentionally) afford the observer to have the aforementioned emotional responses.

This is, for example, done by a fine combination of bold and delicate brushstrokes, able to create a sense of drama, mystery, or intimacy. These kind of effects can be recognized in the drawings below (figure 42 and 43). But also in drawings for design in specific, these effects can be recognized; examples of which are given in figures 46-50 (source of the drawings: 'Ever since I was a young boy, I've been drawing sports cars', Lenaerts).

Composition and form contribute to the emotional impact of drawings as well. The placement and arrangement of elements within an artwork can create a sense of balance and harmony, but also a tension between those two elements. Artists may use symmetry to convey a sense of stability, for example recognizable in the car design drawing of figure 46. Or the other way around, using asymmetry to evoke a feeling of imbalance or unease. The scale and proportions of the objects can also influence the emotional response of the observer.

Interesting examples of playing with this, can be seen while examining the left drawing by Cézanne in figure 44: "The question can be asked, is Cézanne's subject the écorché (the muscle figure, red.) or the spaces created by its gestures? Instead of clarifying that relationship, he forces us into a never-ending back-and-forth, a perceptual tension between projection and recession, near and far." (J. Hauptman in 'Cézanne drawing', 2021). Hauptman continues: "What is so richly textured, dense, material, and

Figure 42: Rembrandt, 'Young Woman Sleeping', 1654

Figure 43: Rembrandt, 'Four Studies of Male Heads', 1636

substantial is actually nothing at all: the triangle of empty space created between torso and arm, when the elbow is folded in as hand cradles head." The perceptual impact of the oscillation between sculpture and space is an interesting one also specifically for drawings of designed objects. What remains unmarked and unrendered, defining their 'unfinished' status, is just as important as what is marked (Hauptman, 2021). Cézanne uses these spots for example as highlights and suggestions of volumes in his compositions, for example in figure 44 (top right). Use of negative space and suggestive lines affords one to use the imagination. By triggering the imagination, a more profound way of perception is being touched. This links back to the analysis in chapter 4.1.7, in which Fish and Scrivener were citated about the dynamically mental representations we continuously form by the integration of meaningful fragments.

The use of omission, suggestive lines (ambiguity) and this triggering of the imagination, also recognizable in the design drawing of figure 45, has been discussed in section 4.1. However, it must not be left unmentioned here, as it is part of the incentives for positive visual perception.

Figure 44: Pencil and water colour drawings by Cézanne: 'D'après l'écorché' (left); 'Théière et fruits' (top); 'Corbeille de fruits' (bottom). In 'Cézanne drawing', Hauptman (MoMA)

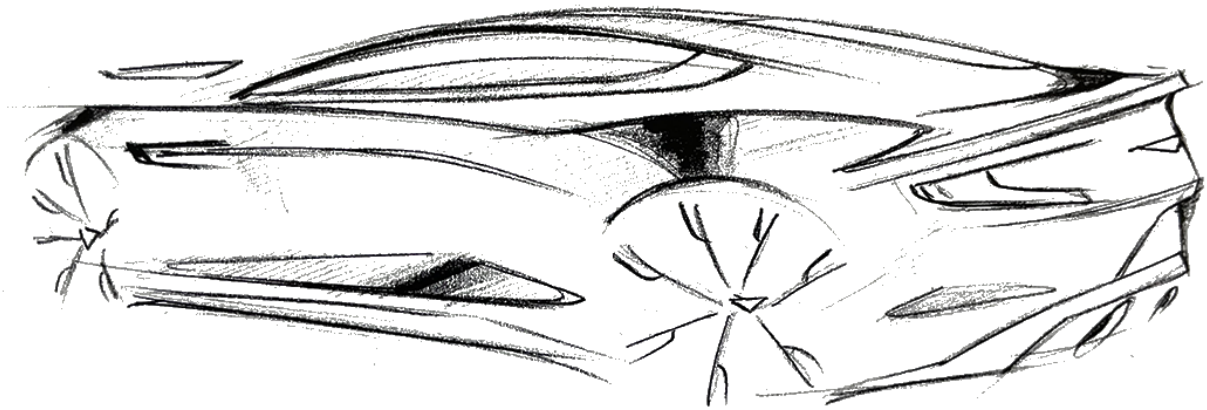


Figure 45: Drawing for the Aston Martin Vanquish ('Ever since I was a young boy, I've been drawing sports cars', Lenaerts)

This and the aforementioned ways of using color, composition, form, subject matter, techniques and plays of light and dark, creating perceptual tension, are significant values for the interpretation of design sketches. Taking all of these stylistic elements and ways of using them into account, the designer can use design sketching to let a spark jump at stakeholders.

The design director for example, as car designer Ewoud Luppens will enlighten in section 5.2, he "thinks with his gut: the drawing that sparks in him, for whatever reason (he gives little argument), is then chosen to continue with." At this point, the affordance of design sketching is, in communication with the observer, one on the highest level of sensory perception.

Figure 46: Drawing for Bugatti Veyron, playing with contrast in perfect balance

Figure 47: Design drawing for Porsche 911, in which the use of colours and protrusions cause a sense of mystery

Figure 48: Design drawing for Ferrari, in which the combination of the colours (opposing warm and cold), the sharp highlights and a clear reflection on the ground cause a dramatic, tough scene

Figure 49: Drawing for Ferrari, including brush strokes and splashes that create the suggestion of speed

4.2.4 Discussion and conclusions

Studying the 'beyond design drawing' perspective, the versatile ways of perceiving pictorial representations and design sketches in specific, has provided more insights on the affordances of sketching. Specifically on the ones with regard to outwards communication. Matters have been discussed on what (design) drawings can consciously and unconsciously do with people and how artists can direct one's way of perceiving them. Multiple affordances of design sketching appear to be central to the interaction between designers and stakeholders.

The stakeholders are the observers or partakers, whose perception of pictorial representations is susceptible to change and depending on subjective values. Perception is constantly influenced by our personal context, the influence of the times we live in and our search for a harmony of interesting (contrasting) characteristics. One's perceptual filter, influenced for example by associations, determines the perception together with certain visual stimuli like order, complexity, contradictions, symmetry

and closure. Furthermore, there is the remarkable ability of drawings to create specific moods and resonate or evoke a wide range of emotions for their audience. The modulation of artistic elements, the way of using colour, composition, form, subject matter, and techniques like certain brush strokes, affords designers to cause these kinds of responses. Examples demonstrated how the designer can, in this way, use design sketches to let sparks jump at stakeholders. At the same time, the sketch can also trigger an 'epiphany' for the designer personally - a spontaneous design move not initially planned, yet, upon reflection, profoundly impactful for the project's subsequent phases (Hoftijzer, 2018). Such sketches possess attention-grabbing qualities and artistic merit. Subsequently, drawing freely and intuitively affords designers to convey information that appeals not only to our reason, but also to our sensory side.

Now that we know a part of the iceberg concerning the psychology behind perceiving pictorial representations, we should be able to better understand the origin and the usefulness of the agency of sketching with regard to human interaction. Next chapter will elaborate on this further, by studying how the affordances of design sketching manifest themselves in practice.

"There are two things... the eye for the vision of nature and the brain for the logic of organized sensations."

(Paul Cézanne, quoted in 'Émile Bernard', 1904)

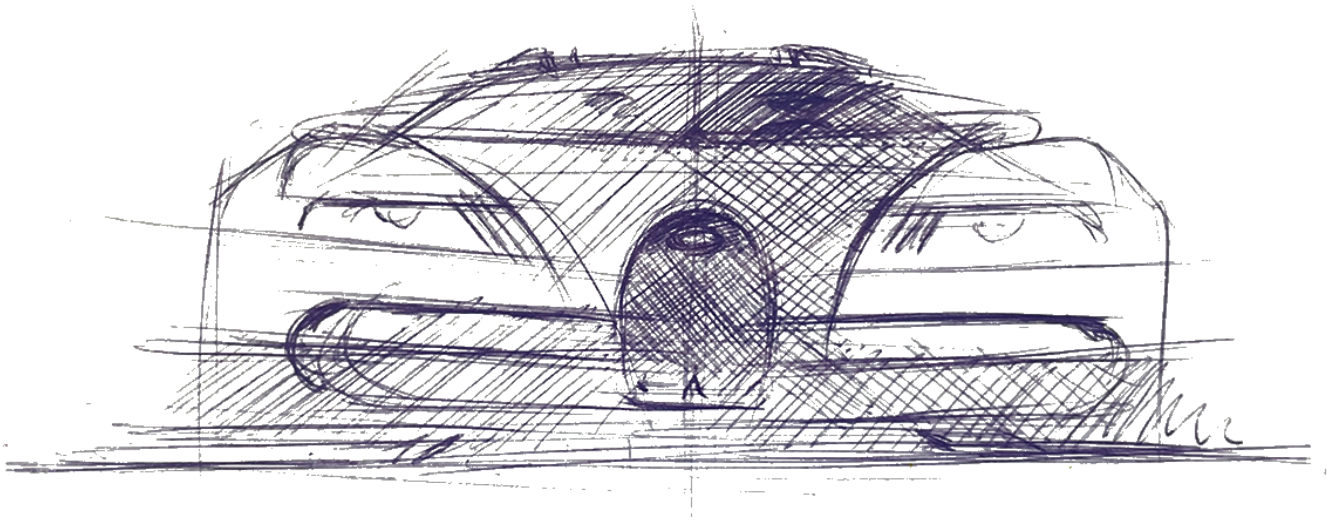
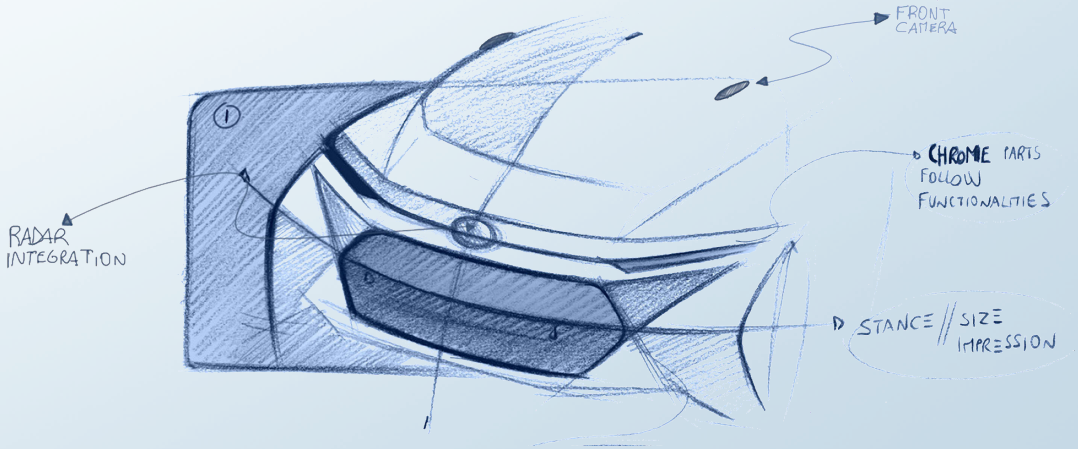


Figure 50: Design drawing for Bugatti Veyron - sharp line strokes radiating decisiveness

5 A practical perspective on design sketching as an agency

This chapter will jump from the theoretical affordances of design sketching to the affordances that appear(ed) in practice. Studying these adds relevant knowledge for the subsequent creation of The Framework for the Agency of Sketching and for considering how the framework can be utilized in the intended context of designers.



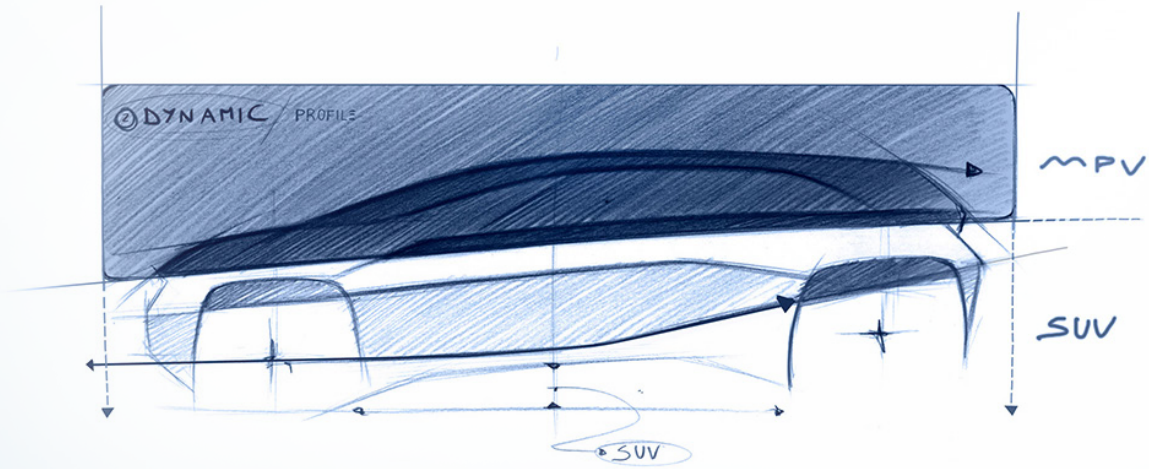


Figure 51: Sketches for 'Offspace' as shared by Ewoud Luppens (Granstudio)

Therefore, research has been done specifically on how and why design sketching has developed into the current state of art.

Subsequently, on the basis of interviews with designers in practice, crucial insights have been gained on design sketching in modern times.

This is followed by an analysis on how contemporary trends and designers' current approaches might shape the future of sketching as an agency for design.

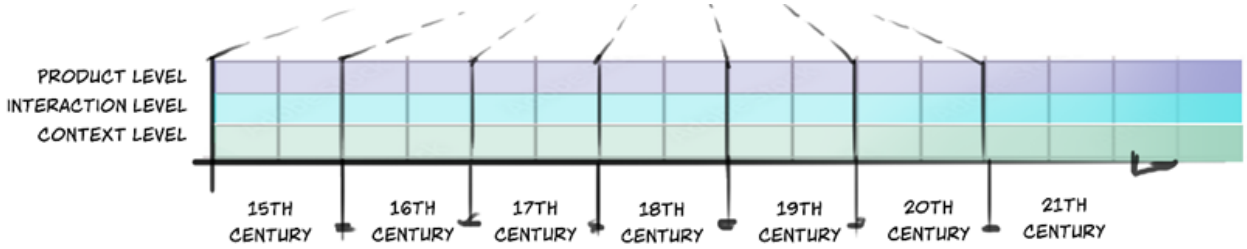
Accordingly, this chapter is divided into the following three parts:

1) **The historical context (5.1);**
2) **Today and today's context (5.2);**
3) **Towards the future (5.3)**

5.1 The historical context

This section will throw light the way design sketching has developed into the current situation. It definitely does not aim to cover the complete history, neither will it directly add to the creation of the framework, but some history knowledge can add to a more complete vision on the agency of sketching.

In order to structure, the gained insights are related to three levels inspired by the VIP method: product level, interaction level and context level. Insights will touch on 1) the characteristics of the sketches themselves (the 'products'), 2) their functions concerning involved people (stakeholders) and 3) relevant influencing aspects of the surrounding context (e.g. the emergence of new technologies). Explanations will be point by point to avoid implying a 'complete' history story.



The 'beginning of design drawing': fifteenth and sixteenth century

One of the first, well-known design sketches are the ones of Leonardo da Vinci.

Observations about design drawing in this period described in 'The Mind's Eye', Ferguson (1977):

"(...) the non-scientific component of design remains primary. It rests largely on the nonverbal thought and nonverbal reasoning of the designer, who thinks with pictures."

"An explanatory text generally accompanied each of Francesco's drawings (Fransesco di Giorgio – Ramelli 'tradition'), but the text was complementary to the drawing and had no meaning in its absence. Some engineers' notebooks contained no text at all."

"The appearance in many of the notebooks of whole series of similar drawings, copied from each other or from other sources, attests to the active exchange of information in pictorial form among technologists."

In the fifteenth century, there was the crucial invention of perspective. Perspective drawings offered a consistent convention for representing three-dimensional objects. The Renaissance invention of perspective eliminated the ambiguity seen in earlier drawings regarding object size and spatial location.

"Nearly as important as the art of printing itself were the techniques of pictorial perspective, which produced qualitative change in the ease with which the visual image in one mind could be conveyed to another mind."

Subsequent graphic innovations have enhanced pictorial representation. Leonardo da Vinci came up with the "exploded" view, which appeared to be a relevant method for designers to convey reality. Contrasting the illustrations by Leonardo and Agricola clearly demonstrates the benefits of employing the exploded view as opposed to an alternative presentation of disassembled components (Ferguson, 1977).

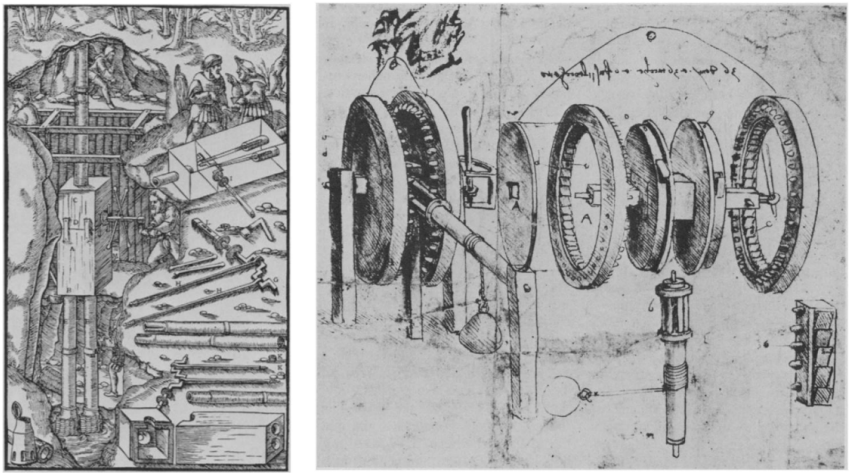


Figure 52: Agricola's water pump (1556) and Da Vinci's weight-driven ratchet device (about 1500), both drawn with the purpose of depicting assembly parts

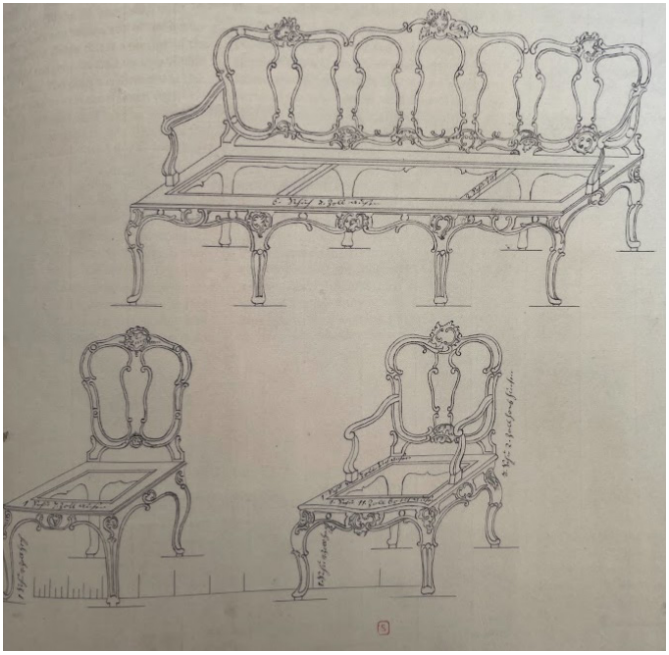


Figure 53: Design for chairs and sofa ('Process', Baarsen 2023), 1750: although early invented, perspective drawing remained difficult for a long time

Drawing throughout the sixteenth, seventeenth and eighteenth century: transformation of roles

During the 16th century, there was a growing recognition of drawing as a key solution to artistic challenges. Esteemed painters, occupied with diverse activities, produced relatively few paintings by their own hands (Gerszi, 1979). The heightened demand for designs prompted a shift in artistic focus toward drawing. Simultaneously, the status of designing artists rose compared to those primarily involved in execution. This separation of roles, unthinkable a century earlier, diverged from medieval labor practices where artists had to manage all aspects from design to the finished artwork. However, in the 16th century, this rigid rule no longer applied. Designing artists enlisted the help of assistants and collaborators to fulfill diverse commissions, showcasing a new division of labor that not only increased the value of drawing but also led to extensive specialization.

This division of labor in the field of artistic drawing continued, also with regard to product designers in particular. In the 18th century, the Industrial Revolution and shifting consumption trends brought about a transformation in the role of designers (Sparke, 1987). Traditionally tasked with shaping forms and surface patterns for objects, designers saw their role become increasingly separated from the manufacturing process as production methods evolved. The growing market's desire for novelty spurred a series of fashionable styles, compelling designers to contribute more artistic input to meet the demand.

The invention of steam power revolutionized spinning mills, enabling mass manufacturing. This, in turn, created more markets, intensifying the link between design and marketing, with a greater focus on taste and fashion in product distribution (Sparke, 1987).

However, in the 18th century, 'design' still implied a close link between paper planning and the final product, inherited from the Renaissance (Sparke, 1987). This connection applied to drawings of designers in pattern books, serving as advertisements and spreading knowledge about styles. They were crucial for communicating fashionable trends and helping manufacturers align with prevailing tastes.

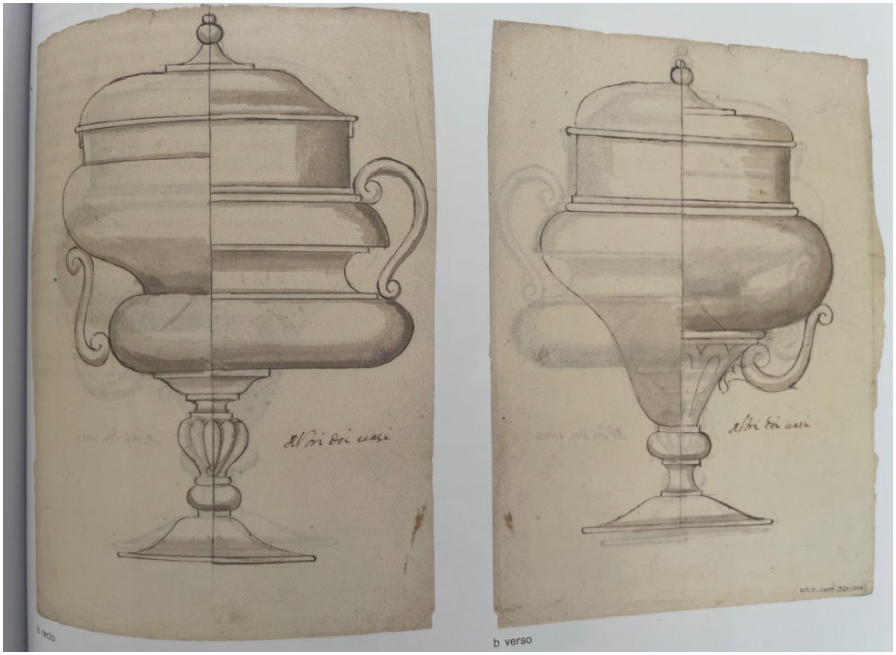


Figure 54: Pages from a notebook that served as a portable salesman's catalogue ('Process', Baarsen 2023), 1590-1610

Design in the ninetheenth and twentieth century

Growing machine specialization and increased division of labor detached design from production activities. Technology largely dictated product design, reducing it to surface decoration rather than a deliberate, planned project. The practice of design significantly aided the growth of capitalism, and capitalism, in turn, has been equally beneficial for design (Forty, 1986): "its appetite for novelty and variety guaranteed the prosperity of designers."

Art Nouveau, along with its national variations, served as a way for countries to openly compete internationally. The architectural and decorative style, also known as Jugendstil, emerged from political, social, cultural, and technological factors. Sparke describes them clearly in 'Design and context' (1987) as the following:

Politically:
It represented newly independent and unified countries (Germany, Italy, Finland) asserting themselves globally and engaging in more extensive international trade.

Socially:
Architects and designers aimed to influence the appearance of modern mass environments, impacting places like underground stations, Socialist Party headquarters, restaurants, and department stores.

Culturally:
It reflected newfound unity across various visual arts disciplines, including painting, sculpture, graphics, glass, silver, and furniture.

Technologically:
It demonstrated a readiness to embrace innovative structural materials such as wrought iron and glass.

Figure 55: Design drawing for a cabinet, 1900 ('Process', Baarsen 2023); "The shape of the cabinet is determined by the twisted, whiplash lines typical of Art Nouveau."

In the aftermath of World War I, the link between political events and design underwent a heightened phase. The 'De Stijl' movement embraced an ideological commitment to a uniform, non-hierarchical society, rejecting class distinctions and artistic elitism. However, 'De Stijl' struggled to significantly impact the mass-produced environment.

Subsequently, there was the Bauhaus movement: emphasizing functionalism, simplicity, and the integration of art and technology, Bauhaus laid the foundation for modern industrial design and visualizations.

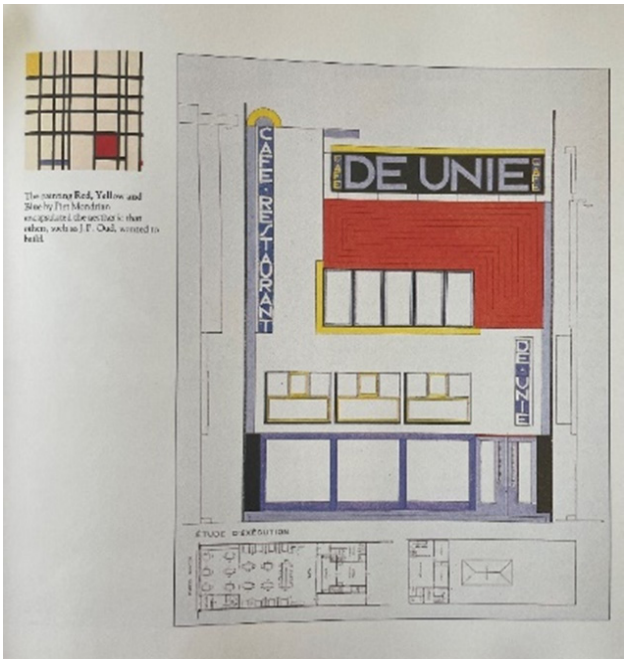


Figure 56: Design drawing for building 'De Unie' inspired by the painting of Piet Mondriaan 'Red, Yellow and Blue'

Figure 57: Modern design for the 'Barcelona Chair' by Ludwig van der Rohe, 1929

In the post-World War II era, rapid industrialization and a growing consumer culture took center stage (see figure 58). Industrial designers played a significant role in shaping the appearance, functionality, and usability of mass-produced consumer goods.

The 1950s witnessed the ascent of mid-century modern design. The focus shifted towards eco-friendly materials, energy efficiency and waste reduction. Approaching the 21st century, digital technology revolutionized industrial design. Computer-aided design (CAD) and 3D modeling tools enabled more concrete design visualizations. Moreover, the concept of user-centered design has started to play a larger role. Section 5.3 will elaborate further on this.

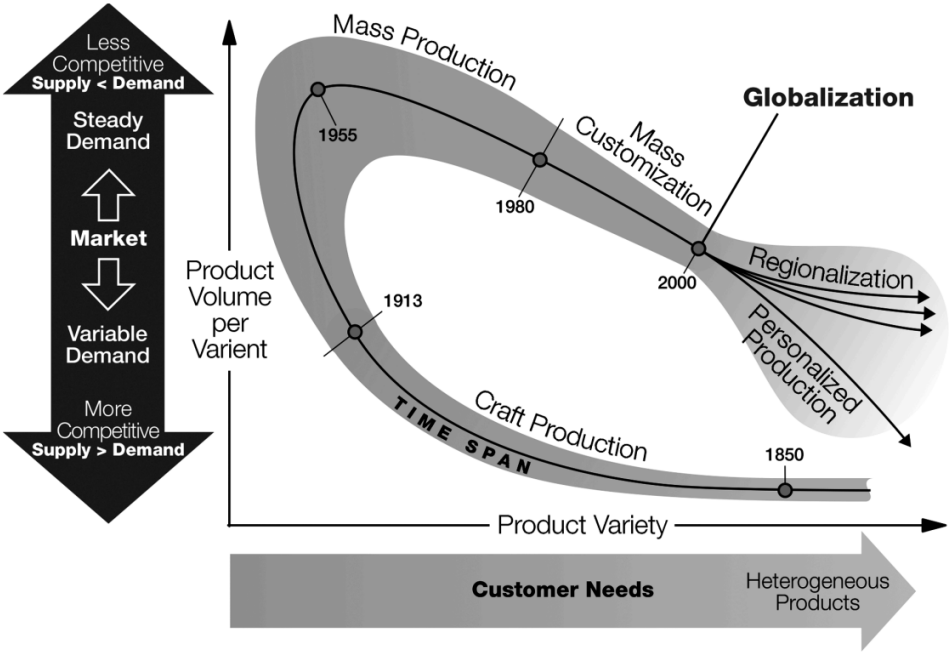


Figure 58: Product architecture and the manufacturing system described by Koren (2010, p. 34)

5.2 Today and today's context

In order to paint a picture of design sketching in the contemporary design context, interviews have been conducted with five designers who work in practice: Ewoud Luppens (Granstudio), Jort Nijhuis (Jort.), Janwillem Bouwknegt (NPK Design), Robert Oude Nijhuis (Visuale Verbinders) and Rik de Reuver (Modyn). All interviewees have been chosen in particular for their active involvement with design and sketching in practice, but each serves a different field (cars, products, visual strategies) and each has a different professional position (company/independent/manager/employee). Of course, this does not pretend to cover the entire contemporary design sketching context, but it does offer interesting insights into it.

The designers were questioned about four topics: about the functions of sketching (the process) and of the sketches themselves, about the interaction with people involved, about their sketching styles and about sketching within the design field in general (particularly the changes caused by over time, including trends). The latter theme will be discussed in section 5.3: Towards the future. The first three themes will be discussed in the current section, as they provide insights into today and today's context. The specific questions and answers with concern to the interviews can be found in appendices 10.1 and 10.2.

Ewoud Luppens
Granstudio

Jort Nijhuis
Jort.

Janwillem Bouwknegt
NPK Design

Robert Oude Nijhuis
Visuele Verbinders

Rik de Reuver
Modyn

5.2.1 About the functions of sketching

First of all, to obtain insight into design sketching as an agency nowadays, the respondents were questioned about the motivations they personally have and the functions they ascribe to sketching activities in the design process. Multiple functions and purposes appeared, which have been defined into the following overarching ones:

1) Communicating with ourselves;
2) Recording of the process: convince of the content;
3) Call for attention, reflection and input;
4) As a work of art;
5) Common understanding;
6) Explanation.

The subsequent paragraphs will provide brief explanations of these aspects, drawing from the insights provided by the interviewees.

1. Communicating with ourselves

First of all, sketching is a way of communicating with yourself, according to Janwillem Bouwknegt. The purpose of the sketching itself is to search for the right design and to find technical solutions. It indicates whether what you have in mind is possible, for example in the right shapes and proportions. You try to find new shapes and solutions, which results in sheets with lots of drawings on them:

"*Making all of these messy sketches helps me to continuously analyze what the client wants, what I want with that and how I can achieve that.*"

(*JanWillem Bouwknegt, NPK design*)

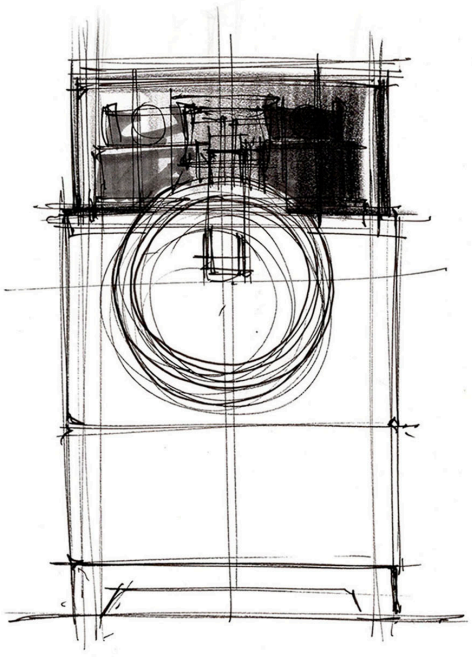


Figure 59: Design sketch of the VSP-P1 NanoPrinter by NPK Design (for VSPARTICLE)

This way, it helps to find out which solution can ultimately best be offered to the client. This communication through sketching is confirmed by several interviewees. For example, Jort Nijhuis indicates that it is also a tool for himself to suddenly see things. He likes to sketch with rough brushes, which he has less control over, but because of which he sometimes sees new forms and ideas in the outliers he makes.

"I often already have the direction of an idea, but while sketching I react to my drawn lines. It is an interplay between the lines I see and the (re)attunement of them."

(Jort Nijhuis, Jort.)

This affordance of sketching, facilitating the designer's internal search for solutions, can be closely related to the discussed theoretical insights in chapter 4. Continuous reflection on the drawn lines is central to this.

2. Recording of the process: convince of the content

It also became clear during the interviews that the drawings play an important role in elaborating on the progress steps in collaboration with the client. By showing the drawings from the start, the designer can substantiate how he/she arrived at a certain direction or idea. This

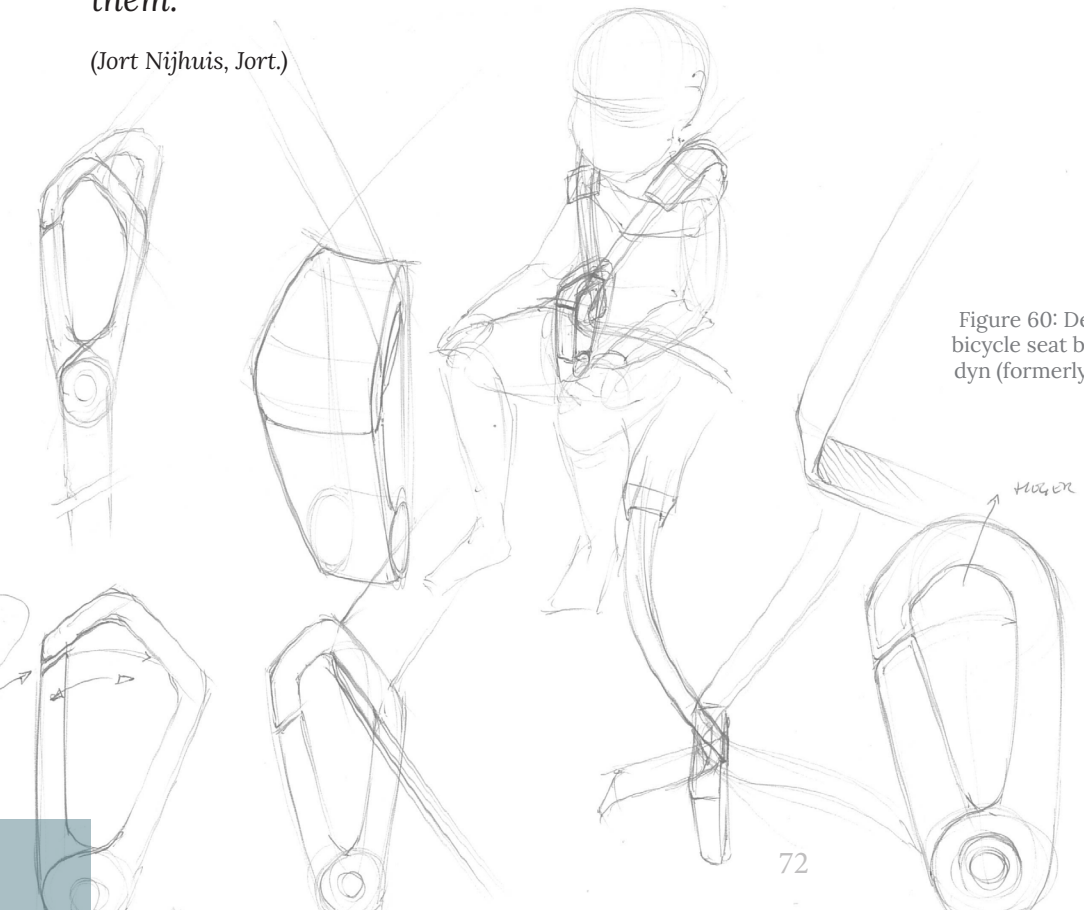


Figure 60: Design for a children's bicycle seat by design agency Modyn (formerly Van der Veer), 2020

can be by showing a set of several consecutive drawings, but also by showing the intermediate stages during the development of one idea into a detailed concept. By recording intermediate steps, as clarified by Jort Nijhuis, someone understands how you get to something. It makes the designers' story towards the client more logical and, therefore, more convincing.

"*It is not a matter of just making a sketch; the sketches form a result, a kind of logbook.*"

(*Jort Nijhuis, Jort.*)

3. Call for attention, reflection and input
Furthermore, examining drawings is more captivating than perusing pages of text, Robert Oude Nijhuis points out. It captures thoughts and discussions in a more enjoyable and succinct manner compared to traditional textual minutes. As a result, he notices that people, especially in larger organizations where individuals engage in manual work, actively review the drawings; a behaviour less common when dealing with written notes. The visuals lower the threshold for people to engage. Consequently, content becomes better accessible for people.

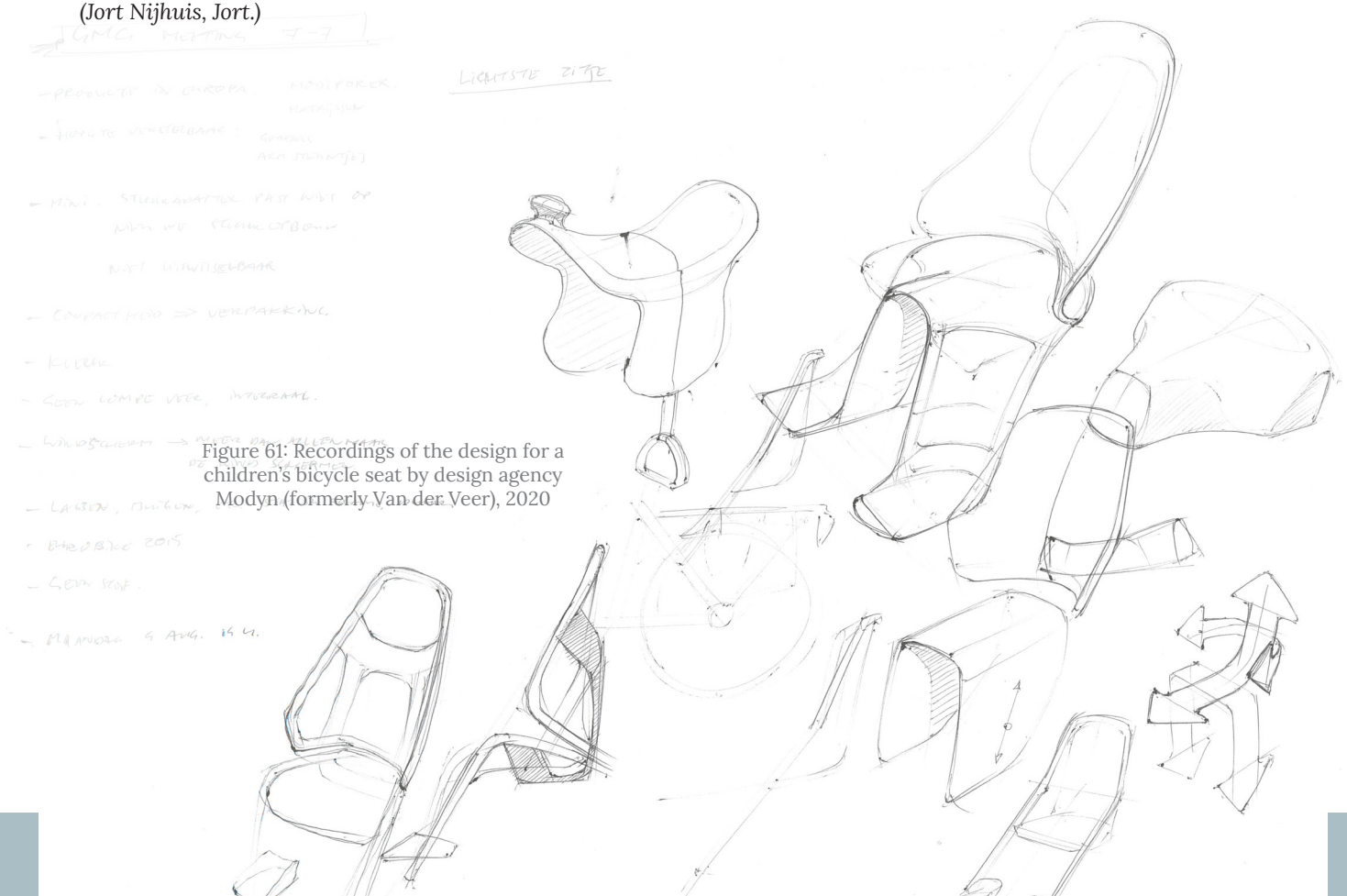


Figure 61: Recordings of the design for a children's bicycle seat by design agency Modyn (formerly Van der Veer), 2020

In addition to attracting attention, the drawings are intended to provoke reflection and input during the design process. This gives the designer crucial information to adjust and continue the design activities in the right direction. A frequently mentioned aspect in relation to this, is that the sketches should not look too neat, especially at the beginning. In addition to the fact that the designer personally often likes to start intuitively, the roughness of the sketch is an important signal to the client. It should indicate that they are still trials; that it is not finished yet, according to Janwillem Bouwknegt. This prevents miscommunication, and anything that has not yet been fully established also provokes discussion/reflection. More sketchy styled drawings make it easier for people to provide input, Robert Oude Nijhuis emphasizes as well. People unconsciously notice the sketchy aspect within the drawings:

"They hold the notion that it is not yet finished and that it is therefore still malleable."

(Robert Oude Nijhuis, Visuele Verbinders)

That is why it is important in the process, according to the interviewees, to start with very rough sketches (see figure 62), encouraging one to offer substantial feedback.

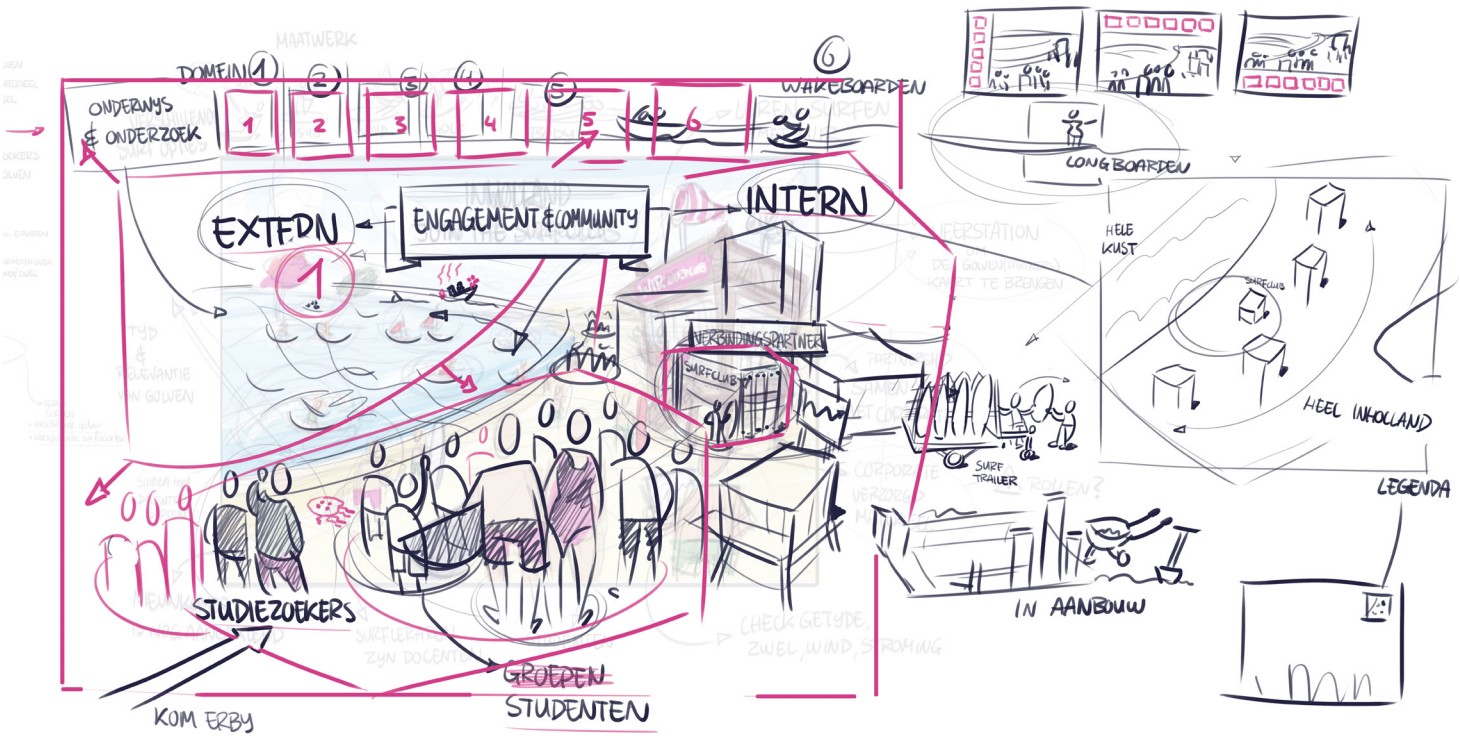


Figure 62: Sketch for InHolland by Robert Oude Nijhuis ('Visuele Verbinders')

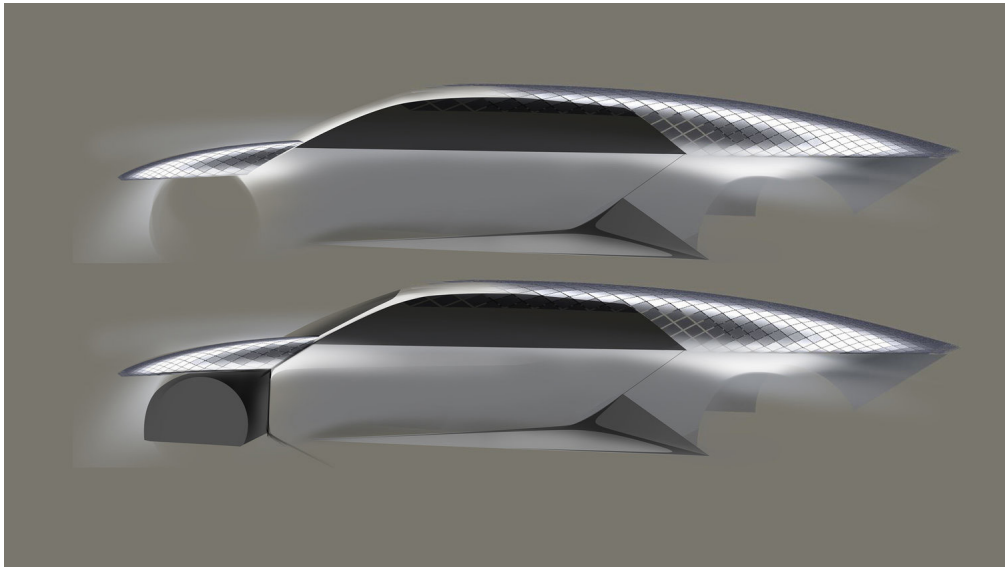


Figure 63: Drawing of 'Lightyear' as shared by car designer Ewoud Luppens (Granstudio)

4. As a work of art

In addition to this sketchy, inviting aspect, it is often important for the drawings to possess an eye-catching appearance (see figure 63). This seems to be in contrast to the rough way of sketching that was just highlighted, but also (precisely) the process drawings can spark. When this is the case, the conceptualized idea can be more inspiring and persuasive to both the designer and the client. This resonates with the aforementioned aesthetic function of sketches by Tversky (2010), evoking feelings of pleasure.

This is particularly evident in the car design world. According to Ewoud Luppens, it is the emotionally attractive aspect of the design drawings that plays a major role, especially in the beginning. It is essential that a spark jumps at the design director. He thinks with his gut: the drawing that sparks in him, for unspecified reasons, is then chosen to continue with.

> *"This means that the design and the drawing are one thing: the director does not distinguish those in this phase."*
>
> *(Ewoud Luppens, Granstudio)*

Adjustments are then made by the designers, while at the same time striving to maintain the elements that expectedly caused the spark. Towards the end of the design process, the drawings become more and more descriptive, but they all retain something artistic and expressive.

5. *Common understanding*
During conversations, the drawings provide visual support. This means, as indicated by the designers, that they form also a powerful tool for collective understanding. Visual metaphors function as a 'kapstok' (Jort Nijhuis) and make substantive structures visible at once (Robert Oude Nijhuis).

Drawings can therefore facilitate conversation and streamline complex processes by ensuring everyone shares a common understanding. Sometimes, people think they have agreed with each other, but then it turns out that they are heading in divergent directions in terms of content. To avoid this, drawings can clarify content and resolve misunderstandings, accelerating decision-making and guiding the design process in the right direction.

6. *Explanation*
As pointed out earlier by Ewoud Luppens, the design drawings become more descriptive as the process continues. The focus is shifting from the gathering of knowledge and new ideas by the designer personally to the transfer of ideas towards clients. The greater the number of decisions already taken regarding the subject to be designed, the more concrete the drawings will appear.

Moreover, frequently a particular narrative needs to be communicated; a specific vision of a company or the underlying source of inspiration. For example, Janwillem Bouwknegt clarifies that clients frequently desire a design narrative that they can share and exude. It is therefore important to include this in the drawings. It can be considered a crucial aspect by, for example, Chinese clients: they often have a specific story, or even a requirement ('it must be inspired by a water drop'), which the designers are supposed to build on.

Furthermore, in the case of tangible product designs, technicians/engineers are often involved. For this purpose, drawings should convey explicit information, like in the exploded view in figure 64. These sorts of drawings can also be created by using CAD programs. The engineers must be able to read off precise illustrations of how the drawn object is put together, for example in terms of materials and dimensions, in order to start the executive construction process.

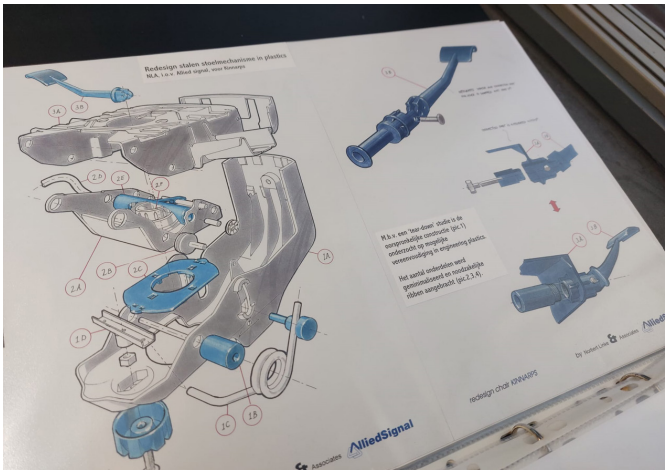


Figure 64: Construction drawing by ir. J.W. Hoftijzer, 1999

> Figure 65: Porsche's design director Michael Mauer explaining his brand design theory regarding the Porsche 911 ('Ever since I was a young boy, I've been drawing sports cars', Lenaerts)

5.2.2 About the human interaction

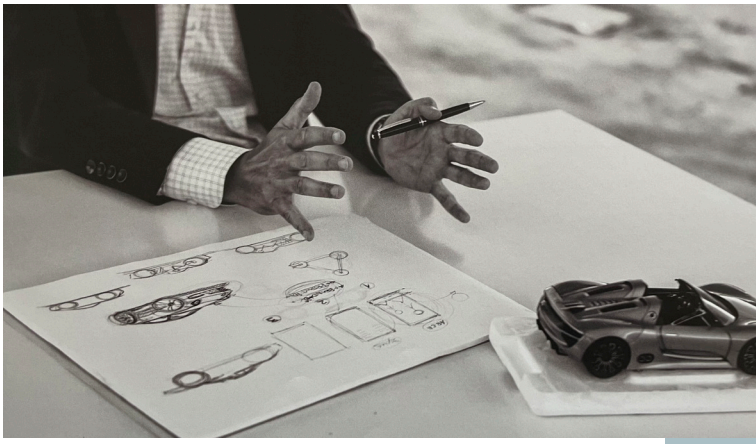
As a design draftsman within the car design world, according to Ewoud Luppens, you have a clear set of people to deal with. Specifically, with the design director, with chiefs who determine what is presented to the director and of course with fellow designers. The chiefs are there to help (unlike the director) and fellow designers have an important function in increasing the pressure to perform. They inspire each other and, at the same time, are very competitive: everyone wants to come up with the best sketches. Chiefs check whether the whole is still coherent and also whether the design drawings do not resemble each other too much.

The dynamics within the group are distinctly different in the initial phase compared to the later stage. This is determined by the design director's choice: when there has been decided on the winning sketch, people become less competitive and more cooperative. Modelers and engineers join in, tasks are divided (to detail within the chosen design) and the chief has to give his thumbs up at regular intervals. The design director presents the visualisations of the design to the highest bosses about twice a year.

Over time, the design process, at least in the automotive design world, has become more divided into specialized areas, leading designers to focus on smaller parts of the process rather than the whole. Perhaps this is in correlation with how complicated the product to be designed is. That is why, in terms of the drawings, one sometimes notices that the older designers are generally good at interpreting and integrating them, while the younger (more specialist) only work with a specific type visualization (or drawing), according to Ewoud Luppens.

Depending on how involved the client is, during the design process you spend a lot of time making your ideas presentable, regarding Jort Nijhuis. When someone is an engineer, the sketches have to be more precise and then they are, for example, cross-sections. It is good to record all intermediate stages, so that someone understands how you get to something. However, it is important to pay attention not to show all idea sketches to the company in question. If part of this is subsequently not chosen to continue, the idea may not be allowed to be used for other purposes or companies.

Drawing also helps to explain things to colleagues. To allow engineers to assess things, you draw cross-sections, is the example Janwillem Bouwknegt gives as well. The manner in which you articulate the idea, particularly the aspect you aim to communicate, is crucial for effectively conveying it, all the while being attentive to the individual in front of you. This also applies to the type of company or organization you are dealing with. A businesslike or a somewhat playful institution each asks for drawings in a different style.



5.2.3 Sketching styles used nowadays

The styles of design drawings differ per company and often also slightly per person. Additionally, the styles can, consciously or unconsciously, differ for more practical reasons.

Differences depending on goal and/or client

To some extent, one adapts the style based on the client. This plays a role in the work of Robert Oude Nijhuis in particular, as the drawing is the final result. He describes his drawing style as follows: "The way of drawing is cartoonish, fast and also design-ish (perspective effect, material, shadow/light). Some companies sometimes find the drawing style a bit childish. Then they sometimes use the idea of the drawings, but have it visualized somewhere else in a different style. I generally have a playful way of drawing (especially when you look at the human figures), which can sometimes vary." Depending on the organization, he sometimes uses a slightly more angular, tighter, business-like style. Furthermore, he sometimes completely omits the faces of human figures, unless a lot of emotion and humanity is involved (such as within the designs for medical or educational institutions): then diversity in the human figures is preferred to be visible, like facial expressions, expressions of emotion. "But," Oude Nijhuis continues, "in general they all are line drawings that are colored with fairly simple material and light expressions (often digitally). The human figures are often in perspective, but never photorealistic and I never remove my lines." The variation in style mainly concerns the general shapes in the drawing: sharper and harder to make it more business-like; rounder and softer at the other end of the spectrum.

The style used at NPK Design can be called reasonably pragmatic. The question 'How do you get the idea to the other person as quickly as possible?' is often central to this. It should look modern and sketchy, and often with color and contrast so that it pops off the screen. The extent to which the style must be so expressive depends on internal or external contact: when communicating with colleagues, it doesn't have to be as fancy, says Janwillem Bouwknegt, but during presentation moments to clients (particularly during the sketching phases), the drawings really have to be splashing off the screen; high level design drawings. This resonates with findings of Hoftijzer et al. (2018) suggesting drawings that serve an external audience and have a high push factor, like the 'epiphany' sketch, are likely to have a high artistic quality and attention value.

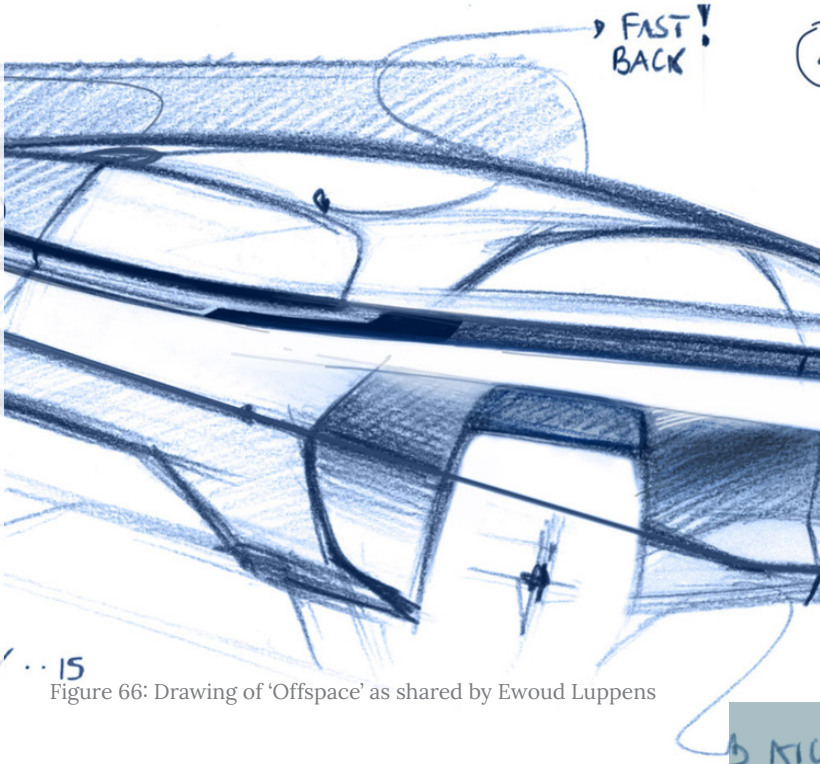
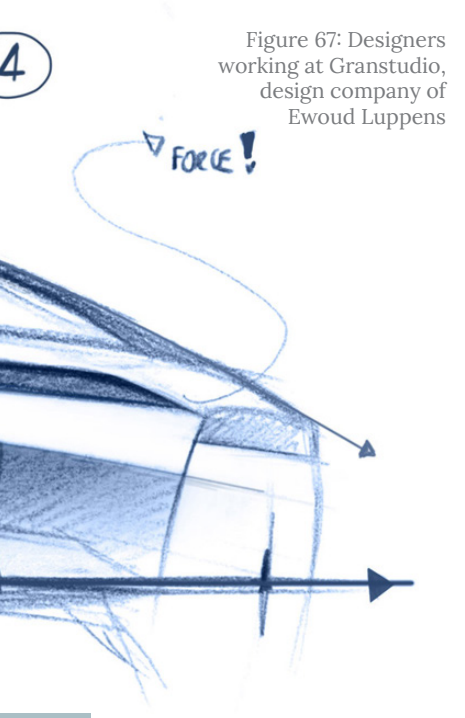


Figure 66: Drawing of 'Offspace' as shared by Ewoud Luppens

While most designers indicate that the differences in style are mainly influenced by the client, car designer Ewoud Luppens indicates that the work of colleagues plays a major role in this: “The sketching styles we use are definitely differing. I myself am, precisely because of the competitive atmosphere, flexible and looking for the new, winning aspect. There are also three other draftsmen within the company, all three of whom have their own style. That also depends on the division of functions: they only draw, while I also give presentations and work in teams. When I start drawing again, I notice that I have to adapt to what I see for kind of drawings around me. Based on what drawing styles I see emerging from the others, I adjust mine in a way that I think could win. In general, my style could be described as more descriptive, as I am more on the design side, while there are also draftsmen within the company who have studied at art schools.” According to Luppens, the drawing ‘as a work of art’ is important. He enlightens: “Car design is fashion. We are constantly looking for new expressions. How it is drawn plays a big part in how it is judged by the design director. People are looking for new ways to get it on paper; even if it is a crazy combination of green and pink, as long as it is fashion!” As mentioned earlier, the style and content of the drawing become one through the eye of the design director.

In short, based on the assessment of clients, design directors and the work of colleagues, the drawing styles are influenced to a greater and lesser extent.



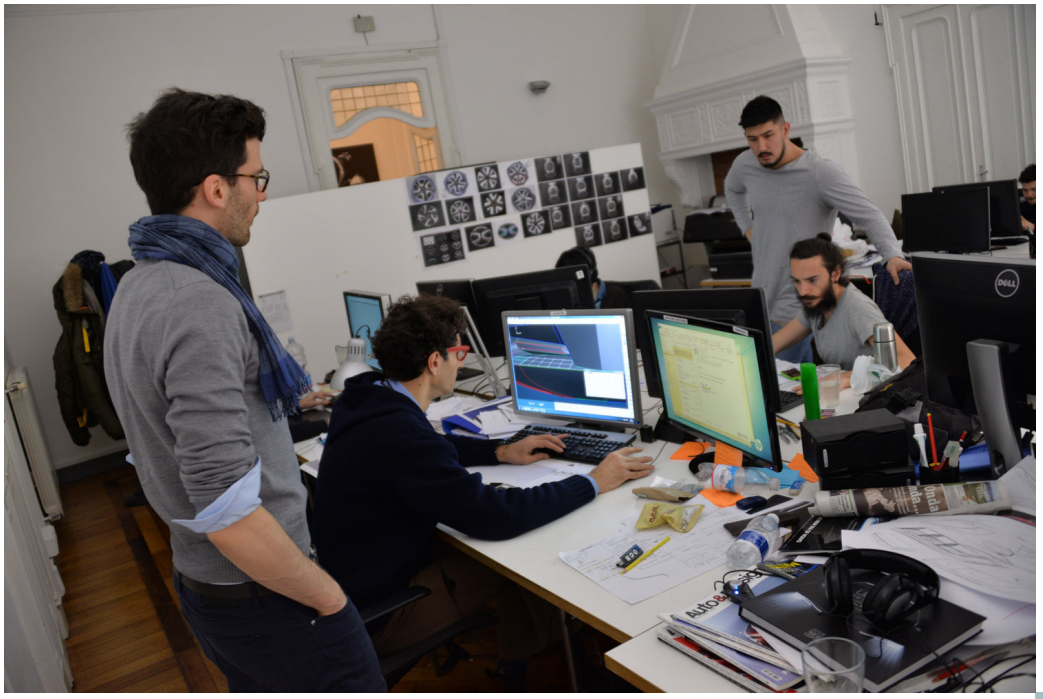


Figure 67: Designers working at Granstudio, design company of Ewoud Luppens

Balance in shown fragments

The sketchy aspect of earlier stage design drawings, which we talked about earlier, also very much defines the style. At first, the sketches look vague and generic, not concrete. It indicates a direction it could possibly go. For example, Jort Nijhuis points out that it should not be too concrete, but still have a clear idea. After all, it is not finished yet, but the client often has less visual imagination than the designer, so enough information must be provided. As far as this balance is concerned, it is trial and error, says Jort Nijhuis: "For example, a client once complained about the type of spokes I had drawn, while I had intended the emphasis entirely somewhere else (the spokes were not fixed yet). Now I no longer draw spokes: I have learned to deliberately leave things out, especially if I don't want any input on the specific aspect yet."

"That is a balance that you have to learn to feel as a designer: especially knowing what to leave out."

(Jort Nijhuis, Jort.)

The balance between what you show in the sketch and what you deliberately leave out, appears to be something that designers develop over time. Janwillem Bouwknegt indicates: "Initially, you simply outline what the design choice is about. So not, for example, defining all kinds of USB accesses and things like that. I try to sketch in such a way that the idea that needs to be conveyed comes across without confusion (caused by superfluous things, red.)." From this, we could conclude that when looking for this balance in your drawing, it helps to have a clear idea of the goal to convey with your drawing. Janwillem Bouwknegt explains that a design choice often has to be made based on the sketch. The subject of this choice must then be central to the drawing. Visualizing services or strategies, on the other hand, often involves certain core values. Then, these should also be clearly stated within the drawing.

"There is a very fine balance between what should be highlighted, depending on what the key points are. The things less important are given less detail in the drawing."

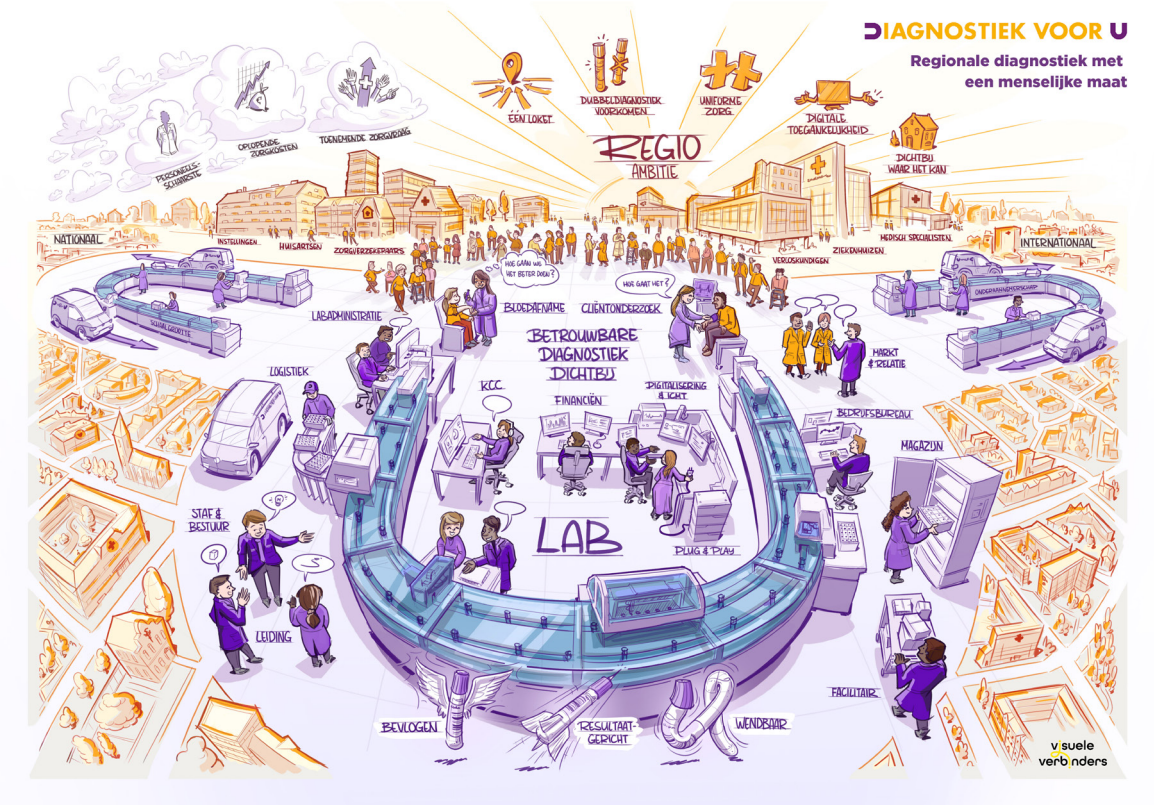
(Robert Oude Nijhuis, Visuele Verbinders)

> Figure 68: Drawing by Robert Oude Nijhuis (Visuele Verbinders), involving varying levels of detail

Experimenting

The extent to which the designer makes his drawing styles differ appears to vary per person. One designer seems to be constantly looking for new styles, for example to make the drawings more innovative, convincing or characteristic, while the other strives for a typical style.

Jort Nijhuis says: "I find it interesting to look for what is possible (regarding drawing style), for example trying brushes with water colour, which also sometimes fails or, for example, is not approved by my previous boss. Usually a typical IDE sketch is expected by the client. It just feels too slick for me sometimes. Moreover, it has happened that the client thought that the



idea was already finished, because the sketch looked so slick, which was an extra reason for me to start sketching more roughly. It is important that the client understands that the idea is not yet concrete. It also offers the opportunity to leave things out, so as not to distract from my communication goal. I also sometimes experiment with aquarel effects (figure 69) or oil paint in Photoshop, using rough brushes as a tool. That gives you less control, but you can see something very nice in the error, for example when you slip out and think 'ooh, quite a good one'. This drawing style differs per person, you also have to have the time to discover new styles."

There is also a lot of experimentation during the search for originality, as is the case with designers such as Ewoud Luppens. According to him, the emergence of Photoshop plays a significant role in this: "I notice that it has facilitated a way to make completely flexible expressions in 2D. The object in the drawing is sometimes more or less still recognizable as a car, but more like an abstract Mondrian creation is also allowed nowadays. Photoshop has made this possible with its wide range of tools." "However," he adds, "it is important to keep track of who is looking at the drawings. The Chinese dare less with such a Mondrian-like creation, a wild artistic expression to start the product with, than, for example, the Americans."

Furthermore, design drawing can be a matter of looking for mutual connections. This is particularly evident when drawing services, strategies and visions. For example, Robert Oude Nijhuis points out: “That is what I find very valuable about working visually: the mutual connections between certain information can sometimes simply not be conveyed only with text. Not even a PowerPoint can do that, because it is a very linear representation (only an A, B, C, ..-relationship is visible there, while that does not necessarily mean to be the intended structure). Everything is interconnected in different ways: a network, linear/circular process, everything at the same time. This is not easy to capture this in any other way than in a drawing. The basic shapes play the most important role here: even a square, cube or cylinder with information at the corners or along the sides, and the connections between them, already makes the structure visible. Complex drawings are therefore not even necessary. In particular, companies are significantly helped with visually showing how the substantive structure actually works.” In this case, the type of network of information determines the drawing style; especially with regard to the visible forms that are drawn.

Janwillem Bouwknegt reveals that at NPK Design, the designers often look at car sketches for inspiration concerning design drawing: “That way, we learned tricks from them with regard to ways of visualizing. A big difference, however, is that car sketchers often keep the drawings to themselves: they are more competitive, their own drawing must stand out compared to others. With us there is no competition between designers, more of a cooperative development of ideas.” According to Bouwknegt, this brings the elements together towards a more corresponding style of visualizing.

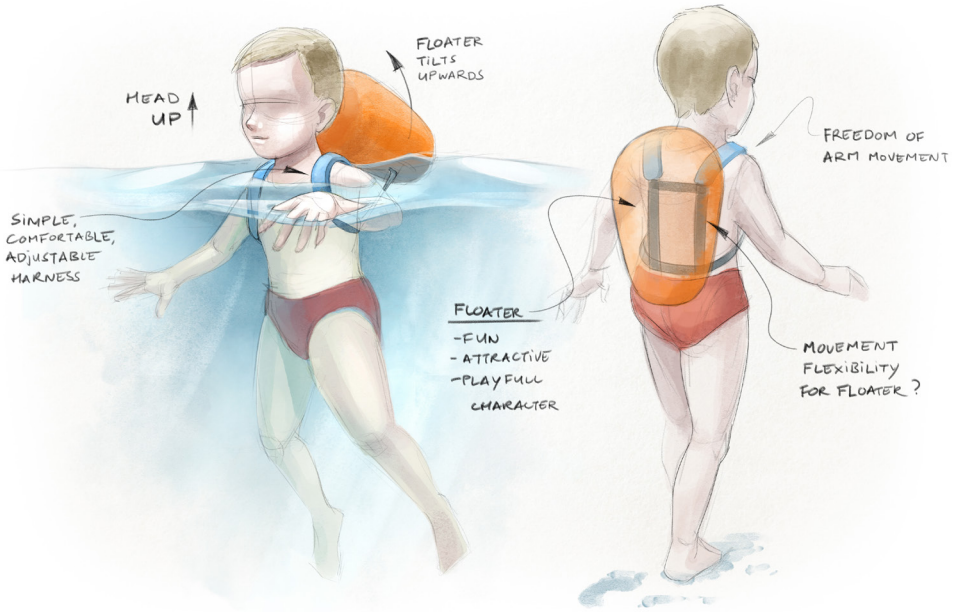


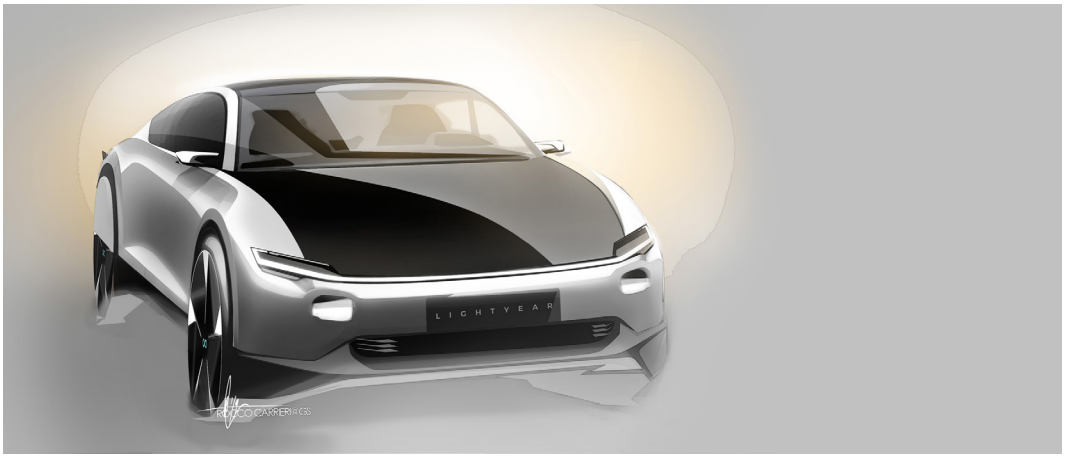
Figure 69: Design of ‘Fibby’ by Jort Nijhuis; use of aquarel effects

Analog vs. digital

The style of the design drawings often also depends on whether they are made analog or digitally. The choice often turns out to be pragmatic, and depends on the purpose of the drawing. It was interesting to hear from Janwillem Bouwknegt that there are clients who are charmed by analogue drawings. The related drawing style, purely from the hand, probably comes across as creative and says something about the competences of the designer. Bouwknegt does indicate that the drawings are then often combined and further elaborated on the tablet or on the computer, which brings about combinations between analog and digital. The analogous sketches are also shown to the client in the beginning, because as a designer you also want to convey the quest (as mentioned earlier): showing the things you have tried and that have led to the later ideas.

The interviewees indicate that the threshold is low to just use paper, post-its or a whiteboard to make (rough) sketches, which is also the reason why this happens a lot in the initial phase of the design. Yet Jort Nijhuis, for example, indicates that he nowadays always draws digitally: "I sketch almost everything digitally (only sketches that are purely internal, to clarify, those I sometimes make with a ballpoint pen). Everything has to be presented to companies or customers: I take them along in the process, and Photoshop offers me exactly the opportunity to save and retrieve all intermediate steps. Showing different degrees of effect also works in persuasiveness towards the client. It also helps you as a designer with the aim of looking for new shapes or character." Also, one gets to know a tool like Photoshop, its broad range of options, better and better: "I like not to draw too tight, but painterly, always looking for new brushes in Photoshop." Consequently, it seems that digital drawing has copied many of the advantages of analog sketching and even added a few more. This subject will be further discussed in the next section: 5.3 *Towards the future.*

Figure 70: Digital drawing of 'Lightyear' as shared by Ewoud Luppens (Granstudio)



5.2.4 Discussion and conclusions

First of all, the interviews have provided information on what purposes and functions of design sketching are reasons for the designers to incorporate sketching and sketches throughout the design process. Their answers have been clustered into six overarching purposes/functions (figure 71): 1) Communicating with ourselves; 2) Recording of the process: convince of the content; 3) Call for attention, reflection and input; 4) As a work of art; 5) Common understanding; 6) Explanation.

Summarizing these, in relation to the human interactions described by the designers, brings about the following insights on how sketching as an agency manifests itself in practice.

First of all, the sketching process affords the designer to have 'internal conversations'; an affordance emphasized by experimenting with different tools. By continuously reflecting on the sketched lines, the designer tries to find new shapes, proportions and solutions while sketching. This creates an interplay between seeing the lines and (re)attuning them, resonating with the literature insights. However, the whole time while thinking about what the client wants and how he/she wants to respond to that: an observation that distinguishes itself from the literature findings. Points 2-6 (figure 63) all include a significant focus on stakeholders other than

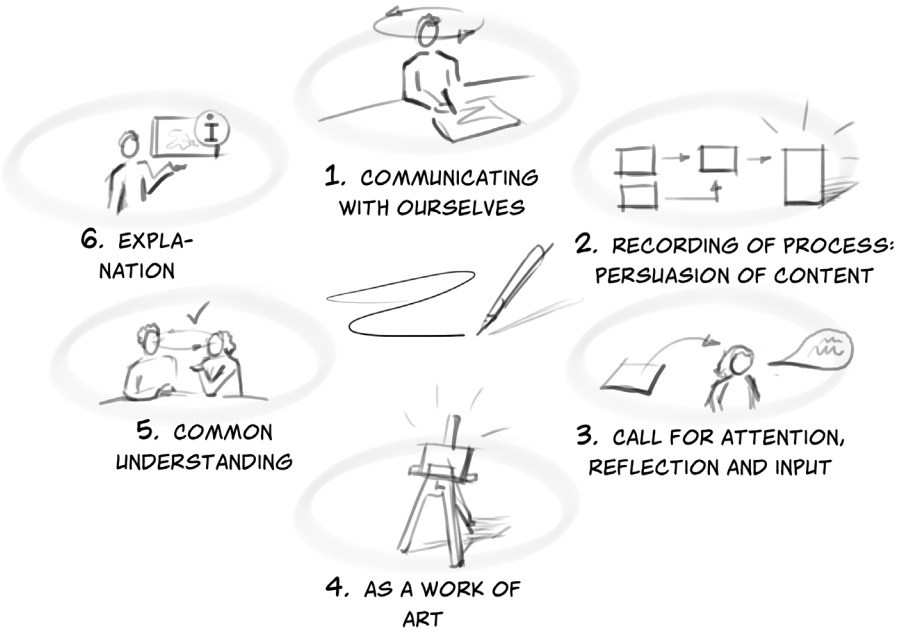


Figure 71: Six overarching purposes/functions of design sketching derived from the interviews

the designer her-/himself. Point 2, to continue with: the progress steps being (digitally) recorded by the drawings, afford the designer to explain himself and convince ideas towards the client. Furthermore, during this interaction, the design sketches play a role in attention being drawn to certain elements, provoking reflection and deliberately inviting for input. These affordances are emphasized when the design sketches contain a balance of shown fragments and do not look finished already. Furthermore, practice showed that design sketches can function as a work of art, affording the designer to let a spark jump at stakeholders. While in the case of design drawings providing more literal information, they can facilitate conversations, a general understanding and (therefore) qualitative decision-making, due to the apparent affordance of clarification.

5.3 Towards the future

This section will analyze how contemporary trends might shape the future of design sketching. What are the current developments and how are designers anticipating on them? What are their approaches and their visions? Will future factors transform the affordances of sketching as an agency for design?

Contemporary trends regarding design sketching will be briefly described, whereafter the corresponding responses of the interviewed designers will be analyzed. This provides a look on current developments in practice. Anticipating on the nearby future of design sketching is necessary to see if its affordances are transforming and can help explore how sketching as an agency can be made perceivable for contemporary designers (chapter 6 and 7), who want to be prepared for the future.

"Should designers fail to adapt, new competencies will emerge to fill the gap left behind. The evidence of history is that design, as a basic human ability, is constantly required to adapt and redefine itself to meet the needs of its time."

(John Heskett, 2001)

Figure 72: VR sketching (Dezeen, 2016)

5.3.1 Trends

In the contemporary landscape, a shift towards mass customization and personalization is emerging as a prominent trend within the digitalization strategies of businesses and the manufacturing processes of Industry 4.0 (Pech and Vrchota, 2022). They state that it goes "from tailored production across mass production and mass customization to mass personification production". Through digital technologies like AR, consumers can try products, e.g. in their interior, and customize the products before purchasing them. This shifting interaction between consumer and selling company is also recognizable within the interaction between the selling company and product designer, namely the act of earlier being involved in the process. Selling companies, or 'clients', prefer experiencing ideas at a stage in which it is still possible to provide input and adjust matters accordingly. This ties in with the fact that the interviewed designers (see chapter 5.2) unanimously emphasized that the drawings they show to the client often look sketchy for a long time during the process; inviting for input. Not only does this change in interaction influence the drawing style, it also influences the choice of (visualization) tools the designer uses. Interviewees indicated that this was a major reason for drawing digitally almost immediately: to make communicating the drawings towards the client easier. It can also be a reason to choose to sketch in VR: to make it possible for the client to experience the ideas in 3D at an early stage of the design process.

According to Koch (2022), "industrial designers are moving away from the initial mass production paradigm they have arisen from and appear to be looking for new ways to innovate within their practice." The arrival of COVID-19 even encouraged that, by forcing designers to work from home instead of in a workshop, resulting in exploring the benefits of ideation and prototyping being done digitally. This made the recent times a catalyst for the adoption of new, transformative technologies. As stated by Novoa Munos et al. (2022), "the conventional function and meaning of sketching have become more ample and undefined since it's expanded from traditional pen and paper to new know-how, such as user experience (UX), immersive experiences (e.g., VR) and new forms of distributed design and production." In addition to the inventions of increasingly advanced drawing tablets, AR and VR have emerged as promising tools for visualization. "Being one of the most recent technology breakthroughs", as stated by Oloyede in Medium (2023), "they offer innovative and immersive experiences that revolutionize the way products are conceptualized, designed, and validated." Regarding the three different levels again, AR and VR are transformative and auspicious tools for the following reasons:

1) On product level, they have the ability to create a mesmerizing experience, with out waste and costs of prototyping materials;
2) On interaction level, the audience (e.g. client/customer) can join the experience, examine and collaborate on the ideas, even from a distance;
3) On context level, they facilitate the trend of the aforementioned mass customization and personification production.

In line with these times of customization and personification, there will be more focus on users' perspective, which is also changing design drawings in terms of content. "Whereas

its origin lies in the sketching and presenting of tangible (industrially designed) products, the discipline has, since the 2000s, extended in various ways, along various dimensions" (Hoftijzer et al., 2023). Several scholars have already deliberated on the "most prominent change within the discipline: the addition of so-called 'storytelling visuals'; sketches of processes, overviews, systems and e.g. journeys, also named 'visual thinking'." This includes the communicative factor of sketches representing various kinds of connections between elements. As the domain of design sketching continues to expand, there is a burgeoning community of practitioners and audiences. Sketching is attracting a diverse range of disciplines, including social sciences and engineering sciences, as well as strategic and technology consultancies (Hoftijzer et al., 2023). This promises to be a valuable change for the multidisciplinary symphony in which industrial designers like to interact, as the act of sketching is one of a language that is universally understood (see chapter 4).

5.3.2 Contemporary approaches and future visions

Considering these current trends, how are designers practically anticipating on them? This section will analyze how the five interviewed designers approach the future in the field of design sketching. This mainly includes the (increased) use of digital tools, experimenting with VR, their vision on the emergence of AI and other matters that might shape their future use of sketching in design.

Digital tools

Like mentioned at the end of section 5.2, digital drawing tends to have copied many of the advantages of analog sketching and even added a few more. For example, Jort Nijhuis stated that Photoshop offers him exactly the opportunity to save and retrieve all intermediate steps, which helps to show the process convincingly

Figure 73: Storytelling visual by Robert Oude Nijhuis for 'DRU - Klantgericht werken' (Visuele Verbinders)

to the client. Digital programs like Photoshop also have a broad assortment of optional tools, e.g. different brushes. This, according to Nijhuis, helps you as a designer with the aim of looking for new shapes or characters, as one can erase, adjust and change tools rapidly. Car designer Ewoud Luppens confirmed that, by his in section 5.2 mentioned notice that Photoshop has been used over time to make drawings easier and faster, and that now it has acquired another added value: it has become a tool for "a completely flexible expression in 2D". The earlier described example of the Mondrian creation demonstrates that: almost not recognizable as a car, but certainly causing a spark. Wild creations like that are made possible by the wide range of provided digital tools.

The arrival of COVID-19 has emphasized the advantages of digital drawing, especially for visual facilitators like Robert Oude Nijhuis. Ways of collaboration and client involvement are changing through the use of digital platforms such as Basecamp, Teams and Miro. The remarkable characteristic of visualizations that ensures that people are interactively involved during a meeting, has become more apparent due to the rise of these online meetings. More people, through-out all sorts of working disciplines, have become familiar with visual design thinking and the value of capturing visions and strategies within drawings. People now understand better what it means and therefore get in touch with it more often, according to Oude Nijhuis. "The only thing is that the 'wow factor' is now a bit more gone ('Ahaa, that's how a meeting can go!')", he explains. More people have started to work in this profession. "I myself was already convinced that working digitally is going great, but with everyone being online it might work even better. When you are together live, there is often more distance between the observer and the drawing. Furthermore, as a draftsman you can obstruct one's view, while via a computer screen one has a direct and constant view of the drawing and even its creation process." Due to the pandemic, working from home, and with that digital work meetings, has become a 'normal' phenomenon that has not simply been reversed (De Volkskrant, 2022). This encourages the making of digital design drawings, as those are easier to share online, according to the interviewees. Oude Nijhuis adds to that: "As I've noticed, it also makes video calling more efficient and fun."

Figure 74: Visual notes for Flevoziekenhuis by Robert Oude Nijhuis (Visuele Verbinders)

Head of the Modyn product designers Rik de Reuver notices that the designers also use digitalities to serve as a source of inspiration: “They are curious, so they search for all kinds of forums and well-known websites to see how others are designing and visualizing.” Initially, they only look at the end result, because that is most appealing at once. Then, they look up how it is originated by Googling the person or company in question and try to dig deeper. The designers do not specifically come up with the examples they find online, but they intuitively incorporate gained tricks into their own design activities. Supposedly, related to the widespread popularity of the Internet that forms ‘the information age’ (Zhang, 2022), the rise of drawing digitally might increase the amount of other designers’ drawings that are online available to get in touch with and inspired by.

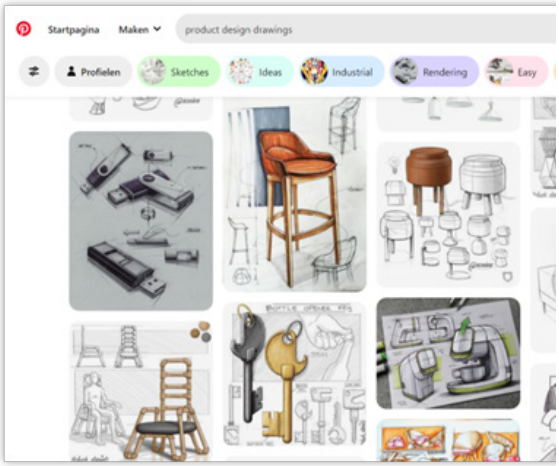


Figure 75: Product design sketches on the internet (Pinterest)

Experimenting with VR

The interviewed product designers all occasionally experiment(ed) with VR, although none of them has (already) fully incorporated the tool within their professional design activities. This has to do with a number of reasons.

VR allows users to sketch and model while providing a 360-degree perspective, which makes it act as a link between hand sketching and CAD modeling. Although no exact data is needed, which is the case with CAD modeling, the clarity of a 3D object’s surface in VR in terms of smoothness, light, and shadow allows for clear visual distinction. This characteristic eliminates ambiguity of the sketches (Lin et al., 2022). Listening to the interviewees, this seems to cause deliberation. Initially, VR sketching, by moving through the air, allows one to sketch freely and intuitively. Yet, the object has a third dimension, which requires the designer to already have a more detailed idea of what it is going to look like. It can also cause an overemphasis on the perfection and visual appeal of the sketches. Jort Nijhuis, for example, mentions: “(...) Still, it takes me longer than drawing in 2D, because you always keep that blockage of the third dimension, requesting me to already visualize more of the product. Sketching in 2D is clearer and faster.” Robert Oude Nijhuis confirms this, by emphasizing that the drawings in a VR environment have to be more explicit and correct.

“In drawings, we often deviate from reality in terms of perspective and depth. People quickly believe it, you can get away with a lot! With VR however, suddenly things must be worked out more truthfully.”

Robert Oude Nijhuis, Visuele Verbinders

"For example, a building should really look like a building, not like a toy," Oude Nijhuis adds. Interestingly, Janwillem Bouwknegt has objectives the other way around. He explains: "We have tried 3D sketches with a VR set, but we are not very fond of that. It is quite rough, which makes it unusable for us. They are mainly organic shapes, while we want to define all of the dimensions quite quickly." Apparently, the fact that VR sketching bridges between hand sketching and CAD modeling, is not necessarily a positive characteristic.

Nevertheless, both Robert Oude Nijhuis and Jort Nijhuis accentuate that there is the advantage of VR, and also of AR, that it can provide the ability to create an immersive experience. This helps with presenting ideas convincingly to stakeholders. For example, Robert Oude Nijhuis describes sketching program MentalCanvas, in which drawings can be made on flat surfaces, which are then placed in a 3D space: "One can then be animated through that space, which provides a very immersive experience. An additional advantage is that everyone experiences it in the same, linear way, so that the intended story of the organization becomes not too ambiguous." Tools like this open up possibilities to communicate ideas in ways that tend to get full attention and impress people. With VR sketching, according to Jort Nijhuis, a kind of studio space could be created, where one can walk through and observe various alternative ideas in a dynamic, lively way. For all that, one should have the VR tools and, equally important, the skills.

Tools like VR sketching (still) require a relatively large amount of time in order to be able to create the output one intended to and is satisfied with. This, in combination with the fact that the software undergoes regular updates and the layout keeps changing, is necessitating users to practice continuously to become proficient (Lin et al., 2022). Robert Oude Nijhuis, as well as Jort Nijhuis and Rik de Reuver mention this as one of the reasons why VR sketching is not yet profitable enough to apply as a tool during the (time-paid) assignment for a client.

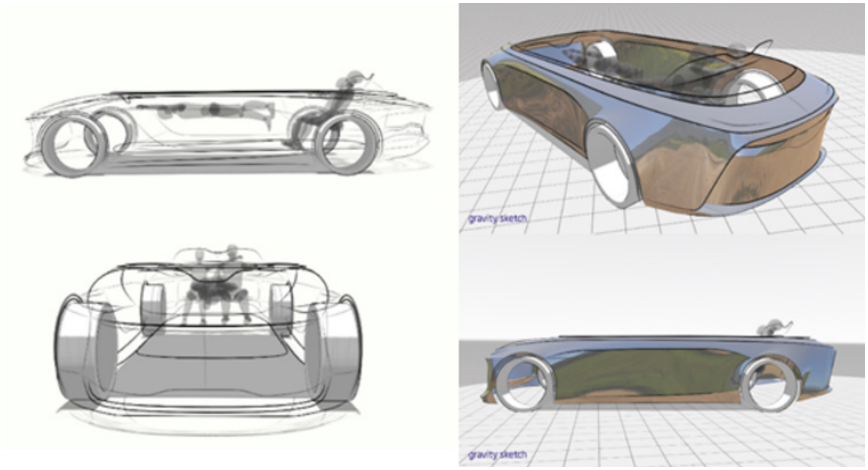


Figure 76: Example of a VR car sketch made in 'Gravity sketch', Lin et al. 2022

The emergence of AI

The current trend that now stirs up the most apprehensive responses, concerns the emergence of artificial intelligence (AI). This technology essentially involves processing data in a way that mirrors the human psychological cognition and creation (Zhang, 2022). Continuously being developed and applied in a broad field of disciplines already now, it brings about complexity, uncertainty and ethical issues. The effectiveness of AI relies on extensive training data, often including private information, posing ethical concerns regarding misuse, tampering and data security in both individual and organizational contexts (Huang et al., 2023). For this reason, Janwillem Bouwknegt of NPK Design is not fond of using it as a tool. "I find it risky in terms of secrecy," he explains. "An external computer system trains itself and therefore also learns from your own decision-making process. That way, you are essentially feeding the computer system with your knowledge. This allows your skills to be given away to other design companies."

However, the introduction of AI technology in the process of industrial design can be valuable for designers to better analyze and apply complex data, improving efficiency and quality (Huang et al., 2023), both by providing descriptive and depictive (visualization) outcomes. Therefore, car designer Ewoud Luppens indicates that, within his company, one is experimenting with it and he suspects that the AI technology will even be authoritatively incorporated into their design activities within the coming months.

"AI, whether you like it or not, is a marvelous tool."

Ewoud Luppens, Granstudio

Admittedly, it should be incorporated in a cautious way, he indicates, "to ensure that it does not take over our entire work." The boss has to come up with a way of using AI that will make them all better off, Luppens adds. Considering all of the (possible) abilities of AI, using it in a way throughout the design process is an unavoidable trend.

However, currently this seems to be happening mostly during the early stages of the process. Mainly as a source of inspiration, rather than for the production of a full-fledged outcome. The technology is not (yet) intelligent enough for the latter, according to the interviewees. Specifically, according to designer Jort Nijhuis, it does not yet have the right level in terms of process and interaction: "During the 3 or 4 years before, for example, a stroller appears on the market, a lot of complex organization takes place. It will take some time before AI understands all that. I see it mainly as inspiration, but it is not possible to have AI further develop a variant." He indicates that it functions purely through the images it has at its disposal, which is not enough now to further determine factors such as color choices and exaggerating perspectives in design drawings, because that involves too complex considerations.

Elaborating a bit deeper on how AI can currently operate, Robert Oude Nijhuis describes a session they did with MidJourney (and some

other AI tools). As a result thereof, he initially is enthusiastic: "It is impressive how you can get very high-quality, artistic drawings (even with a sketchy style) out of it." Also, there is a wide range of different traditional drawing media (e.g. water color effect) that can be applied. Nevertheless, he confirms the notion mentioned by Nijhuis that there is still a limit in complexity that the tool can handle. He explains that the structure and abstract concepts, like business jargon, are not understood by the tool. "Moreover," he enlightens, "if you are short and general, then he can perform well. But if you want to become specific, things will be missing in the drawings that AI provides you. Everything that comes out is beautiful, but the content is not yet useful. It creates beautiful, artistic images, but not a combination of several images together that are in a certain perspective and tell a story. Sometimes it can put things into perspective surprisingly well and such, but then you have a 'lucky shot'." Moreover, the individual drawings all slightly differ in drawing style. Altogether, just like Nijhuis he concludes that the tool is not reliable enough yet to professionally use. For a client, one must be able to make a good time estimate for the assignment, which is not yet possible with the use of AI. According to Robert Oude Nijhuis, in the future it might be particularly helpful to make static visualizations available at once, which then can be used in a more complex visual representation that will still be created by designers themselves.

Overall, AI is a promising technology and, at the same time, still not able to take over the more complex considerations a designer makes during the process of design drawing. By letting AI take over a big part of the sketching process, the designer also misses out on the in this research aforementioned affordances of the activity of design drawing itself. Furthermore, there are the risks that concern secrecy, like Bouwknegt accentuated, in combination with the fact that there are also inadequacies in the way the data is applied. Rik de Reuver points out recent findings of Tegenlicht, talking about AI being "a hungry beast, that must be fed with the fastest chips, enormous data sets and poorly paid labor, in the form of silicon mines, endless rows of power-guzzling servers or Syrians labeling data for the next generation of generative AI." (VPRO Tegenlicht, 2023). Despite their predominantly negative vision on the use of AI, Bouwknegt and De Reuver do not decide to fully neglect it, since it already influences a lot.

"We can't ignore it either: it's there, so we have to relate to it somehow."

Rik de Reuver, Modyn

One thing is clear: there is still a lot to figure out regarding the use of AI; how to deal with this trend is and will remain a challenge in the near future.

Figure 77: Left: drawing made by AI; Right: drawing made by Picasso (source: 'Picasso, Matisse, or a Fake?' by Elgammal, A., Kang, Y., & Den Leeuw, M., 2018)

Approaching the future

Last but not least, the "most prominent change within the discipline" must be mentioned again: the shift towards visual thinking and storytelling. As pointed out before by Oude Nijhuis, the pandemic times have added to this trend. Nevertheless, already in the successive period before, the focus increased on human interaction within the design discipline. According to Rik de Reuver, it has become increasingly common to draw user scenarios. The drawings no longer focused solely on the products, but also on context and corresponding interactions. In addition to this content, the drawings often should contain a 'design story', like Janwillem Bouwknegt already indicated. In fact, the way in which the drawings are presented seems to be also shifting towards an 'interactive' focus. Immersive experiences, like described before, are being made with VR and AR. Adding to this notice is the fact that Robert Oude Nijhuis, with Visuele Verbinders, offers organisations the service of getting an interactive website: a story telling visual is placed on the website of organizations and one can zoom in and move through in certain ways.

Despite the digital and intelligent new ways of drawing, the interviewed designers unanimously emphasize that there remains the importance for designers to keep drawing with their hands. However, there is an observable decline in the sketching skills of young designers entering the work field. Janwillem Bouwknegt: "We notice that the number of hours of drawing education (hand drawing) has decreased. This is at the expense of the skills of the young designers. By drawing a lot, you learn to look better, to estimate proportions better, and more. It works as a kind of design tool. One of which we believe is very valuable." More than once, during the interviews the metaphor of a language is being mentioned. Jort Nijhuis points out that one tends to underestimate design drawing as functioning like a language that is universally understood. Rik de Reuver: "As far as we are concerned, it is our language as designers. This is how we express ourselves in a very precise way." Like Nijhuis, he adds: "Sketching really is a 'universal language': if you do it well, everyone in the world will understand what you want to say." Therefore, despite the fact that the number of hours of drawing education has decreased nowadays, it is expected that hand drawing will remain important with a view to the future.

> Figure 78: Sketching the Porsche 911 ('Ever since I was a young boy, I've been drawing sports cars', Lenaerts)

5.3.3 Discussion and conclusions

Without this value of design sketching being affected, the contemporary trends (will) make alterations to the way designers will benefit from sketching as an agency for design. The insights of this chapter have suggested the following alterations (see figure 79).

To begin with, designers will probably focus more on the specific affordances of design sketching that concern good communication with stakeholders. Finding itself in the midst of the 'fourth industrial revolution', the industrial design field is shifting towards mass customization, personalization and digitalization strategies. This causes a change in the interaction between consumer and selling company as well as in the interaction between the selling company and product designer: one is earlier involved in the process. Designers nowadays show drawings to the client that often look sketchy for a long time during the process, affording clients to keep on giving input. This change is clearly visible when comparing the design sketches of nowadays (e.g. the ones in section 4.2, 5.2, 5.3) with the historical ones of section 5.1, the latter of which look a lot more accurate and finished.

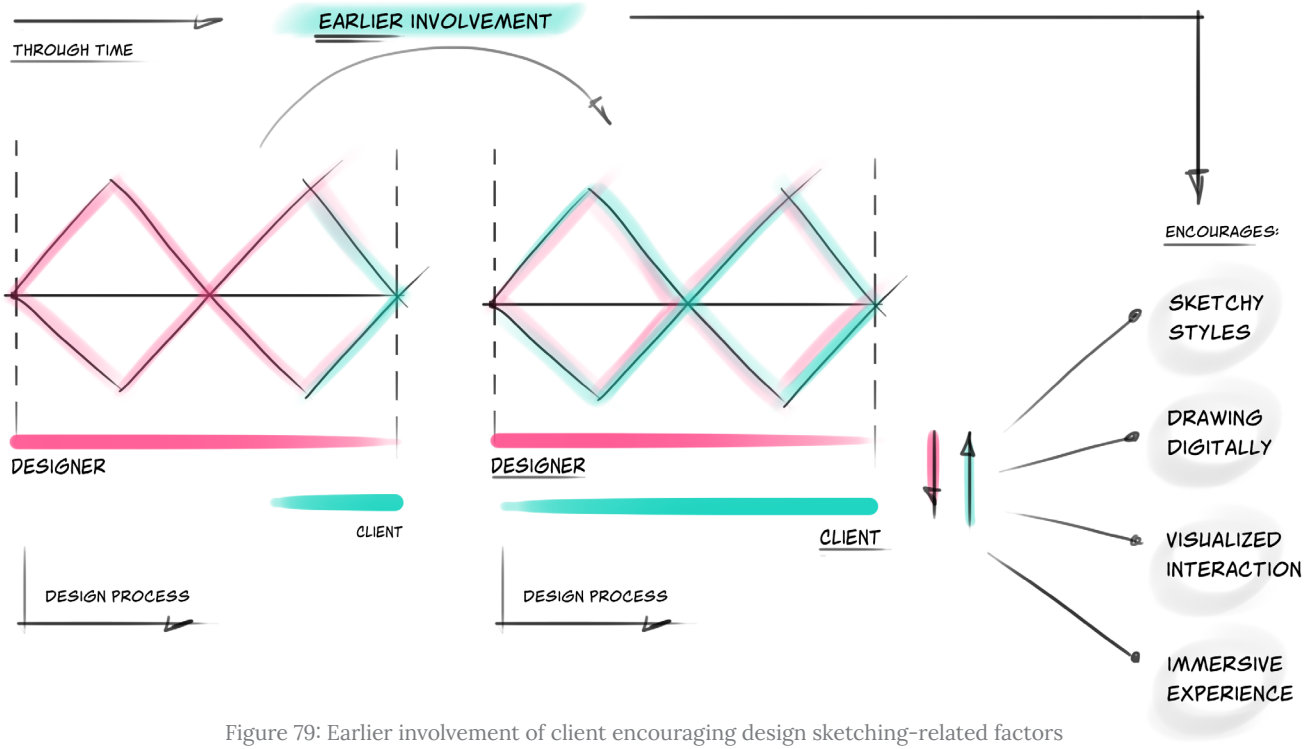


Figure 79: Earlier involvement of client encouraging design sketching-related factors

Furthermore, the shifting interaction contributes to the shift towards drawing digitally, affording designers to share them clearly and easily online. Moreover, the shift in interaction might increase the use of tools like VR and AR, because these new technologies make it possible for stakeholders to experience the ideas three-dimensionally and engagingly at an early stage of the design process, even from a distance.

Related to this increasing interest in affordances with regard to outwards communication, is the trend of the upcoming storytelling visuals. Concerning the agency of sketching, the emphasis will lay on being informative on various levels, involving products as well as visions, strategies, interactions and/or design stories. While human interaction is an increasing part of the content of design drawings, as is the human interaction with regard to the way the drawings are observed. Visuals on which one can zoom in and move through are increasingly popular, fitting with the contemporary digitalization times. Therefore, one could speak of a 'newly' emerging affordance of design drawings: providing an immersive experience of whatever is visualized.

Several advantages of drawing digitally will positively affect the observed affordances of sketching in design practice. For example, the possibility to easily save and show successive process steps improves the recording function of sketches. Furthermore, the wide range of tools that are provided digitally lowers the threshold for the making of an expressive 'work of art', affording the designer to let sparks jump to stakeholders. Additionally, digital 'interactive' drawings, with their immersive characteristics, encourage the drawings' call for attention.

Concluding, it looks like the designers' focus is drawn increasingly towards presenting and communicating outwards. Subsequently, designers might decreasingly get or give themselves space for the by the theoretical study (chapter 4) advocated affordances of sketching in communicating with themselves. The use of digital media asks for more explicit information in an early stage of the process. This will reduce the period of sketching ambiguous shapes and continuously reflecting: the by the interviewees aforementioned interplay between seeing lines and (re)attuning them. Furthermore, the AI technology is apparently already incorporated into this early stage of ideation, supporting that the affordance of 'communicating with ourselves' will be partly taken over by newly developed technologies.

This can be valuable information for the transformation of the proposed framework into a practical tool (see chapter 7).

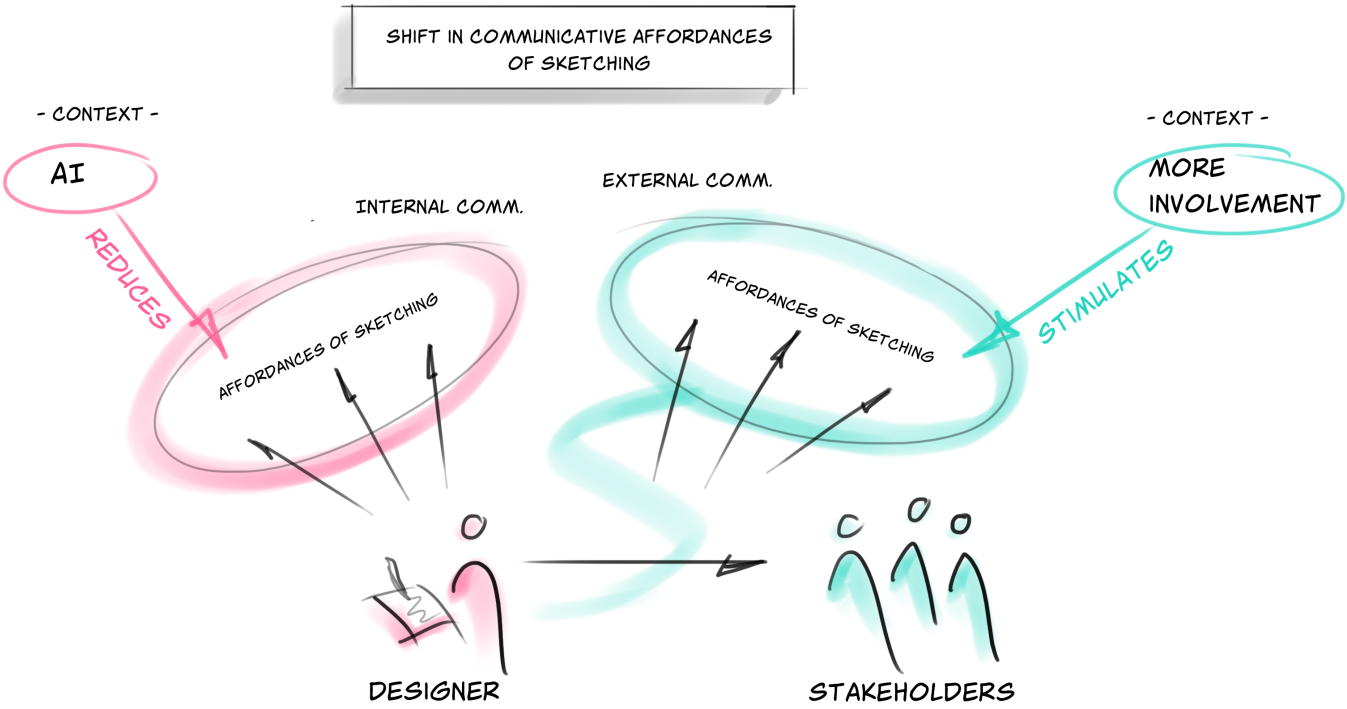
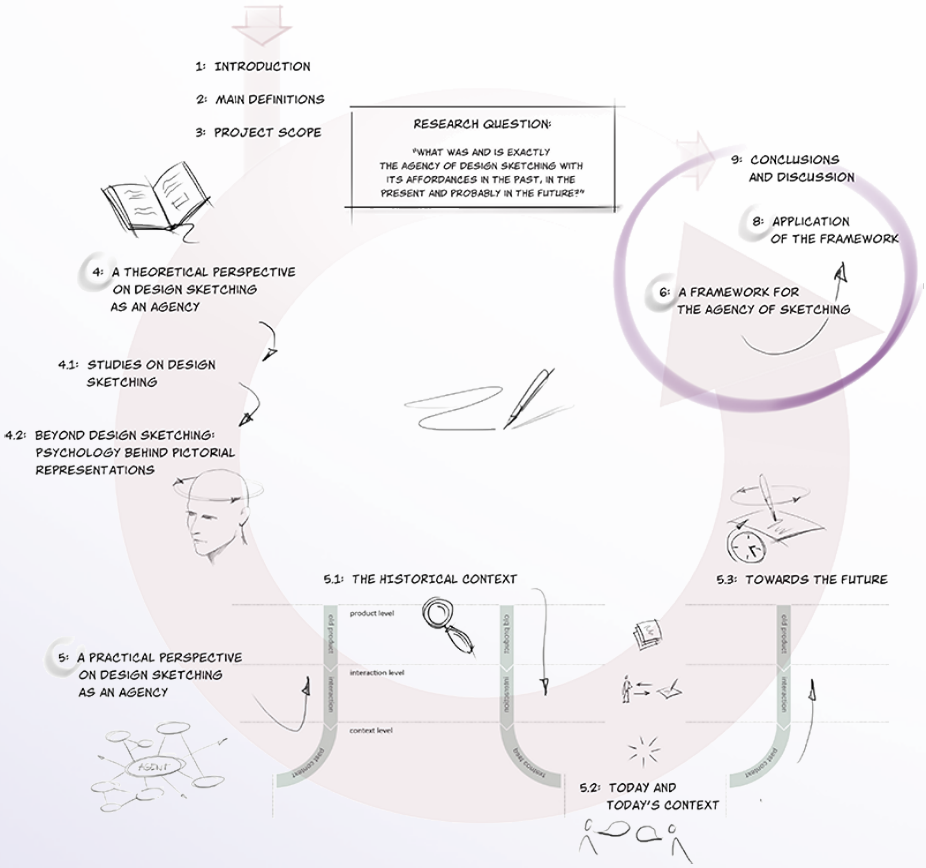


Figure 80: Decreasing focus on internal communication and increasing focus on external communication towards stakeholders

6 A framework for the agency of sketching

Up until this chapter, knowledge has been gathered about the affordances of sketching in multiple phases of design, throughout different times and both from a theoretical and practical perspective. To converge this knowledge into a valuable conclusion, making the way sketching acts as an agency perceivable, there is striven for an overview: one that explains the most relevant facets of sketching as an agency for design. Therefore, serving as a final answer to the research question, a Framework for the Agency of Sketching has been created.



This chapter provides arguments and explanations for the state to which The Framework for the Agency of Sketching has been shaped.

Subsequently, chapter 7 will propose two concept directions that will turn the framework into a tool, which can be used in practice. This can help designers to rediscover design sketching and unlock its benefits.

6.1 The set-up

The foundation of the framework is based on the evidence described in this thesis report, suggesting that the agency of design sketching is initiated by generative internal processes. It is proposed to function as an agent that makes an essential contribution to the design process. Therefore, in the created framework (see pages 104-105), sketching is visualized as something that reminds us of an aorta: functioning as an (internally) valuable contribution to a whole.

The 'double diamond model' (British Design Council, 2005) illustrates the design process through which the vein runs. The choice to utilize this representation of the design process is based on its incorporation of both diverging and converging processes. As outlined in chapter 4.1.3, during problem-solving the act of sketching and its purposes are evolving, by transitioning laterally between less structured, varying ideas and vertically by transforming one concept into a more detailed form (Goel, 1995). Relating this to the process of diverging and converging, the transformative properties of sketching as an agency make a good match with the double diamond model.

As can be seen, the core of the 'aorta' consists of two important pillars of design sketching: emergence and imagery. In the beginning of the design process, there is a constant dialectic between these two phenomena: by (un)intended moves new things will be discovered (Schön and Wiggins, 1992, Suwa, Gero and Purcell, 2006), triggering an interactive state of imagery (Goldschmidt, 2003). The drawings created during this stage encompass specific and incomplete details, incorporating intentional or unintentional uncertainties that play a crucial role in their purpose (Fish and Scrivener, 1990). So in all this, ambiguity of the sketches is important (Tversky, 2010). Altogether, emergence and imagery form the generative loops of (un)intended moves, seeing, imagining, discovering and the interactive state of imagery, due to which differing ideas are appearing. Ambiguity, as a key value, encourages the generative characteristic of these action loops.

Reflecting on these ambiguous sketches, by amplifying the 'mind's eye' (Purcell and Gero, 2006), stimulates a multitude of interpretations and reinterpretations (Tversky, 2010). This loop can be stimulated by the designer shifting focus between new perceptual figures and relations in specific and, by zooming out, new conceptual interpretations of the sketched subjects. These focus shifts ('constructive perception', Suwa and Tversky, 2001, 2003), are allowed by the generative loop of ambiguous sketching and triggers thoughts about more complex visual and functional considerations (Purcell & Gero, 2006). To summarize, the sketched features stimulate interim reflection, bringing about (re-)interpretation and, by closer inspection, (re-)connection of the elements. Consequently, these are the surrounding, 'embracing' pillars, achieving convergence. Here, the key value is mental synthesis.

Following the double diamond model, the designer can go through these processes twice to achieve an end result. However, considering that all of the constructive loops of 'pillars' are

generative, the framework has no fixed end: it is only ending when, citating Goldschmidt (1991), “the designer judges that sufficient coherence has been achieved”.

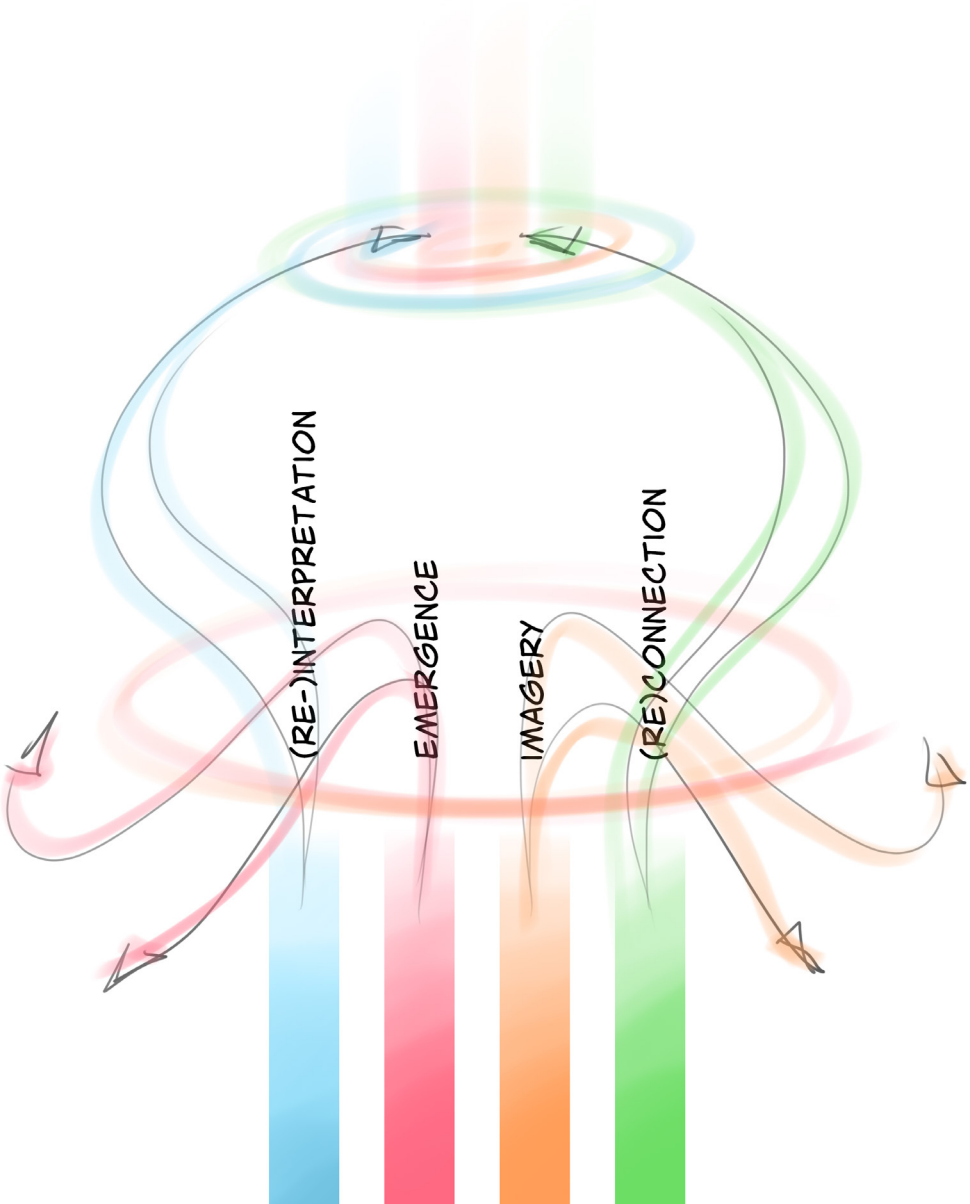
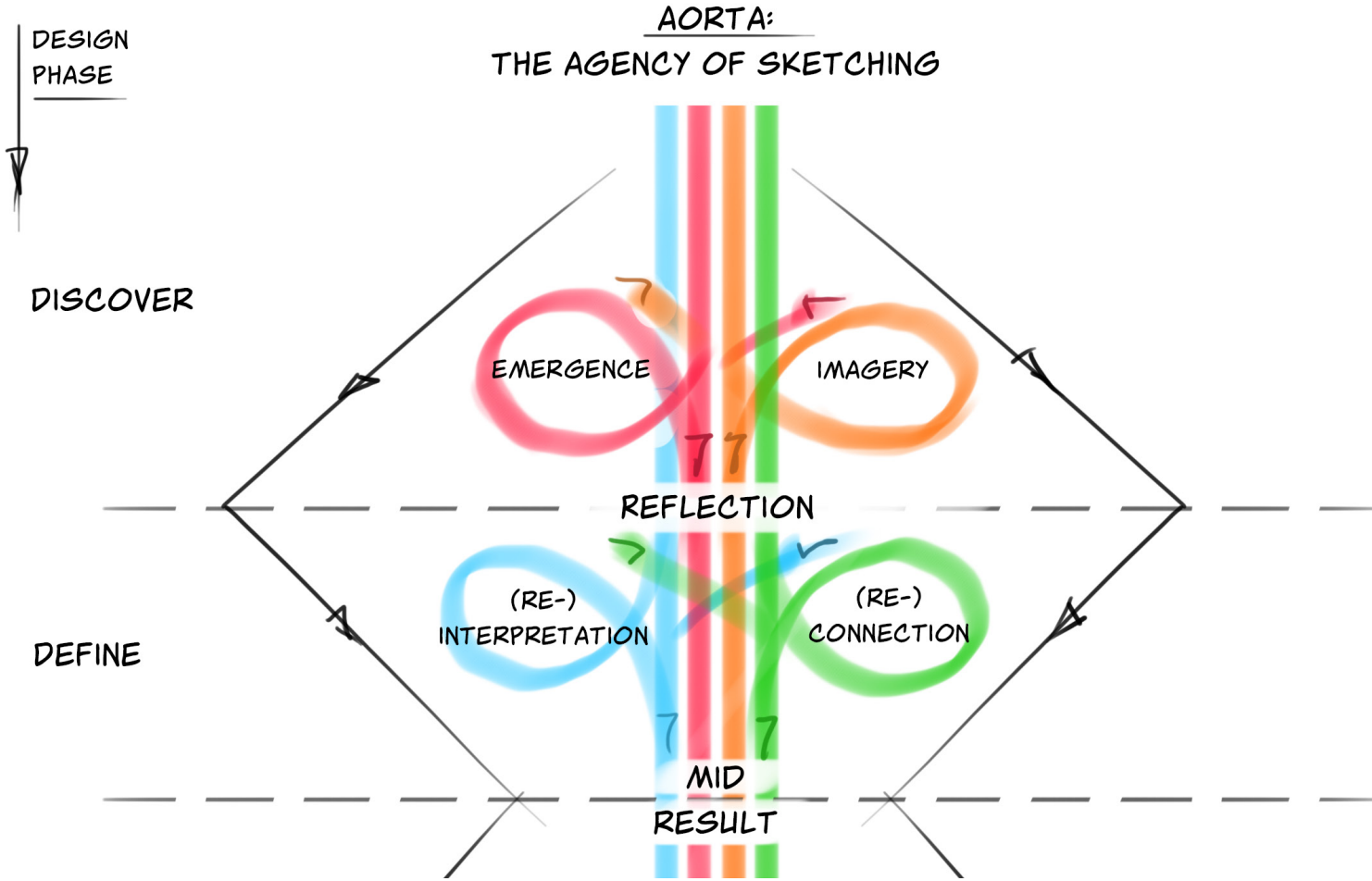
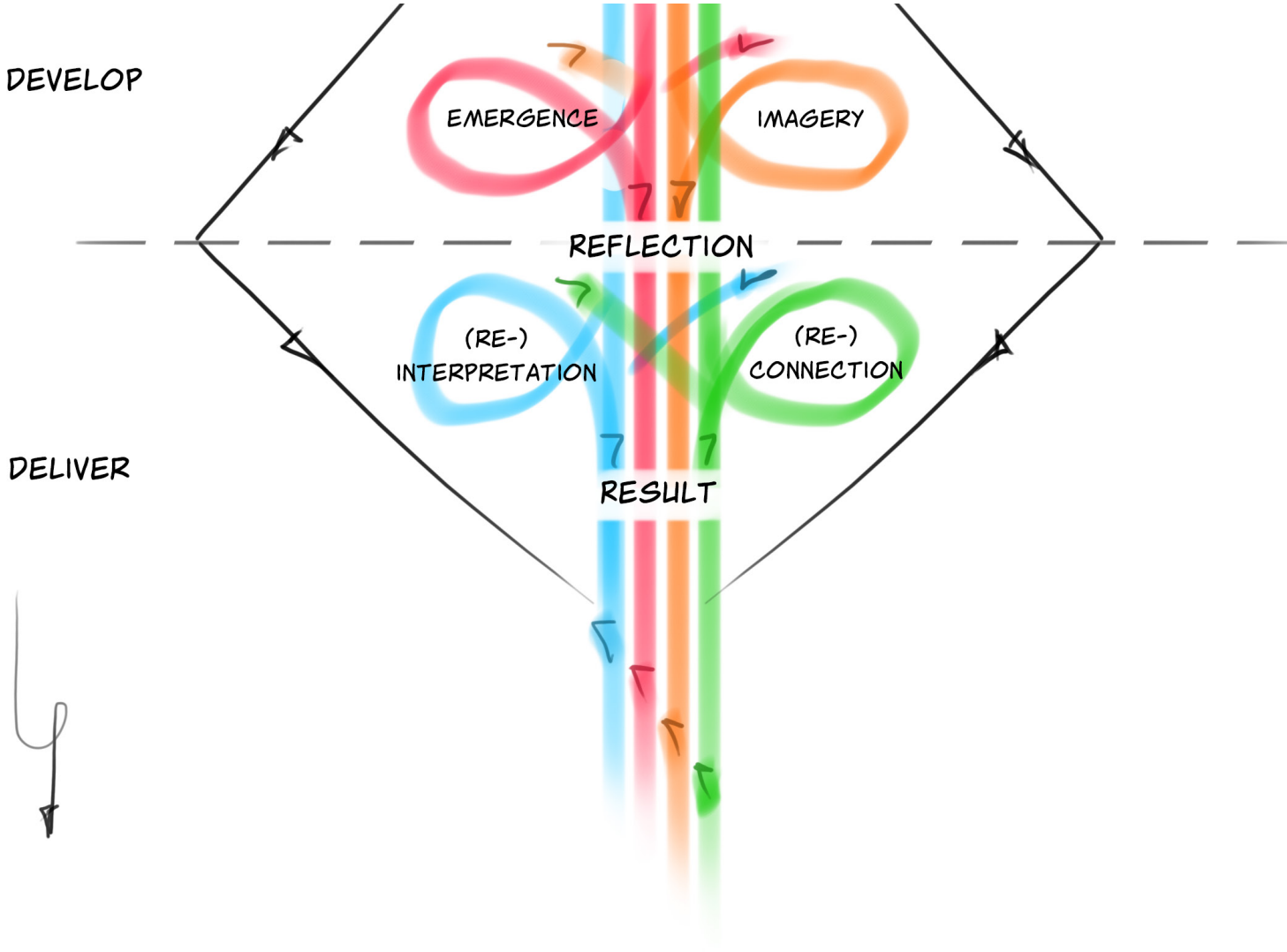
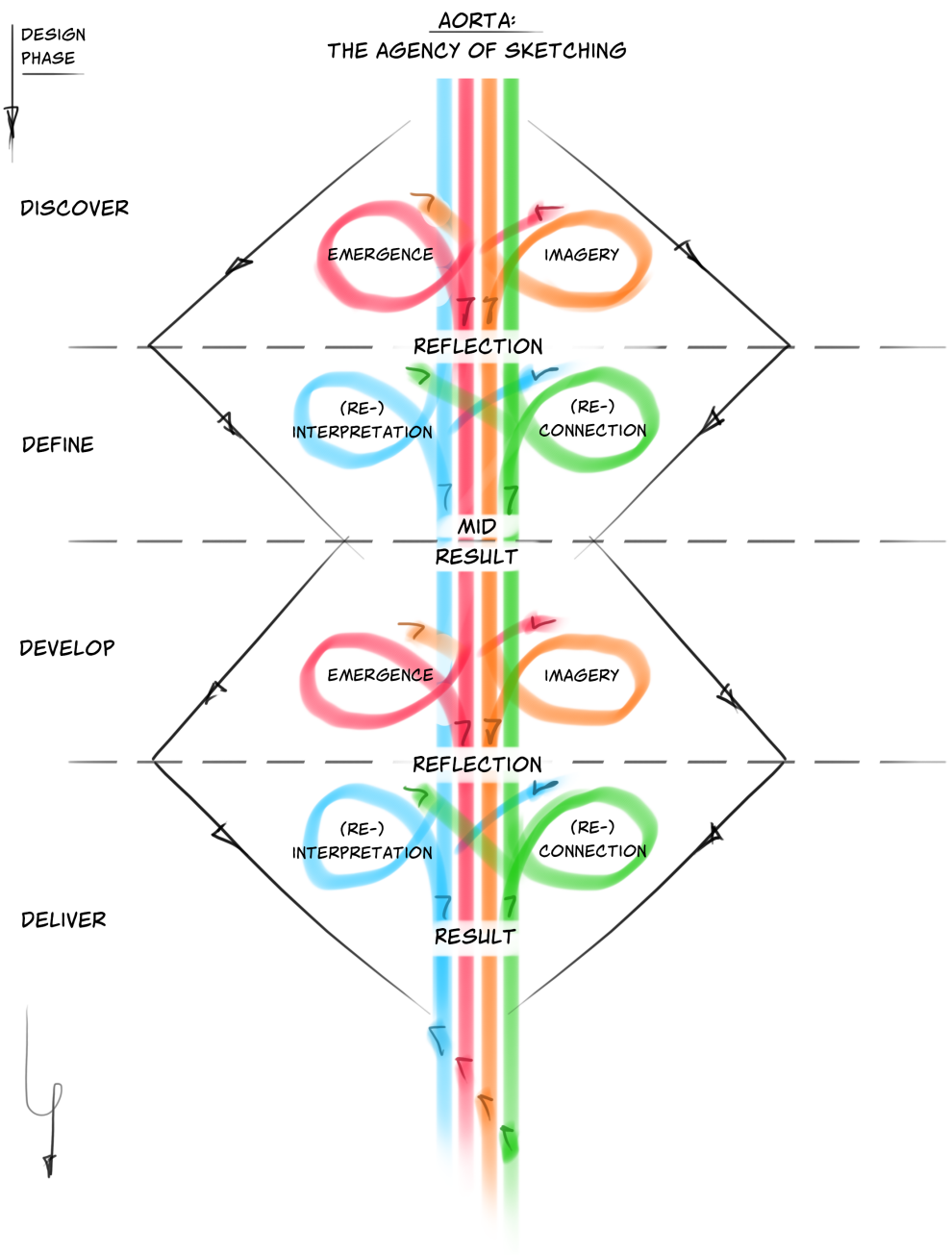


Figure 81: The proposed Framework for the Agency of Sketching




DEVELOP
EMERGENCE
IMAGERY
REFLECTION
(RE-)
INTERPRETATION
(RE-)
CONNECTION
DELIVER
RESULT


AORTA:
THE AGENCY OF SKETCHING
DESIGN PHASE
DISCOVER
EMERGENCE
IMAGERY
REFLECTION
DEFINE
(RE-) INTERPRETATION
(RE-) CONNECTION
MID RESULT
DEVELOP
EMERGENCE
IMAGERY
REFLECTION
DELIVER
(RE-) INTERPRETATION
(RE-) CONNECTION
RESULT

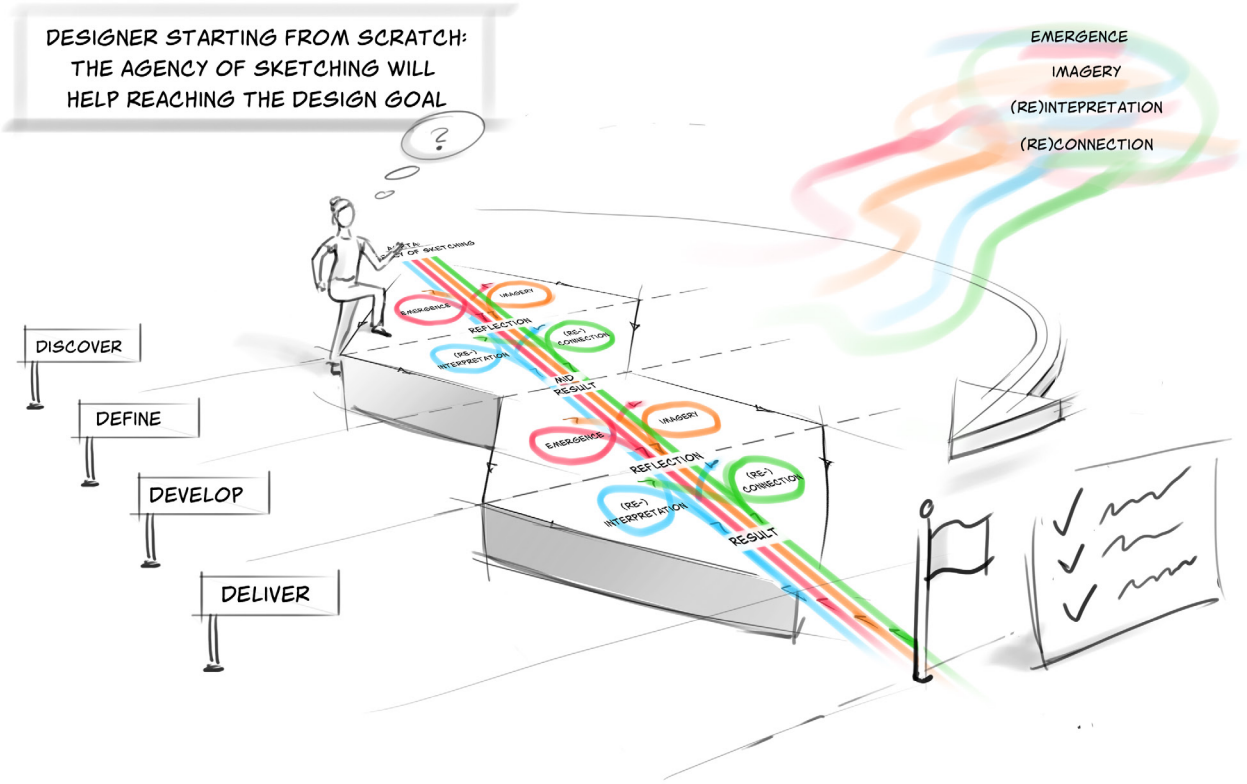
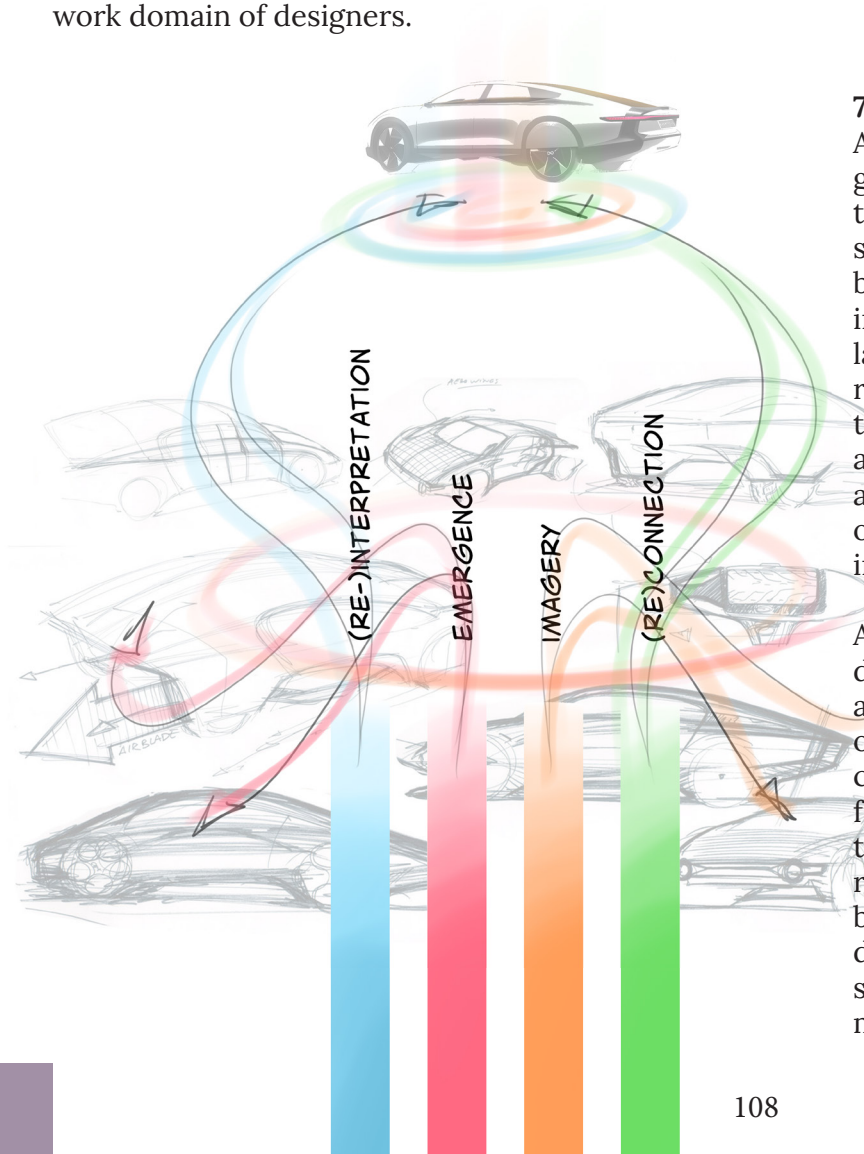


Figure 82: The framework visualizing how the designer will reach the design goal with help from the agency of sketching

7. Application of the framework

The framework captures the essential theoretical affordances that reveal the agency of design sketching. Now, the question can be raised: could it also be relevant in a practical sense? Considering that affordances must be discoverable and perceivable in order to be effective, the framework should be used to reach designers with the following goal: to let them rediscover design sketching as an agency and unlock its benefits. This can be achieved by transforming the framework into a tool applicable in the current work domain of designers.



7.1 Raison d'être

A tool aligned with the stated objective is gaining relevance, driven by the in chapter 5.3 described direction of the design sketching field. Due to the role of AI in both the early stages of design (assisting designers by generating ideas) and later stages of design (creating realistic renders from line sketches), designers of the future are expected to have less of a tendency to sketch. This would be in addition to the already existing decrease of design sketching by the rise of CAD innovations.

As outlined before, the interviewed design directors emphasized that they already notice declining sketching skills of young designers. This comes at the cost of design qualities. Engaging in frequent drawing enhances one's ability to observe more keenly and to accurately gauge proportions, as exemplified by Janwillem Bouwknegt. Moreover, as described in chapter 4, the role of design sketching in converging imagery by mental synthesis and the corresponding

higher quality of solution concepts is confirmed (Schütze et al., 2003, Mulder-Nijkamp and Eggink, 2016). Sketching improves the creativity level of ideas (Kudrowitz et al., 2012), adding to becoming better product designers (Corremans and Vaes, 2018). Sketching contributes to our 'visual literacy', meaning the ability to 'read, write and create visual images' (Harrison, 2022). This implies that the current decline in designers practicing sketching might diminish one's capacity to connect visual information with pre-existing design knowledge and thus to come up with inventive solutions. It could be argued that the brain will experience reduced generative development, by the reduction of internal processes that are initiated by the agency of sketching (chapter 4 and 6).

Hence, the situation calls for increased recognition of the significance of sketching in design. Therefore, The Framework for the Agency of Sketching should be applicable in practice, with the following goal: to let designers rediscover design sketching as an agency and unlock its benefits.

7.2 Core values of the tool

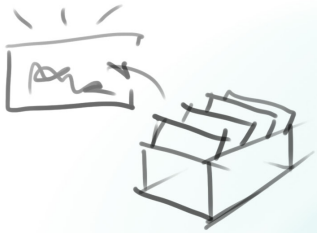
Considering the raison d'être, I suggest the following essential values that the practical tool must adhere to:

- It should be inviting
- It should be accessible with a low threshold (intuitive usage)
- It should have an inspiring effect on the user
- It should be valuable during multiple stages of the design process
- The content should be renewable

While the primary focus of this thesis revolves around the development of the framework itself, as described in chapter 6, there will be a brief exploration of its application as a practical tool, leading to the proposal of two concept directions.

To achieve this, HKJ-questions were formulated, with a commitment to maintaining the core values that the tool should uphold. This resulted in the following sub-ideas.

< Figure 83: Sketches of 'Lightyear' by Granstudio, as shared by Ewoud Luppens



Cards

Gamification

Extension of
ID Cards Loughborough University

HOW TO COMMUNICATE THE FRAMEWORK TO THE USER?

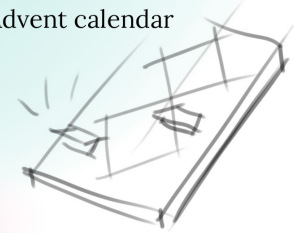
AI chatbot pre-programmed
for framework

Work-buddy

Boxes to open up
per design stage

Touchscreen to
swipe through examples

Advent calendar



Video starting

Provoking only one
simple action

Simple game
on the coffee table

A pen lying there
(giving light)

HOW TO KEEP THE THRESHOLD LOW?

No complicated things
& intuitive use!

Looking through something
(curiosity; immersive)

Integrated drawing tablet
(analyzing your work; suggestions)

..of both

..of other
process sketches

..of end
results

Showing
example drawings

Presenting also
'incorrect' sketches

Inviting blank sheet of paper

HOW TO INSPIRE SOMEONE TO START SKETCHING?

Buddy giving
direct suggestions

Pop-up reminder

Sketch timer

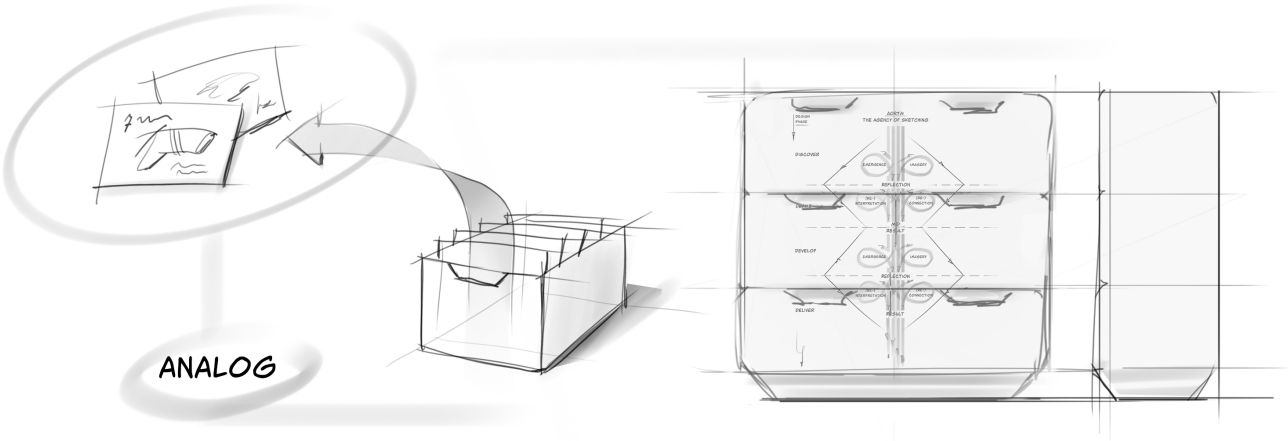

Monthly drawing-contest:
showing winning results
Possibility to add
new cards (or boxes)
Digitally open for input
like Wikipedia
HOW TO MAKE THE
CONTENT RENEWABLE?
Inviting for input through
media like Instagram
Option to upload
your own photos
(open source)
News letter
Algorithm
(varying content)
Peer
reviewing
Gamification
Use of social medium
e.g. Instagram
Use it for
brainstorming sessions
HOW TO ENGAGE
THE COMMUNITY?
Use it to start
conversations
Make it a contest
Inviting to give
ratings
Add ranking lists
Provide rewards
Process-sketches
Sketches of well-known
designers/designs
WHAT SHOULD THE
TOOL SHOW TO THE USER?
Sketches
back in time
Sketches
forward in time
Personal suggestions
with regard to
current design stage
Possible
end results
Reasons why to take
the next steps

7.3 Merging ideas

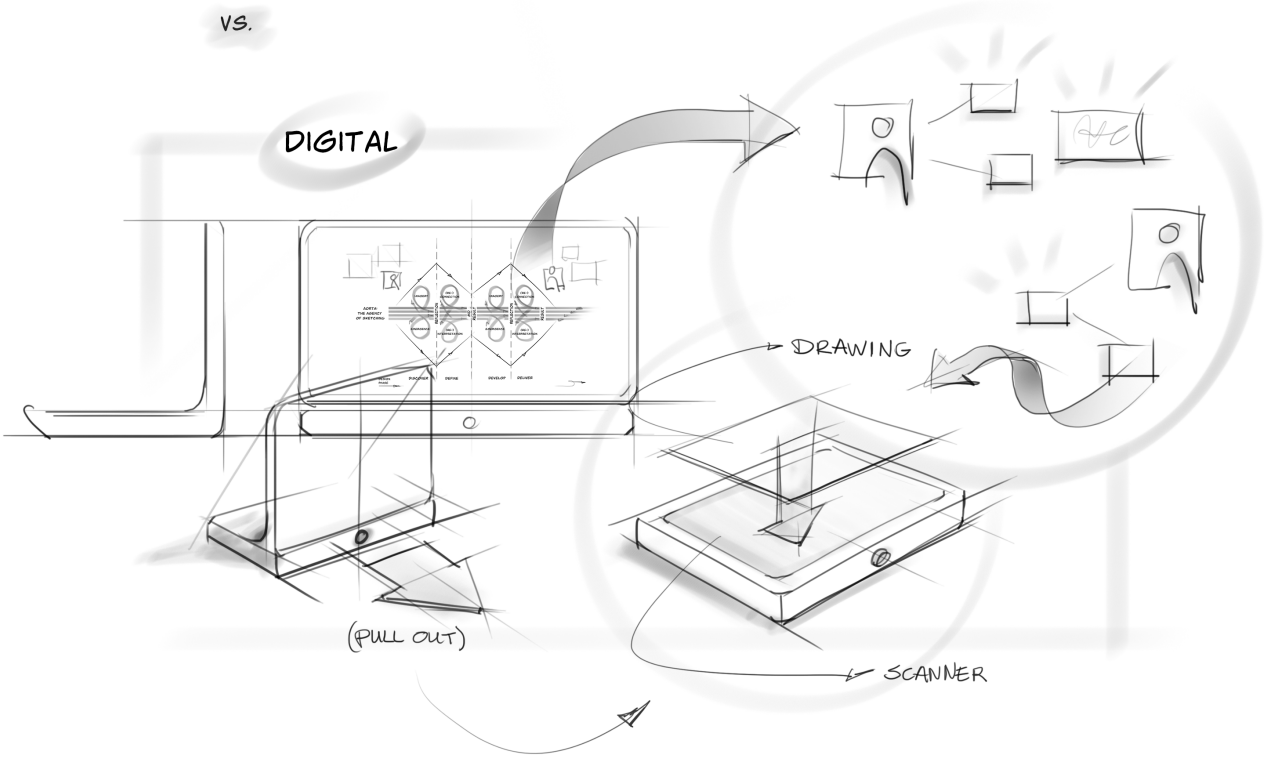
To link and integrate the ideas, several factors need to be considered, such as the following.

AI responds to the current technology trends and provides a wide range of opportunities. This could be combined providing an immersive (VR/AR) experience, one of the observed trends, to let the tool draw attention. Nevertheless, the extensive array of options that come with tools like this, coupled with a more intricate interface, might raise the barrier for individuals to easily use it. A low threshold could be achieved by creating a surprise-effect, using people's natural curiosity to make them interact with the tool. A kind of advent calendar answers to this, by inviting one to open a box when another stage in the design process is reached. This idea involves an intuitive step for people (curiosity) to get in touch with the tool. Boxes with analogue cards can be used to provide examples of sketches in different design stages and, per design stage, presenting varying process steps. Displaying a variety of drawing skill levels should serve to inspire and to retain or instill a sense of confidence. This aligns with the option to make it open-source: other students and/or colleagues can add their drawings. Engagement with others can strengthen the sense of inspiration. The ability to give ratings and rankings, exemplified as a succes in Duolingo, can motivate people even more. Nevertheless, this might evoke a competitive atmosphere, that is not necessarily preferred in a working space or design school. A physical object, like the ID Cards of Loughborough University, can stimulate use of the tool during collaboration with others. A digital medium, however, can easier adapt to a situation, e.g. by scanning a sketch and getting personal suggestions or a wide range of corresponding sketching examples. However, this could lead to a counterproductive effect: generating and providing customized sketches could discourage someone from sketching themselves, by making that less required.

Balancing off considerations like these, led to the solution of distinguishing a digital direction and an analog direction; both with their own advantages. This is proposed in the following two concept directions. Note: these are deliberately called 'directions', since both are relying on different principles, but the containing elements can still be shaped.



VS.



Concept direction 1:
cArts (analog)

Context:
On a desk in working spaces of design agencies or in the drawing studios of design schools

Users:
Designers in the working world (+ their clients) as well as design students

Concise description:
This direction is a response to the fact that a physical object can lower the threshold of using the framework-tool during interactive sessions. Collaborative use is expected to enhance the feeling of inspiration. During brainstorming sessions, students or colleagues can take out cards and have a look at examples of process sketches made in the same stage of designing. The boxes with cards can be 'open source', meaning that one can add their own sketches. Observing sketches of colleagues or student buddies can stimulate to start sketching too.

The boxes with cards not only distinguish sketches corresponding to different design stages, but also corresponding to the varying internal processes (the four pillars). Interacting with the product, e.g. adding your own sketches, therefore stimulates a deeper understanding of the agency of sketching and, in the case of using it together, elicits conversations about it. Moreover, the designer can showcase their design processes to potential clients, making them more confident about your competence, creativity and problem-solving skills.

Furthermore, the tool will remain useful for client meetings throughout the entire design process. Before meetings, the designer can categorize the recorded design sketches and put them in the boxes. During the meeting, it can help the designer to involve clients in his or her steps, inviting the clients to provide useful feedback. The tool, prominently present on the desk of the designer, helps clients understand and value the time the designers spends on the creative process.


ADETA:
THE AGENCY OF SKETCHING
DESIGN PHASE
DISCOVER
LEARNING
IMAGERY
REFLECTION
TIME
DEVELOP
RESULT
DELIVER

Figure 84: Like mentioned in the description, varying interactions can be ascribed to this concept

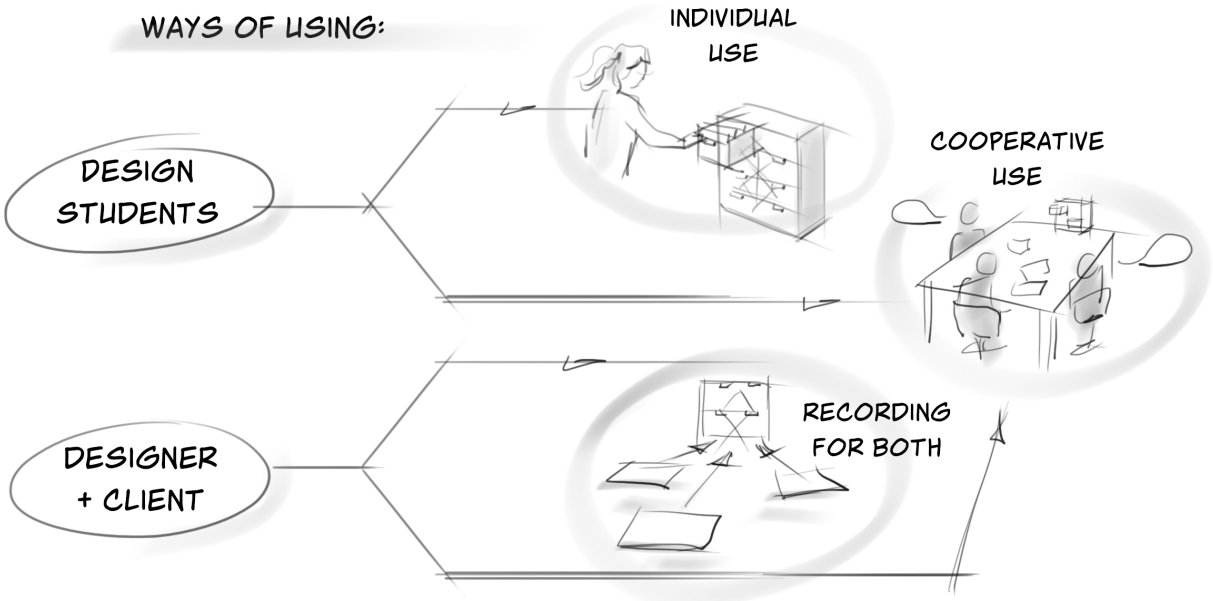
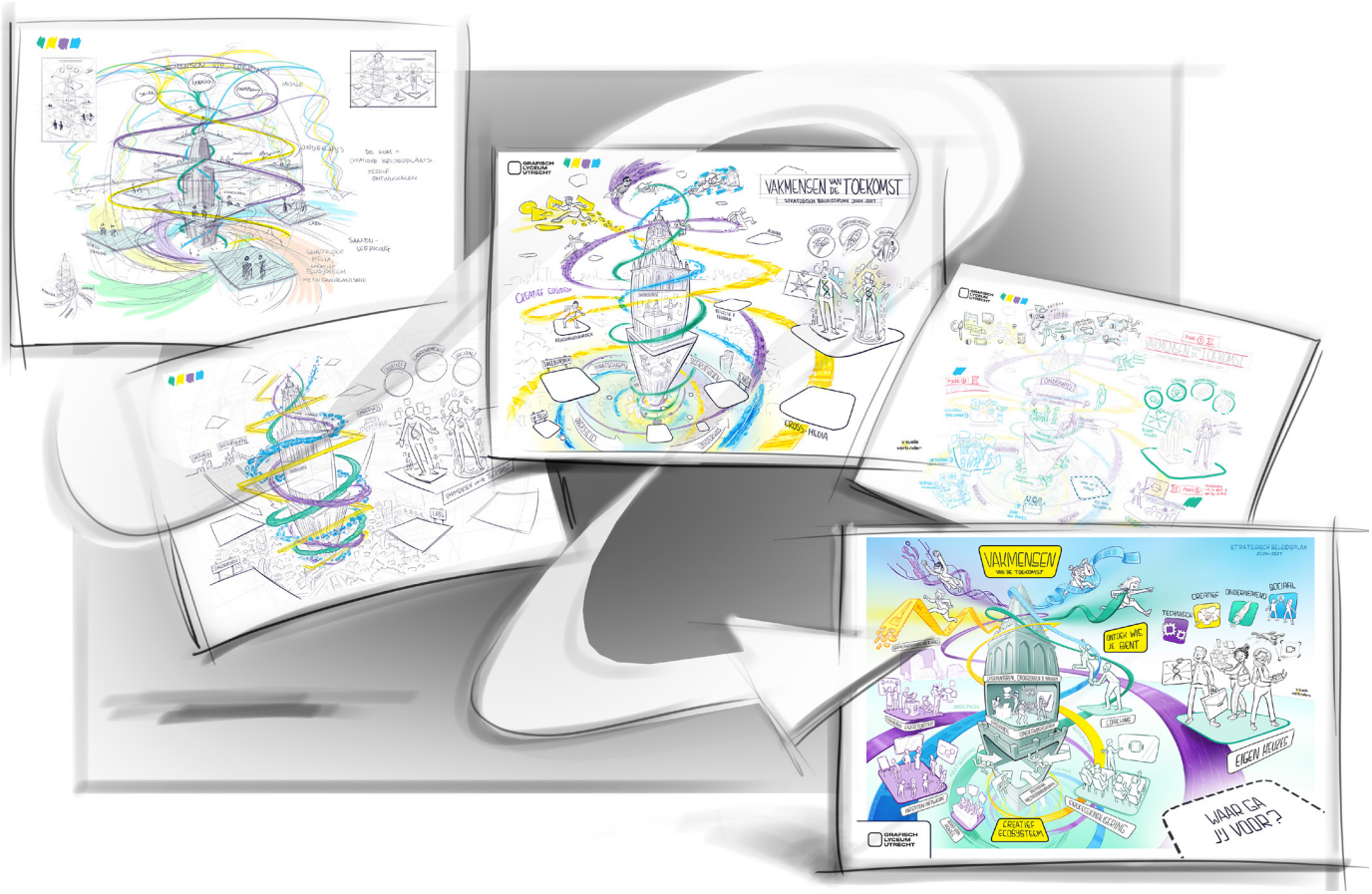


Figure 85: Examples of cards with process sketches of Robert Oude Nijhuis (Visuele Verbinders)



Concept direction 2:
EmPowering Processes (digital)

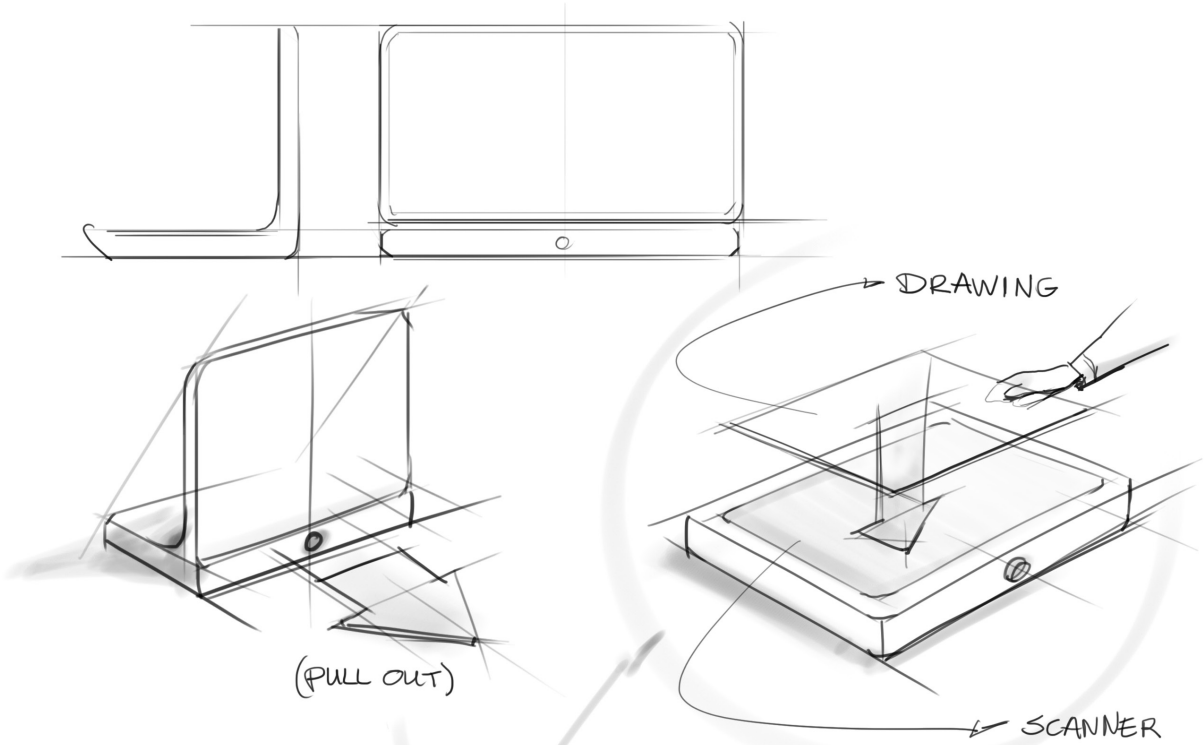
Context:
In the coffee corner of design agencies (+ digitally available on other devices)

Users:
Designers in the working world

Concise description:
This direction is a response to the fact that using a digital medium can draw attention of users and can effectively facilitate renewable content. A touch screen will be placed next to the coffee machine in a design agency. Here, you can upload your sketches by scanning them easily on the spot (see next page).

Additionally, the device draws the attention of designers who have a break from work; the perfect moment to get inspired by your colleagues. This will encourage usage of the tool. Within the framework that is projected on the screen, small pictures of you and your colleagues will be visible, including corresponding design sketches (see figure 89). This way, you can see where the others are in their design processes. By clicking on the picture, their current sketches will be presented. In this manner, you not only gain inspiration from diverse sketch examples, but also have the opportunity to engage in collaborative thinking with your colleagues. In the case you meet over a cup of coffee, the framework-tool will make it possible to, in a low-key way, visually demonstrate to each other what you are currently working on.

The digital framework-tool aims to trigger sketching inspiration, involvement with colleagues and collaboration. More importantly, it elicits a direct understanding of the benefits of creative steps. It also helps structuring the design process, allowing the user to visualize one's progress and gain inspiration for the next stages.


DRAWING
(PULL OUT)
SCANNER


AORTA:
THE AGENCY
OF SKETCHING
DESIGN
PHASE
DISCOVER
DEFINE
DEVELOP
DELIVE

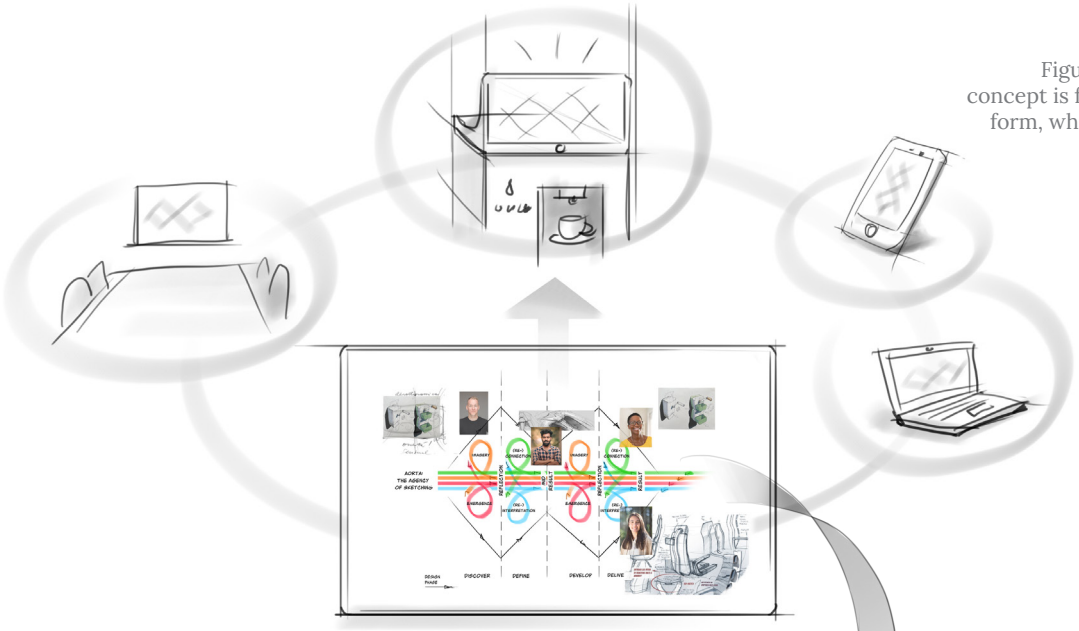


Figure 86: The basis for this concept is formed by a digital platform, wherefore it could be used on various devices

Possible addition

Within the digital concept direction, an AI function could be incorporated. One should be careful with this, for the reason that it carries the risk of taking over the drawing activity, which is exactly not the intention. However, AI is a prevalent technology we have to deal with in the nearby future.

If one would want to incorporate AI, the tool should still require the user to continuesly make sketch moves themselves. Creating interaction by making movements should be key. The screen can be combined with a drawing tablet (figure 88), on which the user can draw something themselves in order to let AI generate an inspiring example, based on the drawn object. AI ought to function as a coach, offering suggestions for the product being designed, while ensuring that the user keeps interacting and therefore continues to sketch.

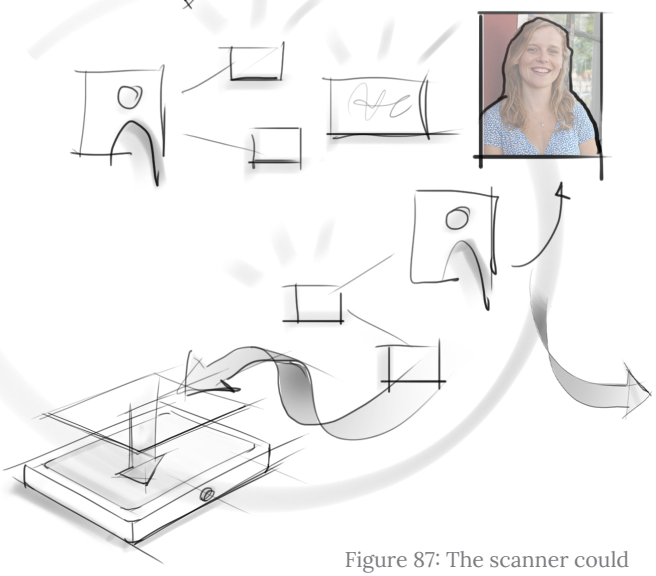


Figure 87: The scanner could attract people to the device and lowers the threshold to make and share analog drawings

To delve deeper into the analog and digital concept directions, it is advised to commence practical testing from this point forward. The scope for this thesis project concludes at this point.

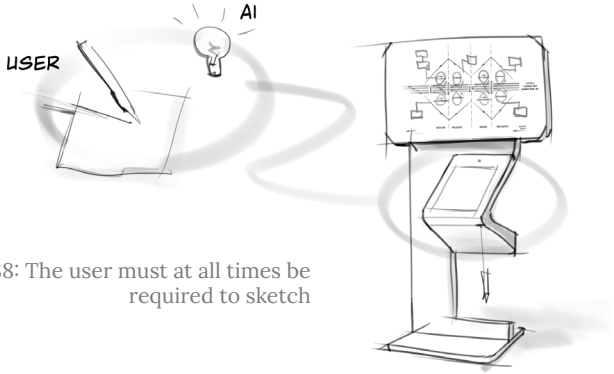


Figure 88: The user must at all times be required to sketch

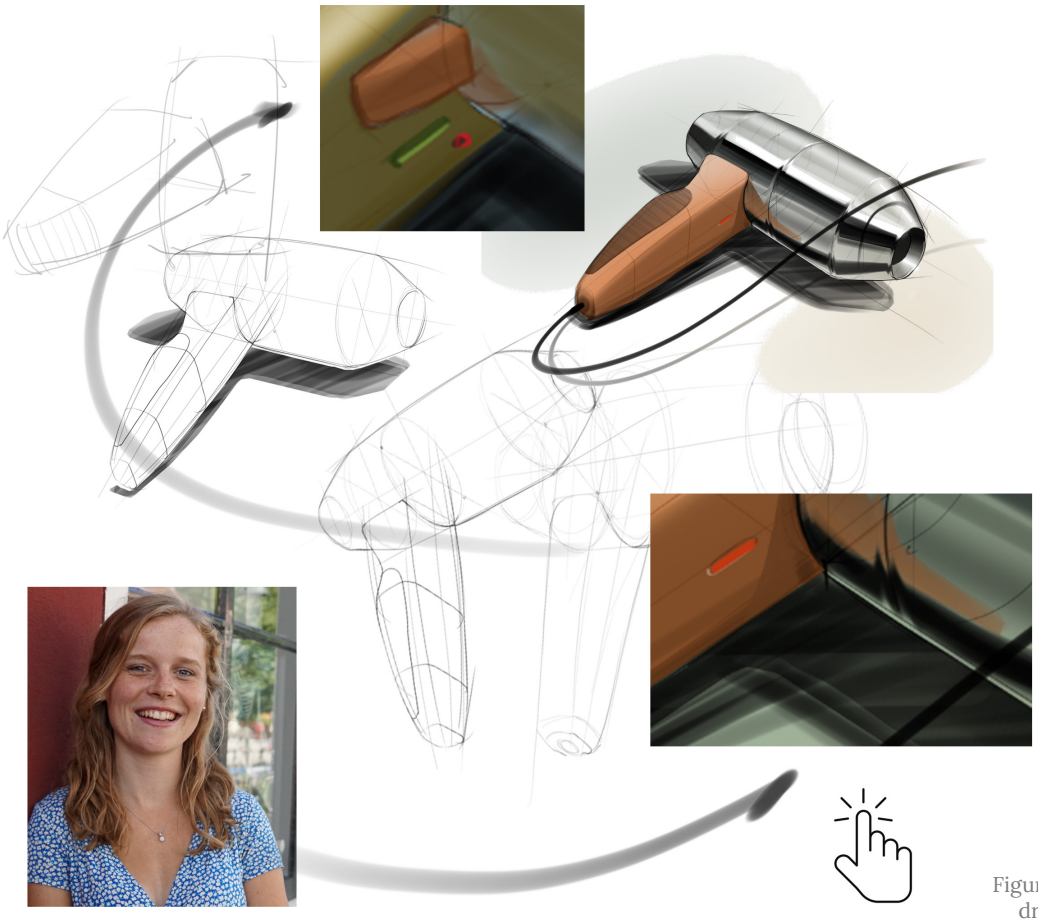


Figure 89: One could see both earlier drawings as well as the latest ones (and click on it to enlarge)

8. Conclusions and discussion

The research question of this thesis was "What was and is exactly the agency of design sketching with its affordances in the past, in the present and probably in the future?" To answer this question, extensive research has explored the various roles of sketching, considering both theoretical and practical perspectives. The crucial affordances of sketching are captured in a framework that reveals the agency of design sketching. Keeping this in mind, one could state the following about the resulting framework.

Overall, by clarifying the agency of sketching for design, the created framework provides an overview that can be used to understand and to communicate the wide range of different affordances. The framework is intentionally concise and schematic. At the same time, projecting the gained knowledge onto current design process models, brings nuance to the recognition of different kinds of sketching, sketches and corresponding affordances. For example, in addition to the function of the ID Cards by Loughborough University (Evans et al., 2020), introduced to provide understanding based on the representation of chronologically categorized kinds of design visualizations, the framework is able to allow for process-related nuances per design stage. These process-related nuances are based on emergence, imagery, (re-)interpretation and (re-)connection, referred two as the four pillars of design sketching. They emphasize that the role of sketching in not only communicating with others, but also in communicating with ourselves.

Contemporary trends seem to change to the way designers will benefit from sketching and suggest that a focus shift is appearing. Designers tend to increasingly pay attention to the affordances of drawing with regard to communication towards others, while there is a decrease in the tendency of benefitting from the affordances taking place internally (see chapter 5.3). This might decrease one's ability to link visual information with existing design knowledge and understanding and to train the brain in connecting different knowledge domains during sketching (see chapter 7.1). Given the advocated value of the internal affordances in particular (see chapter 4.1), and given the emphasis on these in the proposed framework (provided by the four pillars), one could state that the consultation and utilization of the proposed Framework for the Agency of Sketching, and the awareness created along with it, could become increasingly valuable.

However, some suggestions are worth mentioning.

1 Firstly, this research is conducted from a designers' point of view. However, exploring both designers' and stakeholders' perspectives, e.g. by adding client interviews, can enhance the understanding of perceptions on sketching and sketches (although note that the shift towards earlier client involvement fosters realistic viewpoints from the designer).

2 Secondly, the interviews were conducted with participants each of whom serves a different field (cars, products, visual strategies) and has a different professional position (company/independent/manager/employee). However, this variety increases the effect of discrepancies, wherefore future research should involve more interviewees per design field to mitigate these.

3 Lastly, in order to develop an effective tool based on the framework, interviewing designers who do not use sketching (anymore) as a (commonly used) medium could provide valuable insights. Understanding their motives helps in finding ways to resurrect their interest in sketching, aligning with the goal of letting them rediscover its benefits. Moreover, it would help to provide insights on how various design tools and -skills co-exist.

9. References

Aebi, K., Iker, A., Neufeld, L. (2021). Cézanne Drawing. Verenigd Koninkrijk: Museum of Modern Art.

Baarsen, R. (2023). Process: Design Drawings from the Rijksmuseum 1500-1900. Nederland: nai010 publishers.

British Design Council (2005). The Design Process: The 'double diamond' design process model. https://www.designcouncil.org.uk/our-resources/the-double-diamond/

Brun, J., Le Masson, P., & Weil, B. (2015). Analyzing the generative effects of sketches with design the-ory: sketching to foster knowledge reordering. In DS 80-10 Proceedings of the 20th International Conference on Engineering Design (ICED 15) Vol 10: Design Information and Knowledge Manage-ment Milan, Italy, 27-30.07. 15 (pp. 041-050).

Cohen, D. J., & Bennett, S. (1997). Why can't most people draw what they see?. Journal of Experimental Psychology: Human Perception and Performance, 23(3), 609.

Cohn, N. (2012). Explaining 'I can't draw': Parallels between the structure and development of language and drawing. Human Development, 55(4), 167-192.

Corremans, J. A., Vaes, K. R., & Coppieters, W. (2018). Do better sketchers become better product designers?. In DS 92: Proceedings of the DESIGN 2018 15th International Design Conference (pp. 2411-2420).

Da Vinci, L. (2013). Leonardo's Notebooks: Writing and Art of the Great Master. Verenigde Staten: Running Press.

De Botton, A. (2007). The Architecture of Happiness. Verenigd Koninkrijk: Penguin Books Limited.

Designerrs Academy. (2021, 1 februari). Time travel through the evolution of product design. Medium. https://medium.com/detaux/time-travel-through-the-evolution-of-product-design-957221705313

Evans, M., Campbell, I., & Pei, E. (2020). Making the tacit explicit: Developing tools to support collaboration during industrial design and engineering design practice. Loughborough University. http://handle.net/2134/12284078.v1.

Ferguson, E. S. (1992). Engineering and the Mind's Eye. MIT press.

Fish, J., & Scrivener, S. (1990). Amplifying the mind's eye: sketching and visual cognition. Leonardo, 23(1), 117-126.

Five Centuries of European Drawings: The Former Collection of Franz Koenigs : Exhibition Catalogue, 2.10.1995-21.01.1996. (1995). Italië: Electa.

Gerszi, T. (1979). Twee eeuwen tekenkunst in de Nederlanden. Hongarije: Meulenhoff/Landshoff.

Goel, V. (1995). Sketches of thought. MIT press.

Goldschmidt, G. (1991). The dialectics of sketching. Creativity research journal, 4(2), 123-143.

Goldschmidt, G. (2003). The backtalk of self-generated sketches. Design issues, 19(1), 72-88.

Gombrich, E. H. (1977). Art and Illusion: A Study in the Psychology of Pictorial Representation. Verenigd Koninkrijk: Phaidon.

Gombrich, E. (1996). Eeuwige schoonheid. Nederland: Gaade.

Harrison, K. (2022). What is Visual Literacy?. 2022, from https://visualliteracytoday.org/.

Hekkert, P., Dijk, van, M. (2016). VIP Vision in Design: A Guidebook for Innovators. Nederland: Laurence King Publishing.

Hoftijzer, J. W. (2018). If you don't draw it, you will not see it. Design para acessibilidade e inclusão. [Design for accessibility and inclusivity]. L. M. Fadel, V. R. Ulbricht and C. Batista. Sao Paulo, Brazil, Blucher: 59-73.

Hoftijzer, J., Sypesteyn, M., Nijhuis, J., & De Reuver, R. (2018). A typology of design sketches, defined by communication factors; the case study of the Thule Yepp Nexxt child bike seat. In DS 93: Proceedings of the 20th International Conference on Engineering and Product Design Education (E&PDE 2018), Dyson School of Engineering, Imperial College, London. 6th-7th September 2018 (pp. 585-590).

Hoftijzer, J., Sypesteyn, M., & Carelsberg, H. (2023). TEACHING 'HOW TO SKETCH VISUAL STORIES'TO A PROFESSIONAL AUDIENCE: A TAXONOMY OF VISUALISATION STRATEGIES. In DS 123: Proceedings of the International Conference on Engineering and Product Design Education (E&PDE 2023).

Huang, C., Zhang, Z., Mao, B., & Yao, X. (2022). An overview of artificial intelligence ethics. IEEE Transactions on Artificial Intelligence.

Itten, J., Smeets, R. (1973). Kunst en kleur: een kleurenleer over het subjektief beleven en objektief leren zien van kleur als weg naar de kunst. Nederland: Cantecleer.

Koch, C. H. W., Kuys, B., & Renda, G. (2020). A pilot study used to better construct a research direction to understand where industrial design fits within the 4th industrial revolution (Industry 4.0). Proceedings of DRS2020: Synergy. Vol. 2 Impacts., 887-898.

Koch, C. (2022). The future of industrial design and its role in Industry 4.0 (Doctoral dissertation, Swinburne University of Technology).

Kudrowitz, B., Te, P., & Wallace, D. (2012). The influence of sketch quality on perception of product-idea creativity. AI EDAM, 26(3), 267-279.

Lenaerts, B. (2014). Ever since I was a young boy I've been drawing sports cars. Duitsland: Delius Klasing.

Lin, M. H., Chiang, I., Lee, L., & Lu, H. X. (2022). Examining performance of VR sketch modeling tool in personal sketches.

Meerman. M. Prijs van AI. (2023, 8 juni). VPRO. https://www.vpro.nl/programmas/tegenlicht/kijk/afleveringen/2023-2024/de-prijs-van-ai.html

Mulder-Nijkamp, M., & Eggink, W. (2016, April). Innovating from inside the brand:(Re) searching the optimum design strategy for brands a new product innovations. In Global Brand Conference.

Munoz, M. N., Howell, B. F., Hoftijzer, J. W., Manuel, J., RODRÍGUEZ DÍAZ, W. Z., & Kramer, N. (2022). New collaborative workflows-immersive co-design from sketching to 3d cad and production. In 24th International Conference on Engineering and Product Design Education: Disrupt, Innovate, Regenerate and Transform, E and PDE 2022. The Design Society Institution of Engineering Designers.

Norman 2013: Norman, D. (2013). The design of everyday things: Revised and expanded edition. Basic books.

Pech, M., & Vrchota, J. (2022). The product customization process in relation to industry 4.0 and digital-ization. Processes, 10(3), 539.

Prats, M., Earl, C., Garner, S., & Jowers, I. (2006). Shape Exploration of designs in a style: toward generation of product designs. Artificial intelligence for engineering design, analysis and manufacturing, 20(3), 201–215. https://doi.org/10.1017/s0890060406060173

Prats, M., Lim, S., Jowers, I., Garner, S. W., & Chase, S. (2009). Transforming shape in design: observations from studies of sketching. Design studies, 30(5), 503-520.

Purcell, A. T., & Gero, J. S. (1998). Drawings and the design process: A review of protocol studies in design and other disciplines and related research in cognitive psychology. Design studies, 19(4), 389-430.

Reddy, A., Nicenboim, I., Pierce, J., & Giaccardi, E. (2021). Encountering ethics through design: a workshop with nonhuman participants. AI & SOCIETY, 36, 853-861.

Ruskin, J. (1850). Modern Painters. Verenigde Staten: Wiley & Halsted.

Schön, D. A., & Wiggins, G. (1992). Kinds of seeing and their functions in designing. Design studies, 13(2), 135-156.

Schütze, M., Sachse, P., & Römer, A. (2003). Support value of sketching in the design process. Research in Engineering Design, 14, 89-97.

Sparke, P. (1987). Design in Context. Verenigd Koninkrijk: New Burlington Books.

Suwa, M., Gero, J. S., & Purcell, T. (1999). Unexpected discoveries and s-inventions of design require-ments: A key to creative designs. Computational Models of Creative Design IV, Key Centre of Design Computing and Cognition, University of Sydney, Sydney, Australia, 297-320.

Suwa, M., Gero, J., & Purcell, T. (1999). Unexpected discoveries: How designers discover hidden features in sketches. In Visual and spatial reasoning in design (pp. 145-162). Key Centre of Design Computing and Cognition, University of Sydney, Sydney.

Tversky, B. (2001). Spatial schemas in depictions. In Spatial schemas and abstract thought (Vol. 79, p. 111).

Tversky, B. (2003). Navigating by mind and by body. In International Conference on Spatial Cognition (pp. 1-10). Berlin, Heidelberg: Springer Berlin Heidelberg.

Tversky, B. (2010). Visualizing thought. Topics in Cognitive Science, 3(3), 499–535. https://doi.org/10.1111/j.1756-8765.2010.01113.x

Vlooswijk, E. (2023, 28 april). Zo krijg je minder én betere vergaderingen op het werk. De Volkskrant. https://www.volkskrant.nl/beter-leven/zo-krijg-je-minder-en-betere-vergaderingen-op-het-werk~b112a9bb/

Ware, C. (2010). Visual thinking for design. Elsevier.

Wertheimer, M. (1938). Gestalt theory. In W. D. Ellis (Ed.), A source book of Gestalt psychology (pp. 1–11). Kegan Paul, Trench, Trubner & Company. https://doi.org/10.1037/11496-001

Zhang, F. (2022). Design and implementation of industrial design and transformation system based on artificial intelligence technology. Mathematical Problems in Engineering, 2022, 1-9.

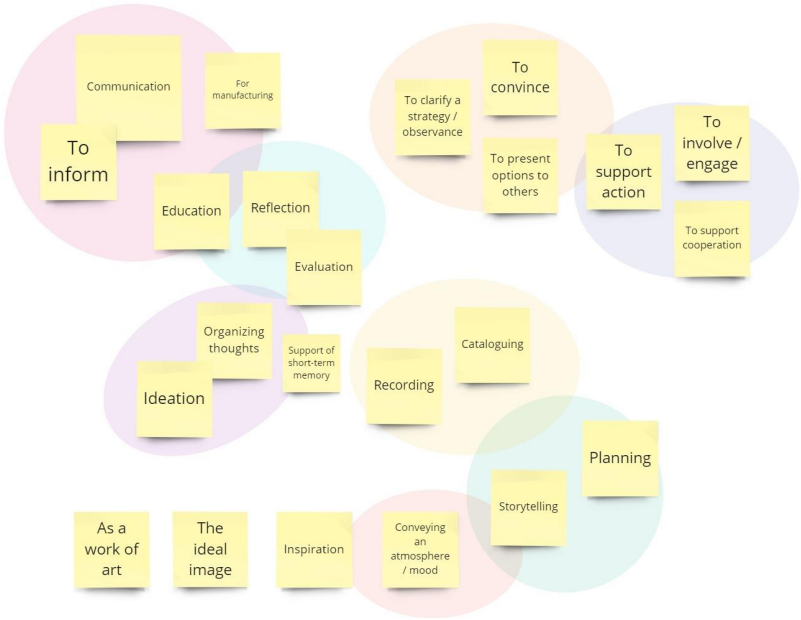
10. Appendices

10.1 Interview questions

Interviewvragen aan ontwerpend tekenaars

1. Over de functies van tekenen (het proces) en tekeningen:

- Welke functies van ontwerptekenen en -tekeningen, bijv. uit onderstaand overzicht, ondervindt je voornamelijk in de praktijk?



- In welke fase van het ontwerpproces en met welke betrokken mensen spelen deze functies een rol?

2. Over de interactie met betrokken mensen:

- Heb je als tekenaar interacties met verschillende mensen/partijen binnen en/of buiten het bedrijf, en zo ja, met wat voor personen?

- Wat is het doel van deze interacties?

- Wat is de grootste uitdaging betreffende deze interacties en/of de communicatie die daarbij komt kijken?

3. Over de tekenstijl:

- Hoe beschrijf je je tekenstijl?

- Waarom hanteer je deze stijl?

- Verschilt deze stijl, afhankelijk van verschillende momenten en/of betrokken personen?

- In hoeverre verschilt de tekenstijl per ontwerper binnen het bedrijf?

4. Over het tekenend ontwerpen als vakgebied:

- Welke trends merk jij als ontwerpend tekenaar in de praktijk?

- Wat is jullie visie daarover en op wat voor manier spelen jullie op deze trends in?

- Kan je externe (context)factoren benoemen die invloed hebben op deze trends en/of hoe jullie ermee omgaan?

- Wat lijken jou de belangrijkste leerpunten om aan beginnend 'tekenend ontwerpers' mee te geven?

- Zijn er leerpunten die jij niet zozeer in je opleidend leven hebt meegekregen, maar relevant bleken om te weten of toe te passen in het werkleven?

Heb je nog een laatste, wellicht relevante/interessante toevoeging, wat betreft de functies van tekenen en tekeningen binnen het ontwerpvakgebied?

10.2 Interview results

In order to make the results out of the interviews easy to read and understand, the answers the respondents gave are written down as running text per theme. The formulation is not exact, but close to what has been told by the respondents. For the literal way of questioning and answering, audios are available from three of the interviews.

10.2.1 *Ewoud Luppens, Granstudio*

Over de functies van tekenen (het proces) en tekeningen
In het auto-ontwerp zijn tekeningen zowel als 'a work of art', 'the ideal image', 'inspiration', 'conveying an atmosphere/mood' en 'storytelling' belangrijk (Miro-afbeelding, red.). De eerste vier hebben namelijk te maken met het emotioneel aantrekkelijke van de tekeningen dat, met name in het begin, een grote rol speelt. Het is belangrijk dat er een vonk overspringt bij de design director. Hij denkt met zijn buik: de tekening die de vonk bij hem teweeg brengt, om wat voor redenen dan ook (er wordt weinig beargumenteerd), wordt vervolgens gekozen om mee door te gaan. Er worden aanpassingen aangebracht, terwijl er tegelijkertijd wordt geprobeerd om de aspecten die de vonk veroorzaakt hebben zoveel mogelijk te behouden.

Tegelijkertijd is de tekening 'as a work of art' belangrijk: auto-ontwerp is mode. Er wordt continue op zoek gegaan naar nieuwe expressies. Op welke manier het getekend is, speelt een grote rol bij hoe het wordt beoordeeld door de design director. Men zoekt naar nieuwe manieren om het op papier te krijgen; al is het een gekke combinatie van groen en roze, als het maar in de mode is! Dit maakt dat het ontwerp en de tekening één ding zijn: de director onderscheidt dat niet in deze fase.

Latere tekeningen zijn meer beschrijvend: de kleuren interesseren bijvoorbeeld minder en de verhoudingen moeten gaan kloppen. Hier speelt het ook een sterke rol door wat voor persoon de tekening geïnterpreteerd wordt. Engineers kijken het liefst naar gemodelleerde visualisaties, omdat die explicieter zijn. Door de tijd heen is het ontwerpproces zich meer gaan opdelen in gespecialiseerde vakgebieden, waardoor de ontwerpers zich over kleinere delen van het proces bewegen in plaats van over het geheel. (Wellicht is dit in correlatie met hoe ingewikkeld het te ontwerpen product is.) Daarom merk je wat betreft de tekeningen soms dat de oudere ontwerpers ze over het algemeen goed kunnen interpreteren en integreren, terwijl de jongere (meer specialistische) enkel met een specifiek type visualisatie (of tekening) overweg kunnen.

Ruwweg bewegen de tekeningen zich door drie fases: 1) Het over laten springen van de vonk; 2) Het specifieker laten worden van het ontwerp (herkenbaar als een auto, maar de magie niet kwijtraken); 3) Het uitvoeren van photoshop-tekeningen en renders (die helpen bij het afmaken van het ontwerp). De visualisaties blijven hierbij echter nog steeds artistiek en expressief.

Over de interactie met betrokken personen
Als ontwerpend tekenaar heb je te maken met de design director, met chiefs die bepalen wat er getoond wordt aan de director en natuurlijk met collega-ontwerpers. De chiefs zijn er om te helpen (in tegenstelling tot de director) en collega-ontwerpers hebben een belangrijke functie in het opvoeren van de prestatiedruk. Ze inspireren elkaar en zijn tegelijkertijd erg competitief (ieder wil met de beste schetsen komen). Chiefs houden onder controle of het geheel nog samenhangend is en ook of de ontwerptekeningen juist niet teveel op elkaar lijken.

De groepsdynamiek is in vroege fase duidelijk anders dan in de latere fase. Dat wordt bepaald door de keuze van de design director: wanneer het duidelijk is welke schets er heeft gewonnen, wordt men minder competitief en gaat het meer richting het coöperatieve. Modelleurs en engineers komen erbij, taken worden verdeeld (om te detailleren binnen het gekozen ontwerp) en de chief moet op gezette tijden zijn duim opsteken. De design director presenteert de visualisaties van het ontwerp zo'n twee keer per jaar aan de allerhoogste bazen.

Door de tijd heen is het ontwerpproces zich meer gaan opdelen in gespecialiseerde vakgebieden, waardoor de ontwerpers zich over kleinere delen van het proces bewegen in plaats van over het geheel. (Wellicht is dit in correlatie met hoe ingewikkeld het te ontwerpen product is.) Daarom merk je wat betreft de tekeningen soms dat

de oudere ontwerpers ze over het algemeen goed kunnen interpreteren en integreren, terwijl de jongere (meer specialistische) enkel met een specifiek type visualisatie (of tekening) overweg kunnen.

Over de tekenstijl
De stijl die gehanteerd wordt verschilt absoluut. Ik zelf ben, juist door de competitieve sfeer, flexibel en op zoek naar datgene dat wint. Er zijn ook drie andere tekenaars, die alle drie een wat meer eigen stijl hanteren. Dat ligt ook aan de functieverdeling: zij tekenen alleen maar, terwijl ik ook presentaties houd en in teams werk. Als ik dan weer ga tekenen, merk ik dat ik me moet aanpassen naar aanleiding van wat ik voor tekeningen om me heen zie. Op basis van wat voor stijl tekeningen ik bij de anderen zie ontstaan, pas ik de mijne aan naar een manier waarvan ik denk dat die zou kunnen winnen. Over het algemeen zou mijn stijl meer beschrijvend genoemd kunnen worden, omdat ik meer aan de ontwerpende kant zit, terwijl er ook tekenaars binnen het bedrijf zijn die aan kunstacademies hebben gestudeerd.

De tekening 'as a work of art' is belangrijk: auto-ontwerp is mode. Er wordt continue op zoek gegaan naar nieuwe expressies. Op welke manier het getekend is, speelt een grote rol bij hoe het wordt beoordeeld door de design director. Men zoekt naar nieuwe manieren om het op papier te krijgen; al is het een gekke combinatie van groen en roze, als het maar in de mode is! Dit maakt dat het ontwerp en de tekening één ding zijn: de director onderscheidt dat niet in deze fase.

Over het tekenend ontwerpen als vakgebied
Zoals genoemd, zijn we met mode bezig. Dit gaat automatisch samen met trends. AI, of je het nou wil of niet, is een mooie tool. Binnen het bedrijf experimenteren we ermee en ik vermoed dat we het de komende maanden echt gaan gebruiken. Op een voorzichtige manier, om te zorgen dat het niet ons gehele werk overneemt. De baas moet iets bedenken waardoor we er met z'n allen beter van worden. Het is een belangrijke trend.

Photoshop werd door de tijd heen gebruikt om makkelijker en sneller tekeningen te maken. Nu heeft het een andere meerwaarde erbij gekregen. Ik merk namelijk dat het een volledig flexibele uiting in 2D geworden is. Het is soms min of meer nog herkenbaar als auto, maar een abstracte Mondriaan-creatie mag tegenwoordig ook. Photoshop heeft dit mede mogelijk gemaakt, met het wijde scala aan tools. Wel is het hierbij weer belangrijk om in het vizier te houden wie er naar de tekeningen kijkt. De Chinezen durven minder aan met zo'n Mondriaan-achtige creatie, een wilde artistieke uiting om het product mee te beginnen, dan bijvoorbeeld de Amerikanen.

De stijl is gebonden aan mode, soms zelfs letterlijk aan kledingmode. Wat een rare insteek is eigenlijk, want auto-ontwerp gaat veel langzamer dan die van kleding. De perceptie van de identiteit van het merk moet voorzichtig gemanaged worden. Als je iets duurzaam wil maken, kan je het beste innoveren op kleinere schaal.

Een tip is om niet vast te houden aan een specifieke methode. Het is aantrekkelijk om iets te doen wat je kent, maar je moet gevoelig zijn naar de context. Bovendien ook goed in het oog hebben wie er beslissingen maakt en wat voor hen aantrekkelijk is. Het is de moeite waard om te zoeken naar limieten van design directors, om die af te tasten, want die zitten waarschijnlijk dichtbij datgene wat voor hen het meest nieuw en verassend is.

Bij het visualiseren tijdens associative brainstorming gaat het vaak om luisteren. Doorgaans willen mensen graag praten, maar ze luisteren niet goed. Als tekenaar is het het beste om te luisteren en datgene wat men bedoelt op papier zetten. Ook als het niet precies raak is, pakken ze het aan om de aandacht te krijgen en op te eisen. Tekeningen moeten gelaagd zijn; iemand krijgt dan de kans om opnieuw zijn verhaal vertellen en moet daar lang mee bezig kunnen zijn.

10.2.2 Jort Nijhuis, Jort.

Over de functies van tekenen (het proces) en tekeningen
Tijdens gesprekken bieden de tekeningen visuele ondersteuning. Ook is het voor het collectief begrip een krachtige tool. Verder kunnen visuele metaforen als kapstok fungeren.

Het is ook een tool voor mezelf om dingen te zien. Ik heb vaak al de richting van een idee, maar tijdens het schetsen reageer ik op mijn gezette lijnen. Het is een samenspel tussen de lijnen die ik zie en het daarmee schaven. Ik schets niet altijd alleen lijnen, maar ook volumes. Qua techniek vergt dat meer: een eerst grof silhouet krijgt lichtval en schaduw. Je kan een product slanker maken dan het eigen-

lijk is, dat is beter te doen dan alleen met lijnen.

Vervolgens kunnen de tekeningen verpakt worden tot een logisch proces of geheel dat toonbaar is voor de consument, bijvoorbeeld door middel van een slideshow. De inhoud daarvan is afhankelijk van de fase van het ontwerpproces. In het begin zijn de schetsen vaag en generiek, niet concreet. Het geeft een richting aan die het mogelijk op kan gaan. Het moet niet een te concreet, maar toch een duidelijk idee zijn. Het is immers nog niet af, maar de klant heeft vaak een minder groot voorstellingsvermogen dan de ontwerper, dus er moet wel genoeg informatie gegeven worden. Wat deze balans betreft is het vallen en opstaan. Zo viel een klant weleens over de soort spaken die ik getekend had, terwijl ik de nadruk geheel ergens anders bedoeld had (de spaken lagen nog niet vast). Nu teken ik geen spaken meer: ik heb geleerd bewust dingen weg te laten, met name als ik er nog geen input op wil. Deze balans moet je leren aanvoelen als ontwerper, vooral dat wat je nog weg moet laten.

In de conceptfase worden de schetsen steeds concreter, om miscommunicatie te voorkomen. Dit is allemaal gelinkt aan waar je in het proces bent.

Over de interactie met betrokken personen
Afhankelijk van hoe betrokken de klant is, ben je veel bezig met het presentabel maken van je ideeën. Wanneer iemand een engineer is, moeten de schetsen preciezer en zijn het bijvoorbeeld doorsnedes. Het is goed om alle tussenstadia vast te leggen, zodat iemand snapt hoe je ergens bij komt. Het is niet een kwestie van even een schetsje maken, de schetsen vormen een resultaat, een soort logboek.

Wel is het belangrijk om erop te letten niet alle idee-schetsen te laten zien aan het betreffende bedrijf. Als een deel hiervan vervolgens niet gekozen wordt om mee door te gaan, mag het idee wellicht niet meer gebruikt worden voor andere doeleinden of bedrijven.

Over de tekenstijl
De stijl verschilt zeker. Ik vind het interessant om te zoeken naar wat er mogelijk is, bijvoorbeeld zelfs met aquarel, wat ook weleens mislukt of, bijv. door mijn vorige baas, niet goedgekeurd wordt. Meestal wordt er door de klant een typische IO-schets verwacht. Die voelt voor mij juist soms te gelikt. Bovendien kwam het weleens voor dat de klant dacht dat het idee al af was, doordat de schets er zo gelikt uitzag, wat extra reden voor mij was om ze wat ranziger te gaan schetsen. Het is belangrijk dat de klant snapt dat het nog niet concreet is. Verder biedt dat mogelijkheid dingen weg te laten, om niet af te leiden van mijn communicatiedoel. Ik experimenteer ook weleens met waterverf of olieverf in Photoshop, met grove brushes als tool. Daarmee heb je minder controle, maar in de fout zie je juist iets heel leuks, bijvoorbeeld wanneer je uitschiet en denkt 'ooh, best een goeie'. Deze tekenstijl verschilt wel per persoon, je moet er ook de tijd voor hebben om nieuwe stijlen te ontdekken.

Ik schets bijna alles digitaal (alleen schetsen die puur intern zijn, om op te helderen, die maak ik weleens met ballpen). Alles moet gepresenteerd worden aan bedrijven of klanten, ik neem ze mee in het proces en Photoshop bied me precies de kans om alle tussentijdse stappen op te slaan en terug te halen. Dat laten zien van verschillende uitwerkingsgradaties werkt ook in de overtuigingskracht naar de klant toe. Ook voor jezelf helpt het met het doel om te zoeken naar vormen of karakter. Je leert een tool als Photoshop steeds beter kennen. Ik houd ervan om niet te strak te tekenen, maar schilderachtig, steeds op zoek naar nieuwe kwasten.

Over het tekenend ontwerpen als vakgebied
Met AI doe ik niet zoveel, behalve af en toe met ChatGPT. Het is vooral interessant als inspiratie, maar het heeft nog niet het juist niveau op het gebied van proces en interactie. Gedurende de 3 of 4 jaar voordat bijv. een kinderwagen op de markt komt, gebeurt er heel veel aan organisatie. Het zal nog even duren voordat AI dat allemaal snapt. Ik zie het dan ook vooral als inspiratie, maar het lukt niet om AI een variant verder te laten uitwerken. Het teert puur op beelden die het tot zijn beschikking heeft. Verdere bepalende zaken zoals kleurkeuzes en het overdrijven van perspectief e.d. zijn voor AI ook nog te moeilijk, omdat het complexere afwegingen met zich meebrengt.

VR vind ik interessant, al lijkt het me lastig om in de ruimte te tekenen. Nu doe ik aan 'sculpting', waarbij ik primitieve vormen (van harde objecten) modelleer en symmetrisch kan maken. Het is intuïtief. Een vorm die tussen 2D schetsen en CAD-modelling in zit, namelijk in 3D werken zonder dat er precieze afmetingen nodig zijn. Toch doe ik er langer over dan tekenen in 2D, omdat je altijd die blokkade van de derde dimensie houdt. 2D is duidelijker en sneller, dus zeker in het begin gebruik ik dat het meest.

Ik zou wel graag een VR-set hebben, maar ik weet niet hoe ik mijn ontwerpen daar presentabel in maak. Ik zou wel graag via VR een ruimte willen zien met al mijn ideeën; een soort eigen studio-omgeving. Het nadeel is alleen dat je je eigen handen dan niet ziet, de verhoudingen komen wellicht minder goed over daardoor en men mist het voordeel van fysiek iets in je handen hebben/voelen.

Wat ik geleerd heb in de praktijk als zijnde twee belangrijke dingen: de tools leren kennen en het analytisch denkvermogen. Behapbare brokjes in uitdagingen aanpakken. Door tekenend te gaan ontwerpen van delen van het uiteindelijke doel, ben je in een beginstadium (met veel onzekerheid) als ontwerper toch nog comfortabel ('Nu even alleen het belangrijkste oppakken'). Dat is iets wat de klant niet zo goed kan.

Schetsen is universeel, een taal die iedereen spreekt. Dat onderschatten mensen. Het is daarmee echt een wapen. Ik heb voor MaxiCozy bijv. weleens banners gemaakt, die nodig waren voor de bazen om budget te krijgen, maar wij mochten zelf niet mee. Dankzij de schetsen op de banners had ik nog steeds invloed, ondanks dat ik er zelf niet was. Verder zijn er cultuurverschillen mee te overbruggen. Chinezen zijn bijvoorbeeld heel letterlijk, Fransozen heel hiërarchisch, maar ze luisteren wel naar de schets, daarmee kan je je bewijzen.

10.2.3 *Janwillem Bouwknegt, NPK Design*

Over de functies van tekenen (het proces) en tekeningen
Het heeft het doel om goede vormgeving en technische oplossingen te vinden, terwijl je met jezelf aan het communiceren bent. Is dat wat ik in gedachten heb mogelijk? Klopt deze vorm, kan dit in de juiste verhoudingen? Je probeert nieuwe vormen en oplossingen te zoeken, waardoor je vellen krijgt met heel veel tekeningen erop. Het vol kliederen helpt mezelf om continue te analyseren wat de opdrachtgever wil, wat ik daarmee wil en hoe ik dat kan bereiken. Het helpt het uitzoeken van welke oplossing we het beste kunnen bieden.

Aan de andere kant helpt het om je idee naar de klant toe over te brengen. Men duikt snel de computer in, maar dat is in mijn ogen minder intuïtief. Je kan daarmee minder makkelijk dingen uitproberen. Bovendien lijkt het dan voor de opdrachtgever vaak al snel 'af'. Dat is het niet, in het begin zijn het probeersels die je wilt overbrengen. Een schets heeft iets van 'hier moet nog aan gewerkt worden'.

Gedurende vergaderingen wordt er altijd getekend. Tijdens het schetsen kom je ook op nieuwe ideeën.

Over de interactie met betrokken personen
Tekenen helpt ook om aan collega's dingen uit te leggen. Om engineers dingen te laten beoordelen teken je bijvoorbeeld doorsnedes. Hierbij speelt het een rol hoe je het idee (specifiek het aspect daarvan dat je wilt communiceren) zo goed mogelijk overbrengt, waarbij het natuurlijk belangrijk is om te kijken wie je voor je hebt.

Over de tekenstijl
De stijl die we hanteren is redelijk pragmatisch. Hoe krijg je zo snel mogelijk het idee bij de ander? Het moet er modern en schetsmatig uitzien, kleurrijk, contrast, van het scherm spatten. Het ligt eraan, als je het communiceert met je collega's hoeft het minder fancy, maar tijdens presentatiemomenten (tijdens de schetsfases) moeten de tekeningen wel echt van het scherm spatten. Hoog niveau ontwerptekeningen.

De stijl die je hanteert kan lichtelijk beïnvloed worden door eigen voorkeur van ideeën, maar de ervaring leert dat de klant toch zijn eigen keuzes maakt. Dat geeft aan dat we niet dusdanig hoge verschillen in esthetische kenmerken van de tekeningen per idee maken. Het is kennelijk niet voorgeprogrammeerd in de schets welke er gekozen moet worden.

In eerste instantie schets je puur waar de keuze over gaat. Niet bijvoorbeeld bepaalde USB-toegangen of dergelijke. Ik probeer zo te schetsen dat het idee dat overgebracht moet worden overkomt zonder verwarring eromheen.

Nog veel analoog naast computerschetsen; we hebben klanten die daarvan gecharmeerd zijn. Wel worden ze samengevoegd en verder uitgewerkt met de tablet of op de computer, dus vaak wordt het ook een combinatie. De analoge schetsen worden in het begin ook aan de opdrachtgever laten zien, omdat je de zoektocht ook wilt overbrengen. De dingen die je uitgeprobeerd hebt en geleid hebben naar de latere ideeën.

Over het tekenend ontwerpen als vakgebied

In 3D schetsen met een set hebben we weleens geprobeerd, maar daar zijn wij niet zo van gecharmeerd. Het is vrij grof, wat voor ons niet bruikbaar wordt. Organische vormen zijn het vooral, terwijl we ze al vrij snel willen definiëren.

AI vind ik qua geheimhouding spannend. Een extern computersysteem traint zichzelf en leert dus ook van jouw keuzes. Dus je voedt als het ware het computersysteem met jouw kennis. Hierdoor kun je je vaardigheden weggeven aan andere ontwerpbedrijven. Verder zijn de ontwerpen die eruit komen niet van dusdanig niveau (vernieuwend genoeg) om er wat mee te doen. Slechts voor inspiratie in het begin, als een soort extra ontwerper met ideeën.

Wij merken dat de hoeveelheid uren van het tekenonderwijs (handtekenen) achteruit is gegaan. Dit gaat ten koste van de vaardigheid van de jonge ontwerpers. Je leert door het vele tekenen juist beter te kijken, beter verhoudingen in te schatten, etc. Het werkt als een soort ontwerptool, die ons inziens heel waardevol is. Wij blijven dat daarom binnen het bedrijf nog veel bijbrengen en vasthouden. Ik beoordeel nieuwe mensen op hoe origineel, vernieuwend, klopt de vormgeving, hoe goed kan iemand tekenen? Iemand die goed kan ontwerpschetsen heeft in mijn ogen een stapje voor.

Om inspiratie op te doen kijken wij ook vaak naar de auto-schetsers. Daar halen we trucjes uit m.b.t. het visualiseren. Een groot verschil is echter wel dat auto-schetsers het vaak voor hunzelf houden: meer competitief, hij moet eruit springen t.o.v. die van anderen. Bij ons is er geen competitie tussen de ontwerpers, meer een coöperatief uitwerken van ideeën, wat voor een andere stijl zorgt.

Er moet een basis-idee zijn in de vormgeving, maar we proberen het wel te onderbouwen. Het moet een verhaal worden. Opdrachtgevers willen vaak een soort 'design story' hebben, die ze kunnen vertellen en uitstralen. Het is ook belangrijk om die vast te leggen. Bij Chinese klanten is dat soms extra belangrijk: zij komen met een design story, of zelfs een bepaalde eis ('het moet op een druppel geïnspireerd zijn'), waar wij geacht zijn op voort te borduren.

10.2.4 *Robert Oude Nijhuis, Visuele Verbinders*

Over de functies van tekenen (het proces) en tekeningen

Tekeningen kunnen gesprek faciliteren en een proces versnellen. Soms zijn mensen bezig met een dusdanig complex onderwerp, dat het lastig is om bij iedereen hetzelfde begrip ervan te krijgen. Dan denkt men overeenstemming erover te hebben met elkaar, maar dan blijkt men inhoudelijk toch verschillende kanten op te gaan. Tekeningen kunnen hier duidelijkheid in aanbrengen: het faciliteren van een algemeen begrip. Het wordt sneller duidelijk, en je kan sneller de juiste kant op gaan. Het versnelt ook de besluitvorming.

Verder is het interessanter om naar tekeningen te kijken dan naar een stuk tekst. Het heeft een soort archief-functie om vast te leggen wat er besproken is, leuker en kernachtiger dan tekstuele notulen, waardoor je merkt dat mensen (met name binnen grotere organisaties, waarin mensen met hun handen werken) die sneller doornemen. Het verlaagt de drempel om mensen erin mee te nemen. Het maakt de inhoud toegankelijker.

Over de interactie met betrokken personen
Het type bedrijf of organisatie is soms belangrijk. Zowel in stijl (zakelijk of speels) als in bijv. welke kleuren er gebruikt worden. Al kan je best vrij omgaan met de kleuren van de huisstijl (kleuren in ander licht zetten of bijv. onder water plaatsen).

Over de tekenstijl
Afhankelijk van het doel. Als de tekeningen gemaakt worden om gesprek te faciliteren, zijn de tekeningen vaak losse flodders, zonder onderlinge samenhang. Maar wanneer je het over de visie van je bedrijf hebt, waarbij alles in losse flodders is geanalyseerd (ideeën, context buiten/binnen bedrijf, wensen, kernwaarden). Wanneer het een vaste vorm krijgt, doordat er keuzes gemaakt zijn, dan maak je een wat complexer, integraal plaatje. Daar zit heel veel in (wat alleen mogelijk is als de inhoud helemaal uitgedacht is en vaststaat).

De manier van tekenen is cartoonachtig en snel. En ook wel ontwerpend (perspectiefwerking, materiaal, schaduw/licht). Sommige bedrijven vinden het soms wat kinderachtig. Dan gebruiken ze weleens het idee van de tekeningen, maar laten het ergens anders in een andere stijl visualiseren.

In zekere mate pas je de stijl wel aan op basis van de klant. Ik heb een speelse manier van tekenen (gaat vooral om

de mensfiguren), die weleens kan variëren. Je hebt een wat hoekiger, strakker, zakelijker stijl (vooral voor onderwijs-instanties, sociaal domein; expressies van mensen belangrijker). Soms kan je gezicht helemaal weglaten, maar daar waar veel emotie en menselijkheid bij komt kijken (zoals hulpverlening), daar wil je juist diversiteit in de mensfiguren, gezichtsuitdrukkingen, emoties laten uitstralen. De mate daarin verschilt dus weleens. Maar over het algemeen zijn het lijntekeningen die ingekleurd worden met vrij simpele materiaal- en lichtexpressies (vaak digitaal). Mensfiguren vaak wel in perspectief, maar nooit fotorealistisch en ik haal nooit mijn lijnen weg. De variatie in stijl gaat vooral om de algemene vormen in de tekening: scherper en harder om het zakelijker te maken; ronder en zachter aan de andere kant van het spectrum. Collega's die kunstacademie hebben gedaan zijn daar wat beter in onderlegd, maar het is altijd te herkennen.

Het grote voordeel van in 3D tekenen is dat het meer belevend is: degene die ernaar kijkt kan als het ware in de tekening stappen, zich inleven in de situatie die afgebeeld is. Verder ziet het er schetsmatiger uit dan een cleane 2D tekening. Dat schetsmatige zien mensen onbewust. Schetsmatiger tekeningen maken het voor mensen makkelijker om input/feedback te geven. Ze hebben het idee dat het nog niet af is, en dus nog kneedbaar is. In het proces is het daarom belangrijk om met een hele ruwe schets te beginnen, zodat je mensen uitnodigt tot inhoudelijke feedback. Daarmee zijn deze tekeningen een grote plus boven infographic-achtige tekeningen.

Er is een hele fijne balans tussen wat er met name naar voren moet komen, afhankelijk van wat de kernpunten zijn. Dat wat minder belangrijk is, krijgt in de tekening minder detail.

Vroeger was het altijd zo dat ik analoog begon (met kleine, ruwe schetsen zonder structuur, op bijv. post-its of whiteboards). Sinds corona beginnen we echter vaker gelijk digitaal. Dan spreken we de klanten online, waarbij we live mee schetsen (terwijl we het scherm delen). Ook dit wordt later pas een product, een visueel communicatiemiddel. De live schetsen gaan alle kanten op, al zijn de klanten er vaak wel al snel van onder de indruk. Ik merk dat ze die ook al snel willen gebruiken, omdat ze duidelijkheid geven in de structuur van wat er besproken is. Het visualiseren zorgt ervoor dat er snel een (inhoudelijk) overzicht beschikbaar is.

Dat is wat ik heel waardevol vindt aan het visueel werken: de onderlinge verbanden tussen bepaalde informatie kan soms gewoon praktisch niet met tekst overgebracht worden. Zelfs een PowerPoint kan dat niet, omdat dat een hele lineaire weergave is (daar is enkel een A, B, C, ..-verband zichtbaar, terwijl dat niet wil zeggen dat dat de bedoelde structuur is). Alles is onderling verbonden op verschillende manieren: een netwerk, lineair/circulair proces, van alles tegelijk. Dat laat zich niet makkelijk op een andere manier vangen dan in een tekening. De basisvormen spelen hierbij de belangrijkste rol: zelfs een vierkant, kubus of cilinder met informatie bij de hoeken of langs de zijkanten en de verbintenissen ertussen maakt de structuur al zichtbaar. Complexe tekeningen zijn hierbij dus niet eens nodig. Bedrijven zijn met name al snel geholpen met het visueel laten blijken hoe de inhoudelijke structuur nou eigenlijk in elkaar steekt.

Over het tekenend ontwerpen als vakgebied
We hebben laatst een sessie gedaan met MidJourney (en wat andere AI-tools). Het is indrukwekkend hoe je hele kwalitatief, artistiek hoge tekeningen (ook echt in schetsvorm) daaruit kan krijgen. Je kan veel verschillende traditionele tekenmedia aangeven (bijv. water colour effect). Toch is het zo dat de structuur en abstracte begrippen (bedrijfsjargon) te complex voor deze tool zijn. Bovendien is het zo dat als je kort en krachtig bent, dan doet hij het goed, maar dan kan je niet specifiek genoeg worden. Terwijl als je specifiek genoeg wordt, dan ontbreken er juist weer dingen in de tekeningen die AI aanlevert. Alles wat eruit komt is mooi, maar inhoudelijk dus nog niet bruikbaar. Het kan nu mooie, kunstzinnige beelden geven, maar niet een combinatie van meerdere beelden bij elkaar die in een bepaald perspectief staan en een verhaal vertellen. Soms kan het dingen verbazingwekkend goed in perspectief zetten en dergelijke, maar dan heb je een 'lucky shot'. Bovendien hebben de losse tekeningen allemaal net een andere tekenstijl. Het is wat dat betreft dus ook nog niet betrouwbaar genoeg, omdat het lang kan duren voordat je iets bruikbaars eruit krijgt. Tijdens je werk moet je een goede tijdsinschatting hiervoor kunnen maken, wat nu nog niet mogelijk is. In de toekomst zou het wellicht vooral goed kunnen helpen met statische visualisaties in één keer beschikbaar maken, die vervolgens door ons gebruikt kunnen worden in een complexere visuele weergave. Kortom, voor nu is het leuk om mee te experimenteren, maar echt inzetten tijdens mijn werk doe ik niet.

Ook met VR en AR, en andere manieren van tekenen, zijn wij aan het testen. Bijvoorbeeld MentalCanvas: op platte vlakken de tekeningen maken, wat vervolgens in een 3D ruimte neergezet wordt. Door die ruimte kan je vervolgens heen geanimeerd worden, wat een heel belevende ervaring geeft. Soms moet een verhaal die een organisatie wil vertellen heel eenduidig worden verteld: dat kan het beste met een animatie gedaan worden. Die geeft namelijk steeds hetzelfde verhaal, steeds dezelfde beelden met dezelfde volgorde, waardoor iedereen precies hetzelfde te zien krijgt. Zo'n animatie maken is heel duur, maar MentalCanvas zou daar oplossing in kunnen bieden. Qua tools, zoals soorten brushes, is het echter nog niet uitgebreid genoeg (alleen een pen of een gelikte vectorbrush). Daarom werkt het als tekenaar nog niet optimaal. VR zou verder nog heel veel werk zijn: aangezien het tijd kost, zal het voor de klant duur worden. De tekeningen in een VR-omgeving moeten namelijk beter kloppen dan normaal, omdat het zich niet zo makkelijk voor de gek laat houden, bijv. qua verhoudingen. Een gebouw moet bijv. echt een gebouw lijken, niet een stukje speelgoed. Wat in een plaat genegeerd kan worden: wij wijken ontzettend vaak af van de realiteit wat betreft perspectief en diepte-werking. Mensen geloven het al snel, je kan met heel veel wegkomen. Met VR moet het meer natuurgetrouw uitgewerkt worden, wat meer tijd kost. Je moet ook duidelijk hebben wat je kan aanbieden en hoe lang dat gaat duren, wat we nu nog niet goed zouden kunnen inschatten. Maar men is er wel mee bezig.

Zo hebben we ook de service om een interactieve website te maken. Een plaat wordt op de website van organisaties geplaatst en daar kan op bepaalde manieren op worden ingezoomd en doorheen bewogen. Dit is dus ook iets wat steeds meer richting een interactieve focus gaat.

Corona heeft een positieve invloed gehad. De sterke eigenschap van visualisaties die mensen tijdens een meeting op een belevende manier kunnen betrekken bij het gesprek, is tijdens de opkomst van online vergaderingen nog duidelijker geworden. Zelf was ik er al van overtuigd dat het digitaal werken fantastisch gaat, maar tijdens online meetings werkt het misschien zelfs nog beter. Wanneer je live bij elkaar bent is er iets meer afstand tot de tekening en sta je er als tekenaar vaak zelf voor, terwijl men via een computerscherm goed en direct zicht heeft op (het ontstaan van) de tekeningen. Het maakt, zoals ik heb gemerkt, het videobellen ook efficiënter en leuker. Verder merk ik dat langzaam heel werkend Nederland bekend raakt met het visueel denken en zakelijk tekenen. Mensen begrijpen nu beter wat je eraan hebt en zoeken het daarom vaker op. Het enige is dat de 'wow-factor' nu wat meer weg is ('ahaa, zo kan een meeting dus ook verlopen!'). Het is dus drukker geworden, meer mensen zijn dit beroep gaan doen. Je moet het wel leuk vinden om steeds weer opnieuw in de materie van een bepaalde organisatie te duiken. Mensen schrijven boeken en geven trainingen/workshops.

Het is belangrijk om je bewust te zijn van het belang van het visueel structureren van inhoud. Het is ook waardevol om te weten wat voor structuren (mentale modellen, visuele raamwerken, etc.) er zijn. In het brede scala is het goed om te weten welke er het beste past en ook het proces hoe je ertoe komt (vanaf moment één is dat moeilijk om te snappen). Een stapsgewijze aanpak helpt hierbij.

10.2.5 *Rik de Reuver, Modyn*

Over de functies van tekenen (het proces) en tekeningen
In het allereerste begin heb je communicatie met klanten over vragen die ze hebben. Het eerste wat wij dan doen is schetsen, al tijdens het gesprek: om daarmee hardop te denken en verslag te leggen van wat je hoort en hoe je het interpreteert op dat moment. De brieving van de klant wordt zo uiteengezet.

Vervolgens wordt de vraag van de klant omgezet in concrete voorstellen, waarbij het uitschetsen van die voorstellen bij uitstek het middel is. In het ontwerpproces wordt er heel veel geschetst en daarmee hardop gedacht: je deelt het met de collega's die ook in dat project zitten. Daarmee stimuleer je elkaar en help je elkaar om de vraag van de klant precies te duiden.

Dan ga je richting een eerste presentatie en wordt het duidelijk of je het goed begrepen hebt. Wederom is hier de schets het beste medium wat ons betreft. Je ziet ook weleens dat er al snel naar 3D-modellen (CAT) wordt gegrepen, maar daar zijn wij wat huiverig voor. Dat ziet er namelijk al veel concreter uit, het straalt iets af van 'Dit is het en veel plezier ermee'. Terwijl we de klant ook echt mee willen nemen in het denkproces. Een schets is dan makkelijker te interpreteren, en vaak nog niet af; half nog in het ongewisse gelaten. Je neemt de klant mee in je eigen denkproces, dat wordt erg fijn gevonden. Ik heb gemerkt dat de klant het heel vervelend vindt om voor feiten gesteld te

worden, wat al snel gebeurt met een CAT-file. ‘Kunnen we nog wat veranderen?’: dat wil je vóór zijn. Je wilt ze echt meenemen en er een gezamenlijk avontuur van maken.

Over de interactie met betrokken personen
Je blijft wel onafhankelijk schetsen van de klant; je collega’s hebben meer invloed op je tekenstijl. Mensen die in een project zitten samen kijken bij elkaar af wat de ander heeft gedaan, waardoor je waarschijnlijk qua stijl onbewust dichter bij elkaar komt. Onbewust zoek je naar een soort gelijkwaardigheid in de uiteindelijke presentatieschetsen.

We nemen de rol aan van adviesbureau. We laten het bijvoorbeeld niet na om de klant te vertellen wat wij denken dat de juiste richting voor hen is. Maar je moet ervoor uitkijken dat je één voorstel eruit laat springen en de andere tweede of derde garnituur is. Dus we streven naar gelijkwaardigheid (qua visualisaties, red.), maar we laten wel weten wat wij denken dat de juiste optie is voor de klant.

Over de tekenstijl
Het zijn vaak wel al snel digitale schetsen i.p.v. digitale, behalve de krabbels die we puur voor onszelf op papier zetten (bijv. in je kladblokje). Naar de klant toe is het altijd digitaal, wat voor het delen en distribueren een stuk makkelijker is. Het is wel waken voor de situatie een tekening ‘te af’ te maken. Aan de andere kant moet het ook wel weer zo precies zijn dat de klant het kan lezen. Een snelle krabbel die je puur voor jezelf maakt is voor de klant vaak niet leesbaar. Het moet wel wat 3D-vorm en kleur hebben, maar het hoeft niet af te zijn. Je laat weleens dingen weg waar je geen input op hoeft. Of je laat dingen weg die juist hetzelfde blijven, bijvoorbeeld als je een product slechts gedeeltelijk gaat veranderen. Een deel kent de klant dan al, dus dan focus je op het nieuwe.

De tekeningen worden vaak wel gedeeld, bijv. in verslagen. En uiteindelijk worden het de klassieke twee of drie concepten, waarvan goede presentatie-renders worden gemaakt en er soms al een 3D-model bij wordt geschakeld (om de juiste verhoudingen/maten weer te geven), al blijven het nog wel vaak schetsen.

Allemaal één stijl hanteren blijkt niet mogelijk. Ieder heeft zijn eigen ontwikkelde handschrift. We proberen wel naar een vergelijkbaar inhoudelijk niveau te streven. En een vergelijkbaar realiteitsgehalte (vooral naar de eindpresentaties toe).

Over het tekenend ontwerpen als vakgebied
We zijn bezig met het experimenteren (de ontwerpers zelf vooral vanaf het moment dat het opkwam). Ikzelf wat minder, aangezien ik ook meer met management bezig ben dan met schetsen. VR-schetsen (Grafity) hebben we een beetje geprobeerd, zijn we nog niet super actief mee. Het is er, en er wordt mee gewerkt, maar het is nog niet dusdanig dat we ermee naar de klant kunnen. Daarvoor zijn we er nog niet genoeg bekwaam mee. Zelf ga ik er waarschijnlijk niet veel tijd meer in steken, maar ik stimuleer het wel bij de andere ontwerpers.

Wij kiezen zeker mensen uit op schetsvaardigheid. Het is wat ons betreft onze taal als ontwerpers zijnde. Zo drukken wij ons uit en dat moet je zo goed en precies mogelijk kunnen. Sketching is gewoon echt ‘universal language’: als je dat goed doet, dan snapt iedereen op de wereld wat je wilt zeggen.

In eerste instantie communiceer je tijdens het schetsen met jezelf: laat je je denkproces los op papier (of tablet/iPad). Vervolgens deel je het met collega’s, en tenslotte met de klant. Kortom, het is gewoon je communicatiemiddel. We proberen zoveel mogelijk beeldend te doen; collages bij maken, zo min mogelijk met taal. In het Nederlands kun je je prima uitdrukken, in het Engels ook best goed, al heb je daar al het gevaar dat je de nuance mist. En bij Frans wordt het al wat lastiger. Daarom proberen we het zo min mogelijk talig te maken en zoveel mogelijk visueel. Dat is eigenlijk de truc.

Gebruiksscenario’s worden soms uitgetekend. Interacties die het product veroorzaakt met mensen. Dat is er wel steeds meer ingegroeid. Het is nu heel logisch om een gebruiksscenario te maken bij een product om te laten zien hoe het zal werken in praktijk.

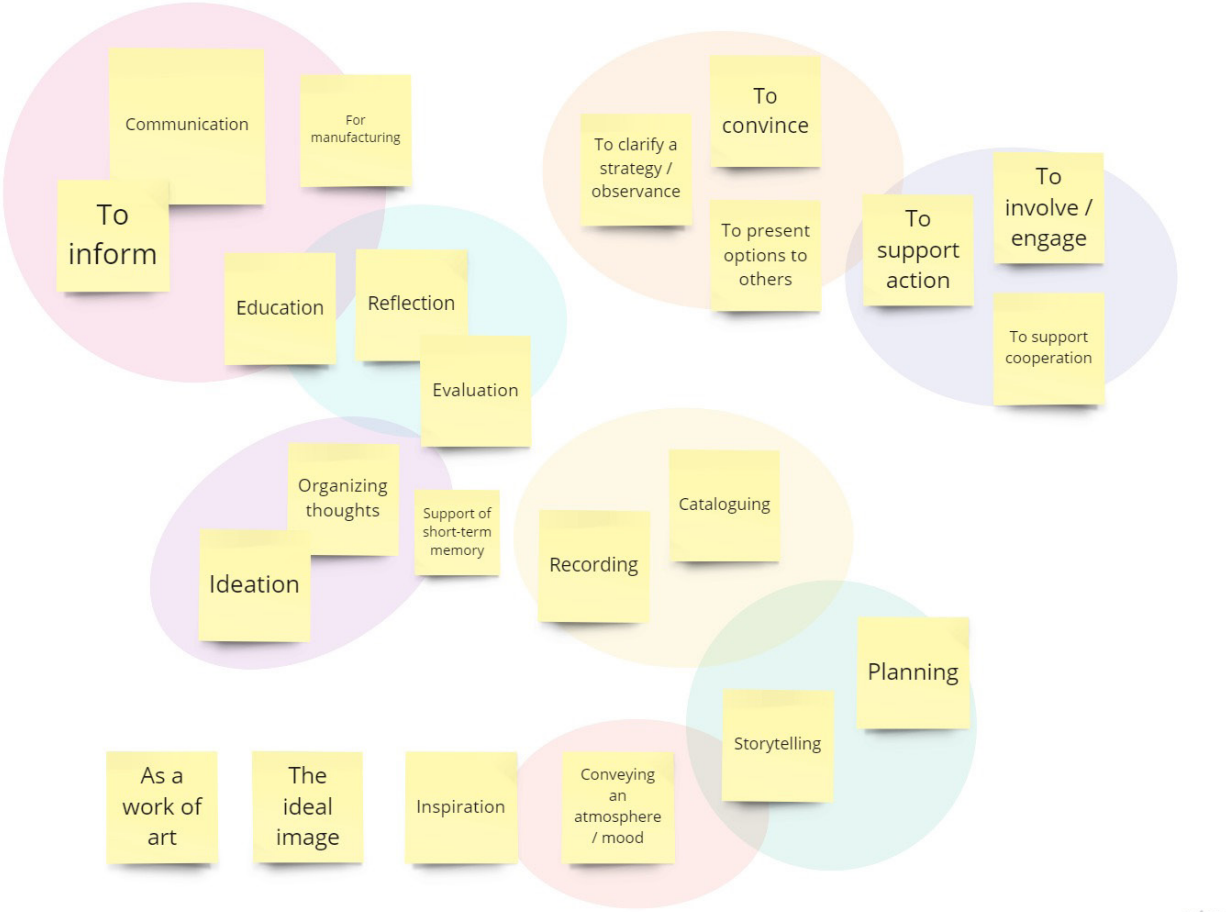
De ontwerpers zijn nieuwsgierig en zitten op allerlei fora en bekende sites te bekijken hoe anderen het doen. Ze gebruiken op die manier voorbeelden om geïnspireerd te raken. In eerste instantie wordt er naar het eindresultaat gekeken, omdat dat in één keer heel erg aanspreekt. Vervolgens gaan ze kijken naar de herkomst door te googlelen op de desbetreffende persoon of het bedrijf en proberen dieper te graven. Niet dat men vervolgens specifiek met die voorbeelden naar voren komt, maar ze nemen het vervolgens intuïtief mee in hun eigen ontwerpbezigheden.

Men krijgt daar ook wel de ruimte voor, om te kijken wat er beter kan, hoe ze zich kunnen ontwikkelen en wat ze willen.

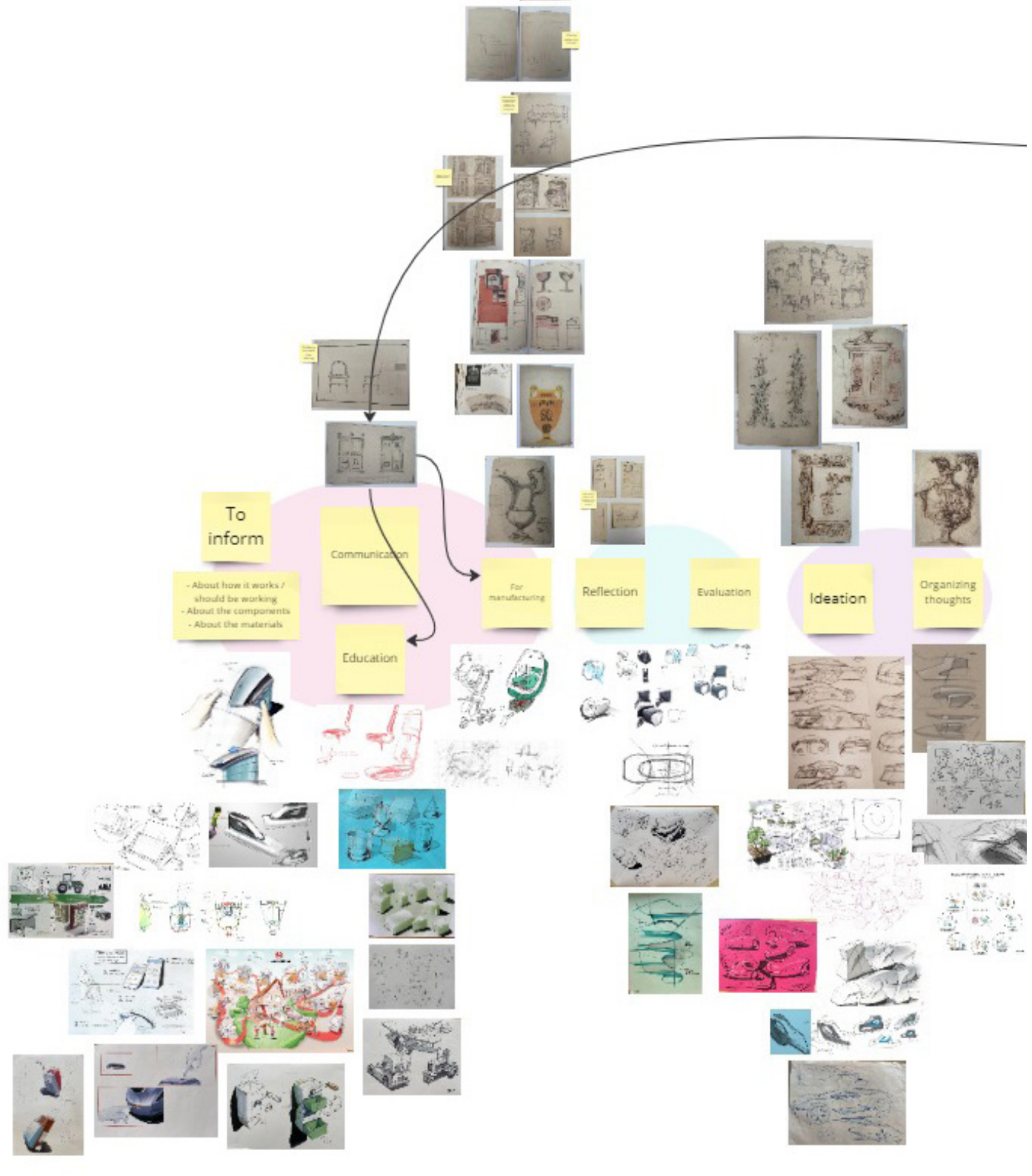
Als het gaat om de grootste uitdaging nu, dan denk ik aan AI. Ik weet niet waar dat heen gaat, dat valt nu nog moeilijk in te voelen. Uiteindelijk is het ook gewoon wat je erin stopt; het menselijke aspect blijft. Zo heb ik in een documentaire gezien hoe mensen nu in derdewereldlanden afbeeldingen zitten te verzamelen en daar een duiding aan geven, zodat AI daar weer mee verder kan. Dat was opzich ook al een naar, shocking verhaal (die mensen krijgen alle rottigheid van de wereld voor hun kiezen). Ik weet niet hoe het zal gaan, nu worden alle dingen dus nog door mensen geduid. Ik weet niet waar dat heen gaat. We kunnen het ook niet negeren: het is er, dus je moet jezelf er op een of andere manier toe verhouden. Wellicht kan je op een gegeven moment zeggen dat het niets voor ons is, maar zover zijn we nog niet. En ik weet niet of die keuze er überhaupt komt, want als het zich eenmaal zo langzaam ontwikkelt, dan moet je er wat mee.

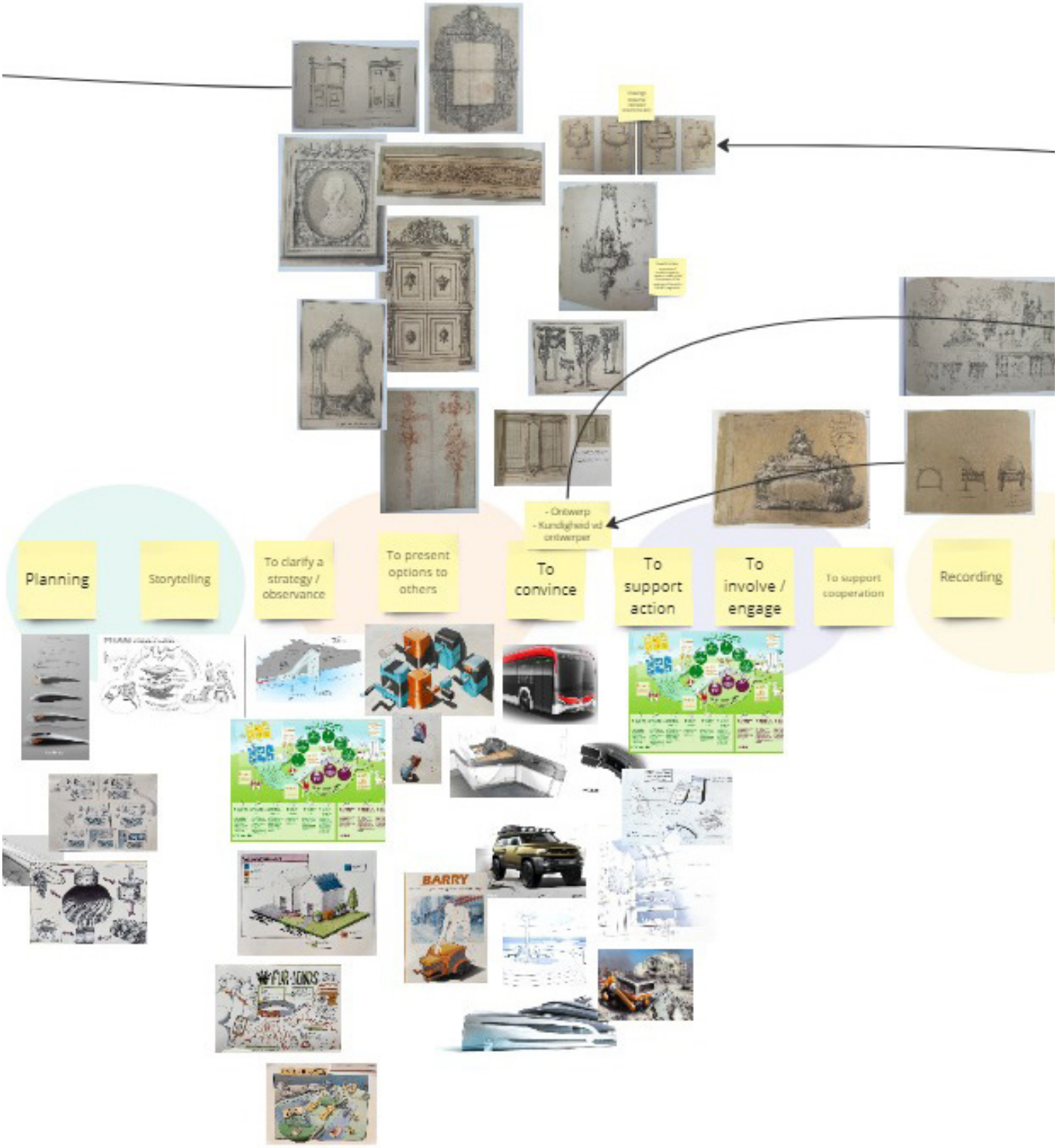
10.3 Mapping functions/purposes of design sketches

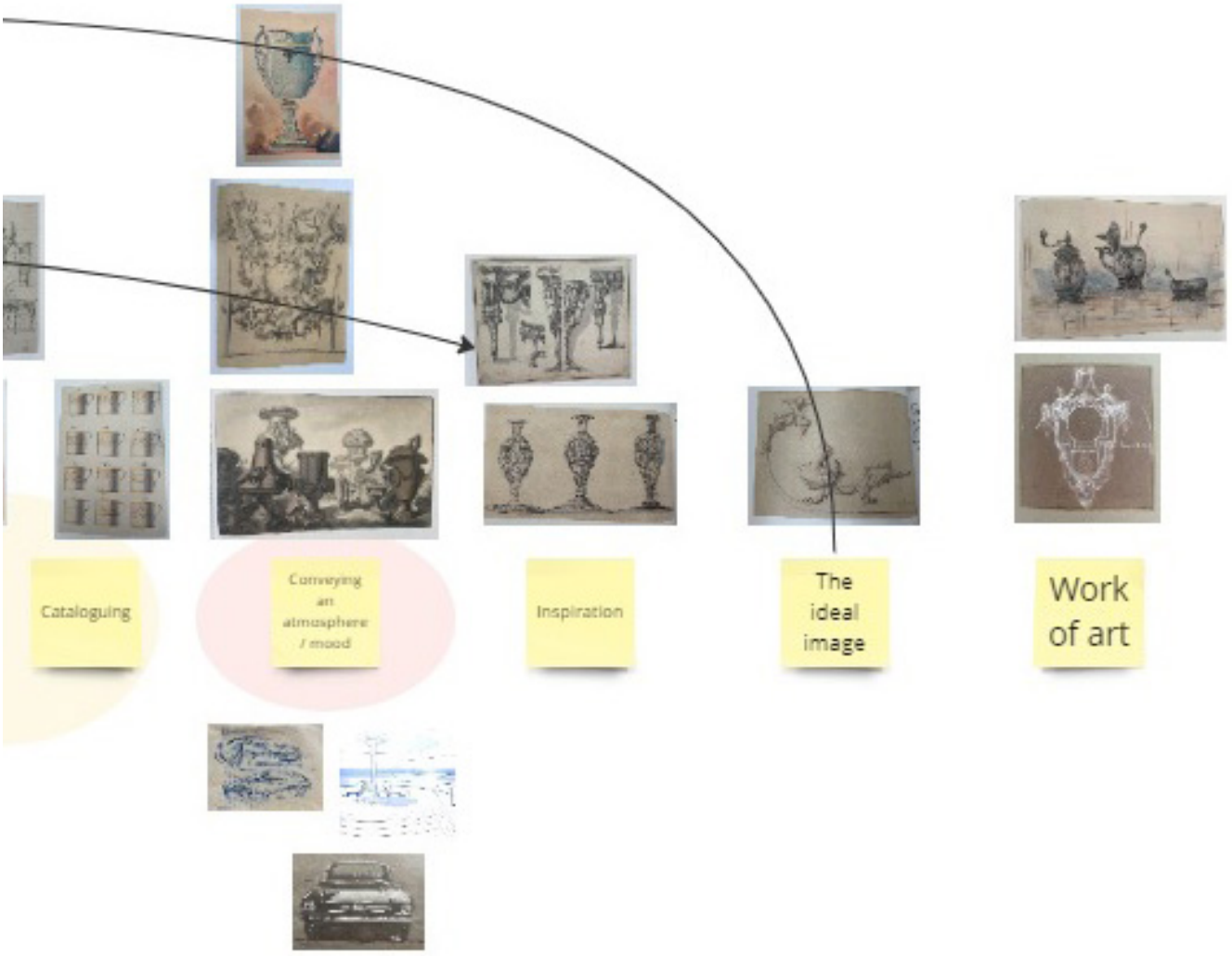
Based on both theoretical and practical knowledge, at some point during this thesis research I created this overview of the functions and purposes of design sketching. It includes purposes of the old design drawings in Baarsen his 'Process' book (2023) and purposes mentioned in literature studies (most of which described in chapter 4), defined and enriched by my own reflective insights as a designer. The resulting overview has been placed here, in the appendix, for the reason that the broad range of sources on which it is built, would bewilder the ordered description of findings in this thesis report.



After that, I categorized a range of design sketches throughout the years within this overview, which was a way to further analyze the different functions/purposes and how they can be recognized and identified. Despite only a limited number of drawings being classified, it offered me insights on purposes that stood out and developments through times. Specifically, observations described in chapter 5 are appearing in this classification overview: most drawings were and are to inform; in the past mostly towards engineers, to show how to manufacture the inventions, while nowadays mostly towards a broad audience, to convey an interaction, a story, strategy or vision. Furthermore, the ideation phase of the design process appears to be the one in which most design sketches are made, which is also visible in figure X. Concerning this, there is another change over time visible: while nowadays rough sketches with multiple options are presented towards the client, previously, it was precisely the most detailed, correct drawings of alternatives that were shown to the client. It had to be the ideal image of a product, so that the client was convinced and knew exactly what to expect. While nowadays, there is more of a goal from the designer to involve the client in the design process, so that important decisions are made together and 'personal input', like a specific story or vision, can be incorporated into the result.


To inform
- About how it works / should be working
- About the components
- About the materials
Communication
Education
For manufacturing
Reflection
Evaluation
Ideation
Organizing thoughts


- Ontwerp
- Kundgjørelse vd ontwerper
Planning
Storytelling
To clarify a strategy / observance
To present options to others
To convince
To support action
To involve / engage
To support cooperation
Recording
BARRY


Cataloguing
Conveying an atmosphere / mood
Inspiration
The ideal image
Work of art

DESIGN FOR our future

TU Delft

6259

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name: van der Wal
initials: A.M.J. given name: Annemiek
student number: 4667522
street & no.:
zipcode & city:
country: The Netherlands
phone:
email:

Your master programme (only select the options that apply to you):

IDE master(s): ( ) IPD (★) DfI ( ) SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: ( ) Honours Programme Master
specialisation / annotation: ( ) Medisign ( ) Tech. in Sustainable Design ( ) Entrepeneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair: Jan Willem Hoftijzer dept. / section: HCD (HICD)
** mentor: Martijn Haans dept. / section: HCD (HICD)
2nd mentor:
organisation:
city: country:

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

comments (optional): I wish to have these two supervisors in the team *(see page 7), for the reason that they have different expertises and backgrounds, while simultaneously they both are deeply rooted within the discipline that I'm going to research.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

TU Delft

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair Jan Willem Hoftijzer date 27 - 02 - 2023 signature

CHECK STUDY PROGRESS

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair. The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: 27 EC

Of which, taking the conditional requirements into account, can be part of the exam programme 27 EC

List of electives obtained before the third semester without approval of the BoE

(X) YES all 1st year master courses passed

( ) NO missing 1st year master courses are:

name Robin den Braber date 27 - 02 - 2023 signature RdB

FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **. Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: (V) APPROVED ( ) NOT APPROVED

Procedure: (V) APPROVED ( ) NOT APPROVED

comments

name Monique von Morgen date - KE 6/3/2023 - - signature MvM

Initials & Name A.M.J. van der Wal Student number 4667522

Title of Project A Framework for the Agency of Sketching

A Framework for the Agency of Sketching — project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 27 - 02 - 2023 — 30 - 09 - 2023 end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

Sketching is a way to (re)organize and develop thoughts, arouse emotions, encourage action and cooperation and inform yourself or others, with which one can reflect (Tversky, 2011). It is inextricably linked to design, as the original Italian word 'designare' actually means drawing. Results of a study by Corremans and Vaes et al. (2018) show that students with better sketch competences are more likely to score higher for their product design projects. Drawing during the design process could maximize the conditions necessary for the reinterpretation of an image and the emergence of new ways of 'seeing it', according to Purcell and Gero (1998). Goldschmidt (1991) defines sketching: "(...) The dialectics of sketching is the oscillation of arguments which brings about gradual transformation of images, ending when the designer judges that sufficient coherence has been achieved."

If we look at the theory of Donald Norman about affordances in design, we could consider the relevance of sketching even higher. As could be seen in figure 1, I found that there is a lot of interaction between drawings, the designer himself and other stakeholders, such as clients and consumers. The relationships between the properties of both the different kinds of drawings and the interacting parties (which, according to Norman, can be called 'affordances') are affected by multiple aspects (e.g. design phase, stakeholders involved, industry field, function of the final design, use of materials). In this web of influencing factors, drawing can be seen as the agent for design; providing the required affordances. To be effective, affordances (and anti-affordances) have to be discoverable - perceivable (Norman, 2013). In this project, I will focus on that subject.

In order to do that, I will research how the interactions between design drawings and their different stakeholders have developed throughout the years and how sketching (now) works as an agent for design. Design sketching has long played a role in cataloguing, in a commercial sense, and as a blue-print for production and consistency, in addition to its artistic value and its developing function for the designer. The Design Museum of Den Bosch recently opened an exhibition that presents a collection of design drawings from the period of 1500 till 1900 (see book 'Process' by Reinier Baarsen), which shows a wide range of drawings with different functions, styles and purposes. Studying these and a variety of other sources like Tversky and Goldschmidt, it seems like sketching has always been an agent for design and still is, affording the people involved to think, elaborate and reflect.

Given the various purposes of sketches and sketching, and given the various stakeholders involved, and given the varying contextual factors, this thesis aims to research and position these elements in a working model: a framework, in order to structure the gained knowledge and insights.

space available for images / figures on next page

introduction (continued): space for images

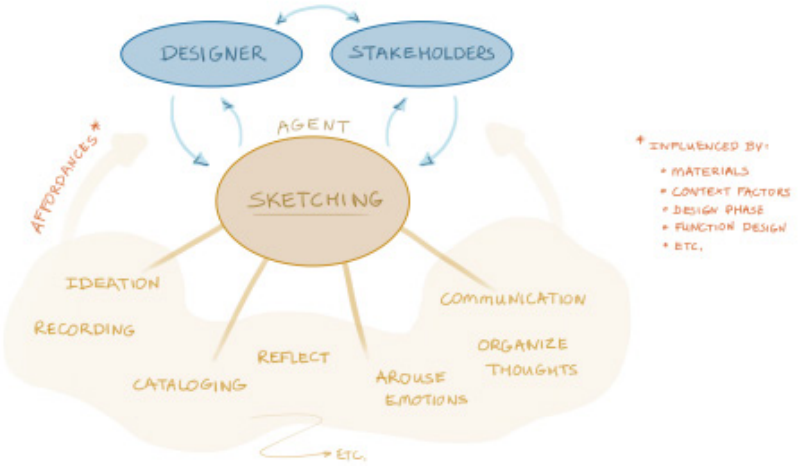


image / figure 1: Sketching as an agent for design

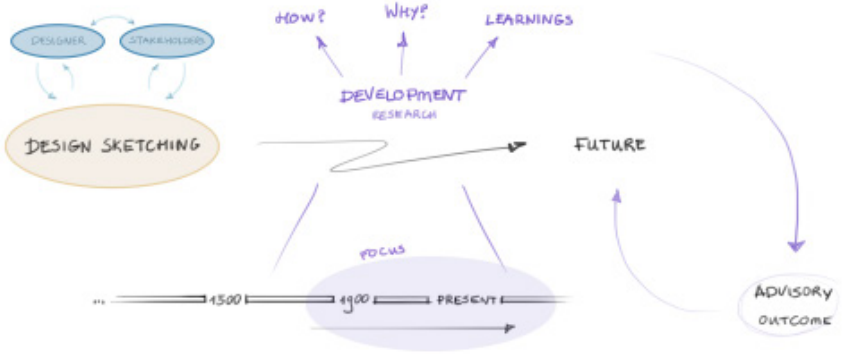


image / figure 2: Schematic overview of the project

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

To make sure that the project is manageable within the set period of time, it's important to set a scope. Therefore, inspired by the exhibition of Design Museum Den Bosch with the time frame of 1500-1900, I will focus on the successive period leading up to today and today's context. The target group to be focussed on, are the contemporary industrial designers.

I have divided the research question into sub-questions, which gives me guidance throughout the project. This led to the following set-up.

Research question:

What can we, as industrial designers, learn from the interaction between design drawings and their stakeholders throughout the years and in the present?

Sub-questions:

- How has design drawing evolved since the early 20th century in terms of style and function and what context factors influenced this development?
- How did the interaction between the designer, the drawing and the other stakeholders develop during this period and what were and are the effects of this?
- What does that say about the role of design drawing now and what can we learn, also with an eye on the future?

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

The aim of this project is to do research on the activity and purposes of design drawing and the involved stakeholders. The research outcomes will be utilized to create a framework, to serve as an advisory model for contemporary designers (e.g. a toolkit or method).

The theory of Donald Norman will be used and the VIP method will be valuable to apply as a frame of reference, as well as literature, musea and interviews with designers and agencies. The final deliverable will be a report describing research findings and highlighting the most important insights. Additionally, inspired by Norman's statement "To be effective, affordances (and anti-affordances) have to be discoverable - perceivable", I will map out the affordances that are created by design drawing. I expect this to be a shaped model/framework, that involves valuable knowledge, functions, styles and context factors, that can be used by contemporary industrial designers and educators within the design field to see in what way, during the process of designing, we can use design drawing to achieve the desired design goals. Therefore, this framework must be accompanied by a realistic vision of how this knowledge can be applied in practice. Furthermore, my ambition is to write a scientific article as a potential co-result, in which sketching will be adressed as an agent for design.

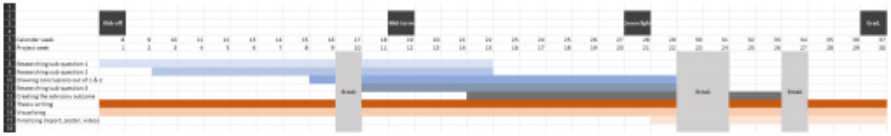
Initials & Name A.M.J. van der Wal Student number 4667522

Title of Project A Framework for the Agency of Sketching

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 27 - 2 - 2023 30 - 9 - 2023 end date



I will be working four days a week on this graduation project, which makes the total number of working weeks 25 instead of 20. Every two weeks there will be a meeting between me, JanWillem and Martijn, during which I will present my progress and to discuss further steps. The plan is to graduate at the end of September 2023.

Initials & Name A.M.J. van der Wal Student number 4667522

Title of Project A Framework for the Agency of Sketching

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

The project was inspired by my personal interest in arts and drawing and by the 'Process'-book that was written on the occasion of the exhibition by Design Museum Den Bosch. Design drawing is something I want to get more engaged with, also with an eye on the working life I envision, so choosing this subject for my end project fits my professional ambition.

Relations between all sorts of disciplines, such as art, literature, people and politics, draw my attention. What is their intention, what is their influence and how do they interact with each other? More specifically within industrial design, my interests go to people and the artistic side. That originates my curiosity towards the interaction between design drawings and the people involved. My ambition in designing, and especially within this thesis project, is that I want to make good use of the IDE domain (people, economy, technology): looking at things from different perspectives, but also looking at how these perspectives come together. How they are connected and interacting with each other and how they should be interacting with each other based on this knowledge.

In order to do that in a valuable way, I want to become competent in zooming in and zooming out at the right moments. That's one of my ambitions during this project: not getting lost on micro level. While doing research, diving into the discipline deeply is important, but also knowing when to draw conclusions and knowing what to do with them.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

*Chair of this project has, prior to the start of this project, discussed the constitution of the supervisory team with Arjen Jansen (chair of the Board of Examiners), who advised positively.

Initials & Name A.M.J. van der Wal Student number 4667522

Title of Project A Framework for the Agency of Sketching

Space for notes and sketches


TU Delft
Delft
University of
Technology