VISUALIZATION

For Better Stakeholder Communication

Master Thesis by Kai Zhang, under the supervision of Jan Willem Hoftijzer, Abhigyan Singh and Hans Roeland Poolman, September 2023

Visualization for Better Stakeholder Communication

Design of a visualization strategy tool and an empowering visual tool for multi-stakeholder projects

Master Thesis

Strategic Product Design

by

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Crash, when I remember her
The flash, it burns our retina
No mind, we can visualize
No mind, we can visualize

SawanoHiroyuki[nZk], ‘Tracer’

Summary

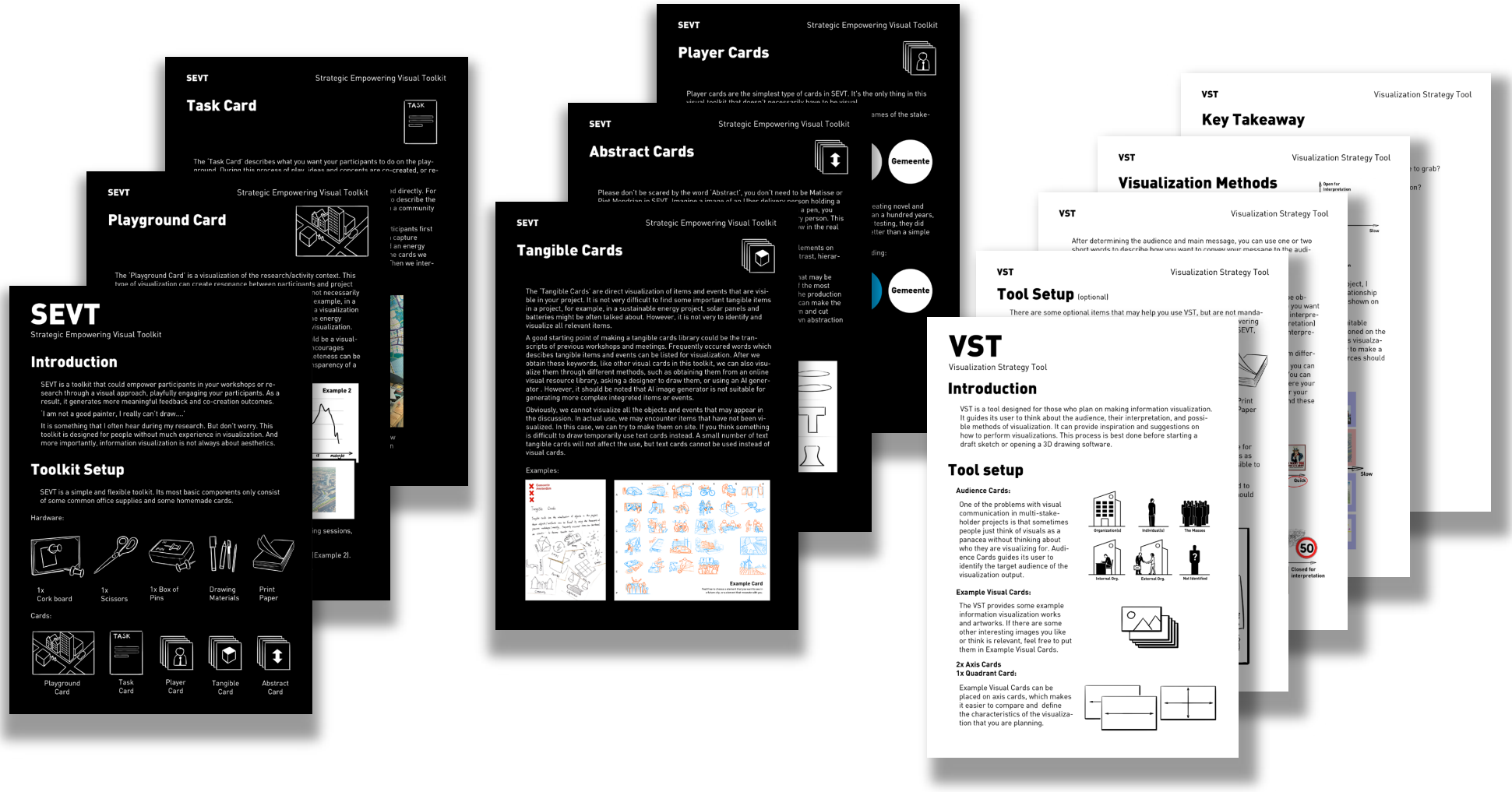
In contemporary times, numerous societal and business projects find themselves contending with a multitude of stakeholders. Designers have also increasingly found ourselves immersed in such multi-stakeholder scenarios. Stakeholders stemming from diverse professional backgrounds often possess distinct knowledge bases, rendering communication within projects a formidable challenge. Some individuals have recognized the potential of visualizing information as an effective means to bridge communication gaps among multiple parties. However, the development of a structured visual communication approach and its practical application within multi-stakeholder projects remain fraught with challenges, both in theoretical and practical realms.

In the theoretical realm, the research of visual communication and visualization constitutes a vast and interdisciplinary field. As it intersects with various disciplines, it frequently engenders disparate theoretical frameworks, thus lacking a unified theory to guide design efforts, or even a universally accepted definition of visualization itself. In this project, a foundational step involved redefining visualization through a literature research, shaping it into a scope capable of guiding the application of visual approaches to facilitate communication within multi-stakeholder projects.

In the practical realm, research was conducted through a series of visualization sub-projects related to LIFE project. Notably, despite a widespread recognition of the potential of visualization in multi-stakeholder communication contexts, considerable resistance was encountered in its practical application. A prevailing perception framed visualization as a skill exclusive to designers or artists. Under the influence of this belief, some individuals struggled to confidently express their ideas visually, and some overlooked their own role in creating visualization strategies, overly relying on the skills and aesthetics of graphic designers.

In order to address the primary stakeholder needs within the LIFE project—namely "Visualization for Co-creation" and "Visualization for Mass Communication"—two distinct tools were developed: the "Empowering Visual Tool" (EVT) and the "Visualization Strategy Tool" (VST). These tools underwent multiple testings and iterations. The EVT was initially employed to motivate residents of the Amsterdam Southeast area to express their ideas visually during a research of their vision of a future city. Subsequently, the EVT was expanded into a "Strategic Empowering Visual Tool" (SEVT), capable of accommodating complex information in multi-stakeholder projects. SEVT was applied in workshops, facilitating active and equitable participation in co-creation and effective collection of visual feedback from participants. However, further testing and validation of SEVT in diverse multi-stakeholder projects remain to be done. In the end, I provide a general guideline for adapting SEVT to other projects for further research and development.

VST, on the other hand, found application in two projects involving the creation of complex visual promotional materials. It effectively engaged stakeholders in the formulation of visual strategies, facilitating planning regarding the target audience, main message, and ways of interpretation. However, the feature pertaining to the selection of visualization methods within VST still requires further testing and refinement.



A overview of SEVT and VST guidelines

Content

Chapter 7. Empowering Visual Tool

Chapter 8. End Result

Postscript

Abbreviations

Since some of the abbreviations in this project are my own definitions rather than generally accepted abbreviations, I will use abbreviations as little as possible in the report. However, in diagrams, abbreviations may still have to be used due to limited space. So here, I provide a list of abbreviations.

The three most frequently used abbreviations are names of my design outcomes:

VST: Visualization Strategy Tool

EVT: Empowering Visual Tool

SEVT: Strategic Empowering Visual Toolkit

Other Abbreviations:

UCD: User Centred Design

LIFE: Local Inclusive Future Energy

VR: Virtual Reality

VfMC: Visualization for Mass Communication

VfCC: Visualization for Co-creation

VfD: Visualization for Dialogue

ISOTYPE: International System of Typographic Picture Education

VvE: Vereniging van Eigenaars (Apartment owners' associations)

MVP: Minimum Viable Product

Chapter 1
Introduction

This chapter gives a general introduction to the relevance of design study and communication in multi-stakeholder context, and the starting point of this project. In the end of this chapter, I provide a reading guide of this report.

1.1 Design and stakeholders

In the realm of business and management during the initial decades of the 20th century, scholars acknowledged the existence of a distinct cohort, which is beyond the widely recognized business shareholders. They shared certain mutual interests and, on occasion, exhibited cooperative tendencies (Dodd, 1932; Follet, 1940a; Preston and Sapienza, 1990; Schilling, 2000). In the latter half of 20th century, scholars began using the term 'stakeholder' to describe this group of parties (Ansoff, 1965). As defined by Freeman (1984), stakeholder is:

> *"Any group or individual who can affect or is affected by the achievement of the organization's objectives."*

In the 1980s, the rise of design thinking and human-centered design in business management allowed the concept of stakeholder to intersect with the domain of design. From the perspective of designers, as the scope of design expands to encompass complex industrial products, service systems, business strategies, and organizational reforms, designers find themselves increasingly immersed within a context characterized by multiple stakeholders (Buchanan, 2015). Nowadays, the utilization of the concept "stakeholder" extends beyond mere proponents of design thinking within the business domain; practitioners in the design field have also developed research, ideation and iteration methodologies tailored to accommodate multiple stakeholders throughout extensive design endeavors, particularly emphasizing participatory approaches (Vink et al., 2008; Sanders & Stappers, 2014). There, conducting a research through design project which involves multiple stakeholders is not only feasible, but also valuable for future design practitioners.

Although I am not a proponent of the overuse of design thinking today, tracing the origins of design thinking, in The Sciences of the Artificial, which first presented design as a way of thinking and problem-solving, Simon (1969) presented visual as a vital way of knowing. As a designer, I will also mainly use visualization as a medium in this project to facilitate communication in the context of a multi-stakeholder project.

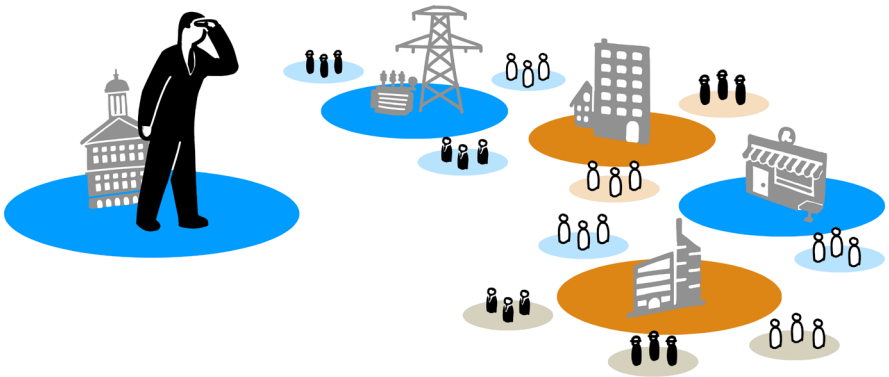


Figure 1. A multiple stakeholder project

1.2 Communication issues

When a project involves diverse stakeholders, its communication usually becomes intricate, or even problematic. Turkulainen et al. (2015) emphasized the significance of stakeholder communication as a pivotal aspect of project stakeholder management, asserting that a dynamic approach is indispensable for understanding the project's evolving context, and formulating effective communication strategies. Diverse stakeholders also encompass distinct knowledge backgrounds, identities, and values, which can potentially bring misunderstanding and even conflicts in communication. Cuppen (2011) perceives conflict as an essential element in stakeholder communication and identifies two distinct responses: the participatory approach, which aims at creating shared understanding and resolving conflicts, and the dialectical approach, which focuses on leveraging constructive conflict.

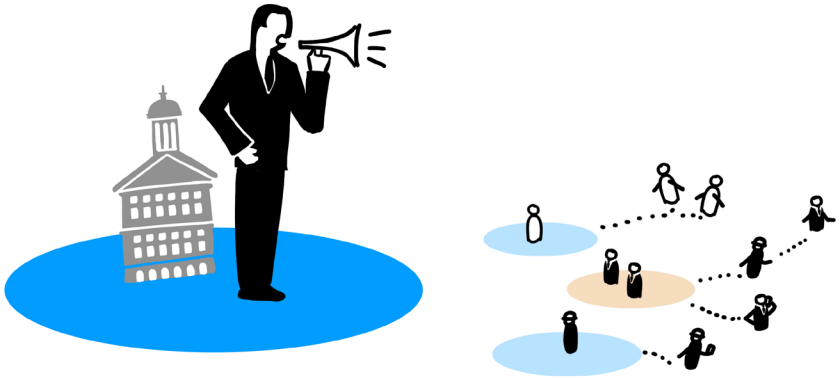


Figure 2. Communication issue

Some researchers propose visual approaches as a solution for addressing multi-stakeholder communication challenges. For example, Schulenklopper and Rommes (2016) effectively imparted visual knowledge, encompassing techniques such as sketches and color theory, to over 300 IT architects, thereby enhancing their ability to engage in effective communication with stakeholders in the business domain. But on the other hand, some researchers propose that visual expressions cannot be universally applied as a panacea. For example, Nicholson-Cole (2005) pointed out when formulating public policies, no one image can attract everyone, and how visual creators choose and deploy visuals in a targeted manner is a question worth careful consideration and reflection. While there is still much to explore in this field, designers' visual skills can come in handy when using visual approaches to facilitate communication.

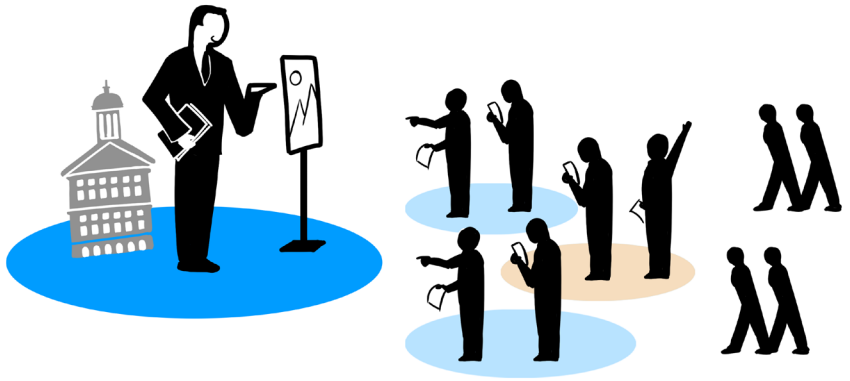


Figure 3. Visual engagement

1.3 Design and visual communication

Within the discipline of design study, there are also researchers and practitioners who sees visual tools and methods in design could be an effective means of communication. For example, some researchers believe, improvisational design sketch is a universal language, which is used by designers to communicate with project stakeholders (Hoftijzer, 2018; Van Boeijen et al., 2020, p.39). When designers present sketches to stakeholders and collect feedback, they serve as an epistemological tool to help designers understand problems iteratively (Vistisen, 2014). The technique of drawing has been used by designers to communicate with customers and users since the birth of the modern design field. Buchanan (2015) wrote that before design was used to create industrial products, the first problem designers solved was communication. The 'design thinking' of that era was primarily reflected in the creation of symbols, fonts and images. However, in the 'four orders of design model' proposed by Buchanan (As shown in Figure 4), communication does not continue to evolve with the continuous development of the design industry and research, it stays at the level of creating symbols. But we know that communication, like everything else in design, has changed dramatically over the past hundred years. This inherent deficiency within the model highlights a pervasive oversight of communication within the design discipline. Designers possess an extensive repertoire of visual skills and knowledge; however, how to effectively employ them to generate broader social value is a thought-provoking question that frequently overlooked by design researchers.

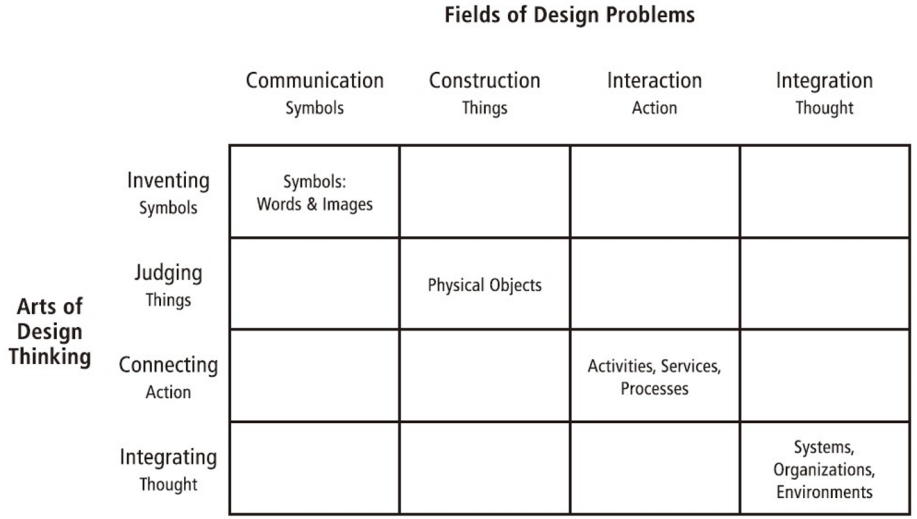


Figure 4. Buchanan's four orders of design (Buchanan, 2015)

1.4 LIFE project

Local Inclusive Future Energy City platform Project (LIFE Project) is an attempt to establish an energy intelligence management system within the Amsterdam Zuid-oost area. In the future, energy demand in this area will increase under the pressure of new housing, but the emergence of electric vehicles, sustainable heating, and energy storage systems also provide opportunities for more efficient energy management in the area. While technologically driven efforts are taken to develop an efficient energy management system, the LIFE project is concurrently oriented towards cultivating an inclusive social platform, taking into account the substantial presence of economically and socially disadvantaged groups in the target area. As a result, the project inherently encompasses the active involvement of resident organizations, business owners, local network operators, the municipality, and various other stakeholders. The diverse array of stakeholders, characterized by their distinct backgrounds and perspectives, offers opportunities for leveraging a visual approach to enhance their communication.

In this graduation project, the LIFE project of AMS Institute was used as the main testing ground of a visualized communication approach. The visualization practices and prototype testing activities I conduct under this graduation project are mostly centered around LIFE project and the energy transition of Amsterdam Zuid-oost area.

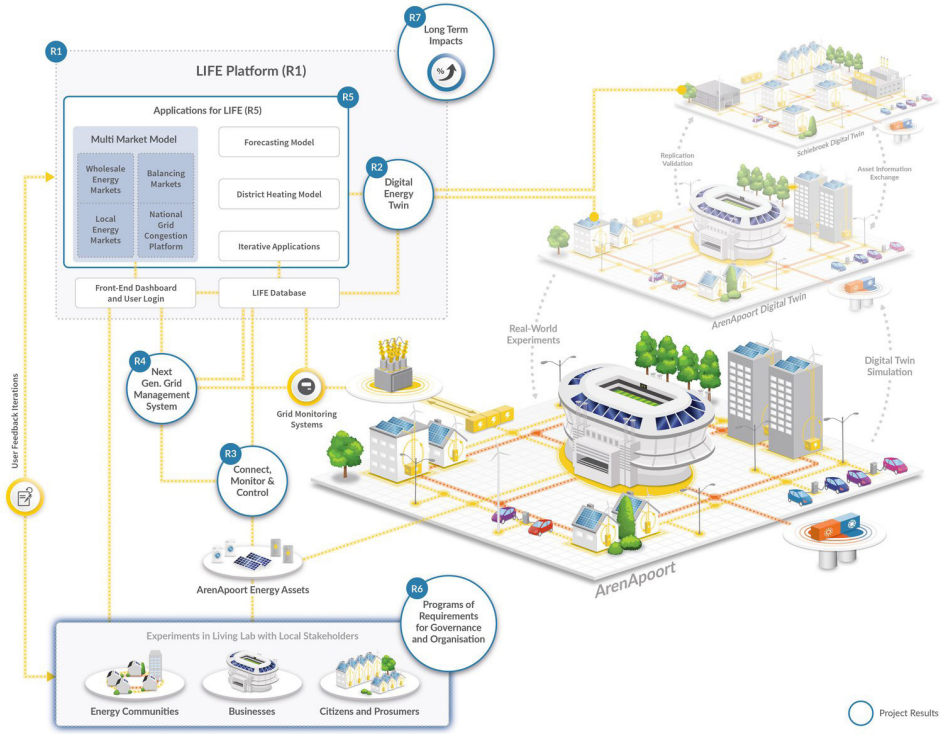


Figure 4. LIFE project (Visualization by Spectral Energy)

https://www.ams-institute.org/urban-challenges/urban-energy/local-inclusive-future-energy-life-city-platform/

1.5 My passion

I am a strategic product designer specialized in visual thinking and communication, and I believe in the potential of this visual approach to benefit others. During my undergraduate studies, I pursued a degree in industrial design with a specialization in automotive design. The curriculum in automotive design education places significant emphasis on developing the visualization skills of designers. In the year 2020, I took a break from university and founded a consultancy firm focusing on product design and user research. Given the constraints imposed by pandemic-related restrictions, face-to-face interactions with clients became infrequent. However, I discovered that during the initial stages of projects, opening Adobe Photoshop during video conferences and creating simple sketches while discussing ideas not only generated intriguing concepts but also fostered improved rapport between myself and clients. This phenomenon held true even for projects not strictly related to product design. After entering TU Delft, I continued to cultivate my visual skills with the aspiration of formalizing this visual approach into a structured toolset.

As a designer, I firmly believe design is a bridge. Initially it was employed to bridge the realms of art and industry, then human and technology, and it presently continues to foster meaningful connections between people. However, the untapped potential within this realm remains substantial. Consequently, I applied for this particular project with the aspiration of utilizing my research and design skills to facilitate stakeholder connectivity, thereby creating enhanced social impact.

Simultaneously, I hold an unwavering belief in the sustainable value that this project embodies. Growing up in Shijiazhuang, one of China's most polluted industrial cities (HE et al., 2012), I have personally witnessed and endured the harmful consequences of unsustainable development. It is this firsthand experience that has compelled me to embark on a project primarily centered around energy transition.

1.6 Initial research question and design question

Based on the background mentioned above, I formulated the following research question and design question.

The research question of this project is:

In what ways can visualization facilitate communication between parties in a multi-stakeholder project?

The initial design question of this project is:

How to design a visual platform that can practically facilitate the stakeholder communication in LIFE project?

The research question will serve as a steadfast guide throughout the entirety of the research and design project, remaining unaltered. However, the design question will undergo modifications, influenced by the problem framing during the research and design process.

1.7 Reading guide

This project predominantly adheres to the double diamond model of the design process; however, owing to the nonlinearity and iterative nature inherent in a design project, the linear textual narrative within this thesis may inherently struggle to accurately describe this process. Consequently, in the end of this Introduction chapter, I present this this Reading guide to assist readers in understanding the various components of the project and the connections between them.

The first diamond in the double diamond model, 'Research Diamond', encompasses three constituent sub-diamonds: 'Theory (sub-)Diamond', 'Practice (sub-)Diamond', and 'Solution (sub-) Diamond', which correspond to the 2nd, 3rd, and 4th chapters of this thesis, respectively.

The 'Theory Diamond' establishes the scope of this project. Through a thorough examination of prevailing definitions of visualization, this chapter forwards my redefinition of visualization within the context of multi-stakeholder projects. Furthermore, it establishes the parameters for the inclusion of specific visualization forms within the defined scope.

The 'Practice Diamond' determines the design target of this project. Leveraging my role as a visual designer, I participated in four sub-projects centered around visualization within the context of the LIFE initiative, exploring what is the visualization process like in a multi-stakeholder project, and what is the stakeholder's need in visualization and intra-stakeholder communication.

The 'Solution Diamond' provides some hints and inspirations for the following design phase. it mainly revolves around a design question, 'Can visual be a common language'. This exploration consists of case studies of three attempts of establishing visual as a universal language in organizations and groups.

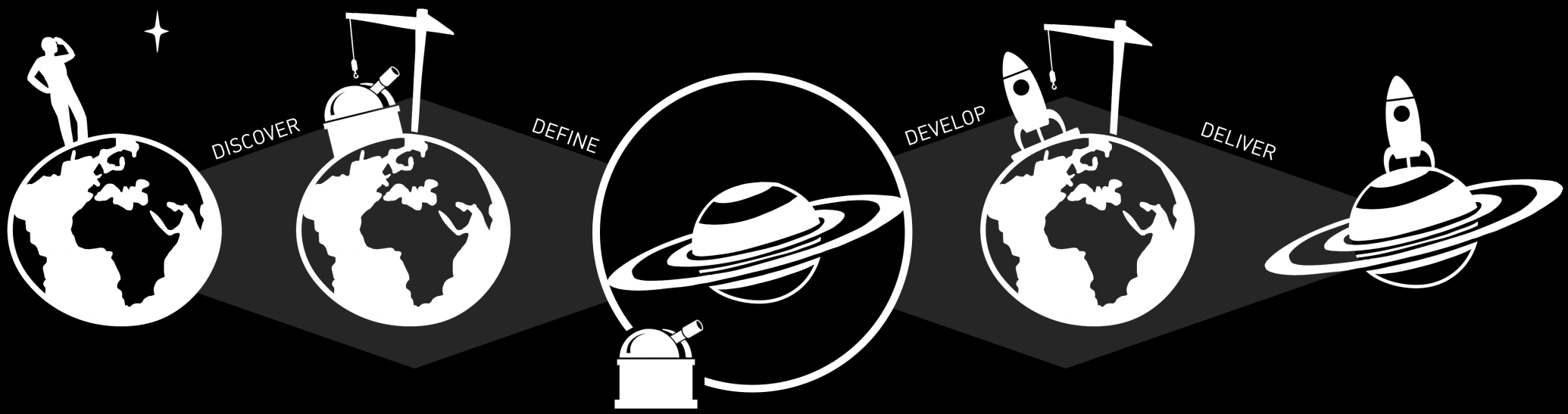
Since the activities and content in Research Diamond (Chapter 2-4 of this report) is relatively complex, I also provide an independent Reading Guide for Research Diamond after the main Reading Guide, showing how those activities contribute to the research and design question.

Before moving on to the second diamond, the 5th Chapter provides analysis conclusion and directions of synthesis, as the closing of the research phase.

The second diamond in the double diamond model, 'Design Diamond', encompasses two sub-diamonds. In the first sub-diamond, Chapter 6, I started with designing an Empowering Visual Tool (EVT) for co-creation activities in multi-stakeholder settings. The original purpose of EVT was to find a way to inspire participants in research and co-creation to visually express their ideas. Subsequently, in order to make EVT compatible with the complex information in LIFE, a multi-stakeholder technical and social project, I improved it into Strategic Empowering Visual Tool (SEVT) and applied it to inter-organizational workshops.

In the second sub-diamond, Chapter 7, I developed a Visualization Strategy Tool (VST) for organizational stakeholders to make better visualizations for mass-communication. VST guide its user to explore the audiences and their interpretation before they find a suitable method of visualization.

Reading Guide



Chapter 1 — Introduction

2 Theoritical Diamond
Definition of visualization, Research scoping

3 Practical Diamond
Visualization practices
Analysis of LIFE Project

4 Solution Diamond
Existing solutions

Chapter 5 — From Analysis to Synthesis

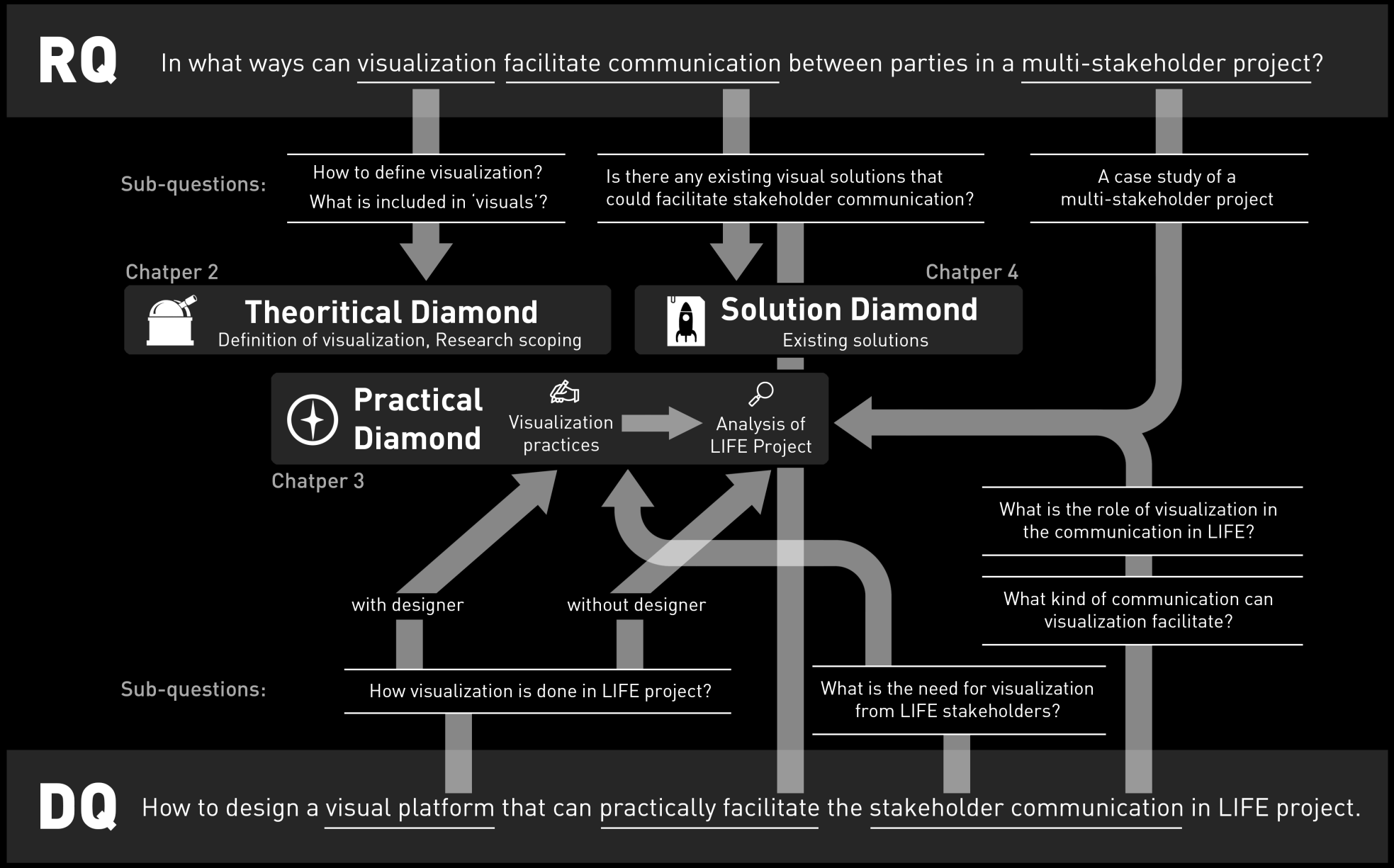
6 Empowering Visual Tool
Design and testing of a visual co-creation tool

7 Visualization Strategy Tool
Design and testing of a tool to improve visualization process

Chapter 8 — End Result

Reading Guide

Research diamond (Chapter 2, 3 and 4)



Chapter 2
Scoping

This chapter defines the scope of subsequent research and design by redefining visualization and discussing the scope of visual materials in multi-stakeholder projects.

2.1 Introduction

In the preliminary research stages of this project, it became apparent that both the practice and theory of information communication through visualization exhibited a fragmented nature. This made me realized the significance of establishing a well-defined scope for the research and design project at hand.

On one hand, the tasks of designing information communication media through the utilization of visual skills by designers appears fragmented. As a designer in the LIFE project and other organizations that I previously worked for, I have been entrusted with a diverse range of visual design responsibilities, encompassing tasks such as sketching energy infrastructure products, creating simple icons, designing posters and leaflets for promotional purposes, developing visual charts to represent quantitative information, and creating visually engaging drawings as conversation starters, among other endeavors. While these tasks may be broadly categorized as visual design, it is important to recognize that they rely on different visual principles, aesthetic standards, and task-specific requirements. For instance, the principles of accuracy and data-ink ratio, fundamental to data visualization, stand in contrast to the "benevolent ambiguity" sought in vision drawing as a means of conversation starter. These fragmented tasks prompted me to further explore the fragmented theories in visual communication.

The field of visual communication encompasses numerous practical theories that could guide visual sense-making. However, there exists a degree of ambiguity and fragmentation regarding its scope of study. Despite being united under the banner of visual communication, researchers from various disciplines such as

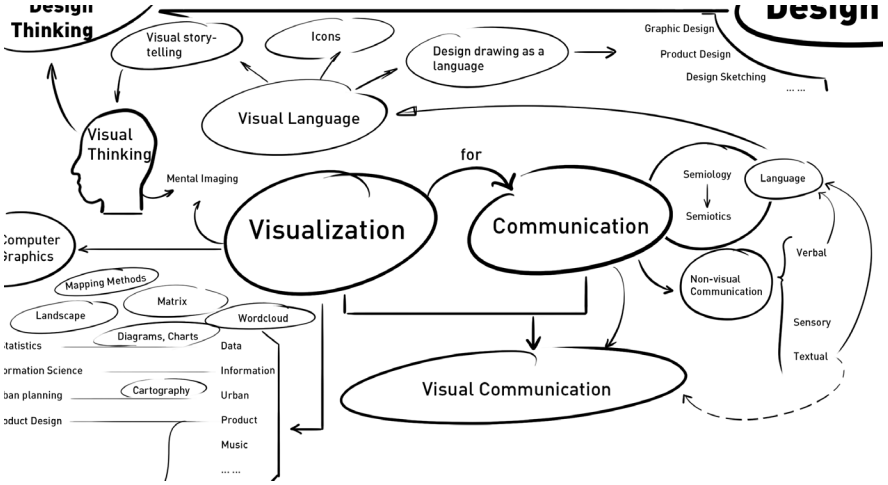


Figure 5. A brainstorming board in early scoping stage

Figure 6. Oak tree and bamboo clump (Smith et al., 2005)

computer science, design, and art typically pursue independent avenues of research, resulting in the absence of a universal theory for visual communication. Some researchers claim that this lack of a unified theory is a result of the interdisciplinary nature of the field itself (Moriarty and Barbatsis, 2005, p.xi). Smith et al. (2005) employs the metaphor of the 'bamboo root' to illustrate the distinctive knowledge structure characterizing the field of visual communication, juxtaposing it against the conventional 'oak-root' shaped knowledge structure observed in other academic disciplines. Conventional academic disciplines exhibit a discernible framework comprising a visible knowledge backbone (trunk) and its practical applications (branches), which are further linked to numerous research branches (roots). In the context of visual communication, the intersection with diverse knowledge fields creates an appearance of fragmented bamboo-grove-like divisions; however, these seemingly disparate bamboo 'trees' constitute an interconnected living entity bound together by shared roots of knowledge.

As a research and design project with a strong emphasis on practical application, it is unreasonable to establish a comprehensive research landscape quadrant for visual communication or visualization from the ground up. However, it remains essential to delimit the scope of research. In this regard, I initiated the process by creating a preliminary overview map of visualization, encompassing a wide array of visual resources. These visual resources are all possible to present in a multi-stakeholder communication context. Consequently, I established a scoping premise of incorporating a diverse range of visualization types.

Subsequently, I executed the following scoping steps: definition of visualization, declaration of the included content, and declaration of the excluded content.

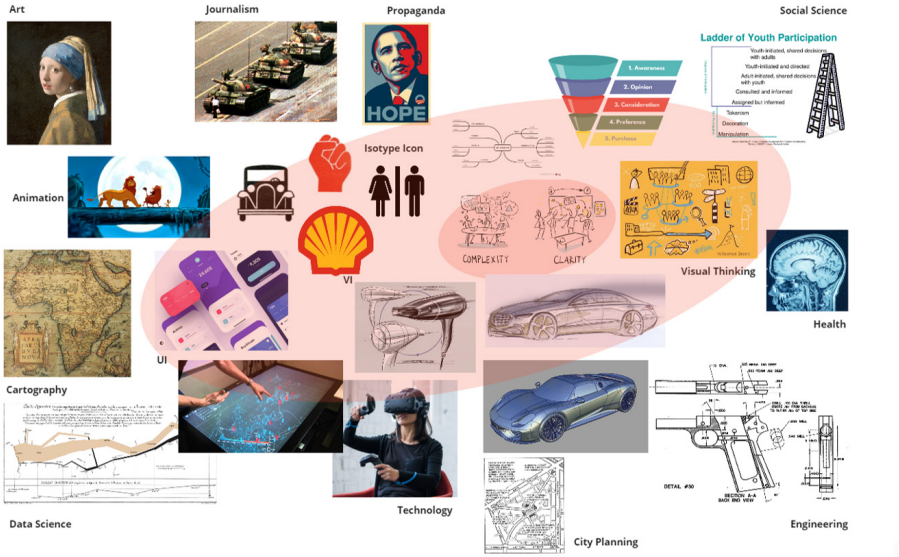


Figure 7. Overview map of visual resources

2.2 Definition of Visualization

In this section I start from examining existing technology-led definitions of visualization. Subsequently, I discuss means of visualization, external and internal input, visual creation and reuse. Finally, a redefinition will be proposed based on the synthesized insights derived from the aforementioned discussions.

Technology led definitions

In recent decades, the rapid advancement of computer science has exerted a dominant influence on the academic discourse surrounding the definition of visualization. A significant portion of the definitions pertaining to visualization originates from technology-driven research. A typical example is the definition by Keim et al. (2006).

> *"We define information visualization more generally as the communication of abstract data relevant in terms of action through the use of interactive visual interfaces."*

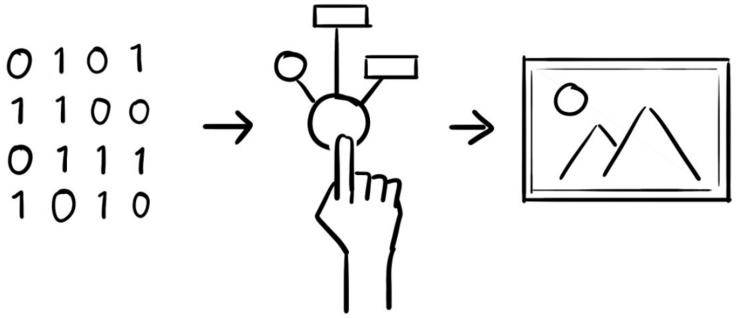


Figure 8. Communication of data through visual interfaces

Several parallel definitions exist, differing primarily in the substitution of interactive interfaces with computer-based technologies such as algorithms and software (Wood et al., 2002; Naps et al., 2003; Carpendale, 2008). These definitions, collectively referred to as technology-led definitions, share a common characteristic of seeing technology as the only means of transforming information into visual representation. For many computer science researchers, information visualization is already a relatively broad definition, in contrast to the narrower concept of scientific visualization, which only includes the type of visualization using numerical data obtained in controlled experimental conditions as input (Keim et al., 2006; Manovich, 2010). While definitions of this type are adequate for solving research problems in computer-related fields, their applicability to a design research project appears limited in scope.

Some scholars, who have ventured into the interdisciplinary realm of visualization, have identified the limitations inherent in these technology-led definitions. Consequently, they have expanded the scope of visualization to encompass not only technological means but also the involvement of draftsmen, artists, and designers (Manovich, 2002; van Wijk, 2005). However, despite this broader perspective, the input for visualization remains predominantly focused on data, even though researchers in this field explore beyond the domain of data visualization.

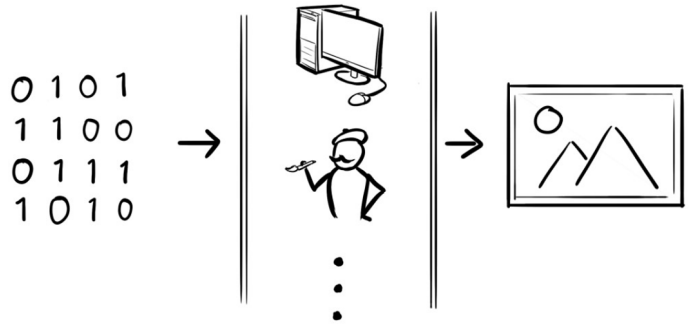


Figure 9. Various means of transformation

External data and internal ideas

If we think about data in a broad sense, it may be any form of information, such as facts or statistics (Pearsall et al., 2010), not just binary representation of 0s and 1s stored within computer systems. However, whether it is facts or statistics, they both exhibit a highly objective nature and are typically stored in mediums external to the human brain. In real-life scenarios, the visualizations we encounter are not exclusively confined to objective data; they can also represent subjective ideas, beliefs, and feelings. For instance, a designer may visually express an initial idea of a product form through a sketch, while a social media user may employ a smiley to visually convey a happy emotion. Certain researchers have formulated definitions of visualization that encompass the incorporation of internal information inputs. For example, in the definition of Ware (2013), concepts and data are juxtaposed as the input of visualization, while Schmitt (2022) believes that visualization is the process of materializing knowledge. In the context of visualization for information communication, it is imperative to consider both internal and external sources of information, encompassing subjective as well as objective aspects.

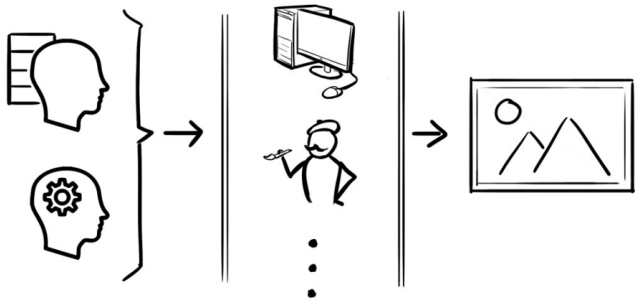


Figure 10. Internal and external sources of information

Visual creation and reuse

Upon recognizing that inner emotions, thoughts, and beliefs can also be visualized, I found that numerous visualizations of such information do not necessarily entail generating visuals from scratch. Frequently, existing visual resources are utilized to materialize our thinking, such as the aforementioned example of the use of smiley emoji. However, in the current landscape, the majority of visualization definitions primarily concentrate on the production process of visuals, often neglecting the aspect of referencing or reusing visual resources. I contend that these acts of reference and reuse are also visualization.

Redefinition

Building upon the preceding discourse, I present herein my redefinition of visualization:

> *Visualization is the transformation of (both internal and external) information into visual representation. It includes both the creation of visual representation, and the reuse of available visual resources.*

In the subsequent phase of research and design, I intend to employ this redefined visualization framework to delimit its scope. However, following the establishment of the definition, additional considerations arise regarding the explicit inclusion of certain elements within the scope that contribute to the multi-stakeholder context of communication, while simultaneously excluding elements that meet the definition of visualization yet fail to facilitate effective multi-stakeholder communication.

2.3 Included Content

Inclusion of diverse visuals

The scope of this research aims to broadly and equally includes all visualization that may be used for multi-stakeholder communication. In a multi-stakeholder collaboration, different kinds of visuals are covered, so this study should include as many kinds of visuals as possible, so that the study can actually cover more visuals that may be brought into the common discussion space by the stakeholders.

The scopes should be defined in a way that is as equal as possible to stakeholders from different disciplines, so that the scopes do not overly favor a category of visualization that relies on knowledge of a particular discipline, such as data visualization that relies on extensive knowledge of statistics.

Inclusion of multi-dimensional visuals

There are visual communication means that have been extended in both temporal and spatial dimensions, such as video, 3D modeling and VR. Due to the specialization and peculiarities of the technologies required to realize multidimensional visual communication, the application and study of them is usually somewhat exclusive, giving rise to the development of distinct fields of research dedicated to these endeavors. Given the frequent occurrence of multidimensional visualizations in the practice of design and visual communication activities, they are duly encompassed within the scope of this study. However, it is important to note that the specific technologies they require will not be extensively discussed, as they are regarded as information carriers in an equal place with 2D graphics.

2.4 Excluded Content

Exclusion of pure text

Some researchers argue that the communication of information through text should also be considered as visual communication. However, the communication effectiveness of text (as a direct visualized form of language) depends mainly on linguistic characteristics (e.g., the use of grammar and rhetoric) rather than visual characteristics (e.g., the choice of font). Therefore, in this research which aims to study visual sensemaking, I need to exclude purely textual communication.

But on the other hand, a visual that is heavily used in meetings, workshops and daily working environment is text organized in a certain spatial relationship. Texts also appear more or less in other forms of visuals. Therefore, it is necessary to draw a clear line between pure text and text that is considered as visual. Over the centuries, artists, designers, and researchers have proposed some taxonomies of visual elements. These visual elements offer the possibility to draw such a line. The early identification of visual elements comes from the classical technique of oil painting. John Ruskin (1857) proposed that everything visible in this world is made up of countless small pieces of color of different shades. This theory that originates from artistic drawings distinguishes three visual elements: color, and its size and shade. Over the next hundred years, it was expanded to the theory of seven elements of art, including line, shape, texture, form, space, color, and value. This seven-point theory is widely used in art education today. Melissa Clarkson (2015) in proposed a taxonomy of elements applicable to visual communication. The main idea is that the creator controls individual graphic elements to create compositional elements that ultimately convey communication elements to the viewer. The individual graphic elements include position, color, size, shape, and orientation. Using these elements, we can easily distinguish between plain text and text-containing visuals. When a creator adds individual visual elements to a text for sensemaking purposes, it becomes a text-containing visual. Individual graphic elements (position, color, size, shape, and orientation) may also appear in pure text. But pure text does not visually create compositional elements (contrast, repetition, alignment, proximity). When visual compositional elements are added to a piece of text, it can be considered a visual resource, a visualization output. The text without visual compositional elements will be considered as pure text and excluded from the scope of this study.

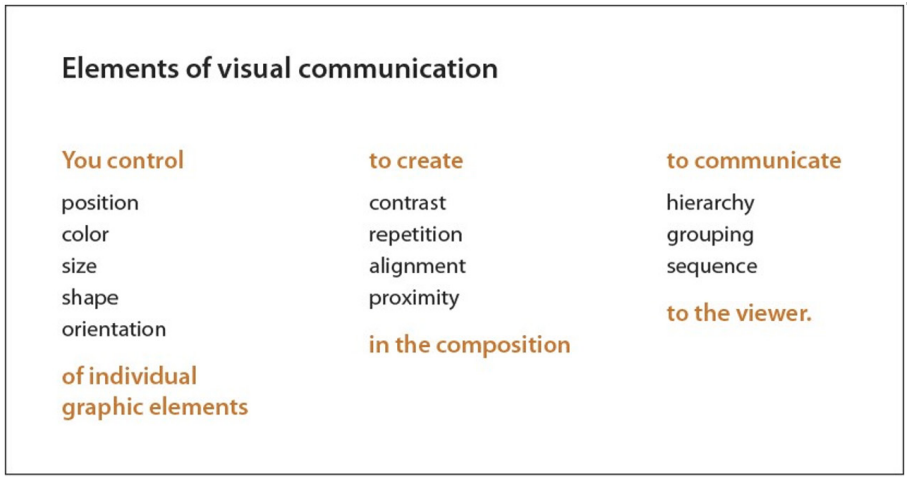


Figure 11. Elements of visual communication (Clarkson, 2015)

In this report, I refer to the transmission of information via spoken language as verbal communication, and the transmission of information via plain text as textual communication. Forms of communication that are not excluded by the above five criteria are considered as visual communication. However, when the visual resource has fewer visual communication elements, I refer to it as weak visual communication, and when the visual resource has more visual communication elements, I refer to it as strong visual communication.

Discussion

This chapter redefines what visualization is in the context of general communication and identifies what kinds of visualization should be included within the scope of a research and design project for multistakeholder communication. Due to the fragmented nature of the visualization field, researchers and practitioners from different disciplines may have different definitions and scopes of visualization. They are mostly adequate in their respective domains, but during my research, I found that the existing visualization definitions are not applicable in the context of multistakeholder communication. For example, most of the definitions were unable to include some forms of visualization that I observed in multistakeholder co-creation workshops: reuse of existing visuals and visualization of ideas.

The scope (comprising definition, inclusions, and exclusions) provided in this chapter serves as a primary compass directing my subsequent research and development endeavors within the solution space. I will design my research based on this scope, focusing on how the visualization that is already happening in the LIFE project can be improved, or how to use the visualization in the scope to improve the communication that is currently through non-visual approaches. Subsequently, during the stages of solution design, the parameters set forth in this scope shall continue to guide the exploration of the solution space.

Key Takeaway

Visualization is the transformation of (both internal and external) information into visual representation.

It includes both the creation of visual representation, and the reuse of available visual resources.

The study of visualization in multi-stakeholder context should include diverse visual materials from stakeholders with different knowledge background.

A clear line should be drawn between visual and textual communication. In this project I use elements of visual communication to distinguish between the two.

Chapter 3
Practical Research

This chapter describes the practical researches that are conducted around LIFE project. It includes four visualization practices that I did as a visual designer, and an analysis of LIFE project.

3.1 Visualization Practices

A designer's perspective

As a designer with some drawing skills, I often use some visual methods to express my ideas in my work, this visual approach is also widely recognized by my colleagues. At work I often get requests for me to help visualize some information or refine some visuals. After entering the LIFE Project of AMS Institute, in order to understand the needs of stakeholders for visualization and their current visualization process, I participated in several small visualization projects as a designer.

Visualization projects

In this study, I mainly used convenience sampling and selected 4 visualization sub-projects related to the LIFE project. After setting my research questions and approach, I made a presentation about my research direction in ENERGIE LAB ZUIDOOST, and published a poster to seek visualization projects from stakeholders of LIFE project. ENERGY LAB ZUIDOOST is an interdisciplinary research organization studying the energy transition in society at the Amsterdam Zuidoost. Some of its researchers come from the LIFE project, but also some from other projects in cooperation with LIFE and LIFE stakeholders. Therefore, not all of the four visualization sub-projects I selected are included under the LIFE project, but they are all related to LIFE and LIFE stakeholders. Their relationship to the LIFE project will be shown on Page 22 'Positions of 4 Visualization Practices'.

In the end, I selected 4 visualization project assignments from stakeholder representatives. For each project, there are usually 2-3 meetings between me (as the visual designer) and the contact person (stakeholder representative). Usually, we discuss the need and focus of the visualization in the first meeting. Before and after the first meeting, I request a checklist of information that needs to be visualized. In the following 1-2 meetings, I will show the visualized draft to stakeholder representatives, collect their feedback, and work with them to frame the visualization requirements and try to discover their latent needs. Finally, the completed visualization will be delivered to project stakeholder representatives through email. In this chapter, all the findings and insights are collected during the processes of these visualization projects.

On page 21, a overview of the 4 visualization practice is provided, with detailed information about the time, task initiator, contact person's knowledge background, method of visualization, vehicle of visualization, purpose of visualization and procedures for each visualization practice.

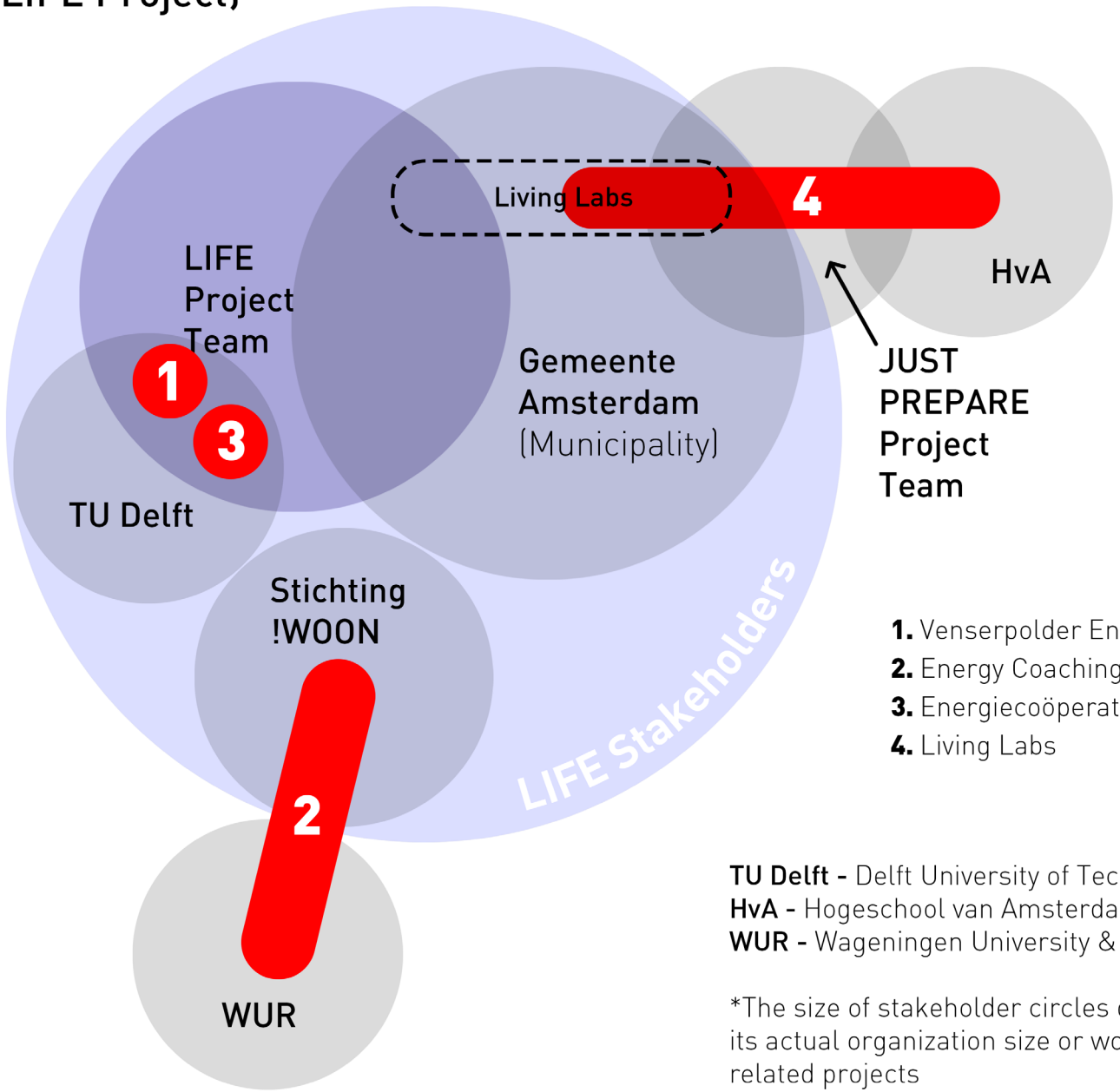
On page 22, there is a visual overview of the relationship between each visualization practice and LIFE project.

Visualization Practices

	1 Venserpolder Energy Community Vision	2 Energy Coaching Leaflets	3 Energiecoöperatie Workshop	4 Living Labs
Time	07/04/2023- 30/05/2023 53 days	16/06/2023- 01/07/2023 15 days	27/06/2023- 03/07/2023 7 days	09/05/2023- 30/08/2023 114 days
Task Initiator	LIFE social team, TU Delft	Stichting !WOON WUR	LIFE social team, TU Delft Stichting !WOON	JUST PREPARE project team, HvA
Contact Person's Background	Strategic designer	Urban economics Researcher	Design anthropologist	City planning researcher
Method of Visualization	Digital sketch	Graphic design data visualization	Digital sketch graphic design	Digital sketch
Vehicle	Digital image, Leaflet	Leaflet	Co-creation template on paper, visual cards	Digital image, Leaflet
Purpose	Advertising material, to create attention and resonance	Advertising material, to create attention, to test its influence on participation	Co-creation material, to help participant generate answer to research questions	to be used in presentation slides for internal and external communication
Procedure	Interview meeting 1 Requirement list Draft (designer) Interview meeting 2 Feedback Final visual	Draft (from initiator) Interview meeting 1 Improved draft (designer) Interview meeting 2 Final visual	Workshop design meeting Requirement list Visualization meeting Draft Visualization meeting Final visual	Interview meeting (schedule) Requirement list Interview meeting 1 Updated requirement list Draft (designer) Interview meeting 2 Final visual

Positions of 4 Visualization Practices

(in Relation to LIFE Project)



1. Venserpolder Energy Community
2. Energy Coaching Leaflets
3. Energiecoöperatie Workshop
4. Living Labs

TU Delft - Delft University of Technology
HvA - Hogeschool van Amsterdam
WUR - Wageningen University & Research

*The size of stakeholder circles does not represent its actual organization size or work proportion in related projects

Venserpolder energy community vision

Citizen Energy Community is a decentralized energy system that generates, stores, shares and uses energy locally (Reijnders et al., 2020). The LIFE project can be considered an effort to develop the Venserpolder and the adjacent area into energy communities. I received my first visualization task from a researcher from TU Delft, who is working under the LIFE project to visualize the future vision of Venserpolder as an energy community in an interesting and attractive way, so as to create publicity among local residents and attract them to participate in the follow-up research and co-creation projects.

Through an two rounds of interviews, and a feedback and iteration session, I created the visualization shown in Figure 12. In addition to this vision drawing, some more pages were later sketched to explain how the eletricity demand changes in a day in a playful and engaging manner, an example image is shown in Figure 13.

Due to changes in the research agenda, these visual materials were not ultimately shown to residents, but they were used as a discussion material in workshop organizer's meetings, and provided some inspirations to the Energiecoöperatie workshops visualizations. Although I was unable to get feedback from the target audience for this visualization, I did get some feedback on the visualization process in discussions with the task initiator, and in discussion groups with other project members, on the visualization output.

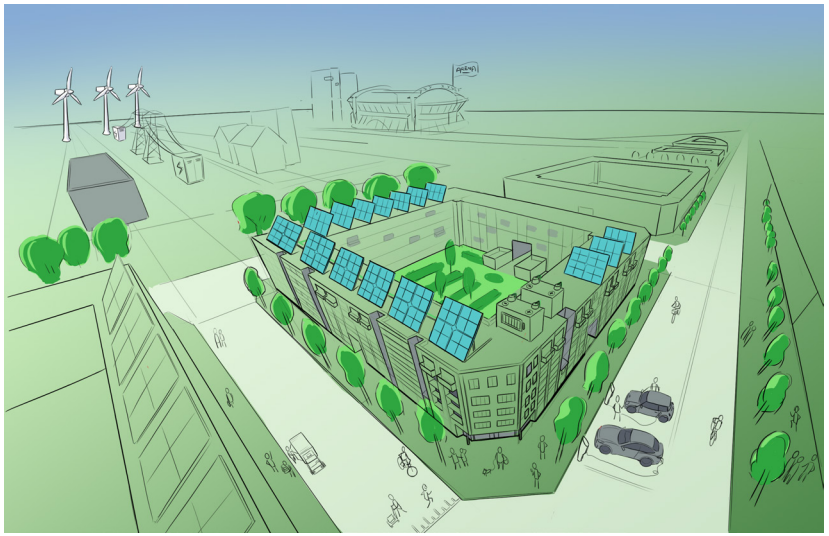


Figure 12. Venserpolder energy community vision

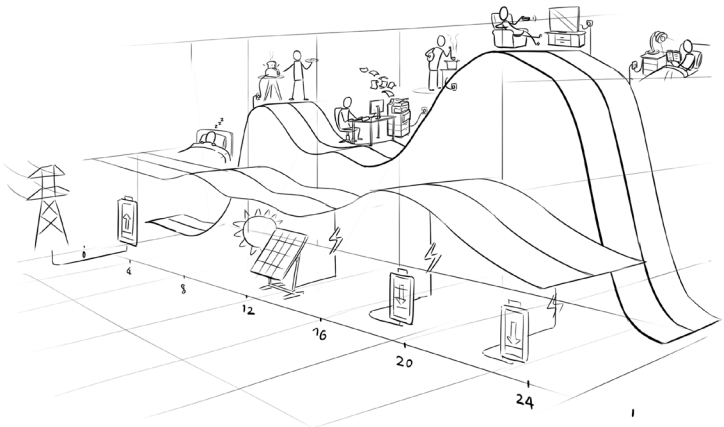


Figure 13. Electricity demand visualization

During the initial interview, my contact person did not provide much detailed information about the expected outcome of this visualization task, only a general direction: “Create a visual that will attract people and engage them in our research project”. The reason behind it is : "The goals of the LIFE project include engagement, and the skills of your designers can bring about this engagement." The contact person also expressed the dilemma that she hoped to solve with a visual approach: "In projects like this, it is often difficult to get people on board in the initial stages".

This visualization sub-project is the first visualization task I undertook after entering the LIFE project. At this stage, I did not fully understand the Amsterdam Southeast area and energy transition goals. Therefore, in the early stages, many communications with the contact person focused on understanding the task context, such as discussions on the socioeconomic status of residents in the area of Amsterdam Southeast, and the plans of installation of solar panels and batteries in the neighborhoods. Since the contact person did not limit the theme of the visual, and our communication mainly focused on the discussion of the context, the visual I finally created in this task was mainly contextual drawings, as shown on last page.

When I brought these visuals to the LIFE project team meeting and discussed them with other project members. One member (a design researcher from TU Delft) said that these visuals connected some of the goals of the LIFE project to the lives of local residents, 'Hey, I can see my community in this image, rather than something not quite relevant to my life'. He said this people-centered perspective can help LIFE to engage local stakeholders.

Another member (project manager of LIFE) agreed with the above point of view, but also believed that there were some problems in the future vision drawing based on the Venserpolder community environment (Figure 12), such as: 'The technical guys may have some opinions on your vision, because the ArenA is on the top of your picture, this means your solar panels are all facing north, and the sunlight are all coming from here, which means they (solar panels) are not working'. Similar problems did arise in my discussion with technical team. A researcher who developes the energy management system pointed out: 'You have directly connected the Venserpolder community to the wind turbines on the diagram, which may confuse people. This gives people the wrong impression that we will directly deliver wind power to the community'.

Since I mainly communicated with a contact person working in community engagement during the visualization process, some technical issues were overlooked. These problems confirm the point of view of Nicholson-Cole (2005) in the Introduction: no image can attract everyone. In a multi-stakeholder project, it often requires the co-creation of stakeholders with different knowledge backgrounds to produce a visualization that fully describes the whole project.

Energy coaching leaflets

Stichting!WOON is a non-profit organization providing housing and energy advice to residents of Amsterdam and a key stakeholder in the LIFE project. One way they support residents with energy knowledge is through 'energy coach' home visits. I received a visualization task from Stichting!WOON to visualize the two themes: 'What happens in an energy coaching session' and 'Energy coaching is becoming popular'. These two themes are integrated into a leaflet design, which aims to encourage local residents to actively participate in 'energy coaching'.

Through an initial interview, and a feedback and iteration session, and with the requirement list provided by the contact person, I created the required visuals. A page of this leaflet is shown in Figure.X. This leaflet design was then printed in large volume and delivered to residential apartments, and its effect of participation encouragement was future examined by the research team.

In the first email to me, the contact person included a draft of a leaflet she had made. She hopes a designer can make the leaflet "look more professional". During our discussion, I showed different visualization methods to her, such as making a cartoon, or using different visual styles. However, this leaflet is not only a promotional material for Stichting!WOON, the sociology researcher at Wageningen University & Research also wants to use it to study the impact of leaflets on citizen participation in energy transition projects, and they did not want a unique visual style to bring research bias and only requires the most basic layout design.

Figure 14. Task initiator's visual draft

In the end, I only made a minimalist design according to the contact person's requirements. The layout of leaflet was redesigned, the a official colour theme of Stichting!WOON was added. Furthermore, a visualization of 'changes in the number of people participating in energy coaching activities between 2019 and 2022' were visualized according to data visualization principles.

Since the feedback for the leaflet is in an unpublished study, I am temporarily unable to access this feedback from residents. However, I was still able to gain some insights of the visualization process: The contact person initially did not consider the main message that this leaflet wanted to convey, but just asked for some photos to be neatly arranged on the leaflet, so that the audience might not be able to capture the leaflet's theme at the first glance, this may stop them to further read the instructional information. In addition, although this is a very simple visualization sub-project, it still contains some information hierarchies, such as the title-content hierarchy, which need to be determined in discussions between the designer and the contact person, but was overlooked by the contact person.

Figure 15. Energy coaching leaflet page 1

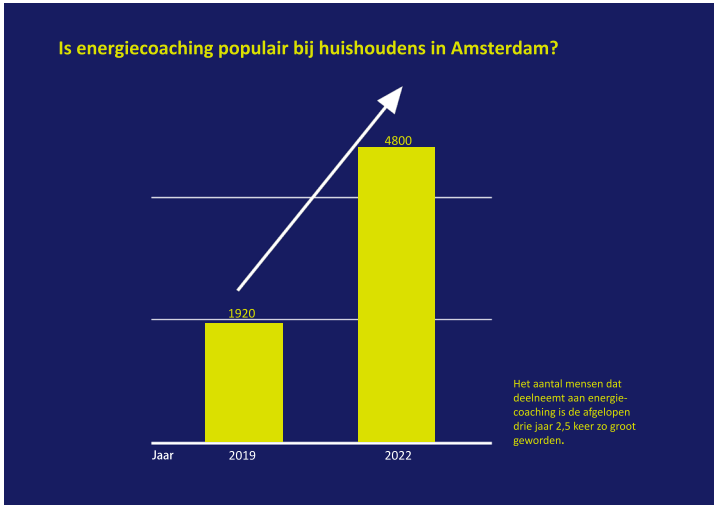


Figure 16. Energy coaching leaflet page 2

Energiecoöperatie workshop

Another key stakeholder of the LIFE project is a group of researchers from TU Delft, as a part of the LIFE social team. They aim to create inclusiveness and energy equality in LIFE through their research. In cooperation with Stichting!WOON, they launched a series of workshop for local residents to explore opportunities and ways to create energy cooperatives locally.

Through two team meetings and multiple email exchanges with workshop facilitators, we co-created the workshop template shown in the picture. The workshop template aims to have conversation about two intricate research questions with participants through gamification design, actively engaging them in a playful manner to collaboratively construct energy communities tailored to their interests and imaginative perspectives.

The two main research questions are:

1. *What do you want a collective energy system in Venserpolder to look like?*
2. *How can this be organized locally, by and for the neighborhood?*

Both of these questions are very suitable to be answered visually rather than described entirely in words. However, if participants are asked to use free-hand drawing to create ideas, there may be an over-reliance on their visual skills, and some people may not be able to confidently enter the workshop. Therefore I proposed a visual gamification approach, using the LIFE project stakeholders

Figure 17. Map card

Figure 18. 'Hero' cards

Figure 19. 'Item' cards

as the 'heroes' of the game, the LIFE project energy equipment and infrastructure as 'game items', and the Venserpolder region as the game's map. Players need to come up with some 'skills' for their 'heroes' to deal with the community's energy challenges. These 'items', 'heroes', and 'maps' will all be visualized in the form of visual cards, these cards are shown on Figure 17-19.

After the co-creation workshop, I again contacted the workshop facilitator and got some feedback about the workshop from him. According to him, normally the workshops in LIFE projects are not organized visually, and the visualization in this Energiecoöperatie workshop made a difference in the following aspects:

1. At the beginning of the workshop, it makes the workshop less serious and opens up the conversation.
2. It helps to focus the conversation to revolve around the research question, avoided the situation in which people talk a lot of things but lost focus.
3. People are all working on a same or similar thing, which can create a collective feeling, this is consistent with the goal of co-creation process and energy cooperate.
4. It balances the right of speech in a conversation, and may help to avoid or improve the situation in which one or two talkative persons dominant the workshop.

Compared with the other three visualization sub-projects, the visualization of the Energiecoöperatie workshop is special in the following two aspects:

Firstly, the visualization of the Energiecoöperatie workshop was completed in a very short time, and the communication between me and the task initiator during the visualization process was very efficient. The project's task initiator team consists of a design anthropologist and researcher, an energy transition advisor, and a strategic designer. In my reflective discussions with them about the visualization process, I mentioned that some preliminary work which happens before the designer takes out his drawing pad is very important to the visualization process. Among them, the design anthropologist believes that this preliminary work may be the process of conceptualization. As a design anthropologist, he has not been trained in sketching or other drawing techniques, but in many years of cooperation with designers, he has mastered the skills of conceptualization, so he can efficiently communicate the workshop concept with me and the rest of the team.

Secondly, the Energiecoöperatie workshop is the only project that uses visualization as part of the co-creation process, where visual is a two-way communication channel. The organizers of the workshop present the theme, context, and elements of their research to the participants through visual channel, and the participants of the workshop also present their ideas to the organizers through the visual channel.

Living labs leaflets

One of the topics that is often discussed in the LIFE project is the renovation and improvement of houses and apartments in local communities with government grants, improving energy efficiency through enhanced insulation, sustainable heating, etc., to achieve energy transition goals. Some Living Labs are planned to be built in Amsterdam to demonstrate these future residence. LIFE project and another project conducted in Amsterdam Southeast area, JUST PREPARE project are both working on the developement of Living Labs. I was assigned a visualization task of creating a leaflet from a city planning researcher from JUST PREPARE project. The leaflet aims to visually present the mismatch of technical developement and social problems in energy transition, and the concept of Living Labs. The task initiator also want to inform residents about the stakeholders involved in JUST PREPARE project, who are prepared to help them to improve their energy efficiency in their housing.

At the beginning of the project, the contact person provided a two-page detailed list of requirements without distinguishing between levels of information. The audience(s) of the visualization was not specified. The task initiator hoped to get a 'multi-purpose visual' that could be used in both leaflets for residents, and presentation slides for internal communication. I first followed my interpretation of the requirement and made a initial draft visual. However this first draft did not accurately convey the main message that the task initiator wanted to express. In the subsequent discussion, I tried to guide the contact person to distinguish the hierarchy of the information, and seperately visualize different themes in the requirement list.

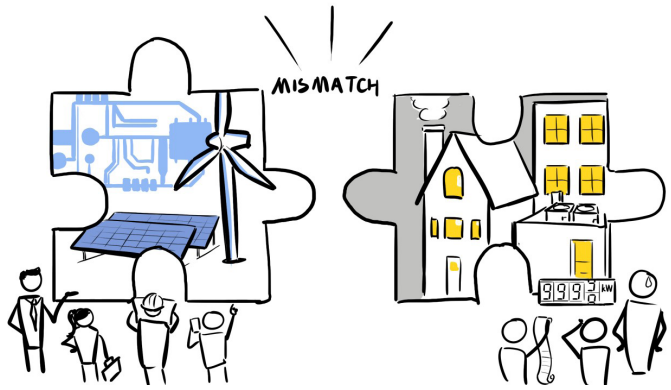


Figure 20. Living Lab leaflet - technical and social mismatch

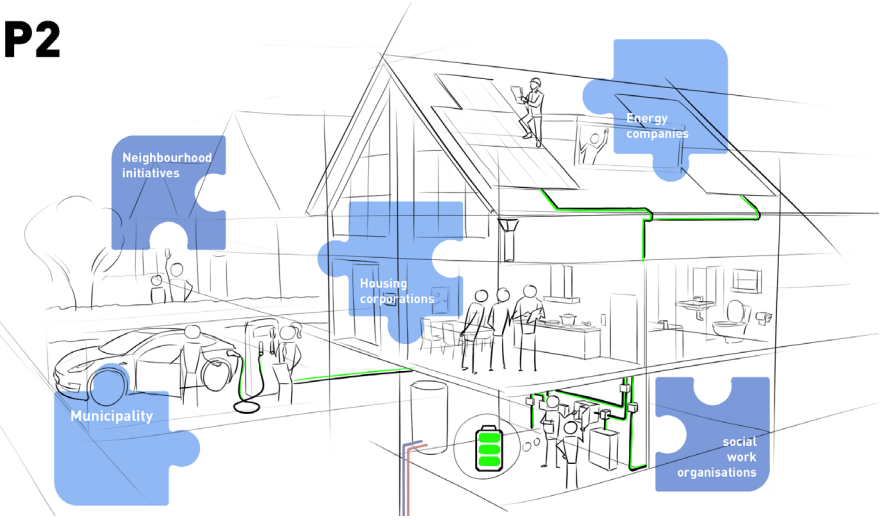


Figure 21. Living Lab leaflet - stakeholder

Conclusion of Visualization Practices

Through a series of aforementioned smaller projects, 5several distinctive findings emerged in the visualization sub-projects within the LIFE multistakeholder project:

1. Stakeholder representatives who requested visualization from designers generally have some preliminary knowledge of the benefits of visualization, such as 'engagement to viewers', or 'easiness to understand'.

2. Apart from the TU Delft LIFE social team who worked extensively with designers, stakeholder representatives often initially perceive designers as a profession primarily capable of making visuals more aesthetic or professional. However, through deepened collaboration, they gradually come to appreciate the designer's skills and methods in problem framing, user empathy, and information categorization.

3. Stakeholder representatives often think they need designers because they lack 'visual skills'. But from a designer's perspective, 'visual skills', like sketching and graphic design, are only a small part of skills and methods that is required to complete visualization tasks, especially for more complex information visualization.

4. For different visualization projects, the required skills are fragmented. For example, vision drawing requires sketching and composition skills, while information visualization requires graphic design skills, and workshop template requires icon design skills.

5. For co-creation scenarios, if participants cannot actively participate in the workshop because they are worried that they do not have enough visualization skills, then some design is needed to bridge the skill gap in visualization practice.

Figure 22. Only a skill issue?

Drawing upon the aforementioned findings, I argue that in multi-stakeholder visualization projects, there is a gap between the knowledge of visual and visual practices. Through regular exposure to visual resources in our daily interactions, we gradually acquire subjective knowledge regarding visual, such as the appreciation of visual aesthetics and readability. Additionally, objective knowledge about visualization can be obtained through research publications and popular science literature. Motivated by this knowledge about visual, we may opt to utilize visuals for information communication. We often know what skills are needed to practice these information visualizations, even if we don't have them ourselves. But between these two clearly visible parts, there is an area that we don't usually think about: the strategy of visualization. We rarely think about how to systematically invoke visual skills to achieve the visual effects we imagine. Questions like 'what kind of visual medium to use?', 'how to arrange information hierarchy?', and 'how the audience might interpret the visual information?' are usually considered unconsciously. When experienced designers are hired to help with visualization, their experience may fill the gap. But this process is mainly dependent on experience, and there is no well-established methodology to guide it.

The above findings provide a preliminary framing of design issues. The focus of developing a visual information communication platform under the LIFE project, a multi-stakeholder project, is to create a set of visualization strategies to guide visualization tasks in different contexts.

The design question is developed into:

> *How to design a set of visualization strategies that bridge the gap between knowledge about visuals and visual practices in a multi-stakeholder project (LIFE).*

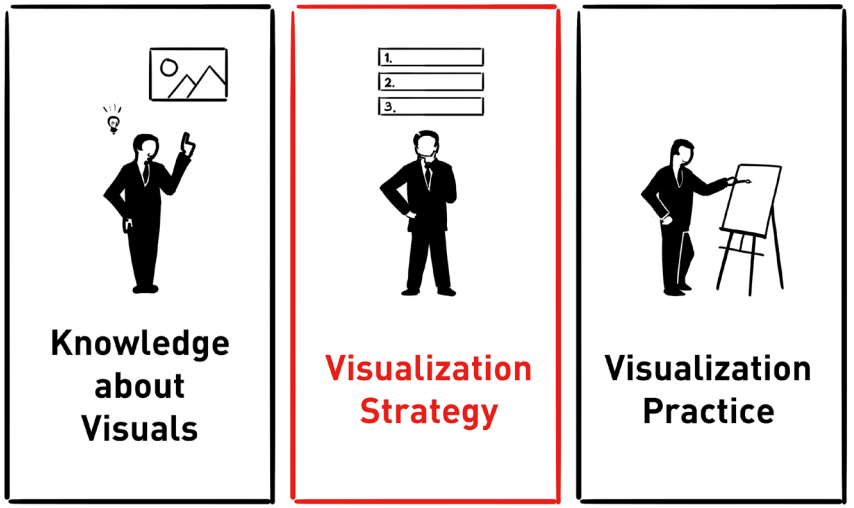


Figure 22. Gap of visualization strategy

Types of visualization method

During the four visualization projects that I mentioned in Chapter 3A, stakeholder representatives usually come to me with the idea that they want my help with visualization. Since I am a designer with some visual skills and they may have seen my visual portfolio, the visualization method they initially envision is usually a design sketch or graphic design. However, I also identified other three alternative visualization methods.

Often when I am requested to make a visualization, stakeholder representatives mention their shortage of visualization skills, and therefore they need a designer like me to complete the task. This suggests that they did consider performing the visualization themselves, but that their lack of visual skills, or their self-perception of their lack of visual skills, led them to eventually abandon the idea.

During iterations of the visualization drafts and communication with stakeholders, some drafts are discarded and some designs are reused. In the design of Living Labs leaflets, stakeholder representatives wanted me to design a visual style template after seeing my first draft sketch, so that they could later apply a uniform visual style and elements to their presentations. These findings support my expansion of the definition of visualization, where I found that visualization is not necessarily a creative or generative process, but can also be the reuse of existing visual resources.

Another topic that is often discussed is the recent rise of AI image generation, and since many people have already tried to create visuals with some of the AI image generators that are currently free and publicly available, they usually mention this technique to me in their discussions as well. And two stakeholder representatives wanted to know if there is any possible application of this technology to our projects from my perspective as a visual designer. Therefore, exploring how AI Image Generator can be used in multi-stakeholder communication may also be of value to them.

In summary, a total of four possible types of visualization method have been identified, namely:

1. Designer's drawings
2. Draw it yourself (DIY)
3. Reuse of existing visual resources
4. AI image generators

These categorization of visualization methods will be used in the design of Visualization Strategy Tool (VST), which is in Chapter 7.

3.2 Analysis of LIFE

Stakeholders

The LIFE project contains diverse array of stakeholders: municipality, energy asset owners, residents, resident associations, energy companies, social work organizations, etc. It is neither realistic nor practical to combine them randomly for analysis and design. According to my visualization practice in the LIFE project and the analysis of project materials, I observed that stakeholders can be classified into three distinct categories: individual stakeholders, organizational stakeholders, and host stakeholders. Individual stakeholders pertain to individual entities, such as residents and employees. Organizational stakeholders refer to stakeholders in the units of companies or organizations. When there is a co-creation workshop, the levels of workshop organizers and participants are usually different. Therefore, there is usually a particular organizational stakeholder that becomes the host stakeholder. Between these three groups of stakeholders, I found the following three types of visualization.

A diagram of the stakeholder structure in LIFE is shown on page 33 (next page). Between these three groups of stakeholder, three types of visualizations are identified, namely visualization for mass communication, visualization for co-creation and visualization for dialogue. These three types of visualization will be explained in the next three sections.

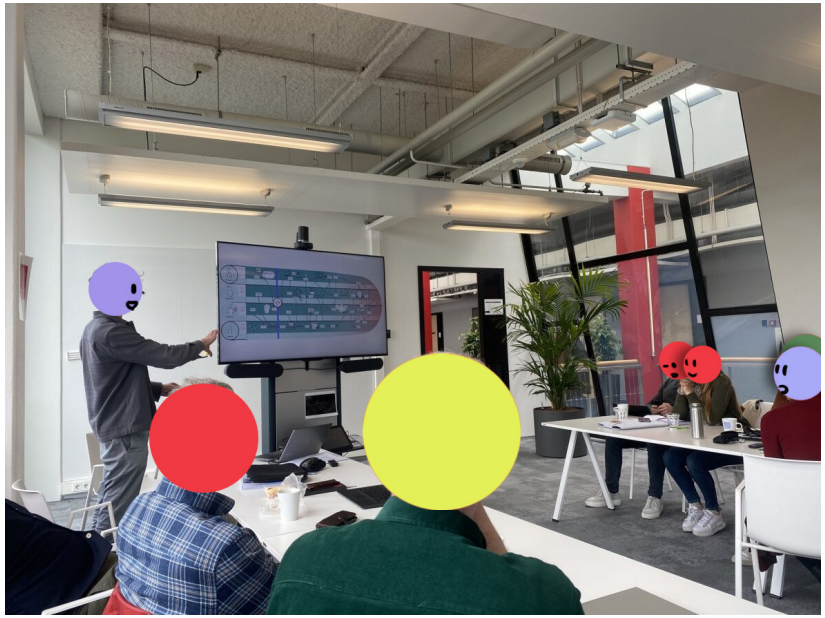
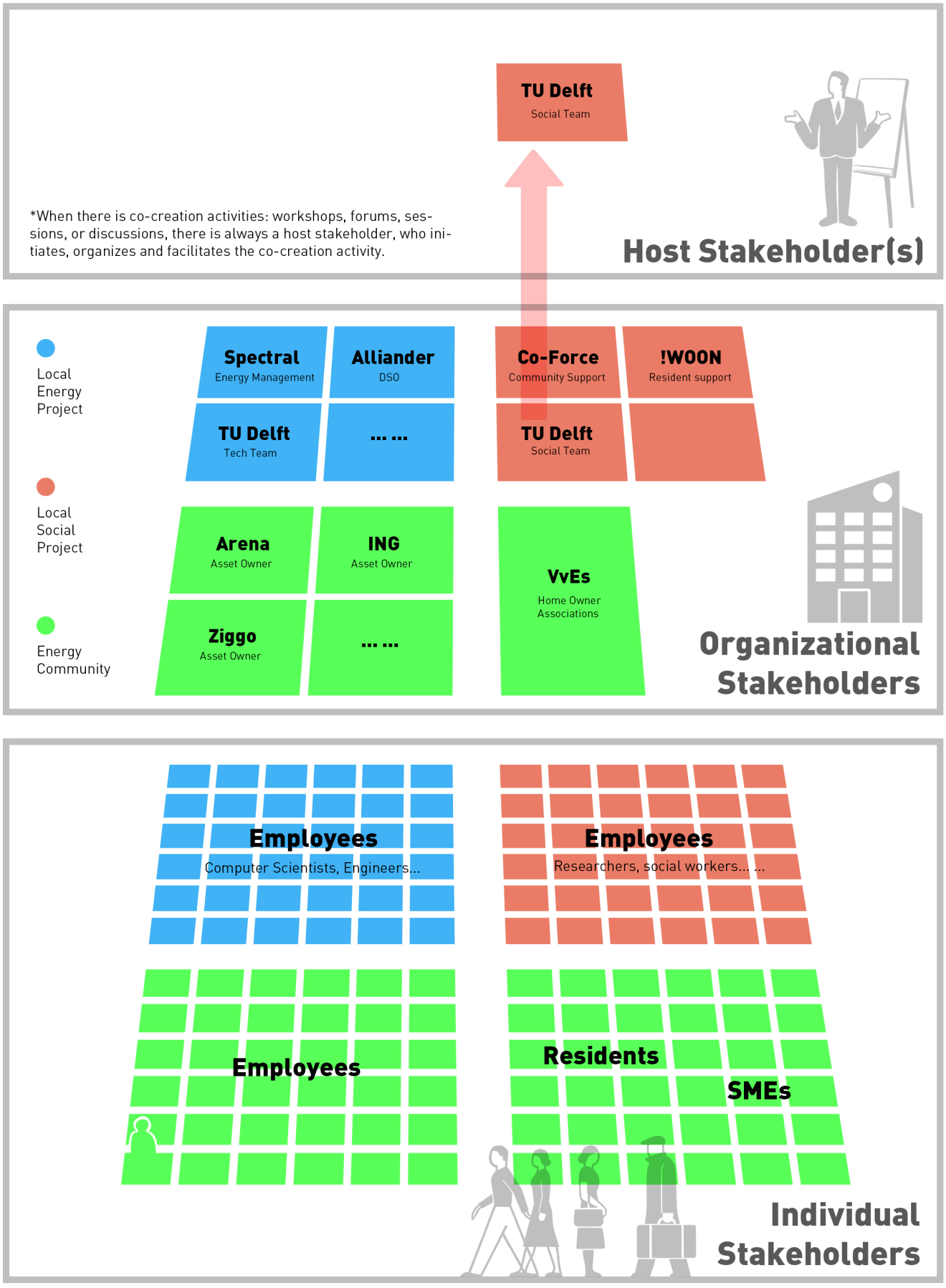


Figure 22. A co-creation workshop (LIFE Partner Day)

LIFE Stakeholder Structure



Visualization for mass communication (VfMC)

As a designer involved in the LIFE project, a significant portion of my visual creation are for the purpose of mass communication. Typically initiated by an organizational stakeholder, these visualizations may target all stakeholders in the project as the intended audience. However, in many cases, the focus may be specifically directed towards individual stakeholders (residents or citizens). The primary objective of visualization within this context is to enhance the visibility of projects or policies. While occasionally facilitating participation, these visualizations predominantly serve as a means of unidirectional information dissemination to the target audience, with limited emphasis on receiving feedback from the audience, as shown in Figure 23.

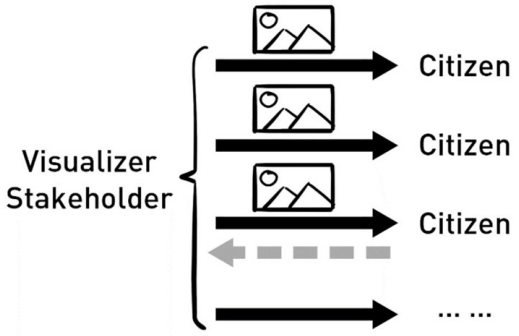


Figure 23. visualization for mass communication

Stakeholder representatives (visualization task initiator) responsible for such visualizations typically predefine the format, such as posters or leaflets. Sometimes they may provide designers with comprehensive task instructions accompanied by a detailed list of requirements, However, this list of requirements must sometimes be redefined together with the designer. Sometimes the information to be visualized is not very clear at the beginning, and designer need to explore and define those information through collaboration with stakeholder representatives.

When the information and requirements are relatively simple and clear, designers can directly visualize according to the list of requirements, and the results can generally be intuitively interpreted by the audience. However, there are instances when the information on the requirements list is large and complex, and a direct visualization may lead to confusion in interpretation. In such circumstances, it becomes necessary to establish or restructure the information hierarchy to facilitate clarity and understanding.

Two typical example of visualization for mass communication are shown in Figure 24 and Figure 25.

Figure 26 provides a illustration of the place of visualization for mass communication on the diagram of three types of stakeholders.

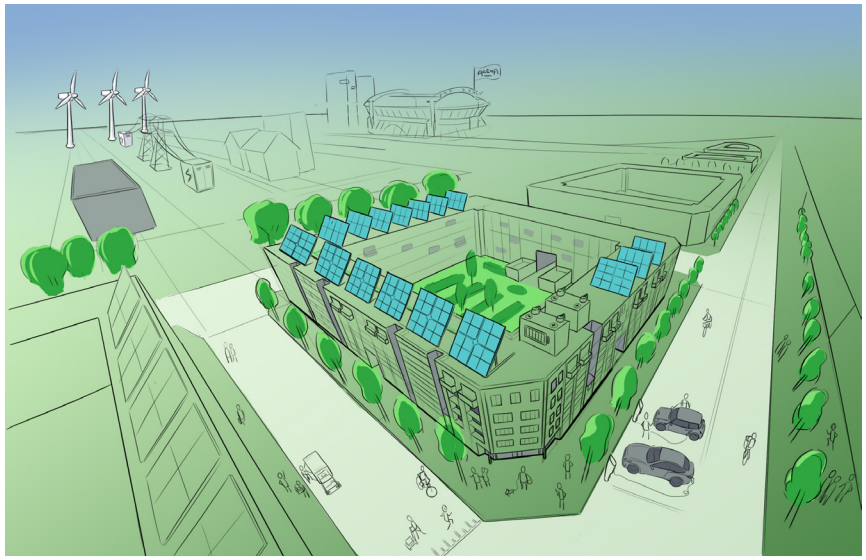


Figure 24. Example I of VfMC

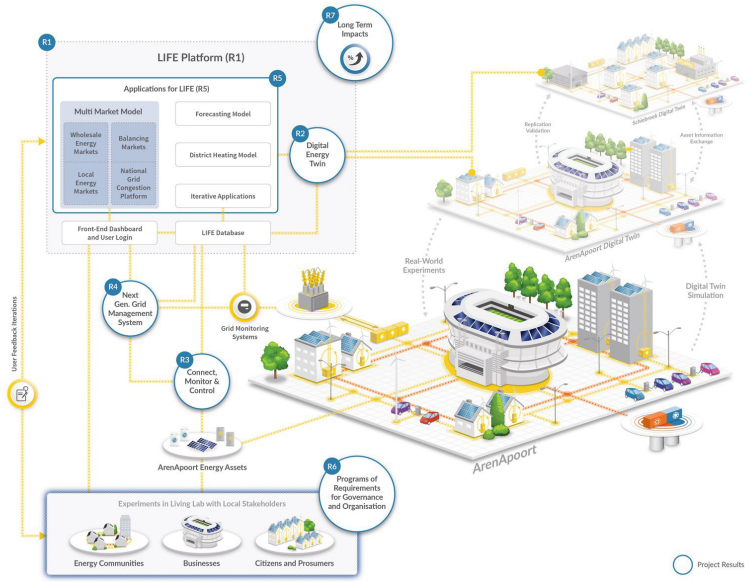


Figure 25. Example II of VfMC

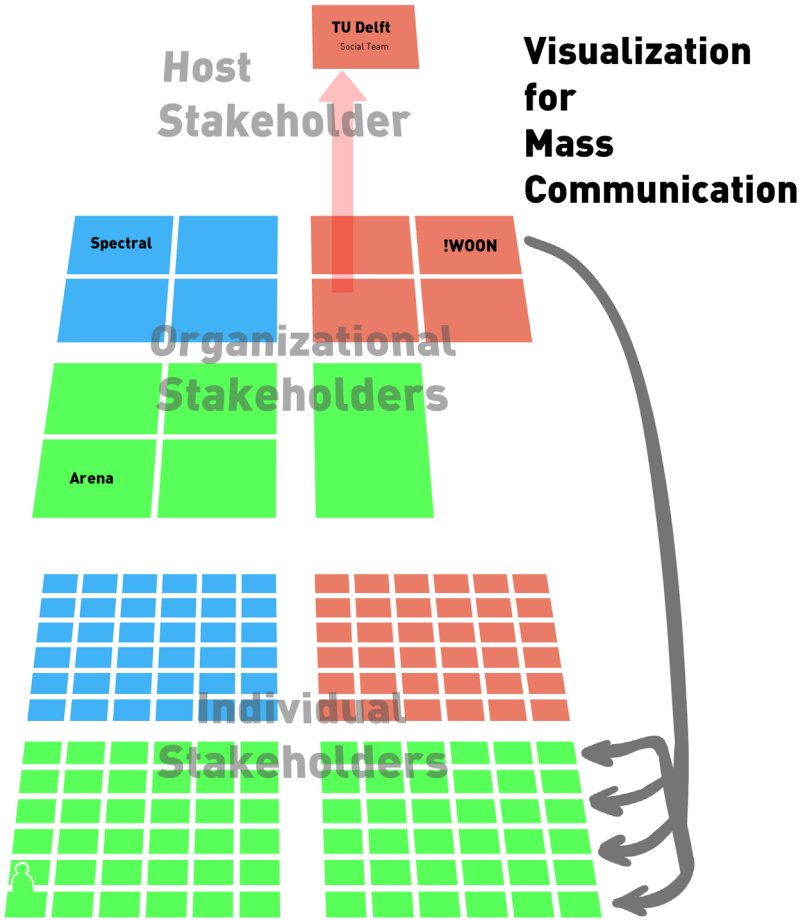


Figure 26. Placing VfMC on stakeholder diagram

Visualization for co-creation (VfCC)

Visualization in the LIFE project is also widely used in co-creation workshops. On the one hand, visualizations employed for this purpose must effectively convey information provided by the workshop organizer (e.g., workshop background, mechanisms and what do they want). On the other hand, these visualizations should also be able to serve as a carrier for feedback information from participants. The inherent requirement for compatibility with two-way information exchange introduces complexities in the design of visualizations for this specific application.

Figure 27. visualization for co-creation

Usually, the visualization in this case is not simply a translation of the textual workshop into a visual one. The visual elements, metaphors, and templates it uses will have an impact on the workshop mechanism. Since co-creation is a two-way communication of information, when designing visualization for co-creation, designers not only need to consider the information that host stakeholders need to convey to participants, but also need to consider providing a empowering tool, so that they can also participate in the co-creation process on an equal basis.

A typical example of visualization for co-creation is shown in Figure 28.

Figure 29 provides a illustration of the place of visualization for co-creation on the diagram of three types of stakeholders. The participants in co-creation activities can be both organizational stakeholders and individual stakeholders.

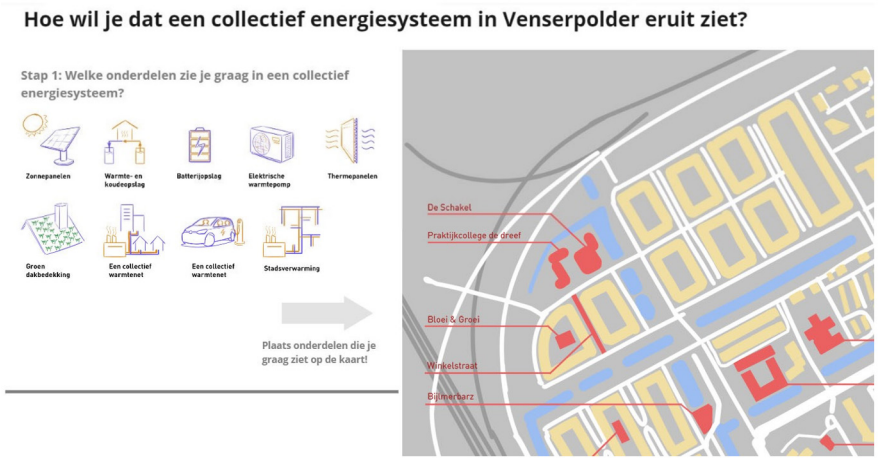


Figure 28. Example of VfCC

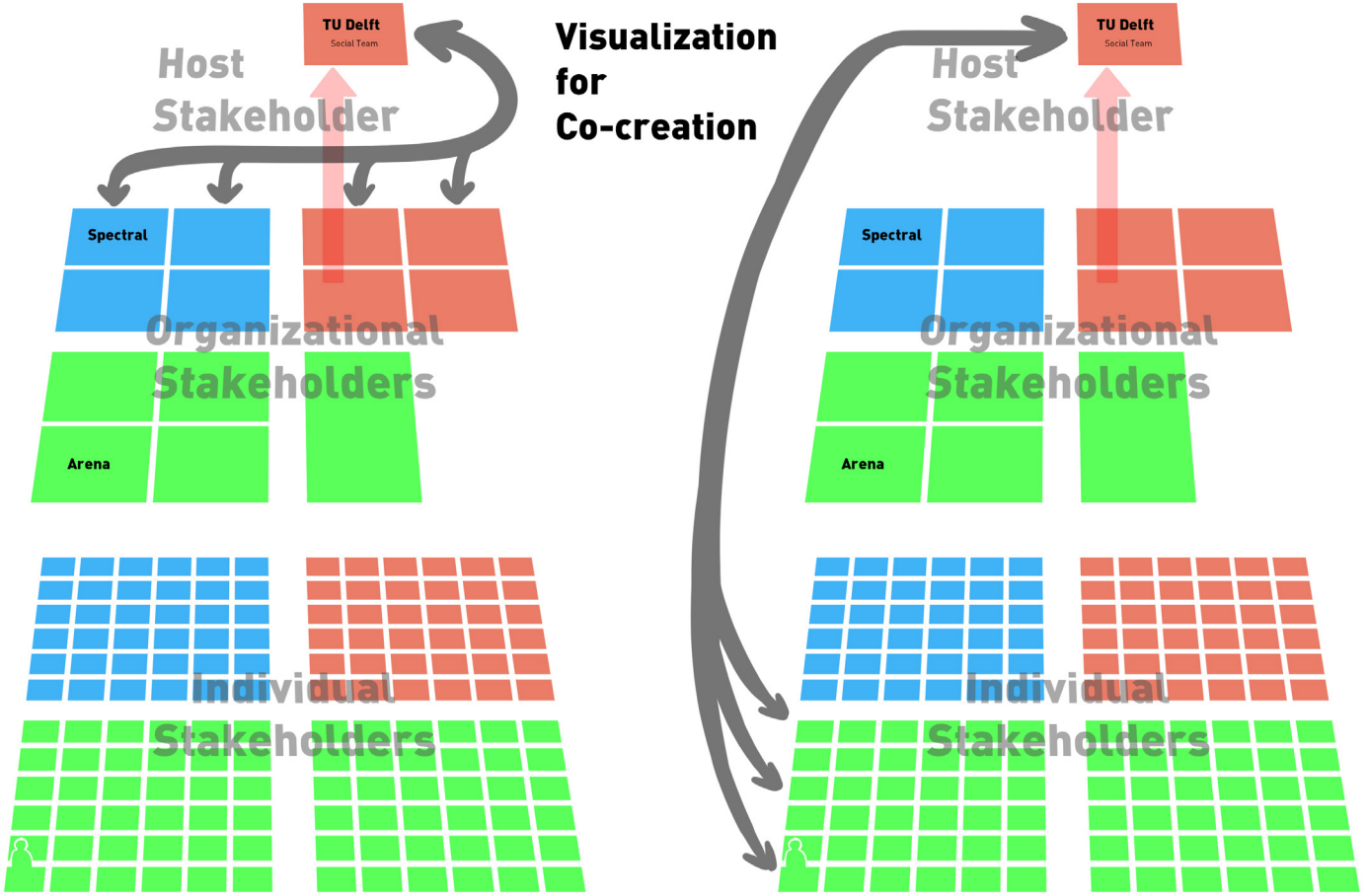


Figure 29. Placing VfCC on stakeholder diagram

Visualization for dialogue (VfD)

Visualization for dialogue commonly occurs between two organizational stakeholders. The most noticeable difference between visualization for dialogue and the above two types of visualization is that in dialogue, the sender and receiver of information are equal in status and voice. For example, a representative of a Distribution System Operator uses a visualization of a power grid to talk to a representative of the Municipality. In contrast to visualizations intended for mass communication, visualization for dialogue possess a more distinct target audience. The visual resources it uses could be more complex and professional, requiring the audience to have a certain knowledge background, or the visualizer to give detailed explanations before the visual message can be interpreted.

Figure 30. Visualization for dialogue

A typical example is the visualization used by the Distribution System Operator, Liander, when explaining its grid system to LIFE project team, shown in Figure 31. Sometime these visualizations are performed by professional technicians or engineers, without the participation of designers. But sometimes visualization for dialogue can also be very simple and quick, such as when a representative of the LIFE project explain changes in energy demand throughout a day and a year to another project stakeholder representative, using a quick and dirty hand-drawn data visualization, as shown in Figure 32.

Figure 33 provides a illustration of the place of visualization for diagram on the diagram of three types of stakeholders.

Figure 31. Example I of VfD

Figure 32. Example II of VfD

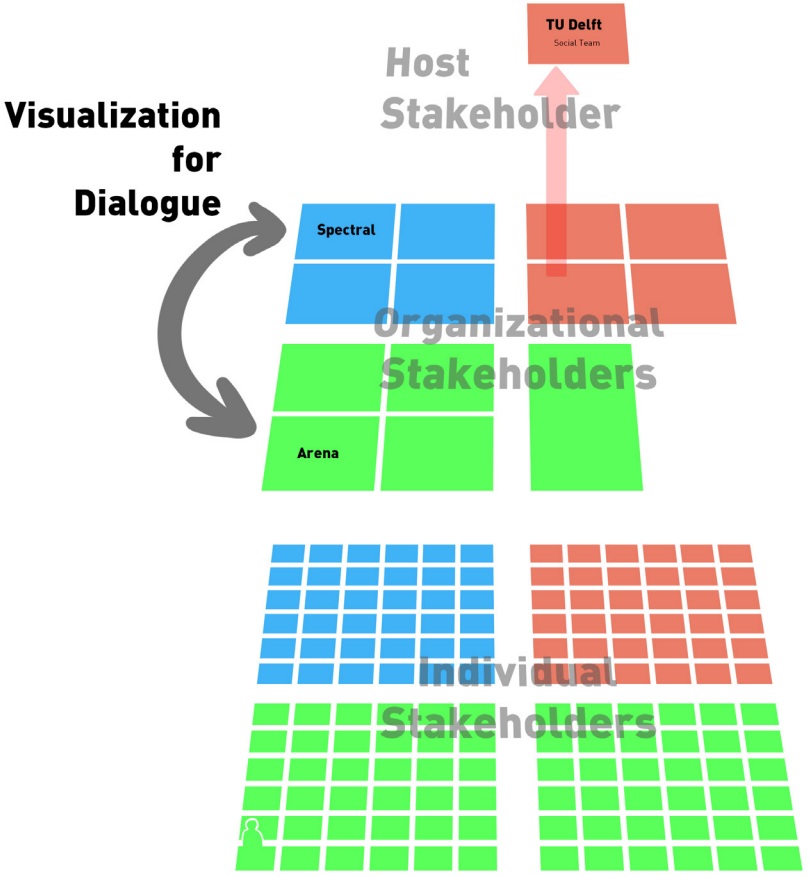


Figure 33. Placing VfD on stakeholder diagram

Problem framing

Before diving into the identified problems, Figure 34 provides an overview and comparison of those three types of visualization.

	Visualization for mass communication	Visualization for co-creation	Visualization for dialogue
Visualizer	Organizational Stakeholder	Host Stakeholder	Organizational Stakeholder
Audience	All Stakeholders	Organizational Stakeholder and Individual Stakeholder (participants)	Organizational Stakeholder
Direction	One-way	Two-way	One-way
Visualization	Mainly effortful	Effortful (Host) Intuitive (Participant)	Mainly effortful
Interpretation	Intuitive/ effortful/ assisted	Intuitive (Participant) Intuitive/ effortful/ assisted (Host)	Mainly assisted
Medium	Poster/leaflet/banner Icon/Logo Video	Workshop template Workshop assets (cards/ figurines/building blocks)	Mainly professional visualizations can also include other
Pain Point	The end solution (type of medium) is usually predefined before the visualization strategy is formulated	Time consuming to plan, a designer need to follow all the preparation meetings, rely on creativity of the planner	Usually need time to explain Visualizer may not have strong visual skills, while designers may not have the professional knowledge

Figure 34. An overview of three types of visualization

Problem framing

Figure 34 provides an overview of the characteristics of the three types of visualization mentioned in the previous section. In the lower section of the table, I have compiled the challenges encountered in the three visualizations experienced by stakeholders. Among these, the issues encountered in Visualization for mass communication and visualization for co-creation predominantly stem from a limited understanding of visualization strategies. In the case of Visualization for mass communication, stakeholder representative responsible for the task often directly engage in visualization practices, instructing designers to visualize a designated set of information using a specified medium (such as a poster), while overlooking considerations of information hierarchy and alternative visual mediums. Visualization for co-creation necessitates close collaboration between designers and stakeholder project teams to formulate an effective visualization strategy, as the visual elements are closely intertwined with the dynamics of the co-creation session. It also requires a tool that enables two-way information communication, especially empowering participant to provide valuable feedback.

The last type of visualization, Visualization for dialogue, stakeholders primarily encounter challenges during the visualization practice phase. Stakeholders involved in these visualizations may lack sufficient visual skills to effectively communicate the visuals to stakeholders outside their specific knowledge domain. Introducing a designer to help making visual for more efficient and effective dialogue. However, if the designer has not engaged extensively in a dedicated professional domain, they may not possess the requisite expertise to execute precise visualizations. Multistakeholder social projects sometimes doesn't have the budget to hire a designer to assist in visual communication, let alone train a dedicated visual designer in the department to specialize in this kind of work.

Due to limited time and resources, in this project, I will mainly design for visualization for co-creation and visualization for mass communication. Since visualization for dialogue relies less on external tools or designers, but mainly on the visualizer's own knowledge and visualization skills, it is not explored further in this project.

After identifying the challenges associated with the aforementioned three types of visualizations, the design question can be refined to:

> *How to design a toolbox to support stakeholders in formulating visualization strategies that enable the creation of visualizations for effective stakeholder communication?*

The toolbox should be modular and able to meet the needs for different types of visualization. It should provide guidance to stakeholders in formulating a comprehensive visualization strategy, enabling them to select the most suitable approach and solution for visualization. This may involve utilizing existing visual resources, guiding stakeholders in creating their own visuals, or providing structured information and requirements to external designers for the execution of the visualization task.

Key Takeaway

In four visualization practices, I discovered a gap of visualization strategy exists between knowledge of visuals and visualization practices, which is often overlooked by people.

Four visualization methods are discovered, they are: designer's drawings, draw it yourself (DIY), reuse of existing visual resources, AI image generators.

In a multi-stakeholder project, three types of visualization are discovered, they are: visualization for mass communication, visualization for co-creation and visualization for diaglue.

In this project, I will mainly design for visualization for co-creation, and visualization for mass communication.

Chapter 4
Solution Research

This chapter explores a research sub-question 'can visual be a common language in multi-stakeholder projects? ' through three case studies.

4.1 Introduction

The starting point of this project was to build a visual platform to facilitate communication in multi-stakeholder projects. During the previous research scoping process, I found a basic consensus in the discipline of visual communication: visual communication is a form of communication that utilizes a cognitive system that is vastly different from verbal communication. It possesses a potential that verbal communication does not have, which has not been fully explored. This idea has also been confirmed by visual users in other fields. This provided me with an inspiration: if verbal and textual communication can hardly bridge the knowledge gap between stakeholders from different fields, thus affecting their communication efficiency, can visual language bridge this gap and become a common language?

Looking back at visual creations from prehistoric times, such as cave paintings from thousands of years ago. They are often treated by anthropologists as early art to study religious and aesthetic values beyond their practical value (Layton, 1981, p.7). However, when viewed solely as works of visual communication conveying practical information, their content is usually clear and straightforward. Modern people, no matter what country or ethnicity they come from, or what language and writing system they use, can usually recognize the cows, deer, and rhinoceroses on the Chauvet-Pont-d'Arc cave paintings. More importantly, these visual materials appeared well before any verifiable writing systems in human history. These archaeological findings give inspiration that visual communication may have been a more versatile and understandable way to convey information than text which transcends cultural boundaries.

Figure 35. Reproduction of Chauvet-Pont-d'Arc cave paintings

4.2 Case Studies

To answer the research sub-question 'Can visuals be a common language in multi-stakeholder projects?', I selected three design cases that aims to establish a common visual language in certain contexts.

Case 1: ISOTYPE

The first conscious attempt I could find to use vision as a universal visual language was the ISOTYPE (International System Of Typographic Picture Education) movement in Vienna, which began in the 1920s. In the context of the structuralism and socialist movement, a group of artists, designers and philosophers attempted to collaborate to create a system of visual symbols that could transcend the boundaries of culture, natural language, and academic education. Their visual repository contains a wide range of visualized information on life, production, politics, religion, and warfare. ISOTYPE is pushed by theby the Vienna's left-wing ruling party in their attempt to create a universal visual guidance system which can be understood by people speaking different languages and with different education backgrounds, it can therefore be considered as the first complete multi-stakeholder visual communication platform. Influenced by the Nazis and the Second World War, the main base of ISOTYPE's activities shifted from Austria and Germany to the Netherlands and then the UK. This standardized visual symbol system was first adopted by the public transportation system in Britain after the war. In the following decades, the name of the symbol system gradually fell into oblivion, but its legacy can still be seen everywhere: for example, the icon used to distinguish male and female restrooms.
ISOTYPE and its modern derivatives - various common icons are a visual platform with low learning cost and low difficulty of use. In most cases it does not require the user to master any visualization skills. They only need to find them from the visual resource library and copy them to use. But it also has obvious flaws: so far, the mainstream application of icons still only uses it to express simple information, or as an eye-catching reminder in front of complex text.

Figure 36. ISOTYPE created by Gerd Arntz

http://www.gerdarntz.org/

Case 2: Buro Brand

Under the trend of promoting visual thinking in business and organizational contexts, there is a recent attempt to use visual as a common language, the Buro Brand Company, founded by visual artist Willemien Brand. Willemien Brand and her company developed a playful hand-drawn symbol system, and offers lectures on business drawing, visual recording, and visual storytelling. In their company vision, they expressed their mission of promoting visual language to a status equal to that of natural languages and writing systems.

I attended a business drawing lesson from Buro Brand. The main content of this course is to teach how to draw common information in office scenes, such as icons of some common items and events, and basic visual relationships. The teacher's infectious teaching can encourage students to actively participate in the visualization process and increase students' confidence in hand-drawing. However, whether this kind of encouragement in class can make participants insist on hand-drawing in their daily work is worthy of long-term follow-up research.

Buro Brand sells these courses primarily to organizational customers, but for a multi-stakeholder project, it is difficult to require all organizations in the project to purchase Buro Brand's courses, so there may be some resistance to promote this solution in a multi-stakeholder project. in addition, cost is also a limiting factor for this solution.

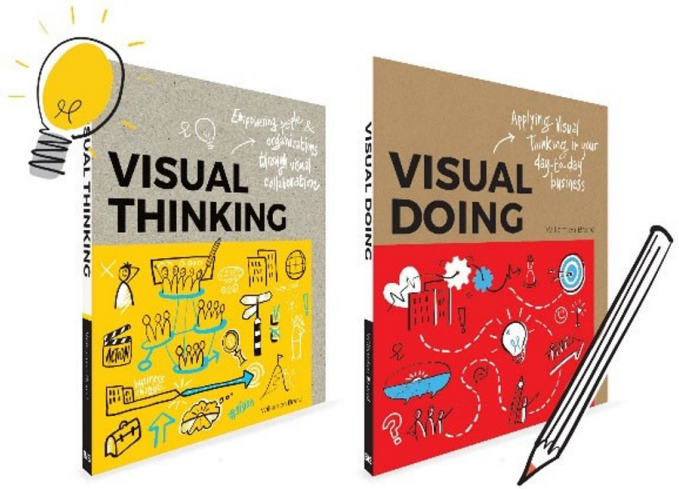


Figure 37. Books by Willemien Brand

Figure 38. My notes of a Buro Brand drawing lesson

Case 3: LEGO SERIOUS PLAY

Although Lego is clearly different from the above two attempts to build a universal visual language: it has not only visual properties, but also physical, tactile and cultural properties. However, according to the book written by the LEGO SERIOUS PLAY team, they also define this method as a language and consider it a means of visualizing ideas, and a channel of communication (Kristiansen & Rasmussen, 2014). In more than 20 years of development, LEGO SERIOUS PLAY has developed into a method widely used in many fields such as organizational strategy, product development, creativity mining, and education.

Several studies have demonstrated the effectiveness of the LEGO SERIOUS PLAY approach in promoting stakeholder communication (Hyvonen,2014; McCusker, 2019; Köhlke et al., 2021). However, LEGO SERIOUS PLAY is primarily a tool for exploring ideas rather than a tool for communication. During use, communication between users is still mainly through verbal channels. If LEGO SERIOUS PLAY is used as a communication tool, then it mainly helps individual users communicate with themselves during the creative process. In addition, the recording function of LEGO bricks is weaker than other visual carriers (such as pictures, videos, etc.). It requires access to photos, text reports, recordings and other means to completely record the ideas generated during use.

In addition, LEGO SERIOUS PLAY is also a solution of relatively high cost. LEGO SERIOUS PLAY kits suitable for multiplayer contexts cost hundreds to thousands of euros. The mandatory need for trained facilitators also brings additional labor costs.

Figure 39. Basic LEGO SERIOUS PLAY kit

https://www.lego.com/en-nl/product/starter-kit-2000414

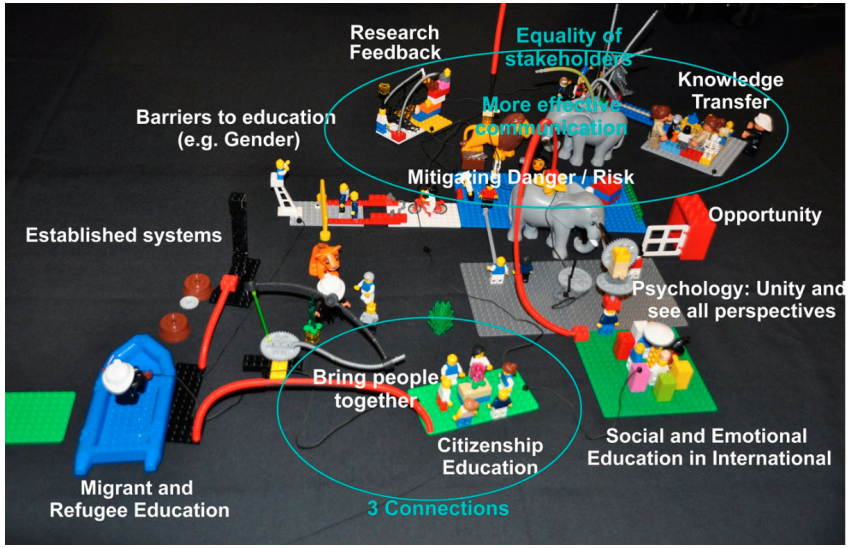


Figure 40. The photo and text recording of a SERIOUS PLAY SESSION (McCusker, 2019)

4.3 Discussion

Each of the three Cases discussed in this chapter has a different focus: ISOTYPE develops a visual language in the age of mechanical reproduction that can be directly reused without relying on visualization skills; Buro Brand focuses on boosting the confidence of clients to actively express their ideas by hand, encouraging them to use it in their workplace; LEGO SERIOUS PLAY focuses on facilitating the generation of ideas, indirectly helping users to communicate. fast visual language; LEGO SERIOUS PLAY focuses on facilitating the generation of ideas and indirectly helping users to communicate.

On the other hand, there are some shortcomings in the visual approaches facilitating communication: ISOTYPE is difficult to express complex information. Buro Brand's simple and quick visual style makes it more suitable for simple information, and getting stakeholders with non-design or artistic backgrounds to fully master the skill of drawing complex pictures on their own requires a great deal of training. LEGO SERIOUS PLAY does not promote communication directly, and its use needs to be complemented by other media in order to meet the needs of communication.The LEGO bricks and assemblies in the complex communication process serves mainly as a conversation starter or reminder, which is a role similar to ISOTYPE icons. All of the above visual languages have certain shortcomings in communicating complex levels of information, which led me to recognize the need to develop a tool that can guide the user through the layers of information in the visualization process.

The three case studies are proven to be effective visual languages in certain contexts. However, developers and business operators of these solutions often neglect to explicitly define the specific contexts in which they are most suitable. Instead, they primarily rely on individuals' general knowledge of the advantages of visualization to promote their commercial solutions. This finding corroborates the observation made in the previous chapter, highlighting a gap that exists in visual strategies, which is between general visual knowledge and specific visual practices.

Key Takeaway

There are already some common visual languages, proven to be effective in certain contexts.

None of the three cases of common visual language is capable of communicating complex information visually.

In order to design a visual platform capable of visualizing complex information, it is necessary to consider information hierarchy

Chapter 5
From Analysis to Synthesis

This chapter provides analysis result obtained from research phase, and synthesis directions for the sebsequent design phase.

5.1 Analysis Result

In the previous four chapters, we mainly found the following Gaps of visualization in Multi-stakeholder communication:

1. Lack of thinking about visualization strategies and the means to formulate visualization strategies

2. Some stakeholders don't feel confident in their visualization skills, this might discourage them from co-creation activities

Framed by the above analysis process, the final design question is:

How to design a toolkit which can guide stakeholders in the LIFE project to formulate visualization strategies, thereby selecting and implementing the most effective visual means to communicate information?

How to design a toolkit which can bridge the gap of uneven visualization skills, thus help stakeholder to engage in co-creation activities equally?

5.2 Directions for Synthesis

The context of this toolkit target is a scenario where a Stakeholder needs to communicate information with another Stakeholder (or multiple Stakeholders). The toolkit should be modular. It should have basic component of visualization strategy tool, which guides the information sender to structure the information and select the most suitable way of executing visualization in their context. This basic component is linked to several solutions to visualization, which may include: using existing visual resources, making drawings by (sender) themselves, working with visual designers, working with AI. The final solution may not include all of these, and the co-creation with LIFE stakeholder representatives and visual designers will determine the most suitable solution for the LIFE project.

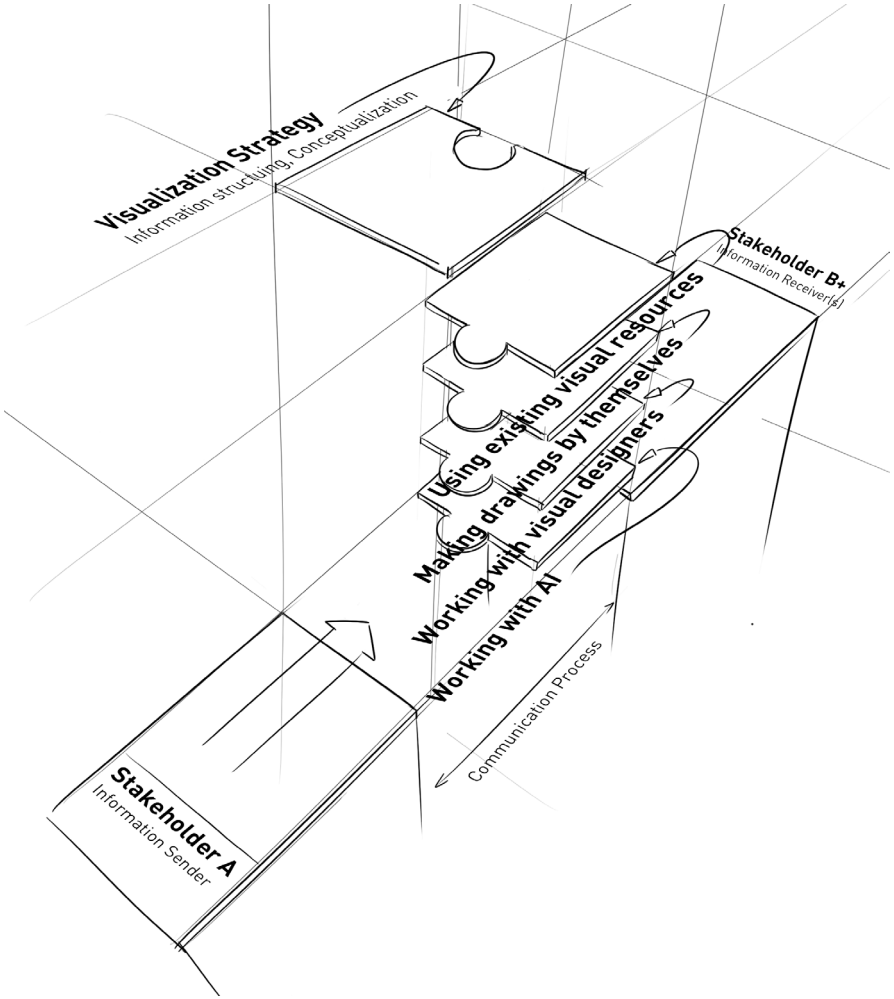


Figure 41. Synthesis direction I

5.3 Inspiration from Visualization Practices

The design phase starts with a visualization sub-project that I did in the visualization practices research phase, which is briefly described in the Chapter 3. In the visualization for Energiecoöperatie workshops, I worked closely with a design anthropologist and created a visual template for a co-creation workshop which involves resident representatives in the target residential area. With the categorization of visualization in LIFE that I formulated in the latter part of Chapter 3, it can be categorized into 'visualization for co-creation'.

The workshop focus on two main research questions:

1. What do you want a collective energy system in Venserpolder to look like?
2. How can this be organized locally, by and for the neighborhood?

The visual template is designed to be a desktop game. The map of Venserpolder is provided as the playground, and players are also provided with 'item cards', which are energy infrastructure and assets that they can deploy themselves, and 'player cards', which are stakeholders in the LIFE project. They are required to list the challenges which may occur when building an energy cooperate in the neighborhood. Then they need to arrange the 'item cards' and skills of 'player cards' to tackle the challenges.

Among the 4 visualization projects, this particular project caught my attention for two reasons:

1. Despite being the most complicated work among the four visualization sub-projects, encompassing not solely the visualization of information but also the creation of rules and dynamic mechanisms, the design process unfolds seamlessly and efficiently.
2. The workshop and the visual tool received positive feedback from both workshop participants and the organizer. In order to further explore the project, I conducted an interview with the main organizer of the workshop, a design anthropologist from in LIFE social team.

According to him, normally the workshops in LIFE projects are not organized visually, and the visualization in this Energiecoöperatie workshop made a difference in the following aspects:

1. At the beginning of the workshop, it makes the workshop less serious and opens up the conversation.
2. It helps to focus the conversation to revolve around the research question, avoided the situation in which people talk a lot of things but lost focus.
3. People are all working on a same or similar thing, which can create a collective feeling, this is consistent with the goal of co-creation process and energy cooperate.
4. It balances the right of speech in a conversation, and may help to avoid or improve the situation in which one or two talkative persons dominant the workshop.

We also discussed the design process of this visual, several of his insights corroborated my earlier research findings. These findings illuminated the potential existence of a gap of visualization strategies, situated between visual knowledge and

visualization practices, which is frequently overlooked. As the workshop organizer, he has no training in visualization skills, so all visualization practices during the design process are performed by a visual designer (which is me). However, prior to entrusting me with the visualization task, he was able to provide me with an organized information packet. This document, while not extensively visual, clearly shows the main research questions of the workshop and the target information to be collected, and divides them into layers. This step before the visual designer picks up the brush is what he calls the 'conceptualization stage', which is similar to the stage of formulating 'visualization strategies' which I envision. He believes that although was not educated as a designer during his years of university, his work experience in a design faculty has given him the ability to conceptualize.

We discussed and agreed that the following components should be included in the 'conceptualization' or 'visualization strategies' stage:

1. Thinking about the audience of the visualization.
2. Information and visual hierarchy.
3. Goal of the visualization, and goal of communication/ research.

In other 3 visualization task that I took, I also discovered the consideration of possible types of visualization methods should also be included in the stage of formulating visual strategies, because most people who want to use visualization but feel that they don't have the skills often only see sketching or computer graphics skills which designers possess, while ignoring other possible methods for visual creation, which they may have easy access to. For example, image generating AI and stock image libraries.

4. Consideration of possible types of visualization methods.

The insight of the visualization strategies tool described above can be used in the all three visualization types in the LIFE project: visualization for mass-communication, visualization for co-creation, and visualization for dialogue. The organizational stakeholders who initiate the visualization project can all benefit from it.

However, the above-mentioned visualization strategy predominantly addresses the needs of organizational stakeholders. In the context of multi-stakeholder social projects, the participation of individual stakeholders is often substantial. While the overarching objective of the LIFE project and the organizational stakeholders within it underscores the significance of inclusivity, there remains a divergence in the weight of influence held by organizational stakeholders compared to individual stakeholders. Thus, it is necessary to develop a visual empowering tool to help individual stakeholders, which in the context of this project primarily comprises residents, local businesses, and small to medium-sized enterprises. This tool serves to amplify their voices, thus addressing a challenge inherent in visualization for co-creation context.

Based on the above discussion, visualization practices provide ideas of two possible concepts of visualization tool which can

benefit stakeholder communication, namely:

1. Visualization strategy tool for organizational stakeholders to create better visuals (Hereinafter referred to as VST).
2. Empowering visual tool for individual stakeholders to make their voice in multi-stakeholder projects (Hereinafter referred to as EVT).

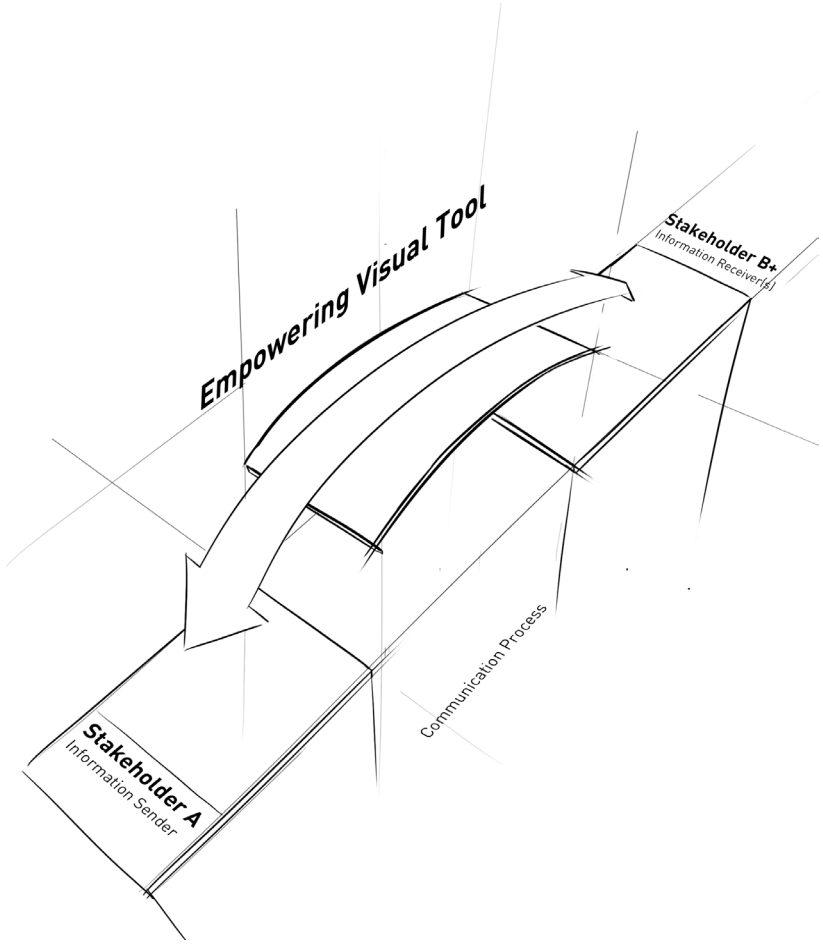


Figure 42. Synthesis direction II

Chapter 6 Visualization Strategy Tool

This chapter explains the design, testing and iteration process of a visualization strategy tool.

6.1 Introduction

As described in the end Chapter 5, a VST should include the following components:

1. *Consideration of audience*
2. *Consideration of elements and information hierarchy*
3. *Consideration of the goal of communication*
4. *Consideration of possible visualization methods*

In Chapter 4, I found that the strategy of establishing a common visual language can only be adopted when the information is less complicated. However, a VST is expected to be compatible with information with complex hierarchy. Therefore, a classification method to structure and analyze complex visualization is needed to design a VST. In this chapter, I started with the design of a classification method of visualization in multi-stakeholder projects. Based on the iterative development of this classification method, and insights from parallel EVT design, components of VST are developed and put together to assemble a modular tool which can guide organizational stakeholders to develop a visualization strategy. Later in the design process of VST, I found that the consideration of elements and information hierarchy is a function which could be better achieved through a co-creation approach. Therefore, it is moved to the next chapter as a part of improved version of EVT, Strategic Empowering Visual Tool (SEVT).

It is important to mention that, the developement process of VST and EVT is two parallel process, which happens simultaneously. But for the convenience of narrative, I describe it in two separate chapters. In this chapter I may quote insights from the development process of the EVT in Chapter 7.

6.2 Initial Classification

This initial classification was done at the early stage of this project, before the above-mentioned VST components were formulated. Initially, some visual resources (the outcomes of visualization) were categorized, yielding three distinct clusters. Subsequently, these clusters were named based on an amalgamation of the shared visual characteristics observed within each cluster. This process ultimately led to the formulation of a three-point classification of visualization: Intuitive Visualization, Assisted Visualization, Composing Visualization.

Subsequently, an expert interview was conducted to scrutinize this classification. I selected a professor specialized in design methods as the interviewed expert. Based on the interview result, I identified two inherent flaws within the classification:

1. From the perspectives of the visualizer and the viewer, a visual may concurrently fall into two distinct categories. While a visualizer may perceive low-complexity visuals as intuitive, viewers may find visuals with aesthetic color theme and intricate details more intuitive.
2. The lines between the three categories are not sufficiently distinct, making it difficult to discern whether certain visuals should be classified as Assisted Visualization or Composing Visualization.

After recognizing the above defects, I started again from the theoretical model of communication, with the consideration of both the visualizer and the viewer. the subsequent analysis and classification process unfolded as follows:

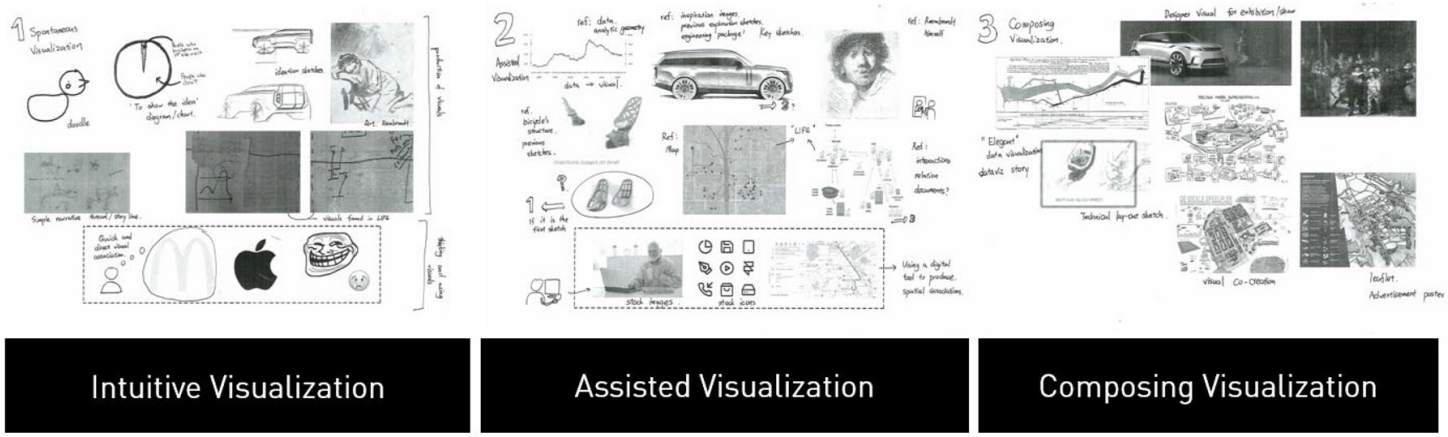


Figure 43. Initial Classification

6.3 VST Prototype I

Returning to a basic communication scenario, wherein a sender (A) and a receiver (B) are involved in a simple one-way communication process, we can employ Shannon-Weaver's Model of Communication (Shannon, 1948). In this context, the sender undertakes the task of encoding a message, which subsequently traverses through a channel. Finally, the receiver decodes the message, and receives its content. In a visual communication process, the act of visualization by the sender can be equated to the encoding process, while the receiver's interpretation can be equated to the decoding process.

Given that both processes necessitate cognitive engagement, the application of Kahneman's (2011) theory of fast and slow thinking becomes relevant in this context. This theory divides the thinking process of the human brain into a fast, automatic, unconscious system (system 1), and a slow, effortful, and conscious second system (system 2). Both the process of visualization and the process of interpretation can be through System 1 or System 2, respectively. Thus, we get four types of visual communication: System 1 visualization and System 1 interpretation (1-1); System 1 visualization and System 2 interpretation (1-2); System 2 visualization and System 1 interpretation (2-1); and System 2 visualization and System 2 interpretation (2-2), as shown in Figure 45. The intuitive visual communication solutions that we found in Chapter 4 can probably be placed in the area of 1-1.

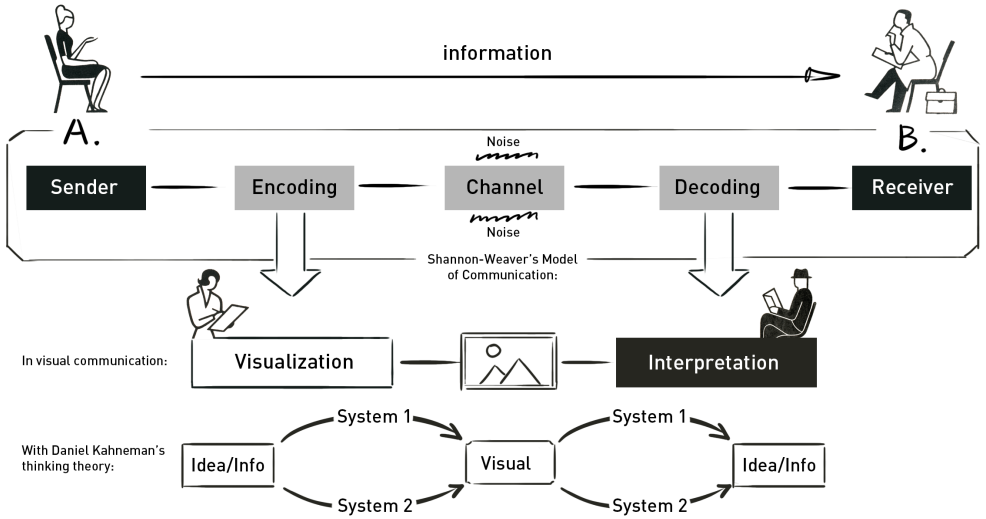


Figure 44. Shanon-Weaver's Model

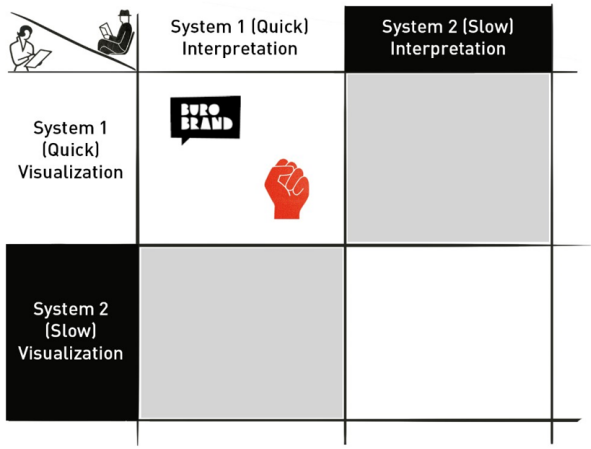


Figure 45. 2×2 classification grid

Considering the more complex and non-pure visual communication in multistakeholder scenarios, I expanded this classification grid, using several questions to make conditional judgments. First, sender A wants to deliver a message. We first determine "Can A immediately use a visual to express it?" If yes, then this process of quickly transforming an idea into a visual is intuitive visualization. If no, then we determine "Does A still try to visualize it? If yes, then this process is effortful visualization; if no, then this process is non-visual communication. Similarly, for receiver B, we can ask the following three judgment questions: "Can B interpret it immediately?", "Can B interpret it after careful study of the visual", and "Can B interpret it with additional information". Then we can get four classifications:
"Intuitive Interpretation", "Thoughtful Interpretation", "Assisted Interpretation" and "Failed Interpretation". Combining the three visualization forms and the four interpretation forms can give us a 3x4 table which includes 12 types of visual and non-visual communication. The classification process and grid are shown in Figure 46 and Figure 47.

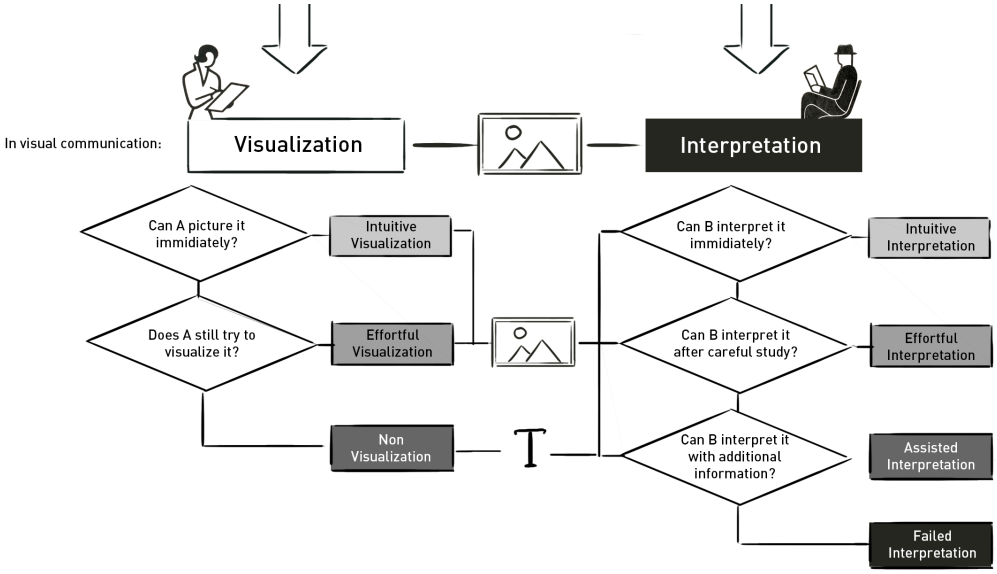


Figure 46. From theories to classification

	Intuitive Interpretation	Effortful Interpretation	Assisted Interpretation	Failed Interpretation
Intuitive Visualization				
Effortful Visualization				
Non Visualization				

Figure 47. 3×4 classification grid

6.4 Definition of Elements

Each element in the classification grid is defined as follows:

Visualization: Visualization is the transformation of (both internal and external) information into visual representation. It includes both the creation of visual representation, and the reuse of available visual resources. Compared with the Shannon-Weaver model of communication, visualization can be considered as the step of encoding in the communication process.

Interpretation: Interpretation is the process which includes the observation of visual materials, meaning extraction and comprehension. Compared with the ShannonWeaver model of communication, interpretation can be considered as the step of encoding in the communication process.

Intuitive visualization (iVis): Intuitive visualization is a quick and easy process of converting ideas into visual representations, without recourse to conscious composing and reasoning process. A typical example could be hand drawing a rough line chart to show a market trend or using smiley emoji in a social media application to express happiness.

Effortful visualization (eVis): Effortful visualization is a process that requires conscious arrangement of visual elements to form a specific composition or visual metaphor. A typical example might be based on a database, designing visual elements, and arranging them into a scientific piece of data visualization.

Non-visualization (nVis): Communication of information may not rely on visual media, such as purely verbal communication. In some cases, the sender may think that visualization is not the most convenient way of expression, or the sender does not have sufficient visual skills to perform visualization.

Intuitive interpretation (iInt): When the receiver can quickly extract and understand the visualized information, the process can be considered as intuitive interpretation. For the receiver, the visual material should be self-explanatory, and it can be understood without conscious reasoning.

Effortful interpretation (eInt): When the receiver cannot extract and understand the visual information at first glance, but can do it after careful reading and analysis, this process can be considered as effortful interpretation. For the receiver, the visual material should still be self-explanatory.

Assisted interpretation (aInt): When the receiver cannot understand the information only by relying on the provided materials, and needs additional information or assistance to interpret correctly, this process can be considered as assisted interpretation.

Failed interpretation (fInt): When the receiver cannot correctly understand the information that is being communicated, it is a failed interpretation.

Some visual explanation is added to the classication grid to make it more user-friendly, as shown in Figure 48.

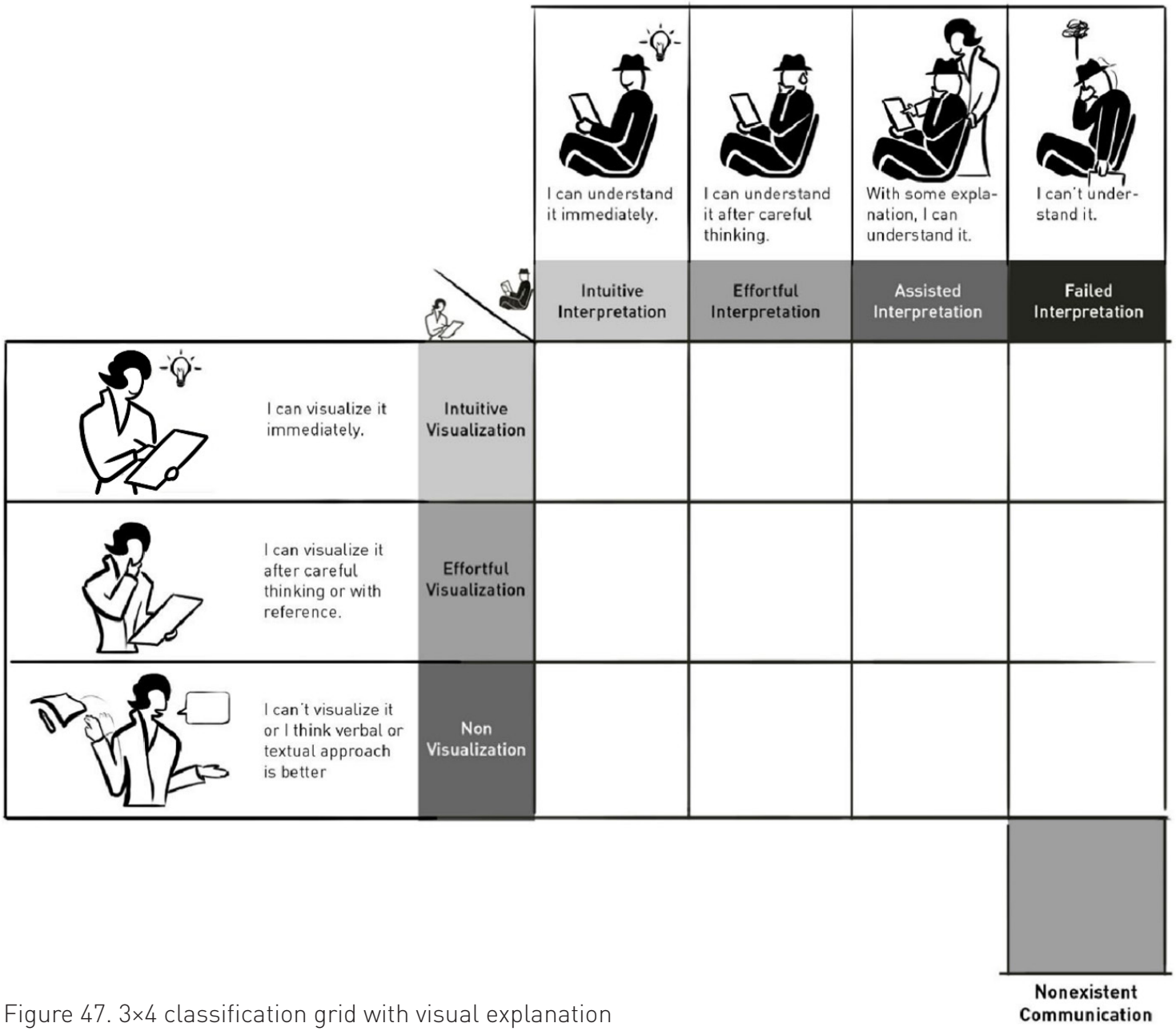


Figure 47. 3×4 classification grid with visual explanation

6.5 Test I

To operationalize this classification framework as a practical analytical tool capable of assessing real-world visualizations, a project centered on the design of an information visualization system within a multi-stakeholder environment was chosen as the testing ground.

Y (pseudonym) is a MSc. Strategic Product Design student of TU Delft. In her research project and graduation thesis, she is developing a remote monitoring and data visualization system for two key stakeholders: colorectal cancer patients and medical professionals (Sun, 2023). In that system, patient should be encouraged to record their daily activities, emotions and energy levels, then these data will be processed and visualized into two versions: one for patients' own reflection and commemoration. One for doctors' monitoring of patients' physical and mental health. This system may also have an influence on other stakeholders which may help the patients, which includes lifestyle coaches, fitness coaches, psychotherapists, support groups. Thus, it can be considered as a multi-stakeholder project, and lies within the scope of my research.

After hearing her ideas, I explained my visual classification grid and asked her to find a box which the current communication of those information fits. She thought that kind of communication does not exist now, but if we try to include it in the workflow of doctors without any product or services created by designers, it could be non-visualization combined with all kinds of interpretations, since patients and doctors would mainly verbally talk about their daily experiences.

After locating the current ways of communication. I asked her about the ideal form of communication that she is envisioning in her design. At first, she thought it should be in the box of intuitive visualization (patient record the information in a quick and effortless way) combined with intuitive interpretation (the visualized information should be easy to understand), because this form of communication (iVis-iInt) seems more advanced and more natural from designer's perspective. But after more in-depth discussion, she found there are different levels of information that need to be communicated, which could fit in the box of intuitive visualization combined with effortful interpretation (iVis-eInt). Because during a monitoring period of several months or more than a year, a large amount of information is usually generated. However, the overly simplified visualization method cannot display more in-depth information, but this information is very necessary for some patients. We also found that there might also be intuitive visualization combined with assisted visualization (iVis-aInt), since some patients want to use the visualization of their daily life data as a reference when talking to doctors. In that situation, patients need to assist the doctor to have qualitative and in-depth understanding of their situation.

After determining these three forms of communication (iVis-iInt, iVis-eInt, iVis-aInt), she then determined the graphical hierarchy and audiences of data visualization of the application that she is developing. She thought this viscom classification is a useful tool in visual communication design.

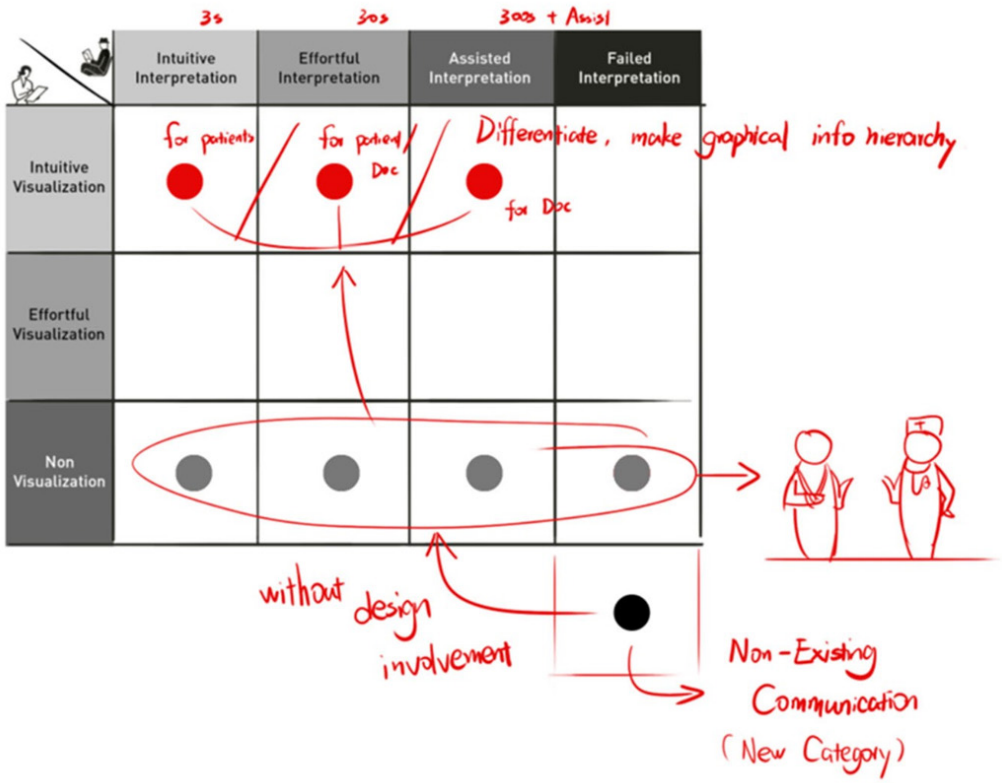


Figure 49. Sketches drawn when explaining the classification model

From this test with Y, I could also improve my visual classification grid: we discovered that designers may also design for a way of communication which is not existing now, this should also be included in the grid.

At present, this grid can already help to differentiate various possible visual and nonvisual information communication methods under a given context, but the interviewer should actively guide the interviewee to compare the advantages and disadvantages of the discovered communication methods to further choose a better solution, and divide the information hierarchy.

The updated classification grid is shown in Figure 50.

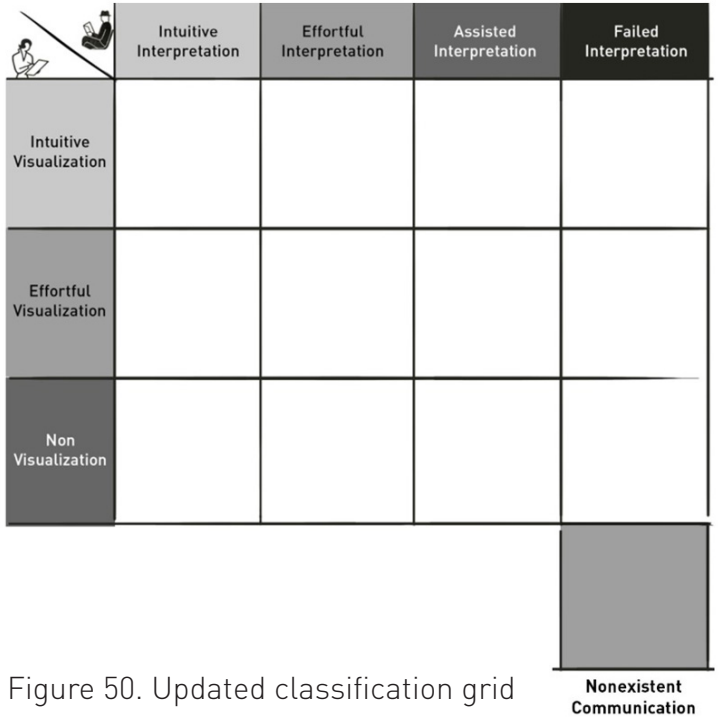


Figure 50. Updated classification grid

6.6 Iteration (VST Prototype II)

In light of the issues identified with the visual classification grid as outlined in the examination detailed in section 7.4, a round of design iteration is undertaken. The main directions of improvement are:

1. Although I try to use illustrations to make the visual classification grid more user friendly and understandable, it still cannot be used independently by the initiator of the visualization project, but requires constant explanations by the designer (me) during use. If I put the tool itself in the visual classification grid, it might fit in the assisted interpretation (aInt) grid. This kind of problem may be because its design starting point is purely theoretical. With the aim of enhancing the design, I revisited my sketches and explanatory notes utilized while interacting with users during the testing phase. During this re-evaluation, it became apparent that the inclusion of axes (without intervals) in the visualization might be more intuitive for users in locating their envisioned way of visualization. Simultaneously, providing some examples on the grid may also aid their comprehension.
2. At present, the classification grid can only facilitate users in contemplating information hierarchy and audience comprehension, yet it falls short of fulfilling the other two objectives of the VST concept: guiding users to think about communication goals and potential visualization methods. The former aspect is currently being discussed in the communication between designer and user, while the latter was not encompassed within the scope of the present testing phase.

Therefore, two main design objectives in this round of design iteration are:

1. Improve the usability of the design, make it more intuitive to users
2. Achieve all proposed functions of the VST concept

Analyzing the reasons for the poor usability of VST Prototype I, I found that it may be that it mixes two objectives into one table, Consideration of audience and Consideration of elements and information hierarchy. The user was able to find the visualization effect she wanted to achieve: Effortful visualization (eVis)-Intuitive interpretation (iInt), but then she did not know what to do with it. She was not able to differentiate between information in different hierarchies without the designer's guidance. In order to improve this, I plan to separately achieve these goals with different modules.

Starting with design for the simpler goal: consideration of audience. In the 4 visualization projects in Chapter 3, I tried to ask the stakeholder representatives to list the stakeholders that they would like to communicate with. In some projects, the target audience is already clear, but in some other projects, stakeholder representatives came to me without the consideration of audiences, with only an idea of making a more engaging visual. They need some guidance here.

In the analysis of stakeholders and types of visualization (in section 3.6), I discovered three types of stakeholders: individual stakeholder, organizational stakeholder, and

host stakeholder. The host stakeholder is the visualizer or sender of the visual information; thus, it is not considered as an audience. Organizational stakeholders can be divided into 'internal organization(s)' and 'external organization(s)', and the communication to individual stakeholders are sometimes mass-communication, but sometimes more targeted. Therefore, they can be divided into 'the mass' and 'individual(s)'. In the end, the audience may still be unidentifiable. This division of audiences are designed into cards, for the visualizer to play and select.

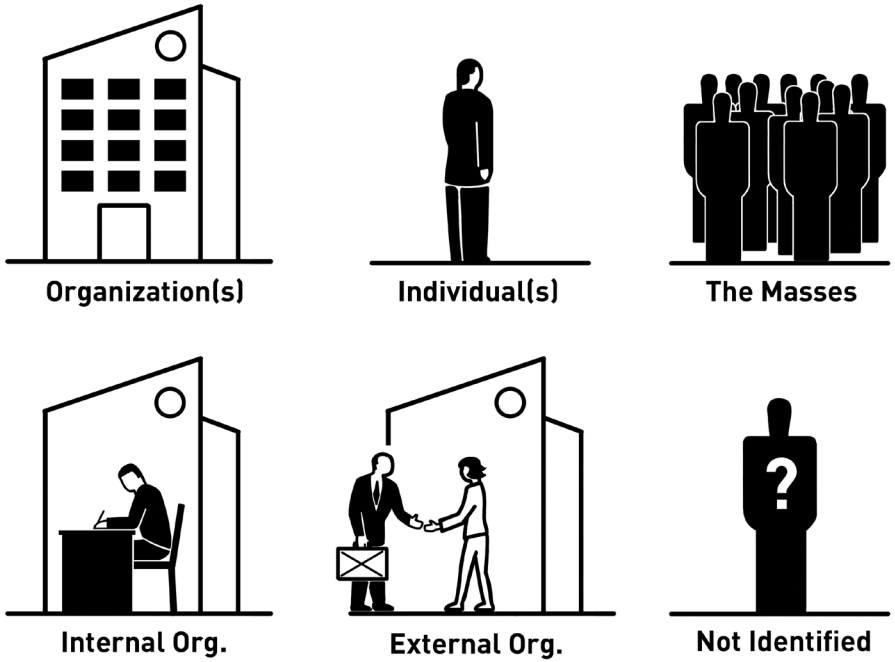


Figure 51. Audience cards

After Audience has been specified, it is necessary to guide the user to consider how their audiences might interpret their visual message. In the testing I found that the quadratic division of interpretation into intuitive, effortful, assisted, and failed also required additional explanation by the designer, which indicates that it is less intuitive for users. However, the user found the axis that I used for explanation is easier to understand. I first tried to use a slow interpretation – quick interpretation axis to distinguish the complexity of a visual.

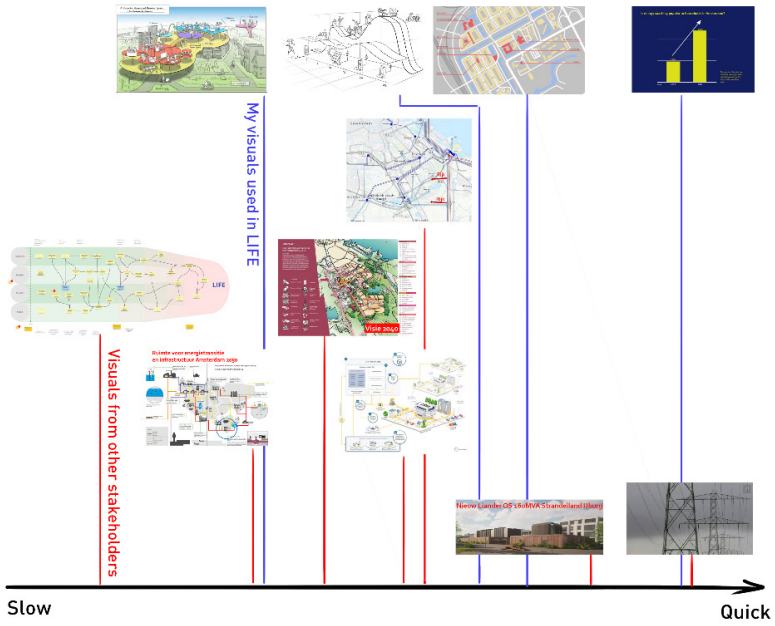


Figure 52. Slow - Quick Interpretation

As shown in Figure 52, I placed the visuals from LIFE stakeholders (with red lines) and my own visuals (with blue lines) that I made for LIFE onto the axis. Then I found only with this slow – quick axis, it is not enough to distinguish some characteristics of visuals. For example, although the image on bottom right (a photo of a transmission tower and cables) and the image on the top right (a simple data visualization with two bars) can both be interpreted quickly, the interpretation is still different. Inspired by a taxonomy of visualization by Hoftijzer (2023), which includes an axis of generative – explanatory – persuasive, I made another axis of open interpretation and closed interpretation.

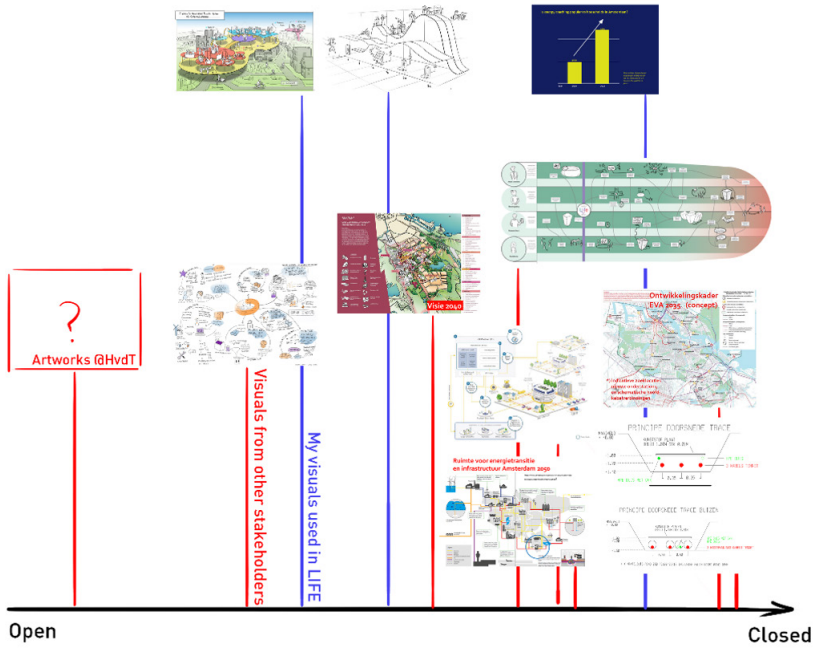


Figure 53. Open - Closed for interpretation

Similarly, I positioned select visuals originating from LIFE stakeholders and my personal illustrations along the aforementioned axis. Upon analysis, it became evident that the majority of images employed within the operational framework of the LIFE project are on the closed interpretation half of the axis. This observation underscores a technical attribute of the LIFE project. At the open end, there exists a vacuum due to the absence of visuals that readily align with an open-ended interpretation within a technology and application-oriented project. Typically, this segment is occupied by artistic creations. Given the exclusive domain of artworks on this axis, it prompted me to employ these two axes for distinguishing various types of visualization methods.
I combined the two axes to form a quadrant grid, and placed the visuals on it. And I found most of the visualization works in LIFE are positioned on the slow – closed quadrant. These visuals are mostly made by designers and engineers. The designer's drawings and graphic designs are more open for interpretation, while the engineering diagrams are more closed for interpretation. The category of designer's drawing fits in this quadrant, but it is also necessary to add 'engineer's drawings' in the category, since it is also widely used in LIFE.

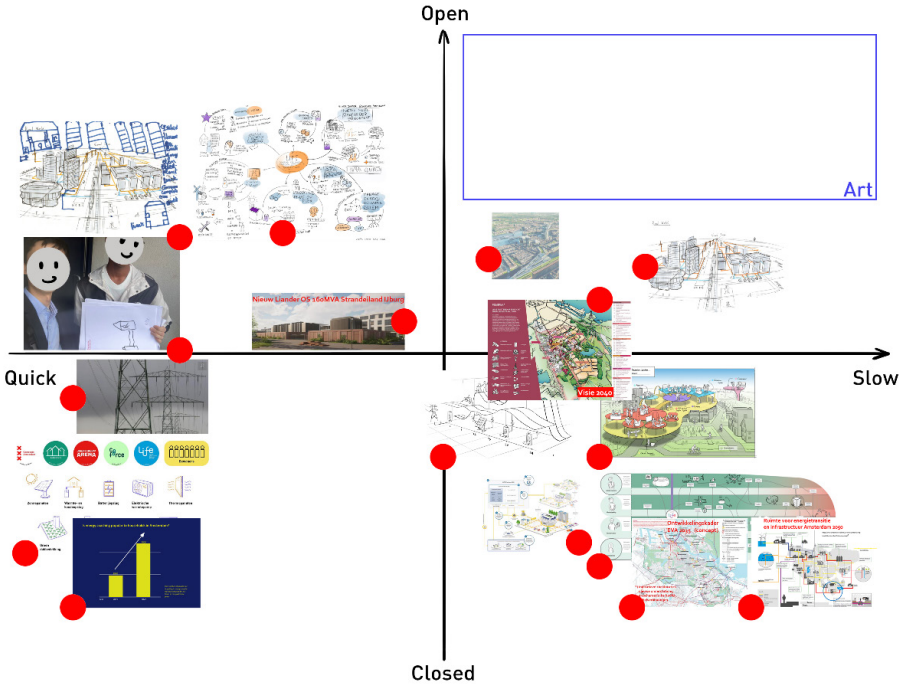


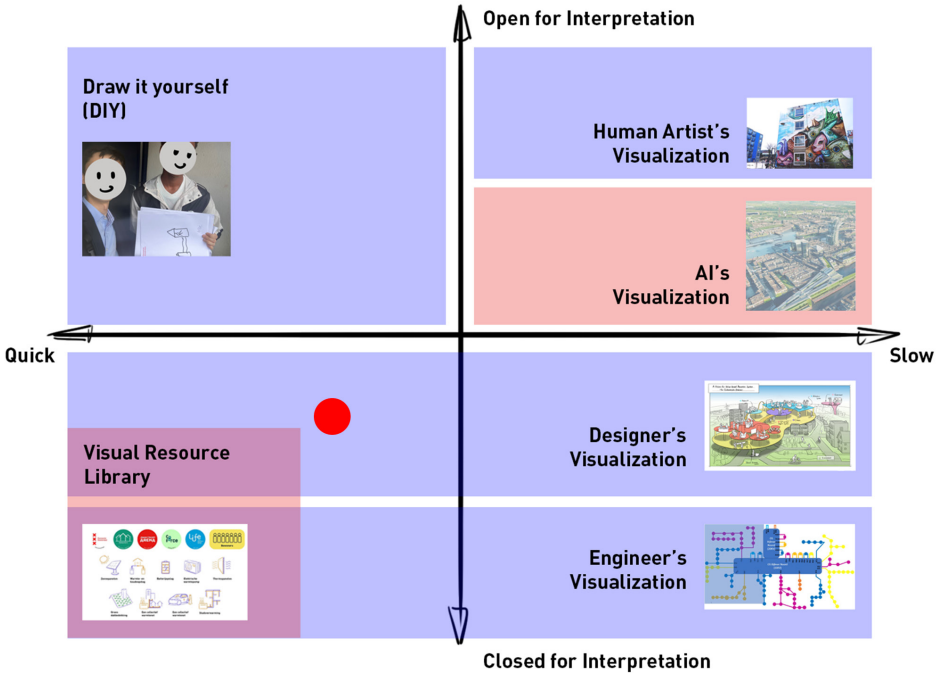
Figure 54. Interpretation quadrant

The two contextual visualizations used in the EVT design in the previous chapter are positioned on the slow – open quadrant, slightly above the middle line. As I explained in the previous chapter, this type of contextual visualization has the potential to be visualized using AI image generators. Above these two visuals there is a vacuum space. It is the territory of visual art, which is nearly absent from LIFE project. However, if there are future multistakeholder projects which may involve visual art, I argue that the top-right cover of this quadrant needs to be filled with artworks made by human artists, instead of AI generators. It is because human imagination are not limited by the existing visual database, while AI generations relies on existing images, and cannot be fully 'open for interpretation'.

Three images are positioned on the quick – closed quadrant, there is one stock photography, one set of icons, and one data visualization work. These images are reusable, or could be produced using resource libraries, which fits the category 3- reuse of existing visual resources, defined in Chapter 3.

Finally, in the top left quadrant of open – quickly interpreted visuals, most visuals are impromptu drawings. It is common in the work of designers, many ideation sketches during design process can fit in this quadrant. However, in LIFE project, the materials used in an open – quickly interpreted manner are less visual. In the co-creation workshops in LIFE, post-it with texts are more frequently used than drawings and images. In my research of the EVT, the visuals collected from participants can fit in this area.

After the above summary, we can draw the conclusion shown in Figure 55. This conclusion quadrant diagram can be included in the toolkit to guide stakeholder who seeks visualization in selecting the most suitable method of visualization.



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There are still two needs to be addressed with VST, namely 2- Consideration of elements and information hierarchy and 3- Consideration of the goal of communication. In the four visualization projects I did for LIFE stakeholders, these two needs were discussed after the first visual draft is completed. However, this discussion process is not structure, some stakeholder representatives can make valid feedback for further iterations, but some stakeholder needs many rounds of iteration and many versions of draft to finally decide the direction to go. Moreover, because of the resistance to drawing, sometimes they can only express their opinions in the form of words, but cannot give visual feedback. Therefore, in order for stakeholder representatives to actively participate in the visualization process, or to provide visual opinions to the designer (if a designer is involved), some tools need to be designed to help them to think and express visually.

In the EVT design and testing process, I found that contextual images can encourage stakeholders to express their ideas and actively engage in drawing. This type of visual can also be introduced in VST. However, the complexity of information processed in VST is higher than EVT. Sometimes it's not just fear and hesitation that prevent people from drawing, but complex systems really cannot be drawn without any assistance.

Considering the following characteristics of the LIFE project:

1. Multi-stakeholder
2. Technical
3. Social

I conceptualized three types of cards: 'player cards', 'tangible cards' and 'abstract cards'. These small cards are designed to be played on a larger canvas, the 'playground card'. The playground card is a contextual drawing. It can be drawn by a designer or generated by AI, depends on whether it is closed for interpretation or open for interpretation, and how realistic and structured it needs to be.

According to the previous interview of the Energiecoöperatie workshop facilitator, using visual player cards printed with logos, is no different to writing their names on a card. Therefore, these cards can be written by the facilitator right before the workshop.
Tangible cards are generally products, infrastructure, and projects that are often involved in workshops. These cards can be drawn in advance by the designer and then reused in different workshops. They cannot be completely replaced by text cards. But when new tangible objects are introduced into the project, one or two text cards can be temporarily added.
Abstract cards represent the relationship of elements. Cards of commonly used visual relationships can be prepared in advance and reused in different workshops. Since the drawing of abstract cards does not require sketching skills, workshop facilitators and participants who have no art or design training can also draw. Prefabricated abstract cards can also be made less refined to encourage participants to draw their own abstract cards. However, since designers generally have stronger visual thinking capabilities, workshops assisted by visual designers may be more productive.

This second half of the visualization strategy tool will be referred to as Strategic Conceptualization Tool. A overview of the VST is shown in Figure 56 on the next page.

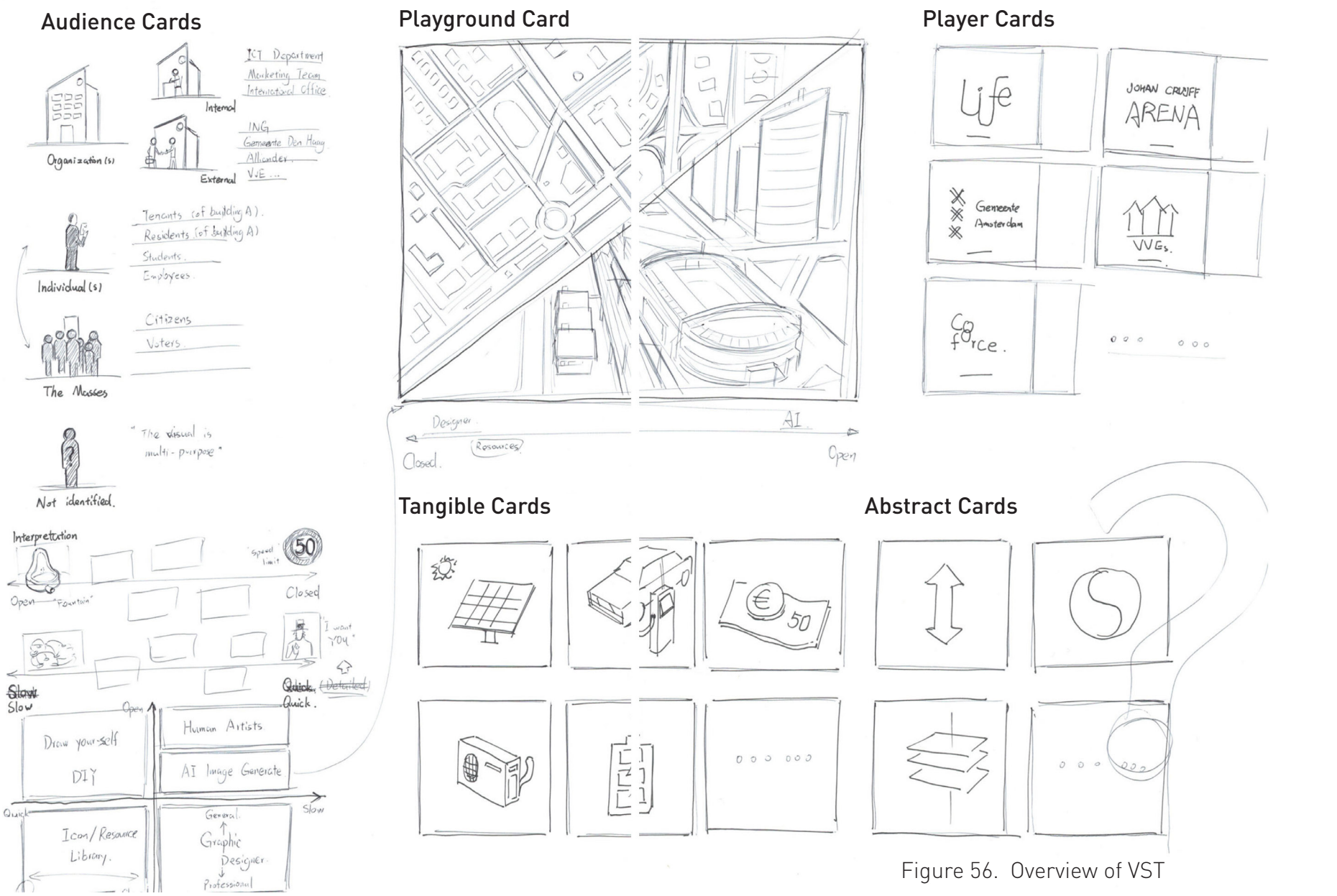


Figure 56. Overview of VST

6.7 Testing

In order to test VST and obtain user feedback, I contacted the LIFE Project Team using convenience sampling. VST is a tool for developing visualization strategies, which can only be used when there is a visualization task. The LIFE Project Team has a visualization task: visualize a Amsterdam Southeast Region as a future city, and show the role of LIFE project in the future city. This task can be divided into two parts. The first part is a future vision drawing about the future city. Since this part of the visualization can involve many stakeholders, it is suitable as a co-creation tool and a natural experiment for EVT. field. The second part is about the visualization of the role of the LIFE project. This part is mainly used to introduce the LIFE project to external stakeholders. It can be considered as a visualization for mass communication, therefore, I will mainly use this part of the task (Visualization of the role of LIFE project) as the test context of VST in this section.

Concept Testing

The test is divided into two parts, concept test and practical test. After getting the visualization task from LIFE Project Team, I showed them the concepts and components of VST in an online meeting and showed how to use VST in Photoshop. I recorded their feedback as I introduced VST. After the presentation session, a semi-structured interview was conducted. The interview started with the following questions:

1. Do you think the Visualization Strategy Tool is helpful for this visualization work?
2. (If helpful) Where do you think its greatest benefit is?
3. (If not helpful) What do you think you want the visualization process to look like?
4. I will be testing the physical prototype in the X building next week. If you come to use VST yourself, how would you like to interact with it?
5. What visual metaphors would you use to describe LIFE project?

The person who contacted me on behalf of the LIFE Project Team during this concept test was a researcher responsible for sustainable urban development. She believes that the VST is helpful in visualizing the role of the LIFE project. Its benefits are reflected in the following aspects:

First, it was an interesting approach and she hadn't worked with designers in this way before. And she gained some new perspectives in the process.

"I saw a lot of interesting images, but what made them special was that you asked me to arrange them to find where I wanted the visual effect, and it got me thinking..."

Secondly, she believes that she can gain a sense of participation in this process, which is different from the traditional way where the client provides a list of requirements, the designer makes a draft, and gets feedback from the client, which allows both parties to actively engage in visual ideas.

"If you can put this tool on the table, I think it will be super cool. It's like having a visual conversation with people, and everybody would be able to talk about their ideas..."

Regarding the question of how to interact with cards in VST, she noted that I used Photoshop to interact with digital cards in my demo, and that the drafts I built with several different cards could be fixed and saved very easily. This kind of fixation and recording is difficult to achieve if you only play around with cards on the desktop.

> *"It is good to have something like what you are doing in photoshop, things can be fixed and saved, not floating around the table but could not find its place in the end."*

Materialization

Before conducting practical testing, the first thing to do is to materialize the digital card system.

I received some suggestions during the concept test that can help materialize: users expect that the materialized VST can still move, fix cards, and record results easily, and pointed out that the move tool in Photoshop is a good reference example. However, Photoshop is not a tool that can be used by multiple people, and it requires some training to operate smoothly. Some online collaborative visual workplace tools similar to Photoshop, such as Miro, provide the possibility of multi-person collaboration. Miro has been fully used in LIFE projects, but checking the images created by stakeholders in LIFE on Miro are usually weak visual communications consisting of a large number of sticky notes. This may be because Miro provides convenient textual sticky note tool, but does not guide users to actively use other visualization methods such as pictures and hand-drawing.

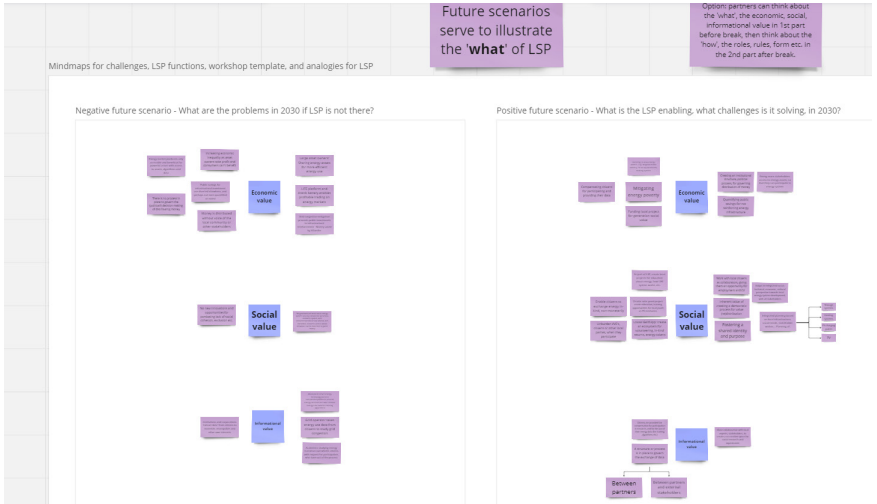


Figure 57. A Miro board in LIFE project

Compared with the sticky notes in Miro, real-life sticky notes encourage users to draw visuals on them. But sticky notes are more difficult to use with pictures because there is glue on sticky notes but not on printed pictures. And if you apply glue on the back of the picture, its stickiness is generally stronger than sticky notes, making it difficult to tear it off without damage and move it to another location like sticky notes. Another solution for using pictures and sticky notes at the same time is to use a combination of whiteboards, sticky notes, and magnets. However, office magnets are generally larger in size, and the number in the office is not large, so they are not suitable for situations where there are many or small pictures. Reused picture resources occupy a very important position in my scope of visualization and VST, so the

sticky notes system that is difficult to be compatible with pictures is not ideal in this design.

I found a suitable tool by tracing the predecessor of Sticky notes: push pins. Before sticky notes came along in the 1970s, people used push pins (invented around 1900) to pin images to cork boards. Push pins can be moved and re-pinned multiple times without losing adhesion, which is in line with the user's expectations for the physical VST function in the concept test. In Appendix III, I attached a list of the advantages of push pins compared to sticky notes, as support for the use of push pin systems.

After the function of moving and fixing cards was solved, I moved on to the materialization of all the cards in VST.

Firstly, two playground cards are sketched, based on the project context of city energy transition and engagement towards residents. The first playground card is a birdeye view sketch of the Amsterdam Southeast area, including landmark buildings of Bijlmer Arena, train station and Venserpolder residential buildings. The second playground card is a sectional drawing of a Venserpolder apartment and a typical home scene.

Secondly, the names of stakeholders are written on small paper pieces to make player cards.

Thirdly, the tangible cards are materialized, using the transcript from previous a workshop as the data source. I obtained the recording and transcript of the Battery Use Case workshop held

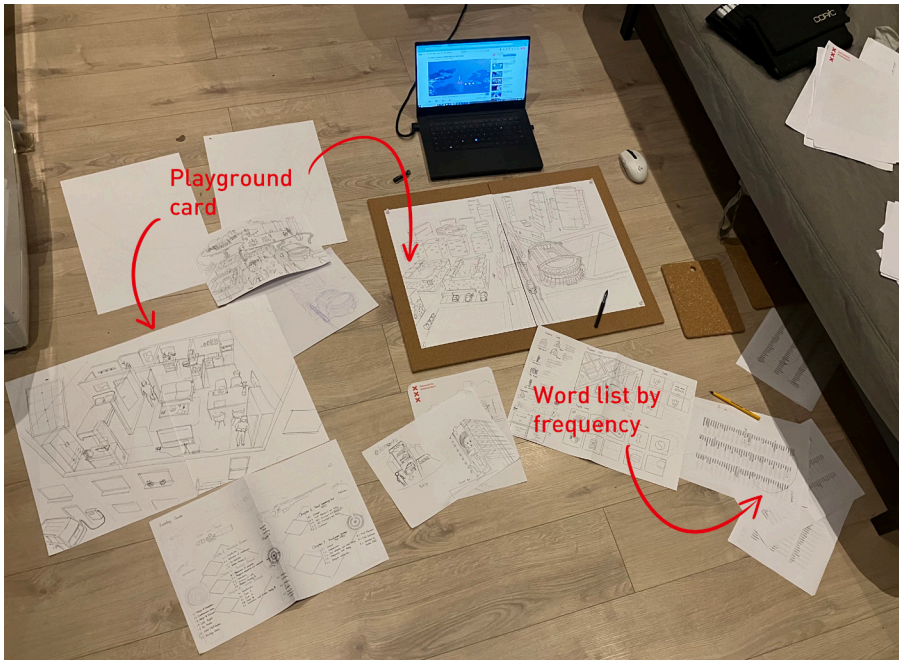


Figure 58. Materialization of VST cards

on March 28, 2023 from the database of the LIFE Project IDE team. The reason for choosing this workshop is that various stakeholders presented at this workshop. I also observed this workshop in person, so I could ensure the accuracy of the keyword list with my observations of the workshop. I then used a word frequency statistics tool to list all words that appeared more than 5 times. Intangible words were removed and synonyms were

merged, and the remaining words were visualized in the form of hand-drawn icons.

Lastly, I used several visual metaphors of LIFE project that I obtained from discussions with stakeholder representatives during the concept testing stage as abstract cards.

Practical Testing

With the materialized VST finished, I scheduled a practical test with the LIFE project team. Two participants from LIFE project team participated in the test. Their roles in the LIFE project are project manager (Participant A), data analyst (Participant B).

According to the task of 'visualization of the role of LIFE project in the future city', I formulated some provocative questions to guide users to interact with VST:

1. *How will you visually describe the relationship between LIFE social platform and LIFE technical platform.*
2. *How does the LIFE project communicate with external stakeholders?*

Please use the templates, cards, push pins, markers and other tools on your desktop to answer the above questions.

Along with the questions, there is a brief description of the definitions and functions of different types of card in VST. This testing session takes 30 minutes (10-minute introduction and 20-minute operation), during which participant's interaction with the prototype is observed. After that, I arranged a 30-minute reflective focus group meeting to get user feedback on the VST prototype.

From the observation of the interaction process between users and VST, I found that participants were particularly interested in abstract cards. They discussed many times which abstract card should be used to describe the relationship between technical platform and social platform, and finally reached a conclusion that all the abstract cards provided in VST can be

Figure 59. Practical testing session

used as a visual metaphor to represent the relationship between two platforms, but the selection of these cards depends on perspectives.

Participant A said: "From the perspective of LIFE, the two platforms seem to be merged together," with the abstract card with a yin-yang shape. He then picked up the square with the arrow, "However, some people also You might be more inclined to use this kind of image to understand the problem." Participant B said: "Yes, the technicians might...". In the end they concluded: "We should take them to different stakeholders, it will definitely lead to interesting discussions".

During the 20-minute operation, the participants mainly had some discussions around the visual materials I provided, but did not make full use of all the visual cards I provided to build the vision. This means that more time is needed to complete the construction of a complex visual. But it may also be because the LIFE Project Team, as the core team that coordinates all stakeholders in the LIFE project, always needs to consider many perspectives, and they bring these perspectives to the discussion, so they need more time to come up with a unified consensus and move on to the next step. At the end, they also recommended that I arrange another testing session with other stakeholders.

The subsequent reflective discussion also gave me some extra insights:

Participant A pointed out that since the tool is not specificly designed for visual thinkers, it might need to be tested with less-visual thinkers:

> *"I think myself, I am a visual thinker, and I enjoy using this tool, but you may need to prove whether it works for others"*

Participant A also expressed that from project management perspective, he expect the tool could generate feedback from the audiences of the visual communication:

> *"Let's say, we go through all these steps, and in the end we can get a beautiful drawing and use it for advertising..., mass-communication. But what happens then? Is there an arrow going back to us?"*

> *"Yes, a co-creation tool, I want to use these beautiful drawings in co-creation, and I think they can generate some good feedback"*

Finally, he drew three rough data visualizations to illustrate to me the three technical goals that the LIFE project hopes to communicate to external stakeholders: the daily energy demand curve, the heating demand and solar supply curves, and the future energy demand and supply curves of Amsterdam Southeast area. This made me notice that the context of the LIFE project is not static, but changes over time, which I did not take into consideration when drawing context card.

Conclusion

During the testing process, the most important insight I discovered is that VST has a tendency to be developed into a co-creation tool. From the user's perspective, they expect a visualization tool to not only create visualizations for them, but also to receive feedback from other stakeholders. From an interaction perspective, the interaction between users and VST is itself a kind of co-creation, especially the conceptualization tool.

At this point, VST is no longer just a tool for visualization for mass-communication (VfMC). This reflects that in multi-stakeholder projects, communication itself is generally two-way, and stakeholders are also looking forward to a kind of co-creation.

Currently, VST can be mainly divided into two parts: Audience and Interpretation part, and Conceptualization part. Since the Conceptualization part has the nature of visualization for co-creation, I incorporated it into the Empowering Visual Tool (EVT) for further testing.

After splitting, the Audience and Interpretation part can still work independently as a tool to guide users to formulate a visualization strategy, so I regard this part as the final result of VST. In order to make VST replicable in other Multi-stakeholder projects, I made a VST guideline, which can be found in the Appendix I.

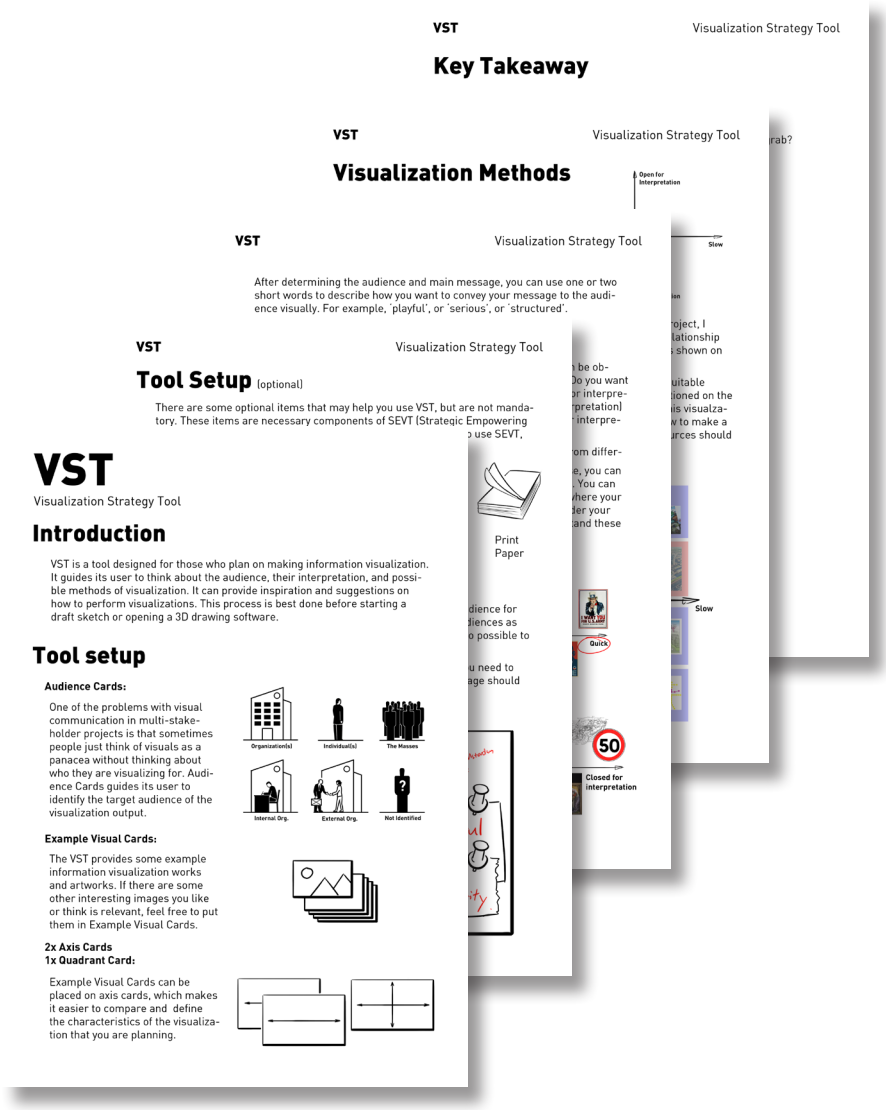


Figure 60. VST guideline

Chapter 7
Empowering Visual Tool

This chapter explains the design, testing and iteration process of an empowering visual tool.

7.1 Introduction

The dvelopment of the Empowering Visual Tool started with the design objective:

> *Empowering visual tool for individual stakeholders to make their voice in multi-stakeholder projects.*

I first took inspiration of some elements from the visualization practice, and designed a prototype with a small library of visual materials, which aims to help residents to start the conversation about future city. Test result proved that it can successfully encourage participants to talk about their needs and visions, but limited the scope of the conversation.

In response to the shortcomings of EVT prototype I, I planned to introduce AI into EVT concept II to reduce the subjective bias caused by manual drawing of topic picture cards, and designed a workflow for batch generation of topic pictures using AI through expert interviews. However, in the process of building this workflow, I found that the AI generator is insufficient in sensemaking capabilities.

Since the path of AI is currently stalled, I re-examined the empowerment method I used and found that it could not give participants enough freedom of expression. Therefore, I started the design of EVT Prototype III. In this Prototype, I gave participants a contextual image related to the research topic. Participants can draw their own ideas on this visual template. Tests have shown that contextual images do have the ability to encourage participants to engage in drawing.

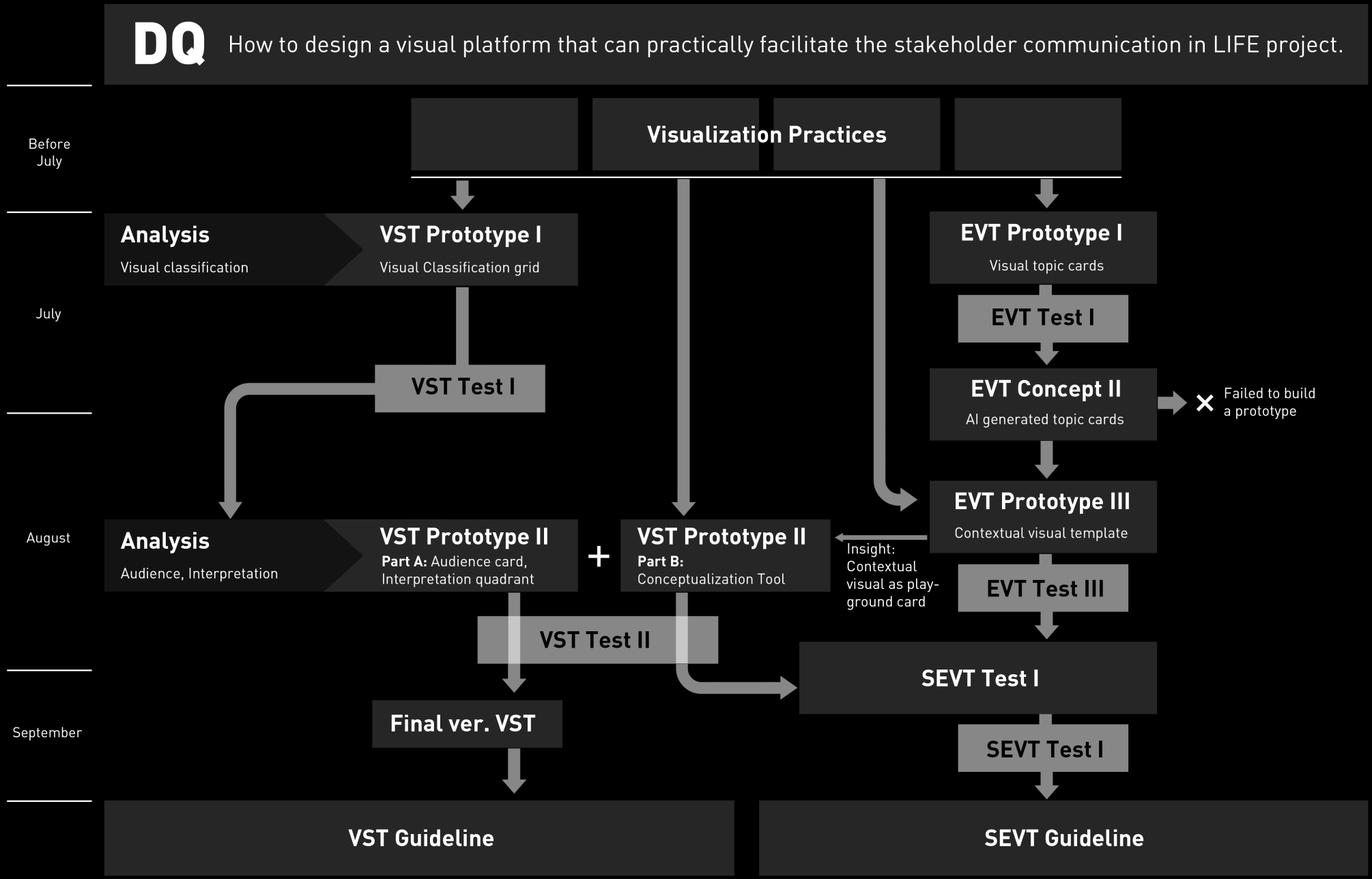
At this stage, EVT is still just a simple tool for individual stakeholders (residents or citizens). But the conceptualization tool that was previously part of the Visualization Strategy Tool (VST) showed its co-creational potential during the testing process, so this part was transferred to EVT to form the Strategic Empowering Visual Toolkit (SEVT), which I ended up working on in a It was tested in a multi-stakeholder workshop. Finally, In order to make SEVT replicable in other Multi-stakeholder projects, I also provide a SEVT guideline.

It should be noted that although Chapter 7, which describes the EVT design process, comes after Chapter 6, which describes the VST design, EVT was not developed after VST. The development of the two is carried out simultaneously, and there is sometimes exchanges of insights between the two. In order to help readers understand the relationship between the two development processes, I provide a reading guide of research diamond here (on the next page). The reason why this reading guide is placed here instead of at the beginning of the paper is that after finish reading the development process of VST, readers can consider it as a baseline, making it easier to understand this reading guide that describes the relationship between VST and EVT.

Reading Guide

Research diamond (Chapter 6, and 7)

DQ How to design a visual platform that can practically facilitate the stakeholder communication in LIFE project.



7.2 Case Context

After determining the two possible directions of the basic concept, I looked for a visualization project within the LIFE project that could serve as a comprehensive testing ground for these two conceptual notions. I received a task from the Project lead of Stakeholder Engagement of LIFE, the main objective is to visualize the future city (Amsterdam Zuid-oost Area) and the role that the LIFE project plays within this urban context.

I assert that this visualization project serves as an ideal testing ground for these two concept directions due to the following rationales:

1. The topic of future cities is relatively open and suitable for co-creation with individual stakeholders. Thus, it can be used to develop and test an EVT.

2. The project demonstrates a considerable degree of diversity in terms of audience, elements, and hierarchy of information, making it suitable for the design of a VST for organizational stakeholders. It should be noted that complex visualizations are not necessarily superior to simple ones, but addressing complexity constitutes a pivotal concern within the realm of visualization design in multi-stakeholder projects. Moreover, visualization tools capable of accommodating complicated information will also exhibit a certain level of compatibility with less intricate visualization projects.

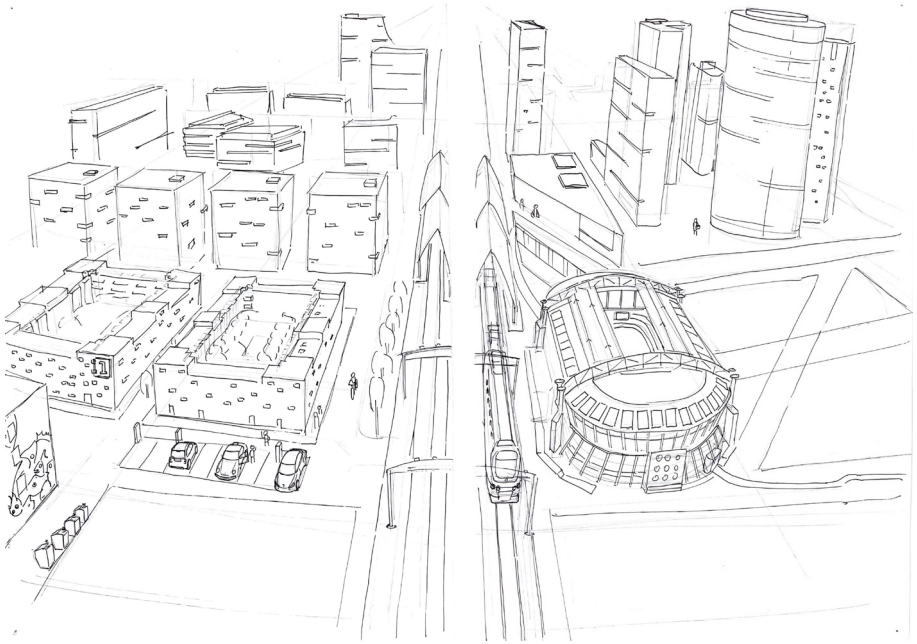


Figure 61. Amsterdam Southeast

7.3 EVT Prototype I and Testing

In order to co-create a vision of future city with individual stakeholders in LIFE project (in this section mainly residents), I designed the following research and prototype, and did a street test in Venserpolder area, Amsterdam Southeast.

1. Many Dutch painters are famous for drawing city (or village) scenes, showing the daily life of various people. For example, Pieter Bruegel the Elder is famous for his genre paintings of peasant life scenes. A more modern example could be Theo van den Boogaard, with his chaotic visual depiction of Amsterdam city. If a painter is going to draw a scene of the Amsterdam Southeast area in the year of 2030, what elements do you think will be in it?

2. You can choose one of the following questions and draw whatever appears in your mind:
   - *If your home is in the painting, how would you imagine it?*
   - *If you are in the painting, how would you imagine yourself?*
   - *Is there anything you want or need in the district?*
   - *What do you think should be changed in the district?*
   - *What do you think should be preserved in the district?*

3. If you don't feel comfortable drawing, maybe you can find some inspirations in the Card of Examples. Is there anything that resonates with you, and can you give some explanation?

The idea of using a Card of Examples as an inspirational tool came from a previous local resident co-creation session (Energiecoöperatie workshop), in which I visualized some energy infrastructures and equipment on a series of cards. These cards are used as 'player's items in inventory' in the gamified workshop, as shown in Figure 62. It is proven to be an effective conversation starter and facilitation tool during the session.

Figure 62. Item cards from Energiecoöperatie workshop

The questions are printed on a paper in both English and Dutch, attached with example visuals: a painting of Pieter Bruegel the Elder ('Dutch Proverbs'), a painting of Theo van den Boogaard, and a Card of Examples (containing city elements drawn by me). All the interview materials are shown in Figure 63. Empty print paper is also provided for respondent to draw on.

I visited the Venserpolder area on the afternoon of July 31, 2023, and randomly selected 10 local residents as respondents. Their information is shown in Table 1, with pseudonym generated by random name generator. In the end, only 2 respondentss agreed to draw and gave me their works, but most of the participants responded to the Card of Examples I provided.

Number	Pseudonym	Gender	Draw	Respond
1	Skye	M	Yes	No
2	Skylar	F	No	Yes
3	Logan	M	No	No
4	Jordan	M	No	Yes
5	Cooper	F	No	Yes
6	Aiden	M	Yes	Yes
7	Nash	M	No	Yes
8	Marshall	M	No	Yes
9	Robin	F	No	Yes
10	Tyler	F	No	Yes

Table 1. Participants EVT test I

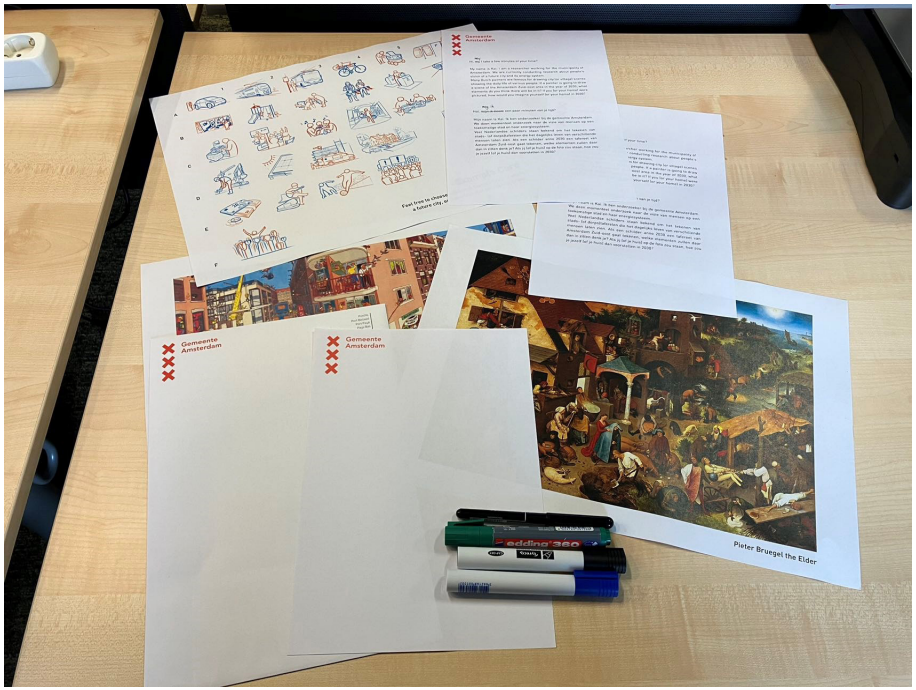


Figure 63. Interview Material

The results show that Question 1 may be a relatively broad question. Only one respondent (Number 2) immediately answered 'Gardens, we need more green', while the rest fell silent or said 'I don't know' or 'that's a difficult question'. After being asked if they could show their vision of the future city by drawing, all the participants expressed their resistance or hesitation to drawing, such as 'I am not a good drawer' or 'I can't draw'. I tried to draw a few scribbled sketches by myself as examples to explain that this interview does not require beautiful artwork, any impromptu hand drawing is welcomed. But in the end, still only 2 respondents agreed to make a drawing. Remarkably, the two individuals who willingly agreed to draw happen to be the youngest and eldest respondents among the entire group of ten participants. This intriguing observation raises the possibility that the prevalent resistance to engaging in drawing activities among the other respondents could stem from a prolonged lack of creative activities and visualization practices over years.

One of the participants, identified as Respondent Number 3, candidly expressed reluctance towards drawing, citing concerns that his drawings might look 'childish.' This apprehension can plausibly be attributed to the prevailing notion that drawing practices are often confined to the stage of elementary education. Subsequently, the prolonged detachment from such creative expressions may make the act of drawing unfamiliar, thereby resulting in discomfort and hesitancy. Furthermore, respondents may struggle with the idea of using child-like drawing style as an adult in serious research is not appropriate, which might evoke feelings of unease and reluctance to embrace

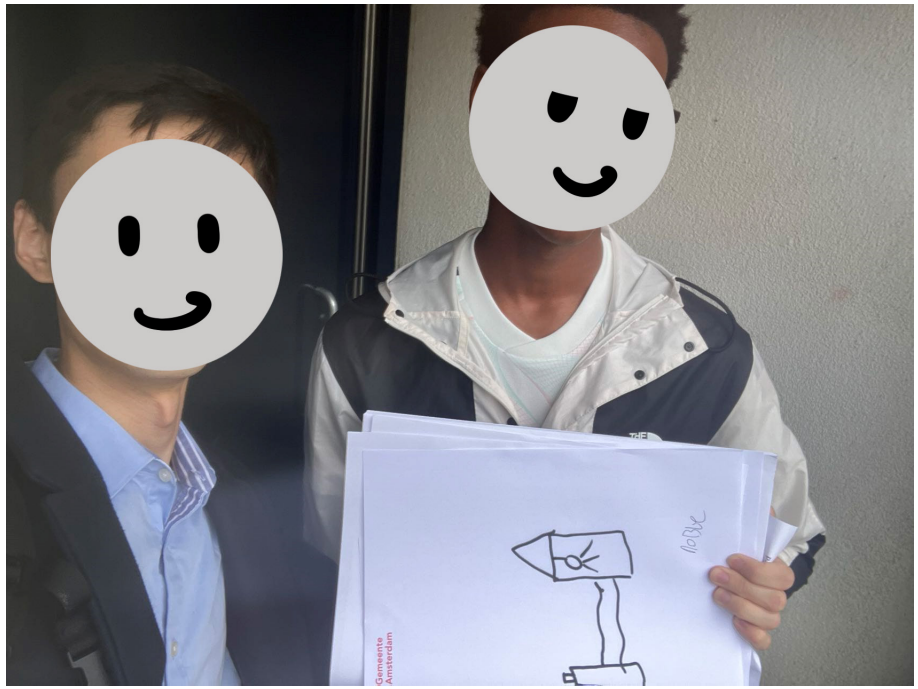


Figure 64. A participant with his drawing

drawing wholeheartedly. One the other hand, it is important to acknowledge certain limitations inherent in the interview test, which might have potentially impeded the respondents' inclination to engage in drawing. As the test was conducted in public spaces, including streets, residential areas, and shopping districts within the Venserpolder district, the surrounding environment might not have offered an optimal setting conducive to the interviewees' ability to comfortably sit down and focus on the drawing tasks.

In Question 3, the introduction of Card of Examples led to some more in-depth conversation, as compared to Question 1. Respondent Number 2 displayed a degree of defensiveness when responding to Question 1. Rather than providing a direct answer, she inquired, "what do you want from me?" and "What are you going to do?". After a thorough explanation of the project's rationale and privacy policy, despite expressing trust, she maintained her stance of withholding an answer by stating, "I cannot give an answer". However, after seeing Card of Examples in Question 3, she immediately selected two elements that she thought were the most important, namely A6 (parking space) and C5 (family dinner). And explained to me the difficulty of parking in the Venserpolder District in detail: during the football matches at the nearby Bijlmer Arena, a large number of fans would irresponsibly leave their cars on the side of the road in the residential area, making it impossible for her and her neighbors to park after getting off work.

On the other hand, although effective as a tool to facilitate dialogue, Card of Examples drawn by a skilled visual designer may hinder the willingness of drawing from the respondent, or create restrictions on the freedom of dialogue. Respondent Number 1, upon viewing the provided materials, including painter's artwork and my Card of Examples, said 'I can't draw something like this, never'. Only through a prompt on-the-spot explanation, accompanied by a quick and unrefined sketch showing that artistic drawing skills were not a required, did the respondent agree to engage in drawing. Furthermore, it is essential to recognize that the visual materials possess a certain guiding influence on the conversation. My Card of Examples, developed as a quick prototype, could not offer a comprehensive reference encompassing the extensive theme of 'Future City.' However, during the test, despite the majority of respondents resonating positively with the provided examples, the ensuing discussions remained confined to the topics provided. Consequently, it became evident that the presence of the Card of Examples exerted a perceptible influence on the scope and trajectory of the test.

Key insights:

1. Many people are afraid to draw, probably due to their worries about lack of visual skills.
2. A series of visual topic cards drawn by a designer can be an effective conversation enabler for workshop and interview participants.
3. Visual topic cards with pre-defined topic may have an influence on the scope and trajectory of the interview and workshop.

7.4 EVT Concept II

Starting from the insights drawn from the first round of prototype testing, I can draw the following design directions:

1. Most people have a resistance to drawing during research. People can be encouraged to draw by some sort of incentive, or a design that tempers the seriousness of the research context. It is also possible to use an example card/template instead of requiring people to conduct on-site sketches to encourage people to participate in visual-assisted research.

2. Although a designer's hand drawing can be an effective conversation enabler, it takes a long time and costs to hire a designer to draw. Among the four visualization methods (Designer, AI, resource, DIY) mentioned in Chapter 5, AI and resource ready to use may be more suitable for this context.

3. The test proves that people rarely talk about things outside the topic provided on the visual example cards. The starting point of the production of these example cards is the subjective understanding of a future city from the visual designer. Therefore, the subjective bias of the designer may have a influence on the research process and participants. The starting point of visualization can be changed to a more objective database with a larger sample size.

Since keywords such as data and AI gradually emerged in possible design directions, I conducted an expert interview with a data scientist (from the Faculty Electrical Engineering, Mathematics and Computer Science, TU Delft) and a design researcher who worked extensively with data scientists (from the Faculty Industrial Design Engineering, TU Delft).

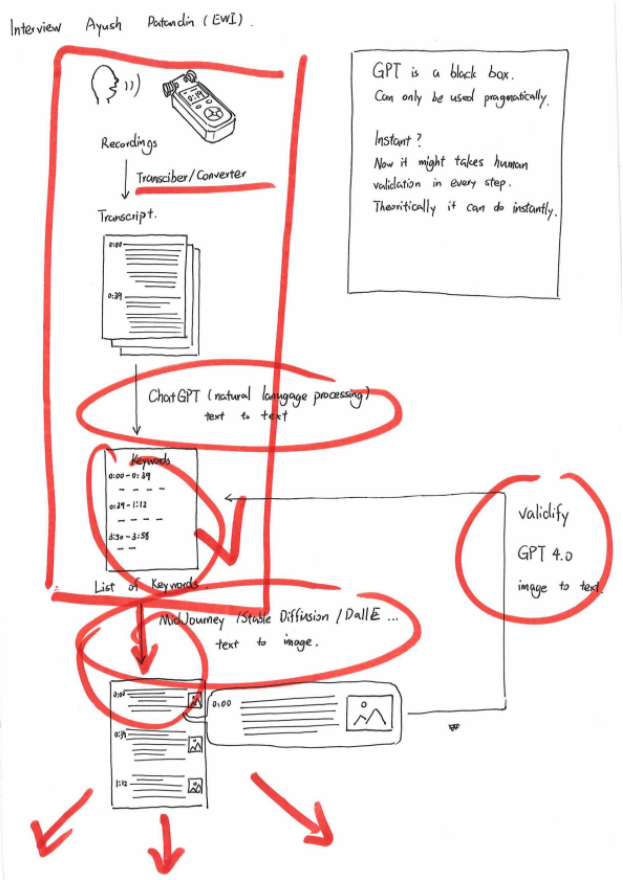


Figure 65. A page of expert interview note

Key insights from the expert interview:

1. In considering the notion of employing objective materials as the starting point for visualizations to mitigate subjective biases of designers and researchers, one feasible approach is topic modeling. However, a prerequisite for this approach is the availability of naturally occurring, researcher-independent discussions pertaining to the research subject as a data source. Typically, topic modeling would leverage discussions from online forums as the data source.

2. Presently, Topic Modeling is typically executed through unsupervised machine learning techniques, which may involve methods such as Latent Dirichlet Allocation (LDA), Latent Semantic Analysis (LSA), Non-Negative Matrix Factorization (NMF). However, the initial outcomes generated might be entirely nonsensical, necessitating iterative adjustments to both the model and the list of keywords before obtaining a usable set of keywords.

3. After obtaining a logically coherent set of keywords, this collection can be fed into a natural language processing AI (such as ChatGPT) for the purpose of interpreting these keywords. The outcomes of this interpretation can then be fed to an image generation AI (such as Midjourney) for the creation of visual imagery.

4. Given that the GPT model has acquired the ability to interpret images after its upgrade to version 4.0, it is feasible to utilize GPT 4.0 to generate description of the AI visualization outcome. By assessing the congruence between these descriptions and the original set of keywords, the accuracy of the generated images can be validated.

5.This entire process can theoretically be realized instantaneously, but before a product that can realize this process instantly is designed and packaged, it takes a lot of time to make adjustments at the code level.

During this interview, the experts confirmed the feasibility of a set of workflows integrating Topic Modeling AI, Natural Language Processing AI, and Image Generation AI. But they also emphasized the level of complexity in the development of such a system. As a design project, it is possible to bypass the algorithmic aspects and instead utilize currently user-oriented AI interfaces, employing a simplified workflow to construct a Minimum Viable Product (MVP). This approach allows for testing the system's usability within actual contextual scenarios.

At this stage, the design vision of the entire visualization process is shown in the image on next page, which includes both EVT (tool for co-creation) and VST (tool for mass-communication). The interviewed experts confirmed the theoretical feasibility of the EVT workflow in this process visualization.

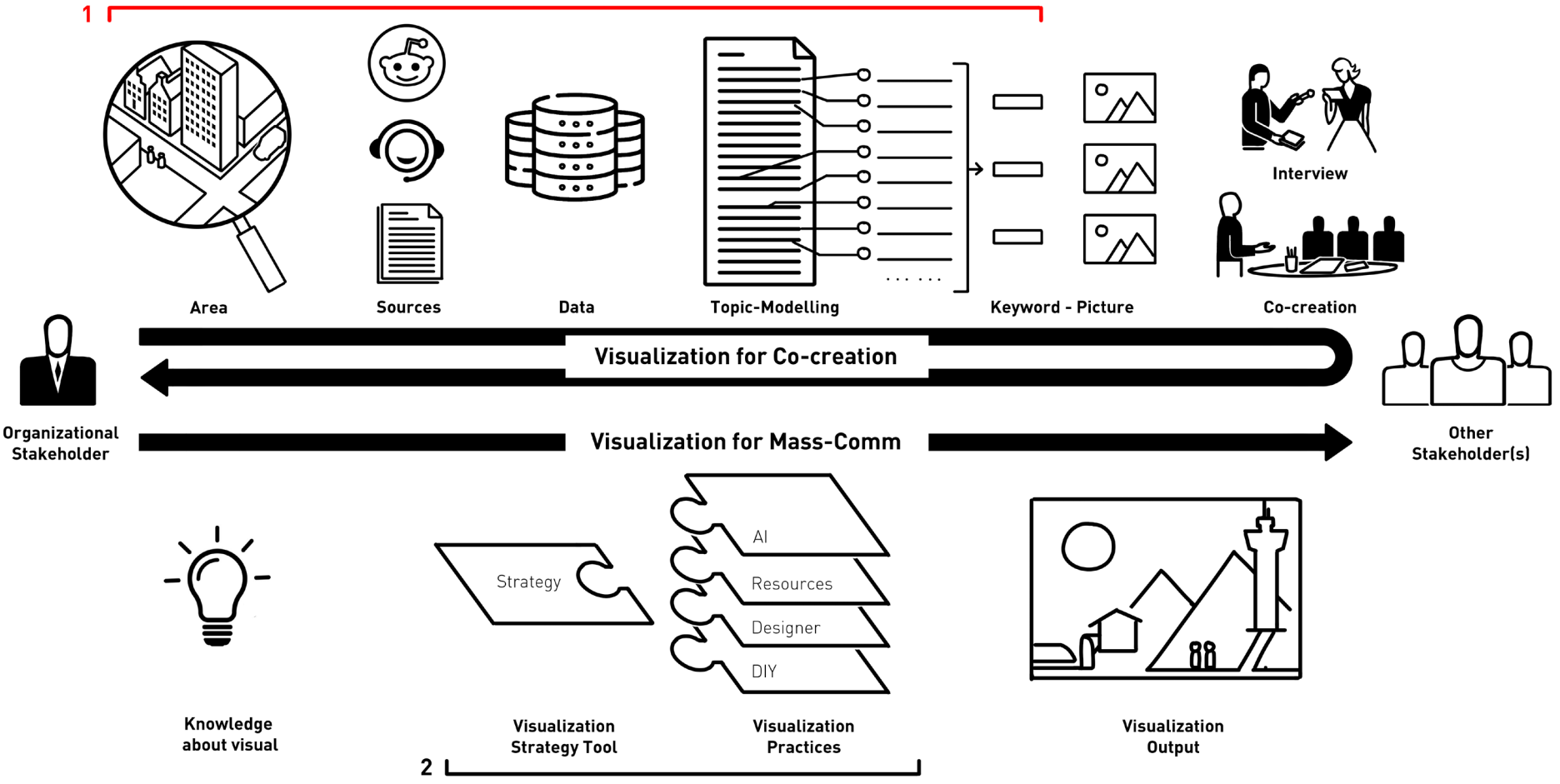


Figure 66. The process of EVT and VST

In order to bring the concept to testing environment, I simplified and adapted the previously described "visualization for co-creation workflow" from the previous section, transforming it into a prototype that is workable under the current experimental conditions.

The major changes are:

1. Although the Top Modelling Process serves as a crucial data source for visualization in research, it becomes relatively less significant in the experimental testing of a visualization tool. Therefore, it can be simplified and omitted for the purpose of this experiment. In order to mitigate subjective bias, I employed Chatgpt to generate 20 keywords pertaining to the future city, serving as the data source for visualization.

2. Due to my limited expertise in coding and the lack of Premium Access to the AI platforms involved, which is essential for processing large volumes of text and images, the entire process cannot be automated at present. Nevertheless, the entirety of the process can still be executed incrementally through manual operation using AI applications equipped with user interfaces.

The adapted workflow for testing is shown in Figure 67.

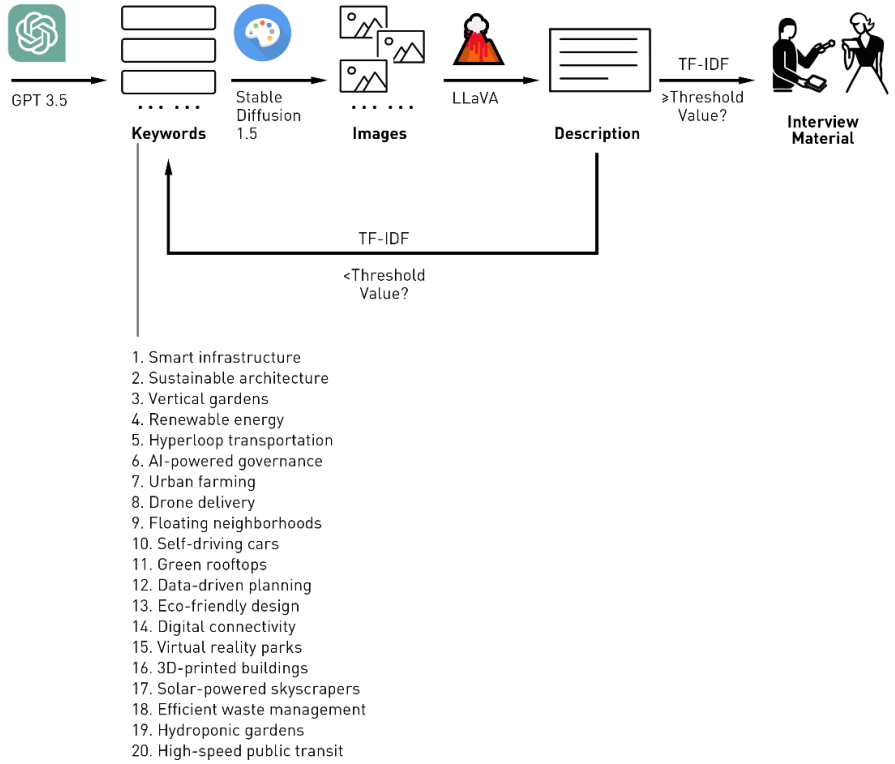


Figure 67. Adapted workflow of EVT II

However, in attempting to utilize Stable Diffusion for generating the list of 20 keywords about the future city provided by ChatGPT, I encountered some technical issues.

I observed that despite the 20 keywords generated by ChatGPT do not contain complicated relationships, the image was generation AI was incapable of performing sensemaking tasks. This conclusion was reached with the following observations:

1. Regarding the visualization of abstract keywords, such as "AI-powered governance" humans are capable of associative thinking. For instance, the term "governance" may evoke thoughts of governments, further leading to associations with classical governmental architecture, while "AI" might trigger associations with chips or robots. Experienced designers can leverage such associations to amalgamate diverse concepts like governmental buildings, chips, or robots into a cohesive sensemaking icon. However, Stable Diffusion lacks the capability to perform this associative process. It can only directly synthesize unclassified results from its database. As a result, it may generate images similar to this presented below. Although it is identifiably to be related to data or AI, the meaning of governance has been lost in the generative process.

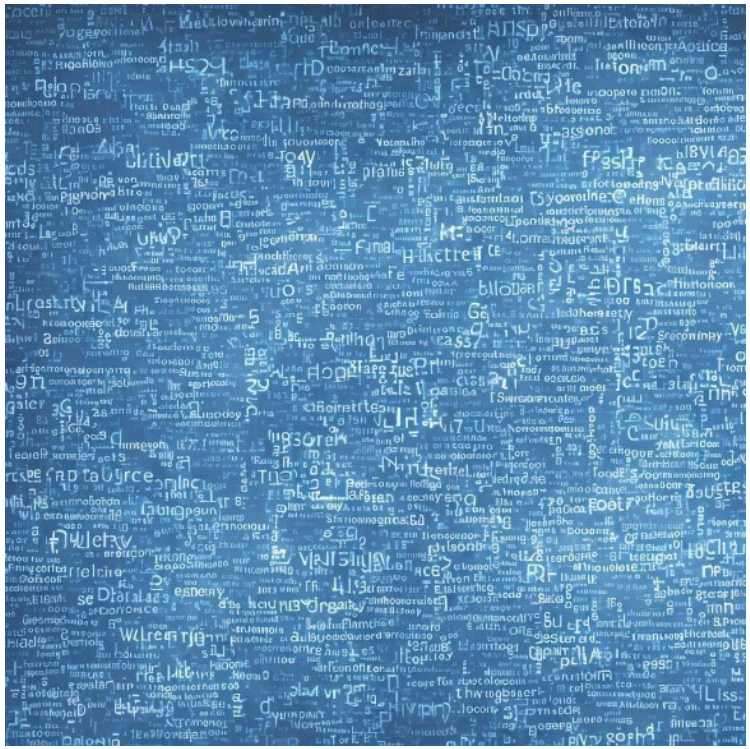


Figure 67. A Stable Diffusion's visualization of sustainable architecture

2. The above phenomenon of meaning loss often occurs in the visualization of tangible objects. For example, the picture shown in Fig.X is a visualization of the keyword urban farming by Stable Diffusion. We can see the elements of 'farming', but the context 'urban' become less recognizable.

Figure 68. A Stable Diffusion's visualization of urban farming

3. When designating the AI-generated visual style as icon/ symbol in Stable Diffusion, the generated visualization results almost completely lose their meaning. For example, Fig.X shows a Stable Diffusion visualization of 'Sustainable Architecture', and the visual style is designated as 'UI icon style'. I suspect that AI can only imitate the overall visual aesthetics, but cannot understand and process the meaning of any icon.

Since the majority of AI-generated visuals often struggle to fully express the entirety of the keywords, setting a threshold for TF-IDF semantic similarity assessment to determine if the visual aligns with the keywords becomes impractical. In addition, AI visualization has problems such as being unable to handle complex relationships and generate meaningful text, which further hinders me from using AI to generate visual example libraries for research.

Figure 67. A Stable Diffusion's visualization of sustainable architecture

7.5 EVT Prototype III and Testing

EVT Prototype I demonstrated the feasibility of visual materials as a tool to assist individual stakeholders in expressing their needs. However, the attempt in EVT Prototype II to enhance this process through the utilization of AI was unsuccessful. Following this failure, I conducted a reflective analysis of the entire research, design, and testing process. During the testing phase of EVT Prototype I, I observed a resistance towards drawing among individuals. Subsequently, I acknowledged the validity of this resistance and sought to guide individuals towards visual thinking by employing pre-constructed visual cards. The subjectivity introduced during this guidance process emerged as a primary concern I aimed to address in EVT Prototype II. However, an alternative design approach could involve challenging people's resistance to drawing and designing tools to guide individuals in expressing their needs through drawing, this may also address the possible subjective bias brought by the designer.

With this notion in mind, I revisited the Energiecoöperatie workshop, the source of my idea of an EVT. Within the visual tools I designed for the workshop, aside from visual asset cards, there was also a map serving as a playground. The workshop participants' positive response to the visual asset cards might stem from the fact that this playground facilitated a connection between the visual asset cards and real-life contexts.

Such visualization of contextual information possesses the potential to stimulate individuals' creativity, thus guiding them towards proactive expression. With this idea in mind, I chose a scribble sketch about the context of LIFE project from the visualization drafts I made in previous visualization sub-projects for LIFE stakeholders. Subsequently, I employed the prompt 'future city Amsterdam Zuidoost, photorealistic, bird's eye view' to generate an image using Stable Diffusion. I then adjusted its transparency to 70% using Photoshop. The rationale behind adjusting the generated AI image's transparency and opting for a scribble sketch is that an incomplete image might more effectively guide participants to sketch or voice their thoughts. The designer's sketch is juxtaposed with the AI-generated image to test whether contextual visualization can function as an Externalization Visualization Tool (EVT), encouraging individuals to express their ideas about the future city through drawing.

I randomly selected 10 participants near the Station Amsterdam Bijlmer ArenA. Before proceeding to the testing session, I checked and confirmed that all 10 participants live or work in the Amsterdam Zuid-oost area. Among them, five individuals were provided with sketches created by designers (M1-M5), accompanied by a sheet of paper bearing the question 'What do you want to see in a future city, and can you draw it on this picture?' in both English and Dutch. The other five individuals were given AI-generated images along with the same set of questions on a paper (A1-A5). I recorded whether they did the drawing, and if they responded to the questions and provided valid information.

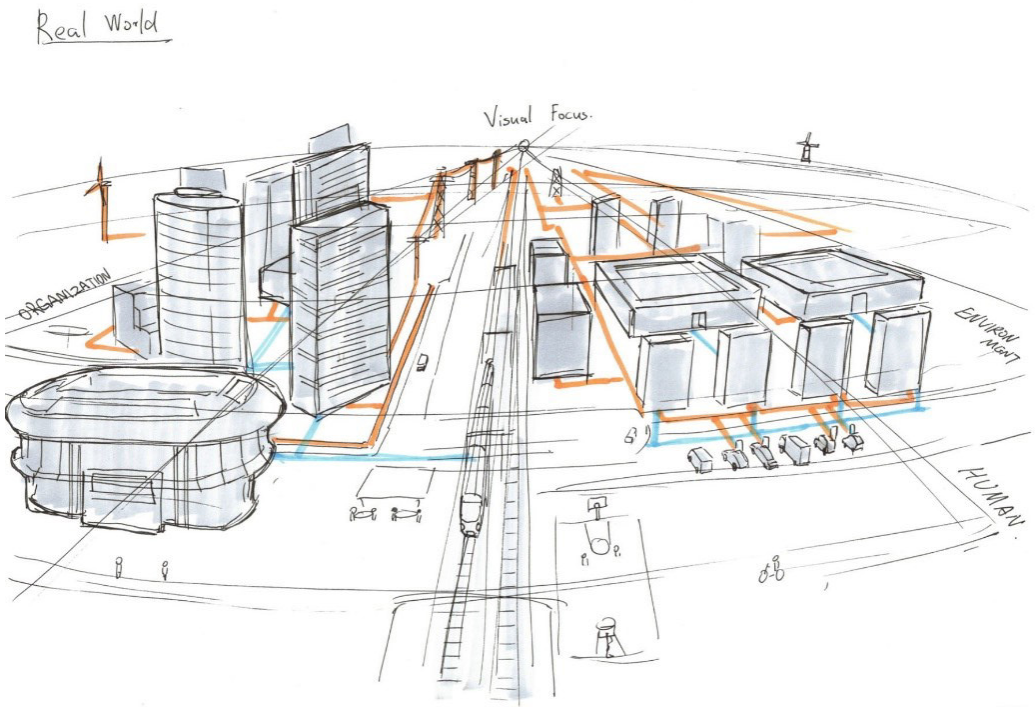


Figure 68. Hand drawn template

Figure 69. AI generated template

Since the test was conducted near the train station, some people refused to participate in the test due to time reasons. Those who refused to participate without fully reading the materials I provided were not considered participants and were not recorded. All 10 particpant are listed on Table 10, pseudonyms were generated by random name generator.

Number	Pseudonym	Gender	Draw	Respond
M1	Kurt	M	Yes, with help	Yes
M2	Rene	M	Yes	Yes
M3	Vic	M	Yes	Yes
M4	Steele	F	No	Yes
M5	Cameron	F	Yes	Yes
A6	Murray	M	Yes	Yes
A7	Danni	M	No	Yes
A8	Sidney	M	Yes	Yes
A9	Logan	M	Yes	Yes
A10	Bailey	M	Yes	Yes

Table 2. Participants EVT test III

Compared to the previous test (EVT Prototype I) where respondents were asked to draw their ideas on a blank sheet of paper, the percentage of respondents who agreed to draw was significantly higher in this test.

Although most of the interviewees would still emphasize that they could not draw, after my encouragement, only two interviewees insisted on this reason and refused to draw. Participant M1 first responded 'I can't draw, sorry'. After seeing the visual material, he got some ideas but still can't draw it, then he asked me to help him to visualize his thought. He explained that he was born in Amsterdam Southeast area and he thinks he belongs there, but the recent rise of rental costs is driving local born people out of this area. He still wants to stay there but hope to see some discounted rent or more friendly housing policy for the locals. After I helped him draw his idea, he asked me for a blue marker, drew a rectangle with a 'P' in it, and told me that he wants the city planners to keep the free parking spaces.

The majority of participants engaged in drawing during this testing session, and among them, certain participants demonstrated particularly active involvement on the canvas. Participant M3, in particular, spent 20 minutes sketching his envisioned future Amsterdam Southeast area, incorporating himself into the depiction. Throughout the artistic process, he provided continuous explanations to me. He expressed the desire for the future Amsterdam Southeast region to feature numerous hotels and entrepreneurial hubs, aiming to attract partners for local industrial investments. Concurrently, he emphasized the

need for establishment of vocational schools to train skilled workers, enabling the local populace to possess adequate expertise for factory employment. He aspired to operate a consultancy firm in the future Amsterdam, helping people in entering the local industries. Remarkably, he even incorporated his envisioned mansion in the drawing, complete with a garage, indoor basketball court, and a family theater.

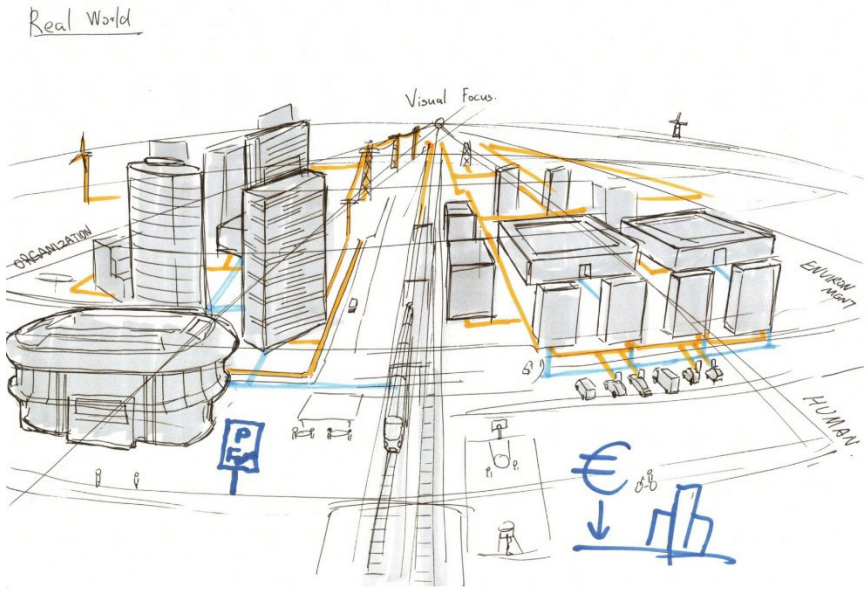


Figure 70. Participant drawing, M1

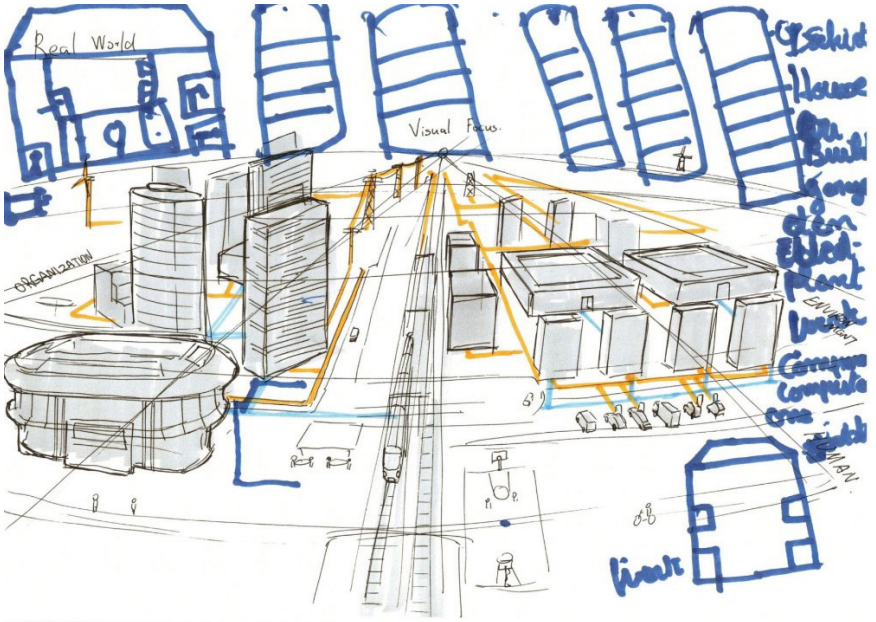


Figure 71. Participant drawing, M3

Comparing the designer's drawing and the AI generated contextual visualization, the AI generated ones can accomplish the goal of encouraging participants to draw, but falls short on encouraging people to draw in a more detailed manner and talk about their deeper needs and desires while drawing. 4 out of 5 participants agreed to draw and provide explanation of their drawing, this percentage of drawers is the same as the previous group using designer's drawing. The only participant who refused to draw, A7, recognized it is a visualization of a city area which looks similar to Amsterdam Southeast, and asked why there are some differences, and whether it is drawn by computer programs. He noticed in the AI visualization, there is an area which seems like a lake. And he said that he hopes 'something similar could be built in South-east (Southeast), to make it beautiful, as other cities in this country'. The difference between AI visualization and reality might sparks some interesting conversation, but we cannot expect such a happy accident to happen in every research with AI generated material. Therefore, it is reasonable to consider this as a potential bias which is difficult to control.

Among the participants who agreed to draw on an AI visualization, most people drew something abstract, or something general about the area, in contrast to the previous group, in which people drew tangible objects with details. Participant A6, drew some radial lines on the picture and explained that he wants to see something new in the residential area. 'This area is too old, everything is old, like me', 'Now only people from outside, immigrants live here, I want to see some new faces, we need to mix people, white people, black people, Chinese people……'. I speculate that this difference in participant's visualization outcome and conversation focus is caused by the difference between designer's visualization and AI generated ones. Although the interview question didn't mention LIFE project and energy transition, my visuals somehow reflect the context of energy transition, with the focus on city infrastructure, this guides people to think about this context and give related answers. On the other hand, AI generated image only visualizes a general theme of Future City Amsterdam Southeast, this finally leads to more general response.

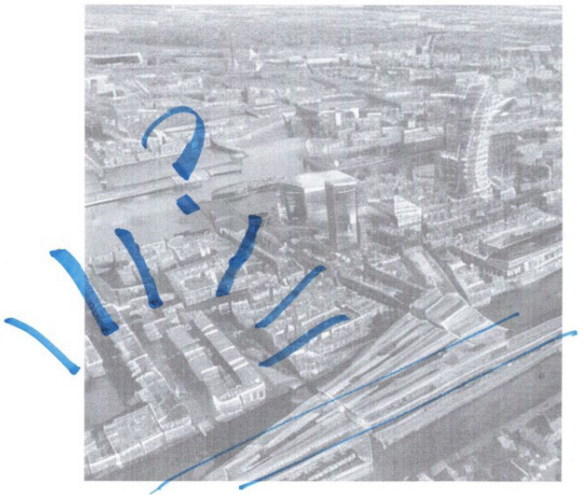


Figure 72. Participant drawing, A6

In general, AI can meet the design purpose of EVT, that is, as a tool that can create resonance and encourage people to draw, and express their knowledge and opinions about the target context during the process of drawing. However, tweaking some details could make it look closer to the designer's drawing. For example, the incompleteness of a designer's drawing may make people more comfortable in expressing their ideas and opinions about it. It might be better to assign the visual style as 'designer's drawing' to achieve this effect. (In the AI visualization process in this section, I mainly used AI model 'Stable Diffusion v1.5', it is a model less capable in generating the visual style which imitates designer's drawings. Therefore, I assigned the visual style to 'photorealistic', which this AI is better at. After this round of interview, I found that there are some AI models which is better at designer's drawings, for example, DALL·E 2 by OpenAI.) Furthermore, after a few images are generated, some iterative measure can be taken to modify the prompts, and adjust the generated image to fit the context.

7.6 SEVT

The previous section in this chapter explains the design and testing procedure of a visual prototype aims to enhance communication within the context of co-creation. The primary emphasis resides in the acquisition of feedback information from participants who commonly possess limited voice of speech within multi-stakeholder initiatives. In the end, the EVT Prototype III successfully achieved the goal of encouraging participants to draw and talk about their ideas and opinions during the visualization process. Both designer's drawings and AI generated visualization can achieve such empowerment, however, in terms of the depth of insights obtained from the co-creation activities, the AI generated images used in this research are still not as capable as designer's drawings. Some directions for further iterations to improve the AI to achieve similar effects as designer's drawings are proposed in the end of this chapter, these includes the imitation of the sketching visual style, and constant adjustment of input prompts to fit context.

At this stage, The Empowering Visual Tool (EVT) design only addresses the need of visualization for co-creation, and it is still a quick tool which is suitable for organizing short workshops and exploring simple research/co-creation questions.

However, at the end of Chapter 6. A decision was made to move a part of the Visual Strategy Tool (Conceptualization Tool) to this chapter, due to its co-creational nature. Since this part of VST also obtains some insights for design from EVT Prototype III, such as contextual drawings as empowerment tools. They are also included in the Conceptualization Tool of VST. Therefore it can also be considered a further development based on EVT Prototype III. Finally, this tool that combines VST and EVT is called Strategic Empowering Visual Toolkit (SEVT).

SEVT is a toolkit that could empower participants in workshops or research through a visual approach, playfully engaging your participants. As a result, it generates more meaningful feedback and co-creation outcomes. SEVT consists of five type of cards and some basic tools, as shown on Figure 73.

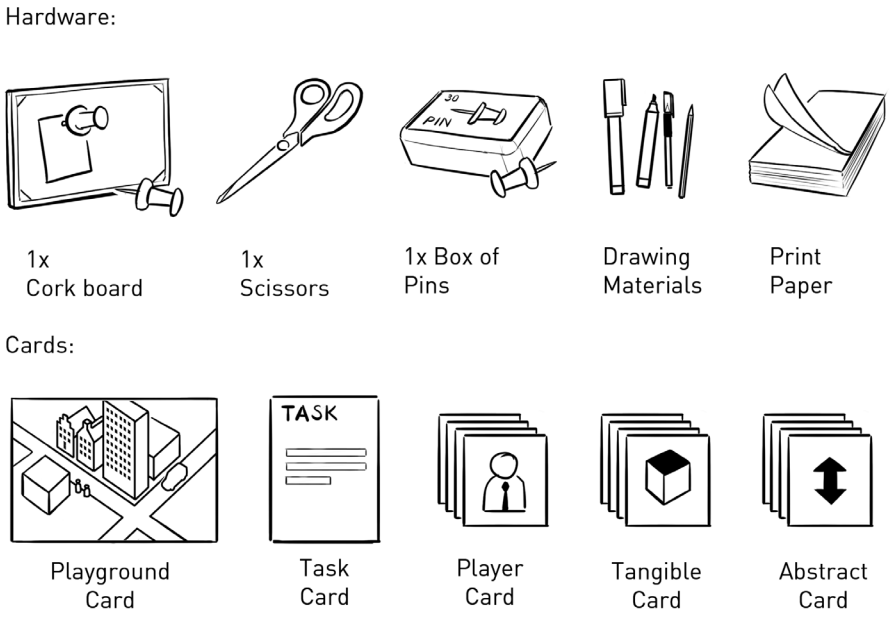


Figure 73. SEVT components

The elements in SEVT are defined as follows:

Playground card:

The playground card is a visualization of the research/ activity context. This type of visualization can create resonance between research/activity participants and the project context.

It can be a drawing by a visual designer or artisit. It can also be a existing visual downloaded from resource libraries. It can also be generated by AI image generator. For visualization methods, please refer to Visualization Strategy Tool (VST).

A playground card should be 'incomplete' in some ways, this is because a 'incomplete' visual may encourage people to react upon it (Calabretta et al., 2016, p.49).

Task card:

The task card links the research/activity goals with the visualized project context (playground card).

It could be a question/ a series of questions that guides participants to draw on the playground card, or use player cards, tangible cards and abstract cards to create something. The participants can express their rationales, needs and wishes during this play process.

Player card:

Put the name of project stakeholder on a card, and that's good enough for making a player card. My prototype test proves that using logos or icons here does not make much difference than simply using name cards, but some colour coding might help to distinguish cards.

Tangible card:

Tangible cards are the visualization of objects in the project, these objects/artifacts can be found by using the transcripts of previous workshops or meetings. Frequently occured items can then be visualized to become tangible cards.

Abstract card:

Tangible cards are the visualization of objects in the project, these objects/artifacts can be found by using the transcripts of previous workshops or meetings. Frequently occured items can then be visualized to become tangible cards.

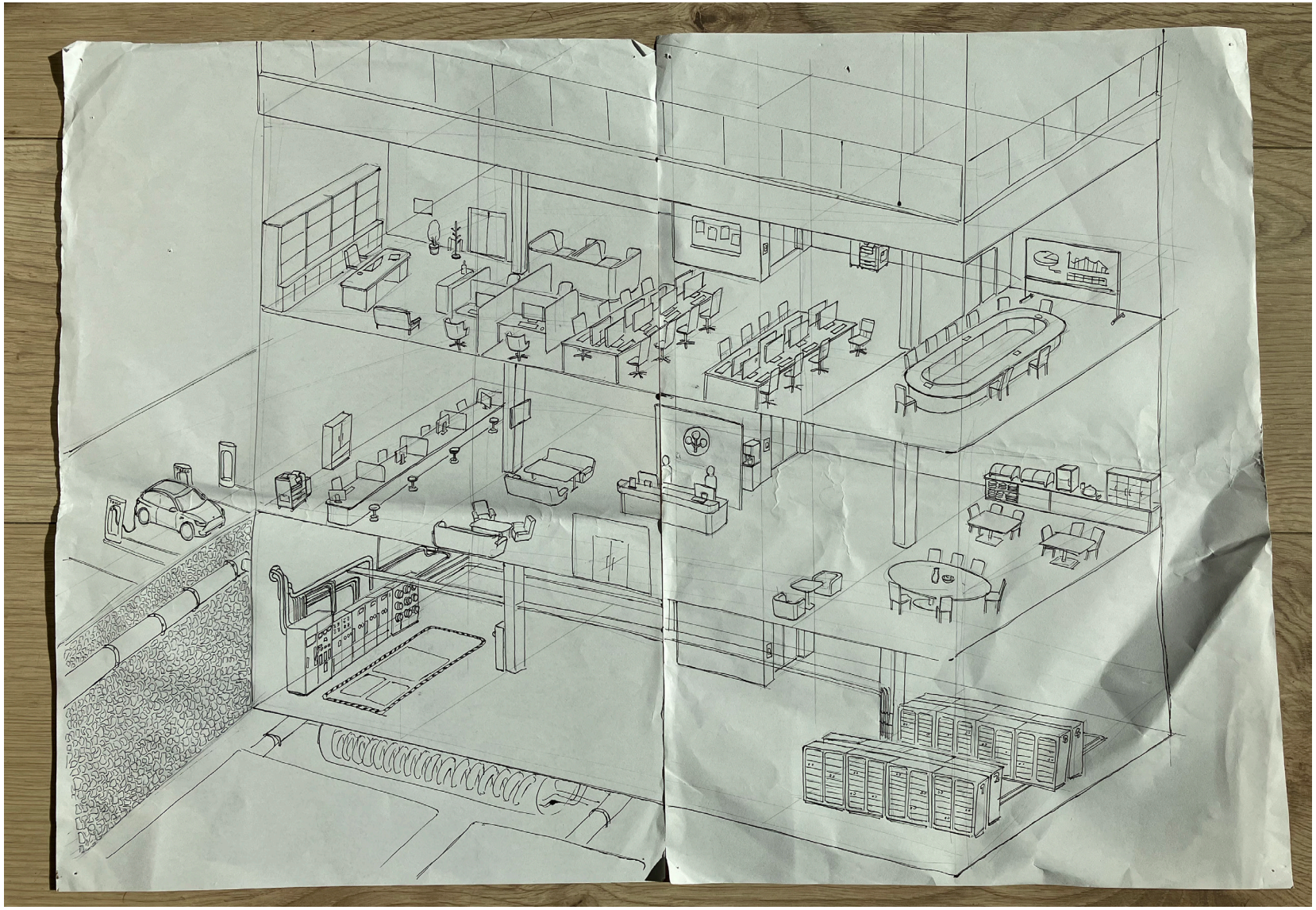
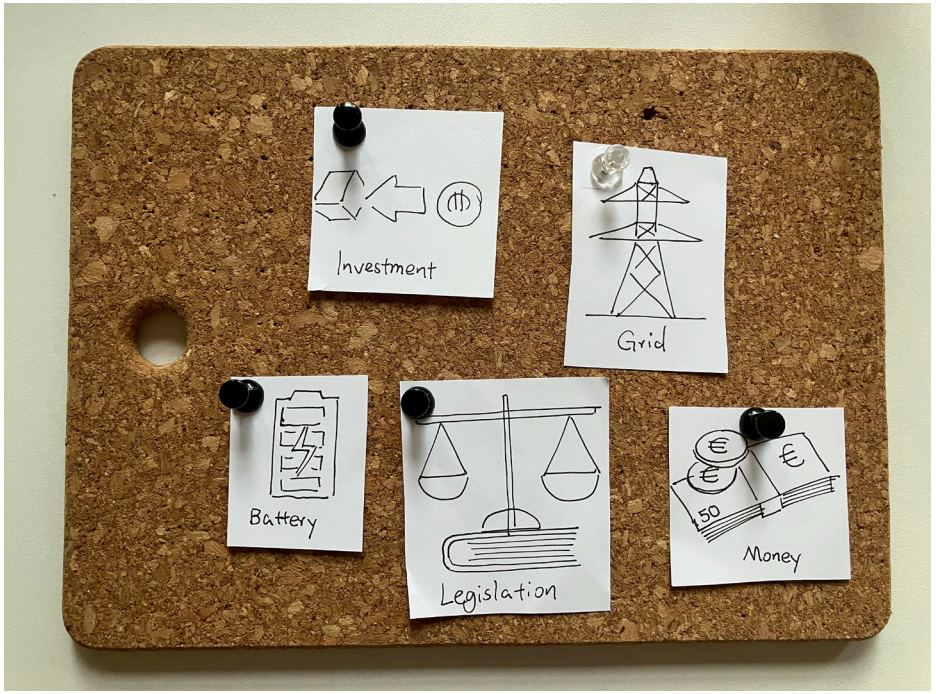


Figure 75. A example of playground card

Figure 75. A example of player cards

Figure 76. A example of tangible cards



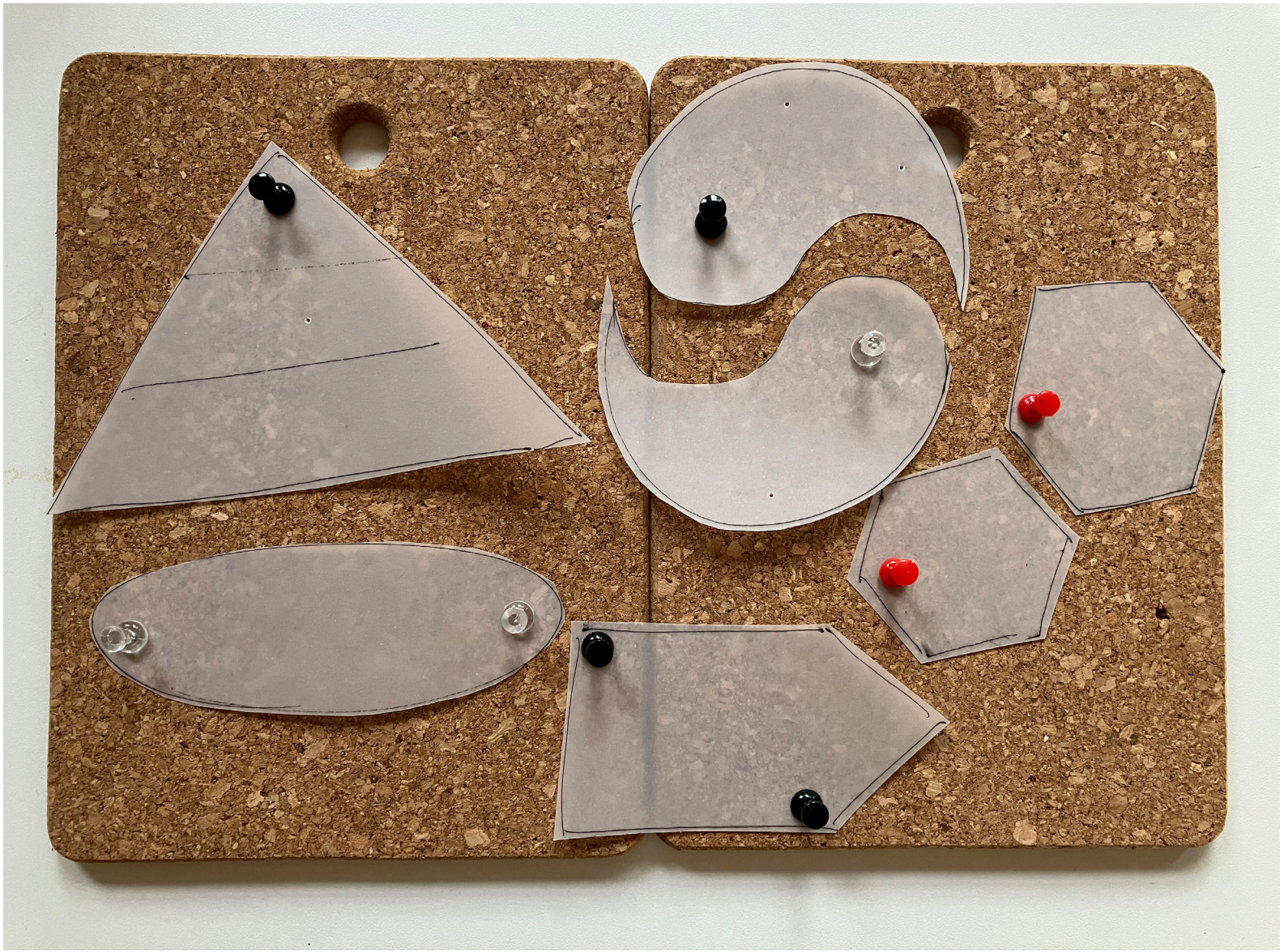


Figure 77. A example of abstract cards

Test Session

The testing of SEVT can be seen as an extension of the previous testing of EVT Prototype III, described in the last section of Chapter 6. With the experience obtained from the previous test, I planned this test in an energie commissaris (energy commissioner) meeting, organized by Stichting CoForce (Foundation CoForce). In total, 10 energy commissioners works in different sectors of energy transition came to the meeting and joined the test.

The meeting started with a 90-minute routine work presentation and discussion, and then I was allowed 30 minutes for prototype testing. In the test, 10 energy commisioners, and one co-force employee responsible for social media were expected to use the SEVT tool to construct a vision of the energy transformation of the Amsterdam Southeast region.

1. I first showed them a playground card pinned on the cork board, and then asked them to draw a small card to briefly introduce their various energy transformation efforts in the Amsterdam Southeast region.

2. After everyone has finished drawing, I ask them to pin the small cards they drew on the playground card, and briefly introduce what they drew and the reasons for placing them in the location they chose.

3. I then placed the playground cards on a table in the center and asked them to use the tangible cards, abstract cards, player cards, blank cards, drawing tools, and push pins I provided to construct a visual to illustrate their work. What is the relationship between work and the LIFE project?

4. After the 30-minute test, I randomly interviewed several participants to collect their feedback.

The setup of this workshop serves two purposes:

1. Testing of SEVT tools and collection of feedback.

2. At the same time, I also obtained data from the workshop to complete the task of visualizing to show the role of LIFE project in the future city.

Test Result

The co-creation results on the board are shown on the following pages: Figure 78 is a photo of the board after testing phase 2, when participants finished placing their drawings on the board. Figure 79 is a smartphone scanned version of Figure 78, for better visibility. Figure 80 is the final outcome, after testing phase 3.

Figure 78. Co-creation result, after phase 2 (photo)

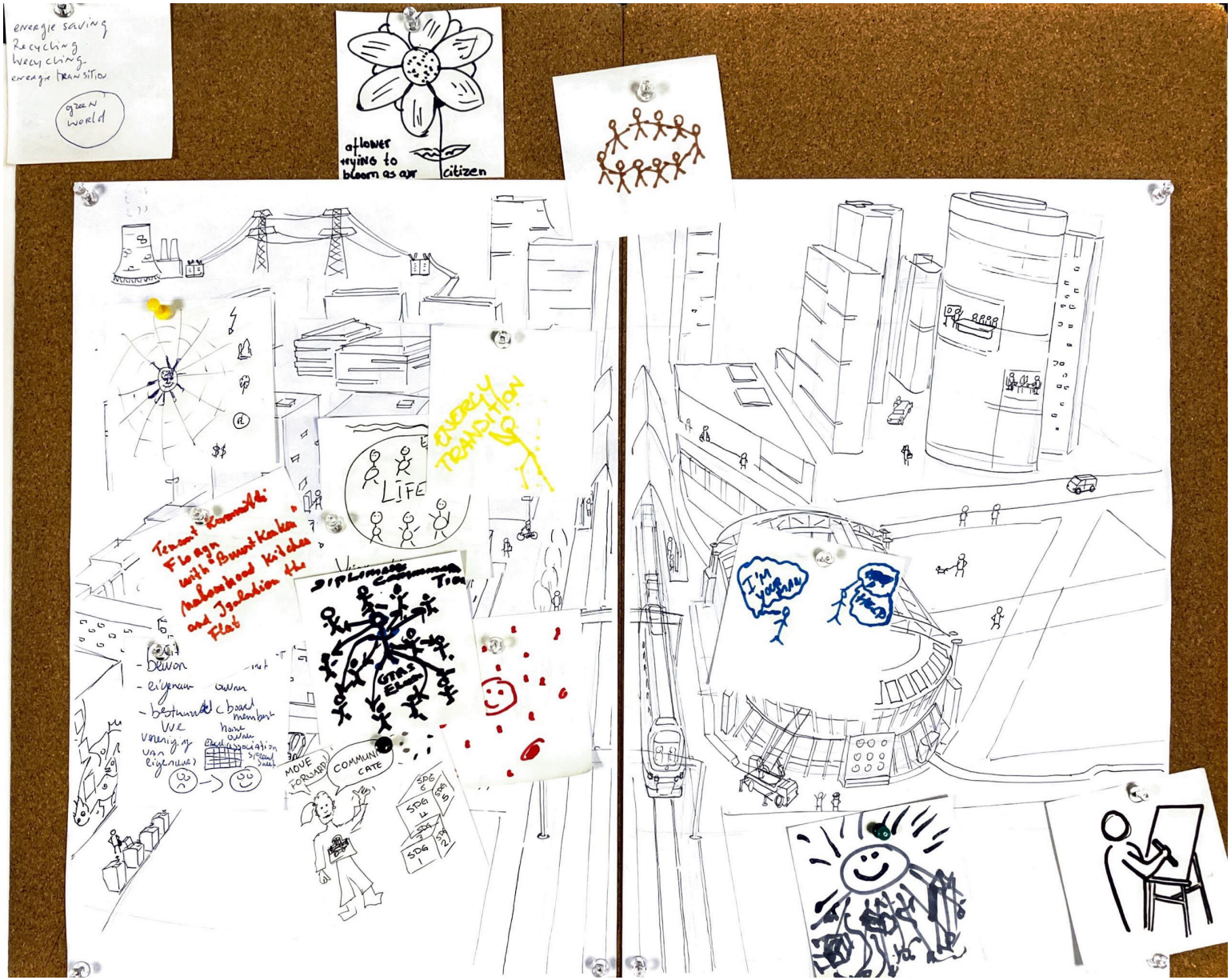


Figure 79. Co-creation result, after phase 2 (scanned)

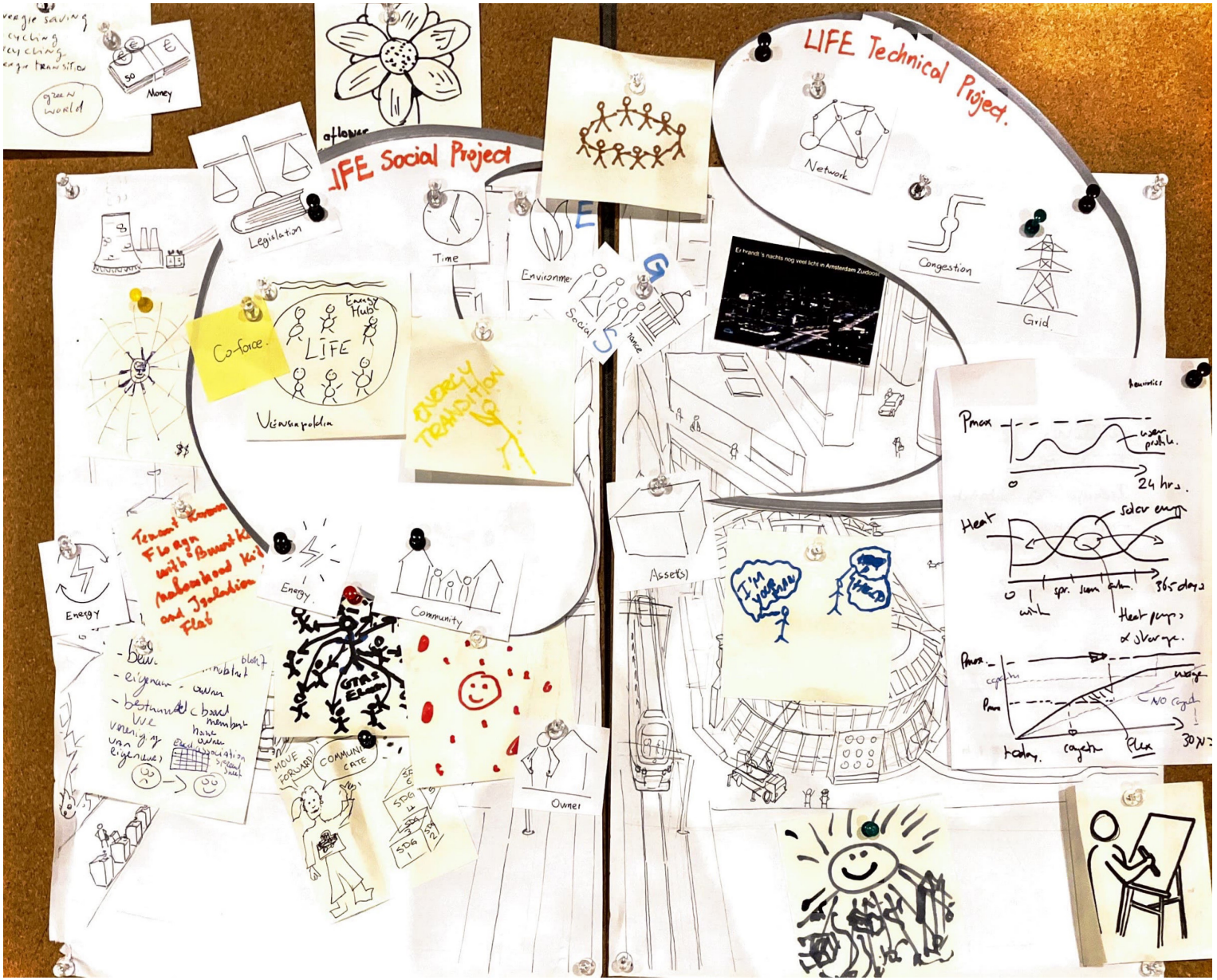


Figure 80. Co-creation result, after phase 3 (scanned)

The co-creation results on the board are shown on the following pages: Figure 78 is a photo of the board after testing phase 2, when participants finished placing their drawings on the board. Figure 79 is a smartphone scanned version of Figure 78, for better visibility. Figure 80 is the final outcome, after testing phase 3.

Insights

Overall, the process of this workshop was smoother and more efficient than the previous testing of EVT Prototype III. 11 participants completed all planned co-creation objectives within 30 minutes. This efficiency may be caused by:

1. Compared with EVT Prototype III, the elements in SEVT are more clearly defined. And the process participants need to complete is broken down into clear steps.

2. I start with a question relevant to the workshop participants, which is to ask them to first describe where their work fits into the energy transition. This is an easier question to answer and allows them to move more comfortably into co-creation.

3. My own workshop facilitation skills have improved

In subsequent interviews, I also received feedback from some participants on the workshop process and experience.

One of the interviewees left a positive comment about the creativity of the process:

> *"You (designers) can make things very creative that we can't do in our jobs...I can come up with ideas that I couldn't think of when working myself"*

Another participant expressed her interest in the interaction with SEVT:

> *"I like it that you give us pins to stick our drawings on the board, it gives us a feeling of 'decision is made'... ...you know, city planning is a decision making thing... ... I think it really fits in this... ..."*

There is also a participant who likes the 'collectivism' of SEVT:

> *"I feel that we are working on one thing, everybody... ...It reminds us that we are working on a same project"*

In this test, I first showed the playground card and then asked all respondents to draw a simple card on their own. After receiving such a task, only one participant presented his worriness in his drawing skills. I then explained that this drawing task is not about aesthetics, but focus on ideas. If they still don't feel comfortable drawing, it is also okay to write in text. In the end of phase 2 (drawing task), 9 participants finally made a visual drawing, and only 1 participant made a card with only text. The participant who was initially worried about drawing skills first started with writing texts, but finally drew something at the

bottom of the card (as shown on the bottom left of Figure 79). Overall, this degree of engagement in visual expression meets the main design goal of the SEVT: empower participants in visual communication.

The test also revealed some problems with the workshop setup, in that it was still relatively easy to record the non-visual data of the workshop in Phases 1-2 (drawing task): as each participant presented his/her own drawings in turn, it was possible to record their descriptions of their drawings in the form of audio recordings or notes. However, after entering Phase 3 (composition task), the recording of non-visual data started to become difficult because all 11 participants were working on the same playground card, and the scene started to become a bit noisy, so it was difficult to recognize valid information in the recordings. It was also difficult for me as a facilitator to record multiple groups of simultaneous discussions in the form of field notes.

In future workshop settings, it might be more efficient to use groups of 4-6 people. Since the previous 2-person workshop also had the possibility of two people focusing on the discussion and reducing the efficiency of the creation. It is also possible to include special observers in the workshop, in addition to the facilitator, who are responsible for taking notes on the insights, so that the facilitator can focus on guiding the participants. Overall, this test proved the feasibility of SEVT, but the process of integrating SEVT into the project context and the setup of the workshop needs further testing and adjustment.

As an epilogue to this chapter, I also provide a guideline of SEVT, to ensure that it is replicable in other multi-stakeholder projects. Figure 81 provides an overview of this guideline, and a detailed version of SEVT guideline is attached in Appendix III.

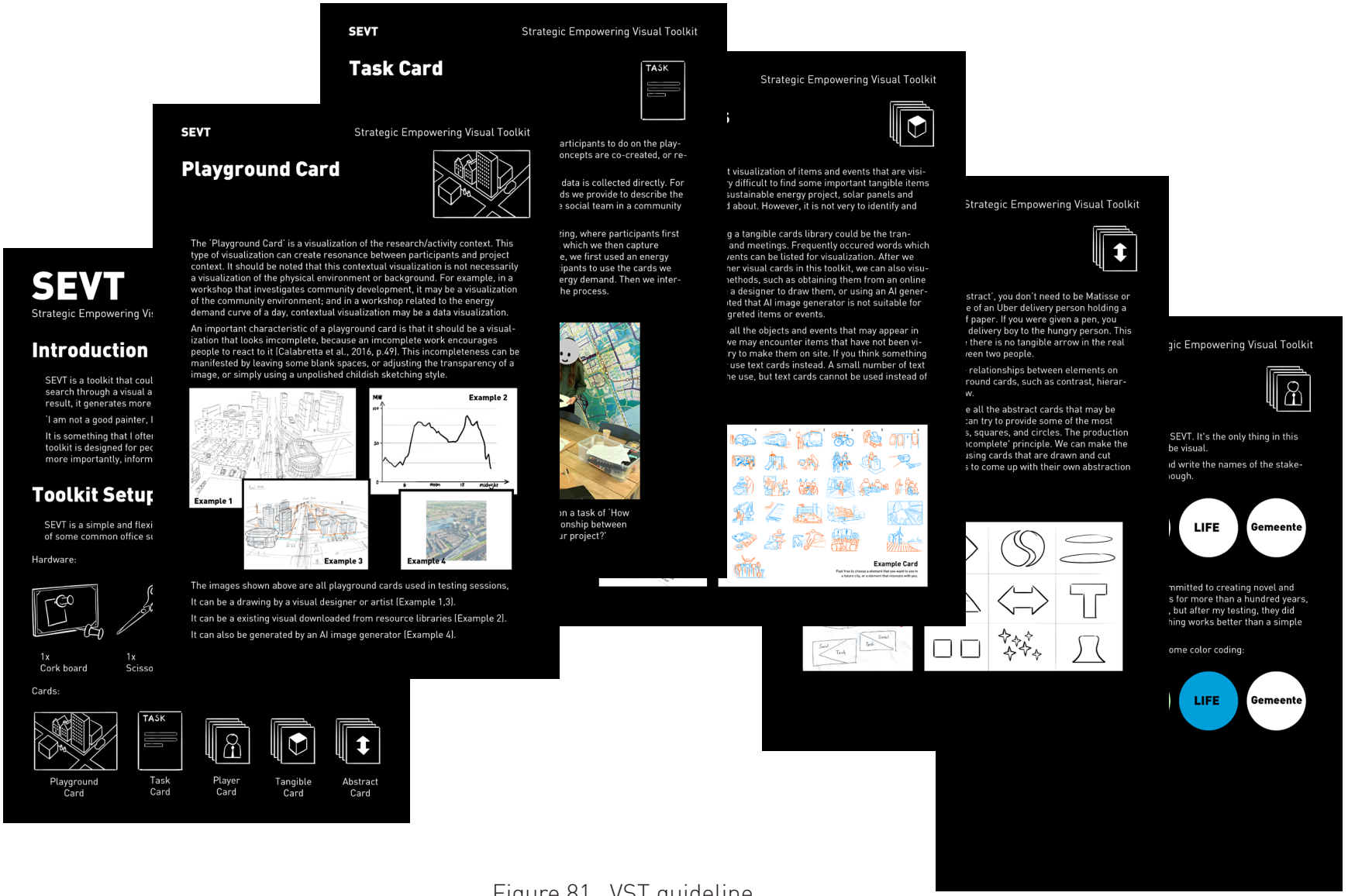
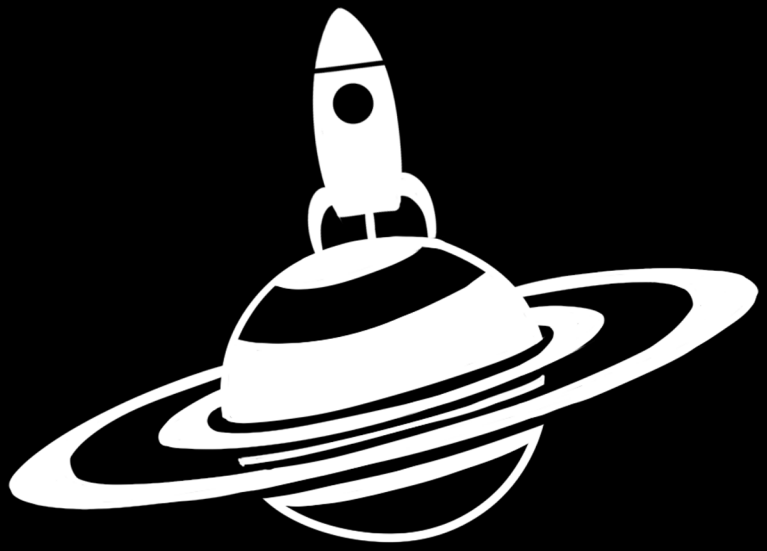


Figure 81. VST guideline



Chapter 8
End Result

This chapter provides a general discussion of the design question and research question.

8.1 Discussion of the Design Question

The initial design question of this project is:

How to design a visual platform that can practically facilitate the stakeholder communication in LIFE project?

During the design process of this project, a total of three outcomes emerged:

The first is the Visualization Strategy Tool (VST), which guides stakeholders who want to communicate information to others to create visuals that better suit their communication needs, and in the process think about their audience and how they will interpret it. This tool can indirectly facilitate stakeholder communication in LIFE projects.

The second one is the Empowering Visual Tool (EVT). In the later prototype, it successfully communicated the goal of co-creation to local residents as event participants and inspired them to actively participate in the visualization process. Through their hand drawings, as well as audio and field notes records during the hand drawing process, researchers and developers can obtain their needs, wishes, and ideas based on the project context. It is mainly used in one-to-one visual interviews (one researcher meets one participant).

The third is Strategic Empowering Visual Toolkit (SEVT), which can be considered a more advanced version of EVT. It is suitable for one-to-many scenarios (one researcher connects 4-6 participants, and observers can optionally be added). It can facilitate complex visualization for co-creation, such as projects involving intricate stakeholder relationships that is hard be investigated in one-to-one interviews.

Overall, the three tools work in different communication contexts, and they collectively achieve the design goal, which is practically facilitate the stakeholder communication in LIFE project. For other multi-stakeholder projects, VST and SEVT are also two replicable tools. With the guidance in the guidelines, project managers can easily adapt these visual tools to their project context.

The only question left is, can these three tools together be considered as a visual platform?

According to Merriam-Webster. (n.d.), a platform is defined as:

1. a flat horizontal surface that is usually higher than the adjoining area
2. a declaration of the principles on which a group of persons stands
3. a means or opportunity to communicate ideas or information to a group of people
4. the grounds or basis for further action

Definition 1 is a tangible or physical platform, which is not the type of platform in my design question.

Definition 2 is applicable in politics, not for information

communication.

The outcomes of this project fit in Definition 3, they are all means to communicate ideas or information to a group of people. Moreover, EVT and SEVT allows bidirectional information communication, to and from a group of people.

They also fit in Definition 4, VST is a ground or basis for making sensemaking visualization. EVT and SEVT are grounds or basis for communicating research goals to participants, and generating feedback from them.

In conclusion, the design outcomes of this project answers the research question that was set in the beginning. They can collectively serve as a visual platform that can practically facilitate stakeholder communication in LIFE project.

Validation with Designers

I believe that a one-person discussion is incomplete. Therefore, I arranged a validation session with three designers. This validation session is in the form of an online focus group meeting. Before the meeting, materials of this project are sent to participants. These includes VST and SEVT guidelines, as well as some outcomes from testing sessions, such as Figure 80 on page 107.

The three participants are: one strategic designer and medical system design researcher (D1), one automotive designer (D2), one graphic and visual communication designer (D3).

Since I and the three participants are all native Mandarin speakers, the meeting was in Mandarin. The transcript was then translated and analyzed in Engish.

Participant D1 finds VST valuable in her field of work because consideration of audience compensates for the knowledge gap between information sender and information receiver.

> *"In medisign projects, when you need to consider patients and doctors, there is always a knowledge gap. Sometimes professionals think that they know everything because they are professionals, but then communication problems occurs due to this over-confidence, and it really did cause some big troubles, like the example of Martha's Rule."*

Participant D2 believes that considering audience is an ability that designers learn and internalize in their work, but a tool that helps people to aquire this ability could be helpful to people in non-design fields.

> *"We always need to consider our audience, we always design with our persona, our target user in mind. And when making visualizations we also need to consider our boss, who sees our design first. But I don't think a lot of others have this empathy ability."*

Participant D3 finds SEVT useful in her workflow. She explained that for most of the time, graphic designer work in a tranditional design process, in which there are not a lot of stakeholders,

but only 'Party A' and 'Party B'. (In China, design professionals usually use this term borrowed from legal industry to decribe their relationship between their clients, as written on their contracts. Party A is client, and Party B is designer). But even without considering multiple stakeholders, SEVT is still useful for traditional design workflow. In the design process, apart from beneficial iterations, there are also many 'vicious iterations' caused by customers not being clear about their needs or unclearly expressing their needs. SEVT can reduce such 'vicious iterations'.

"Sometimes a customer come to you, asking for a 'colourful black'. And you first design a colorful image, he says it is not okay. And then you design a black image, he says it is again not okay. Then you design a half-black half colourful image, it is still not accepted. And in the end he may think the first image is the best."

"I think your tool can help to reduce this sort of useless communication. Show them a bunch of black cards, and a bunch of colourful cards, and we can figure it out with them"

8.1 Discussion of the Research Question

The research question of this project is:

In what ways can visualization facilitate communication between parties in a multi-stakeholder project?

Along my research path, I have found many ways in which visualization can help to facilitate communication between parties in a multi-stakeholder project.

1. In the Solution research, the first case study of ISOTYPE reveals that we can create a symbol system that is simple and easy to identify, and promote it as a universal language continuous reuse. This strategy is already in use for decades, in traffic signs and visual guidance systems.

2. In the Solution research, the second case study of Buro Brand reveals that we can educate people to acquire basic visualization skills, so everyone can create basic visual symbols themselves to engage in visual communication. If this engagement can be sustained, they can develop their visual skills deeper and deeper.

3. In the Solution research, the third case study of LEGO SERIOUS PLAY reveals that we can facilitate communication through the visualization or materialization of ideation process.

4. In the design of SVT, I found that guiding people to think about visual hierarchy, audience and their way of interpretation can help to set visualization strategies, thus producing better visualization and resulting in smoother visual communication.

5. In the design of EVT, I found that giving a incomplete contextual image as a template can encourage them to express their thoughts visually. Ideas that is difficult to collect in a verbal or textual channel can be communicated in this way.

6. In the design of SEVT, I found that on top on EVT's contextual image, a modular visual toolkit can be given to users to empower them in visualizing the ideas that is too complicated to be drawn directly with a pen and a template.

In conclusion, the research findings in this project corresponds with the theory that visual is an important way of knowing (Simon, 1969; Vistisen, 2014). EVT and SEVT can be considered as an epistemological tool, in which the researcher creates a visual and uses it as a probe to gain information from the participant. Throught my research, I also found that Nicholson-Cole (2005)'s conclusion that no visuals can be attractive to anyone in the formulation of public policies can be updated into 'no visuals can be attractive to anyone, in any contexts'. This is because some visuals are indeed designed as universal icons, for attracting people regardless of their identity. For example, ISOTYPE and visual guidance system is exactly this type for visuals, and they were indeed used in formulating public policies. The attractiveness of a visual not only depends on identity of audiences, but also the context in which the visual is shown. Modular and interactive visuals can be attractive for a broader range of audiences, since its meaning can be redefined by its

audience, who is also the user of the interactive visual at the same time.

In Chapter 1, Introduction I found that some theories from design studies overlooked the development of communication design, and still consider it as a primitive form of design. In the four orders of design theory (Buchanan, 2015). The solutions for design problem "communication" sits on the top left covern of the model, and it only includes the creation of words and symbols. However, only two visual communication solutions that I explored can be placed in the block of "symbols, word and images" on top left. Visualization Strategy Tool (VST) that I designed enables users to judge audience and their ways of interpretation, as well as constructing information hierarchy. LEGO SERIOUS PLAY also allows construction and interaction. In Empowering Visual Tool (EVT), research participants are expected to draw on the visual template as an interaction in the project context. And Strategic Empowering Visual Toolkit (SEVT) allows the integration of ideas in workshops, which can composite a vision of a system, or a organization. All solutions in this project are designed to facilitate communication in multi-stakeholder projects. But they go into the territories of construction, interaction and integration, before the communication goal is reached.

This neglect of communication complexity in Buchanan's (2015) model may be due to the fact that communication in this model of design problems corresponds to relatively early communication models, such as Shannon-Weaver's Model of Communication (Shannon, 1948), in which communication was

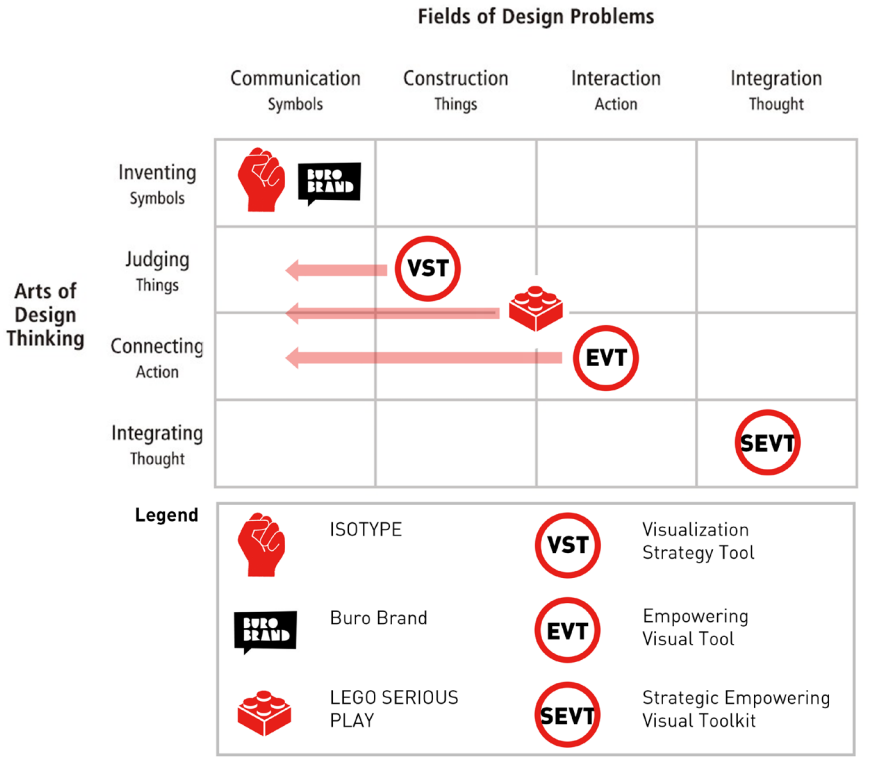


Figure 82. Placing the communication solutions on Buchanan's four orders of design

considered as a simple unidirectional process from message sender to message receiver. However, communication models have also been modernized in the past 75 years, and some of the more advanced models were proposed by other researchers. Schramm's model of communication (Schramm, 1953) accepted bidirectional information exchange. The transactional model (Barnlund, 1970) takes into account both private cues and public cues. Where private cues echo the visualization of internal ideas considered in the scoping phase of this project, public cues may have some connection to the reuse of common visual resources.

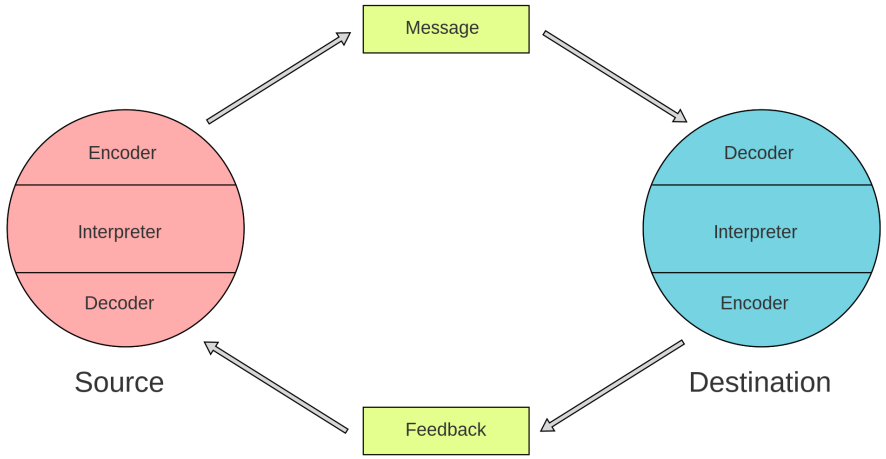


Figure 83. Schramm's model of communication (Schramm, 1953)

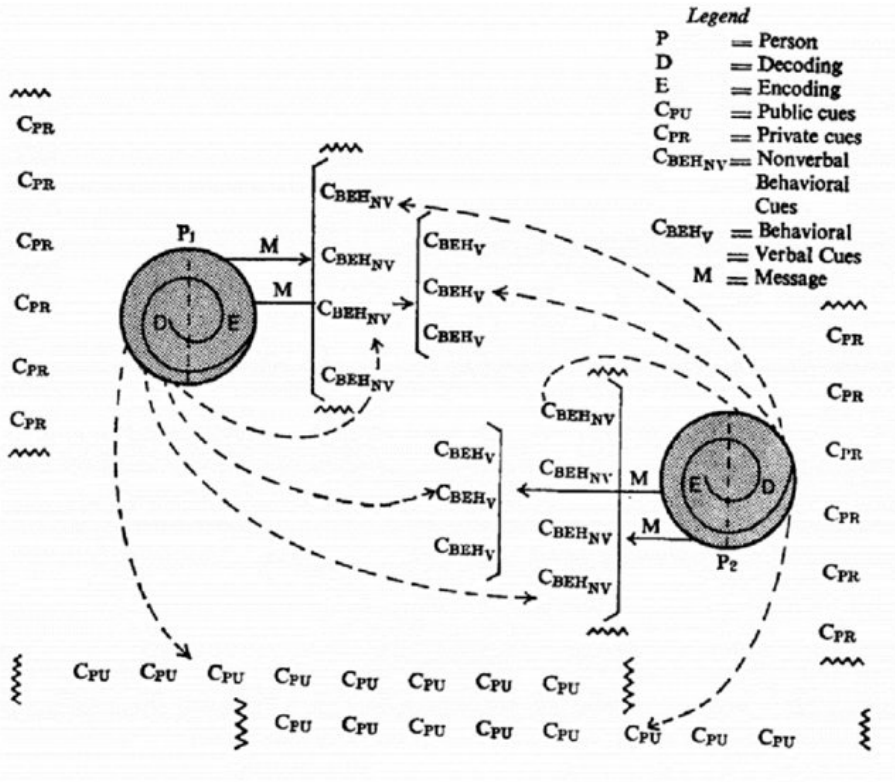
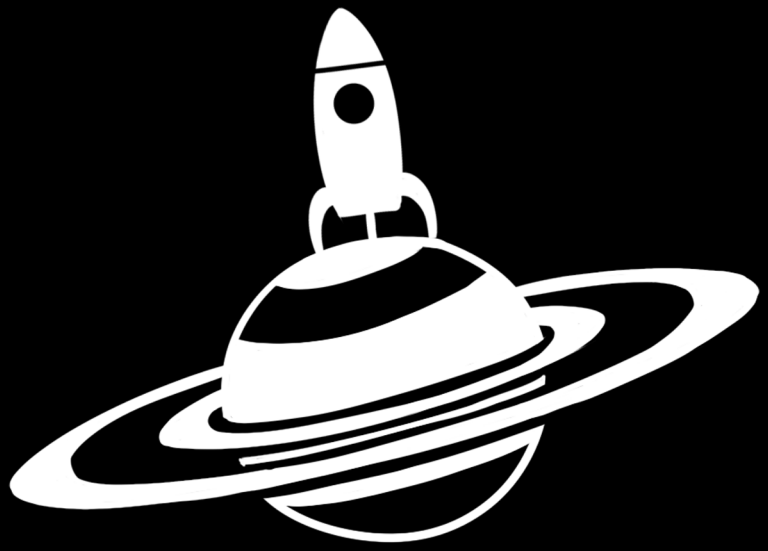


Figure 83. Transactional model of communication (Barnlund, 1970, p.59)



Postscript

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I appreciate my parents and the rest of my family: Jianmin Zhang, Yimei Yang, Zhehao Sun, Qing Ran and Yingtao Sun. I still remember the hot summer evening 20 years ago, when my father drew a truck, and its engine, gearbox and chassis on a blank sheet of print paper. And thousands of childish drawings that my mother collected. It is this memory which drives me to my career as a designer and car mechanic. During this project, it is the mental support from my family that helps me to regain confidence whenever I am in doubt of myself.

I appreciate Al Pacino, the greatest actor in human history, at least in my opinion. It is your performance that gives me confidence to challenge my introvert and self-doubt personality and reach out to researchers and interviewees with my unpolished designs, which is the essential part of this research through design project.

18 September 2023
Zoetermeer, Netherlands
Kai

Appendix I - VST Guideline

VST

Visualization Strategy Tool

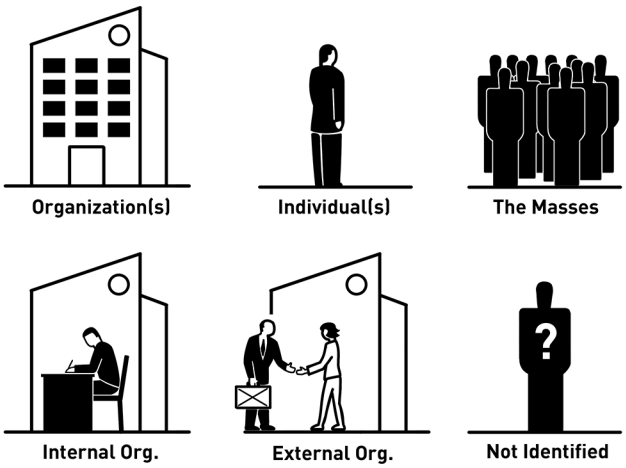
Introduction

VST is a tool designed for those who plan on making information visualization. It guides its user to think about the audience, their interpretation, and possible methods of visualization. It can provide inspiration and suggestions on how to perform visualizations. This process is best done before starting a draft sketch or opening a 3D drawing software.

Tool setup

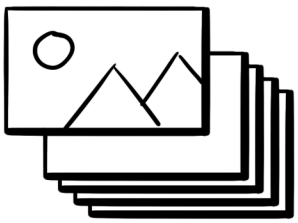
Audience Cards:

One of the problems with visual communication in multi-stakeholder projects is that sometimes people just think of visuals as a panacea without thinking about who they are visualizing for. Audience Cards guides its user to identify the target audience of the visualization output.



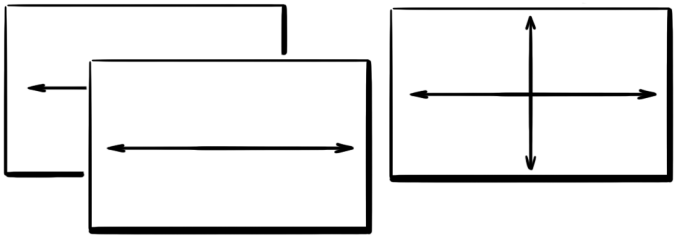
Example Visual Cards:

The VST provides some example information visualization works and artworks. If there are some other interesting images you like or think is relevant, feel free to put them in Example Visual Cards.



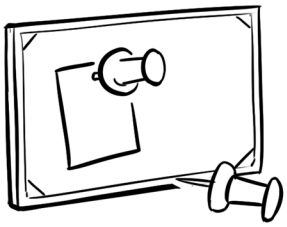
2x Axis Cards
1x Quadrant Card:

Example Visual Cards can be placed on axis cards, which makes it easier to compare and define the characteristics of the visualization that you are planning.



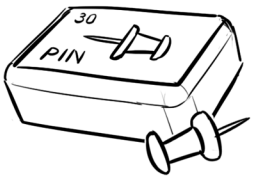
Tool Setup (optional)

There are some optional items that may help you use VST, but are not mandatory. These items are necessary components of SEVT (Strategic Empowering Visual Toolkit) for research and co-creation, so if you are likely to use SEVT, you can prepare them in advance.



1x
Cork board

1x
Scissors



1x Box of
Pins

Drawing
Materials

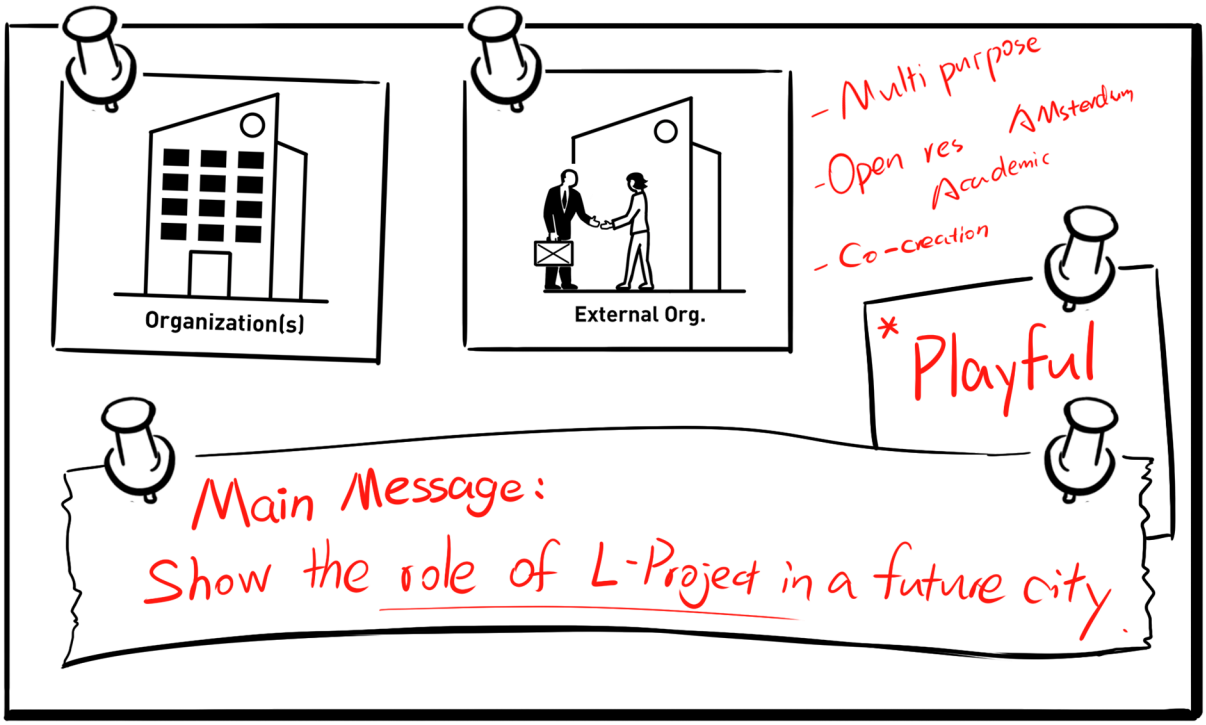
Print
Paper

Audience and Message

First, select the audience card(s) that you think are the target audience for this visualization project. It is possible to specify these target audiences as much as possible, but if they are still vague at this stage, it is also possible to just select suitable cards.

After identifying your audience, write down the main message you need to convey on a slip of paper. It should be noted that this main message should be a '3-second-message', so it should not be too complicated.

Example:



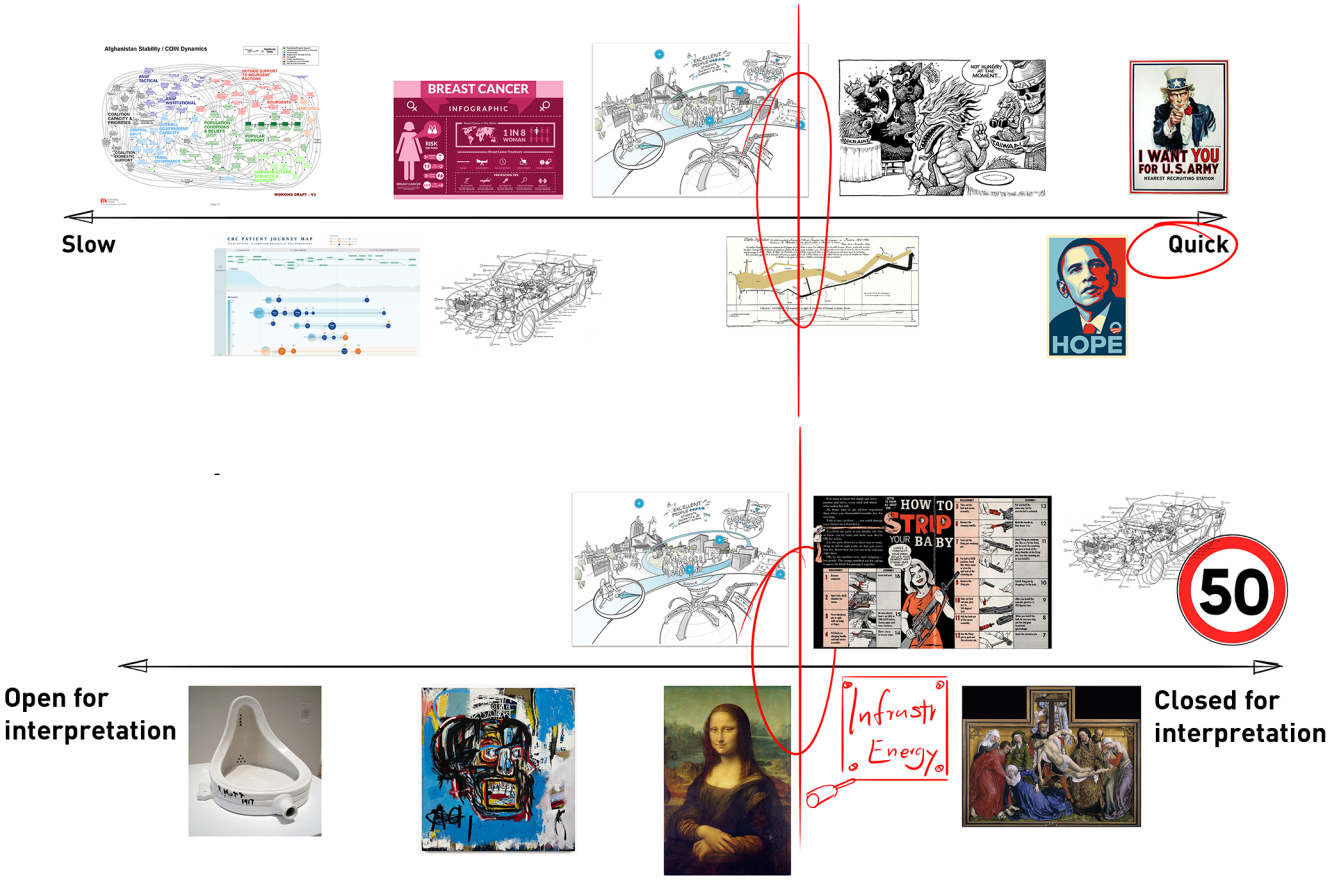
After determining the audience and main message, you can use one or two short words to describe how you want to convey your message to the audience visually. For example, ‘playful’, or ‘serious’, or ‘structured’.

Interpretation

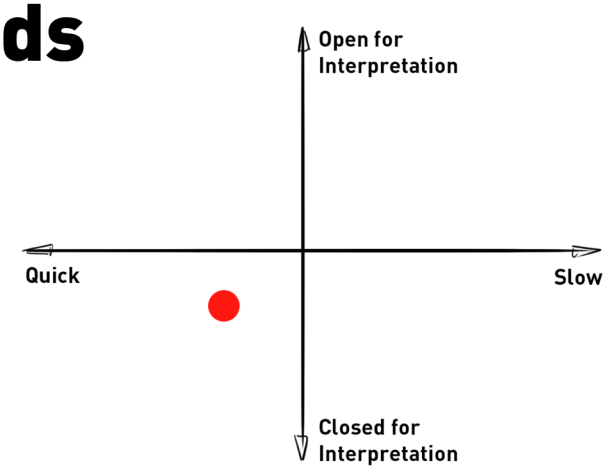
How will your audience interpret your visuals? Should information be obtained with a quick glance, or through slow but detailed reading. Do you want your visualization results to be open for interpretation or closed for interpretation? There are two important axes of interpretation: (Slow interpretation) - (Quick interpretation), and (Open for interpretation) - (Closed for interpretation).

VST provides some representative pictures, including art works from different periods, and info-graphics for visual communication. Of course, you can also add other pictures you like or that are related to your project. You can first try to arrange them on the axis, and then try to find roughly where your planned visualization should be. Note that you should try to consider your audience's perspective during this process: How will they understand these images?

Example:



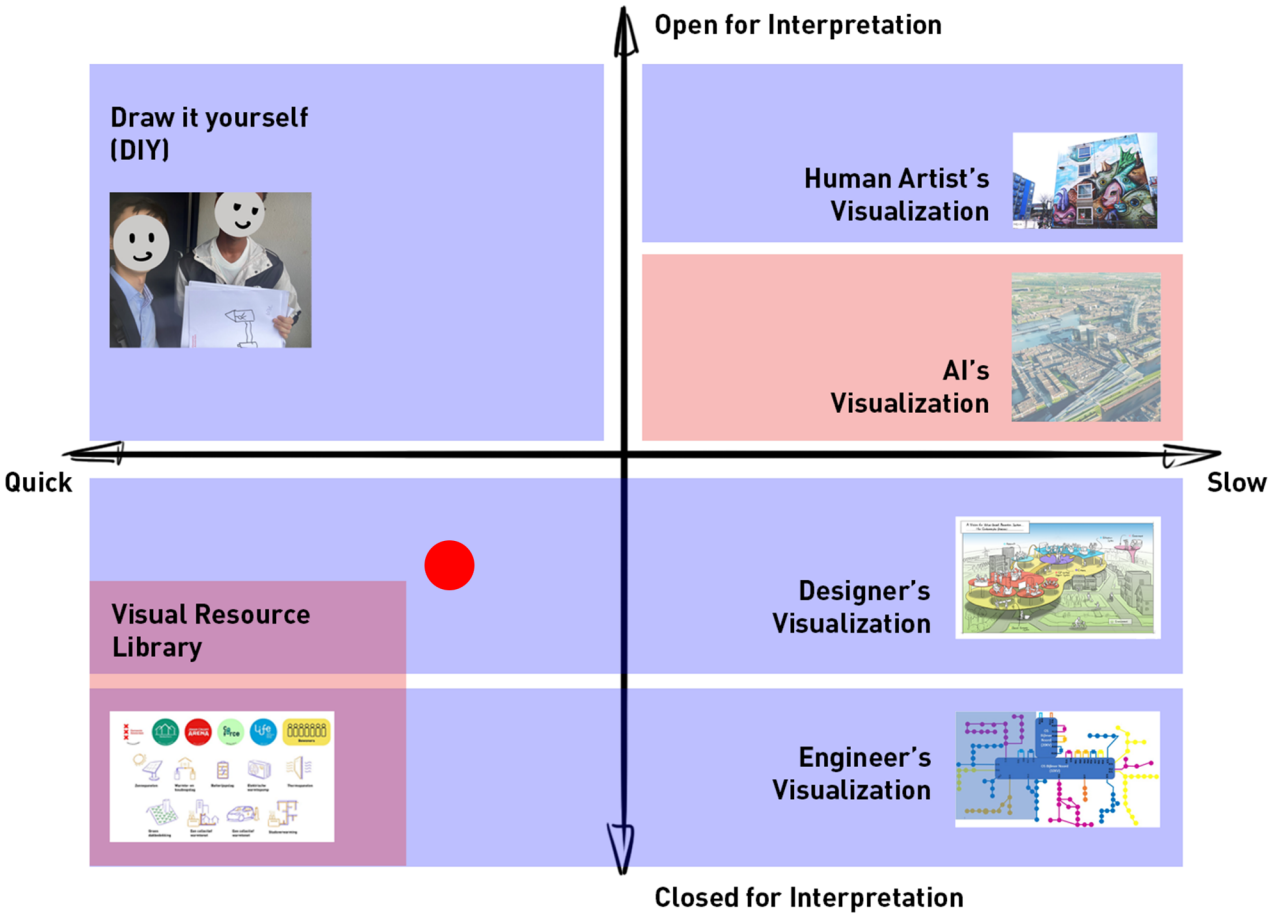
Visualization Methods



After finding suitable positions on both axes, we can combine the two axes to form a quadrant diagram, on which we can locate our visualization, as shown on the image on the right.

By categorizing the visualization outputs in a multi-stakeholder project, I found that their position on the quadrant diagram had a certain relationship with the method in which they were visualized. This relationship is shown on the image below.

This quadrant diagram can be used as a reference in choosing a suitable method for visualization. For example, if your visualization is positioned on the area of the red dot, it might be better to ask a designer to make this visualzation. However, this quadrant is not the only factor that decides how to make a visualization. Other factors such as project time, budget and resources should also be taken into consideration.



Key Takeaway

- Who is the main audience of your visualization?

- What is the 3-second-message that you want your audience to grab?

- How do you want your audience to interpret your visualization?

- Did you find a suitable method to make your visualization?

Appendix II - SEVT Guideline

SEVT

Strategic Empowering Visual Toolkit

Introduction

SEVT is a toolkit that could empower participants in your workshops or research through a visual approach, playfully engaging your participants. As a result, it generates more meaningful feedback and co-creation outcomes.

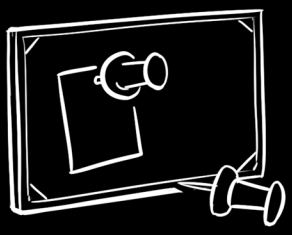
'I am not a good painter, I really can't draw....'

It is something that I often hear during my research. But don't worry. This toolkit is designed for people without much experience in visualization. And more importantly, information visualization is not always about aesthetics.

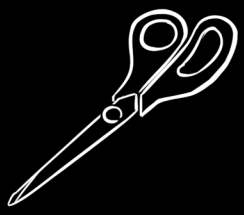
Toolkit Setup

SEVT is a simple and flexible toolkit. Its most basic components only consist of some common office supplies and some homemade cards.

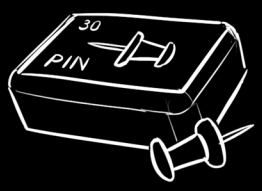
Hardware:



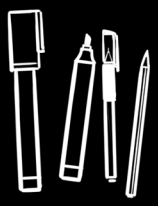
1x
Cork board



1x
Scissors



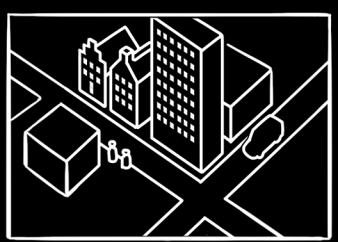
1x Box of
Pins



Drawing
Materials

Print
Paper

Cards:

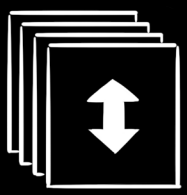


Playground
Card

Task
Card

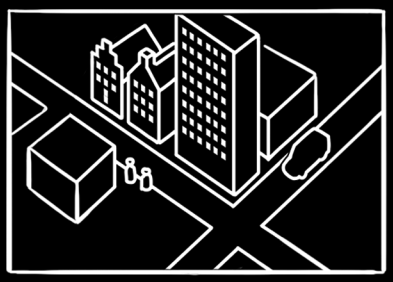
Player
Card

Tangible
Card



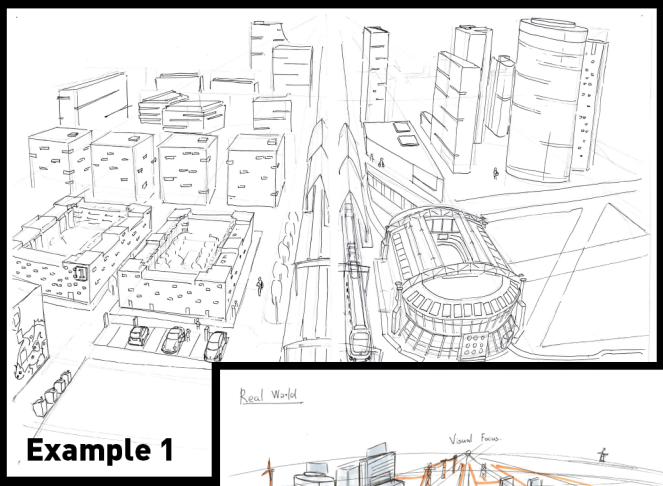
Abstract
Card

Playground Card

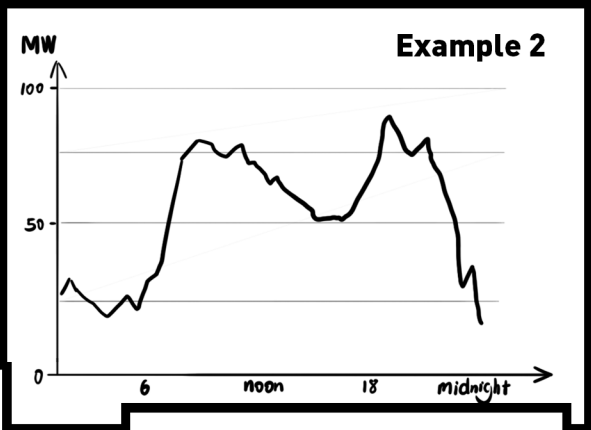


The 'Playground Card' is a visualization of the research/activity context. This type of visualization can create resonance between participants and project context. It should be noted that this contextual visualization is not necessarily a visualization of the physical environment or background. For example, in a workshop that investigates community development, it may be a visualization of the community environment; and in a workshop related to the energy demand curve of a day, contextual visualization may be a data visualization.

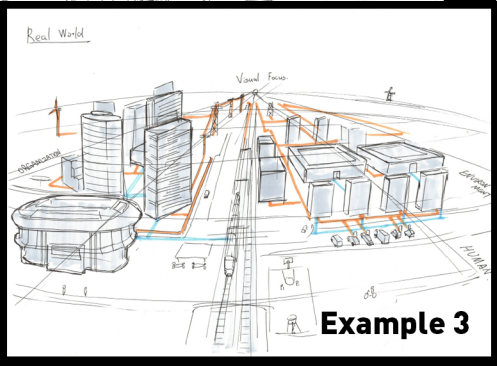
An important characteristic of a playground card is that it should be a visualization that looks imcomplete, because an imcomplete work encourages people to react to it (Calabretta et al., 2016, p.49). This incompleteness can be manifested by leaving some blank spaces, or adjusting the transparency of a image, or simply using a unpolished childish sketching style.



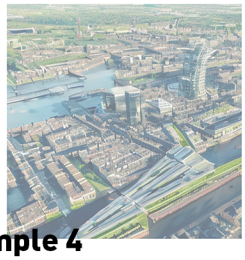
Example 1



Example 2



Example 3



Example 4

The images shown above are all playground cards used in testing sessions,

It can be a drawing by a visual designer or artist (Example 1,3).

It can be a existing visual downloaded from resource libraries (Example 2).

It can also be generated by an AI image generator (Example 4).

Task Card

The 'Task Card' describes what you want your participants to do on the playground. During this process of play, ideas and concepts are co-created, or research data is collected.

This task can be a construction activity in which data is collected directly. For example, we can ask participants to use the cards we provide to describe the relationship between the technical team and the social team in a community energy transition project on the playground.

The process can also be inspirational or sensitizing, where participants first gain some understanding or ideas through play, which we then capture through interviews or focus groups. For example, we first used an energy demand curve as a playground and asked participants to use the cards we provided to connect their daily activities with energy demand. Then we interviewed them about their understanding during the process.

Two workshop participants working on a task of 'How would you visually describe the relationship between technical team and social team in your project?'

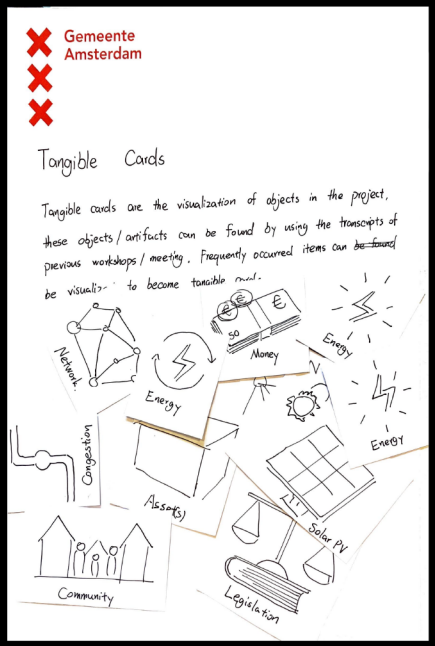
Tangible Cards

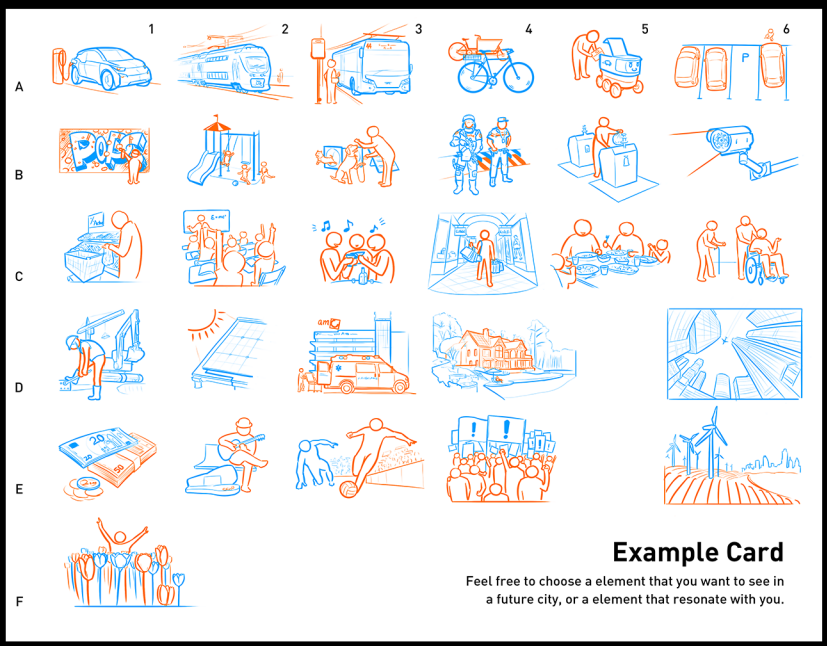
The 'Tangible Cards' are direct visualization of items and events that are visible in your project. It is not very difficult to find some important tangible items in a project, for example, in a sustainable energy project, solar panels and batteries might be often talked about. However, it is not very to identify and visualize all relevant items.

A good starting point of making a tangible cards library could be the transcripts of previous workshops and meetings. Frequently occured words which descibes tangible items and events can be listed for visualization. After we obtain these keywords, like other visual cards in this toolkit, we can also visualize them through different methods, such as obtaining them from an online visual resource library, asking a designer to draw them, or using an AI generator . However, it should be noted that AI image generator is not suitable for generating more complex integreted items or events.

Obviously, we cannot visualize all the objects and events that may appear in the discussion. In actual use, we may encounter items that have not been visualized. In this case, we can try to make them on site. If you think something is difficult to draw temporarily use text cards instead. A small number of text tangible cards will not affect the use, but text cards cannot be used instead of visual cards.

Examples:





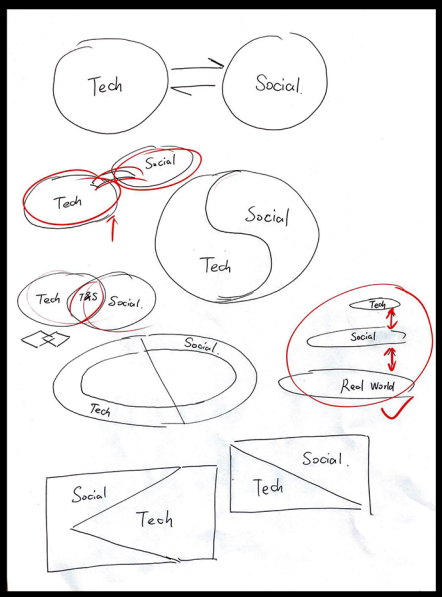
Abstract Cards

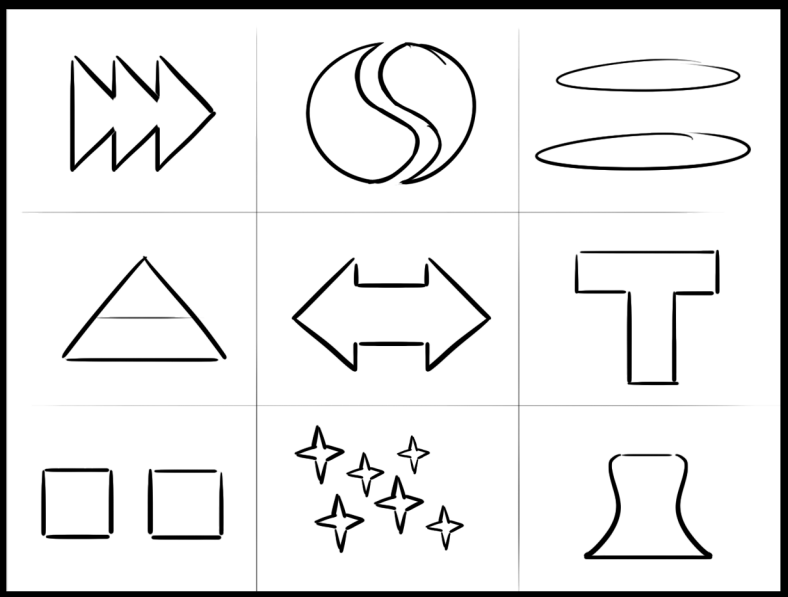
Please don't be scared by the word 'Abstract', you don't need to be Matisse or Piet Mondrian in SEVT. Imagine a image of an Uber delivery person holding a pizza and a hungry person on a piece of paper. If you were given a pen, you might use it to draw an arrow from the delivery boy to the hungry person. This arrow is a perfect abstraction, because there is no tangible arrow in the real world to describe the relationship between two people.

Abstract cards can be used to describe relationships between elements on player cards, tangible cards, and playground cards, such as contrast, hierarchical order, sequence, and service flow.

Like Tangible Cards, we cannot prepare all the abstract cards that may be used before the workshop begins. We can try to provide some of the most basic shapes, such as arrows, triangles, squares, and circles. The production of abstract cards can also follow the 'incomplete' principle. We can make the pre-made cards look rough and avoid using cards that are drawn and cut neatly. This can encourage participants to come up with their own abstraction during use.

Examples:





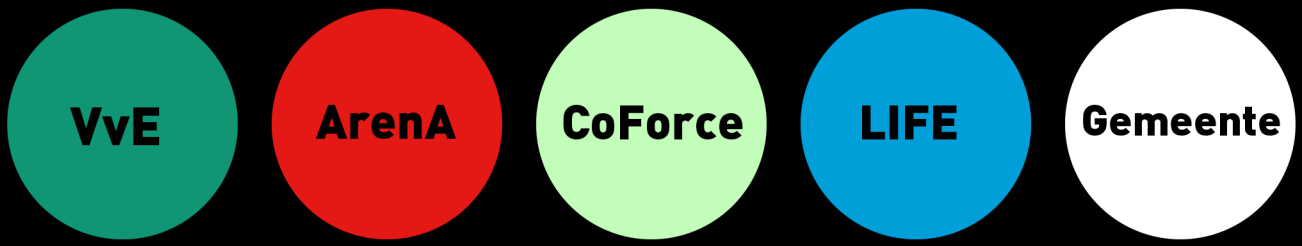
Player Cards

Player cards are the simplest type of cards in SEVT. It's the only thing in this visual toolkit that doesn't necessarily have to be visual.

You only need to find a card of suitable size and write the names of the stake-holders involved in the project on it. That is enough.

Although the design community has been committed to creating novel and recognizable brand logos and visual identities for more than a hundred years, I do not deny their role in the business world, but after my testing, they did not work well in co-creation workshops. Nothing works better than a simple name card.

Of course, if you have time, you can also do some color coding:



Appendix III - Why push pins are 100 times better than sticky notes?

Product designer perspective:

1. Pins are more reliable. Pinned paper do not usually fall off from the cork board. Sticky notes usually tends to fall off from every surface they stick to, glass, white board, paper...

2. Pins are more modular. Pinned paper can be moved from one place to another, from one board to another, without losing its adhesiveness.

3. A pin lasts much longer, it takes way more time for a metal pin to rust, than a sticky note to lose its stickiness.

4. Pins have more function than a piece of paper with glue, it can stick a paper onto the board, it can also highlight important information in a more accurate manner.

5. Pins are more sustainable. Although most pins are made of plastic and they need to work with paper. It has an affordance of encouraging the user to take it seriously, instead of writing something quickly and throw it away.

6. Pins are expandable. It can be used to pin cards, papers, posters, drawings, anything made of paper, while sticky note can only stick itself onto a wall.

User perspective:

7. Pins are more eye-catching. Like when we are making powerpoint slides, every bullet point has a bullet hole/dot in front of it. The pin can serve as the bullet dot and make the structure of the board clearer. On the other hand, it is easy to get lost when swimming in an ocean of sticky notes.

8. When pinning a card on a cork board, it gives people a feeling that the decision is made, while sticky note is a tool which gives people less feeling of responsibility. I believe replacing sticky note with pins may decrease the percentage of nonsense comments, but still, need to be tested.

9. You may argue that sticky note works on most surfaces, but pins only work on specially designed cork boards. However, offices don't naturally come with a white board or glass, which people usually use to write on, or stick sticky notes on. Offices can also be designed to equip a cork board.

Appendix IV - Activities Log

1. Co-creation Workshop Observation
   1A. Battery Use Case 1 (20230228)
   1B. Battery Use Case 2 (20230328)
   1C. LIFE Partner Day (20230516)

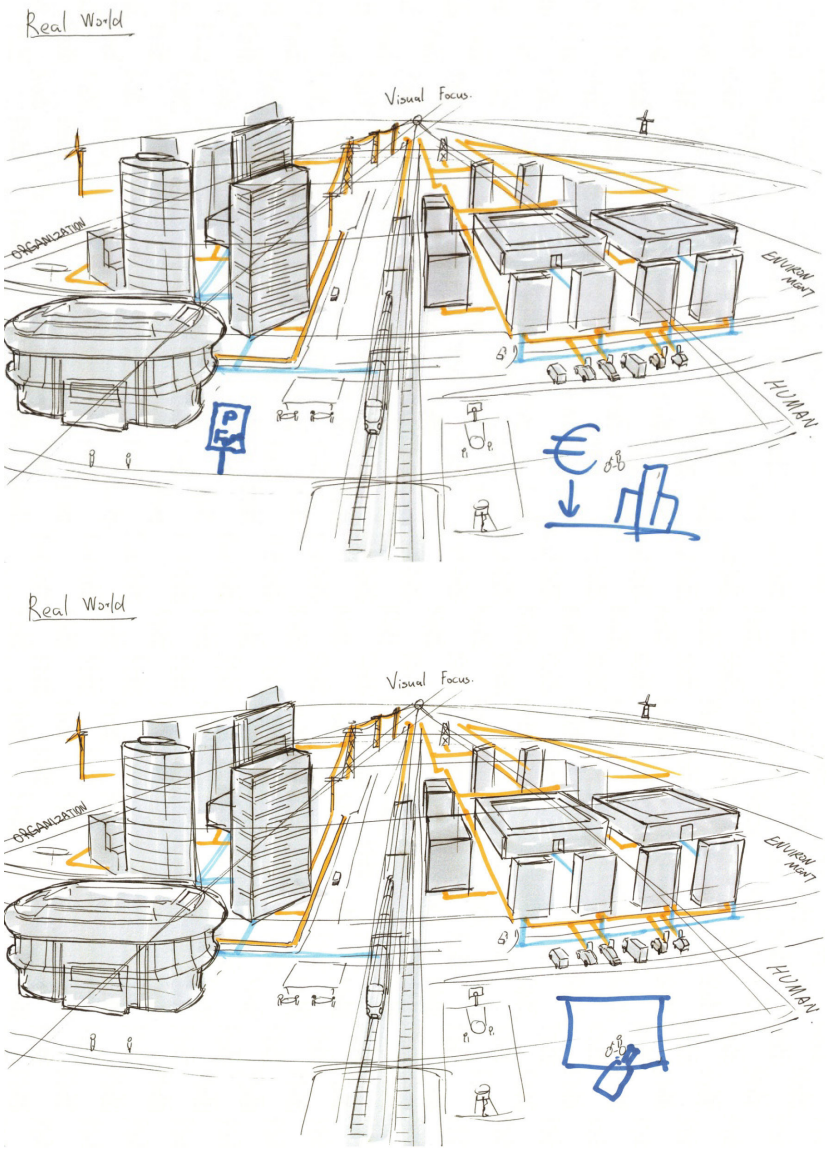
2. Task from stakeholder representatives
   2A. Researcher A TU Delft (Energy Community Venserpolder)
      -2 Meetings (20230407/20230421)
   2B. Researcher B, AMS Institute (Living Labs)
      -3 Meetings (20230509/20230612/20230713)
   2C. Researcher C, WUR/StichtingWOON (Energy Coaching)
      -2 Meetings (20230616/20230623)
   2D. Researcher A, D and E (Energy Cooperative Workshop)
      -2 Meetings (20230627/20230629)
      -Additional Interview
   2E. Hans Roeland (AMS Institute)
      -3 Meetings (? / ? /20230801)
      -2 Sync Meetings Researcher F (20230801/20230823)

3. Visual classification co-creation
   3A. Automotive Designer G, Chang'an Auto China, visual typology ideation.
      -1 Workshop (20230507)

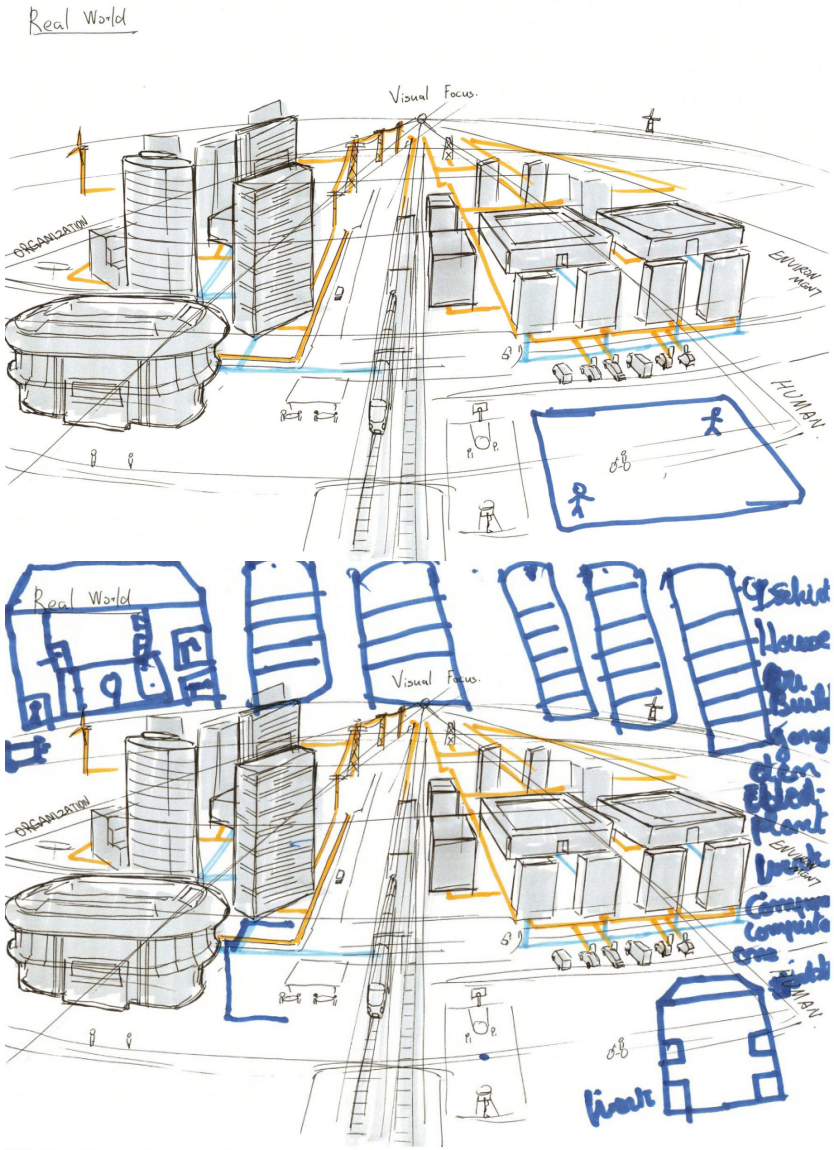
4. Expert Interviews
   4A. Researcher H, Erasmus MC (Healthystart and Flatland, 20230613)
      Scientist I, TU Delft (EWI, 20230613)
   4B. Professor J, TU Delft (Healthystart and Flatland, 20230706)
   4C. Professor K, TU Delft (Visual Classification Method, 20230615)

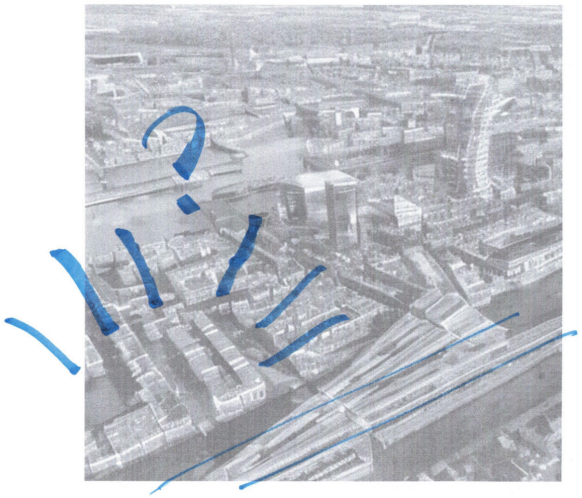
5. Prototype Testings
   VST:
      5A. Design student L, TU Delft (20230622)
      5B. LIFE project team, 2 participants (20230829)
      5C. Test workshop, LIFE project team (20230905)
   EVT:
      5D. Venserpolder street interview, 10 residents (20230731)
      5E. Bijlmer station street interview, 10 residents (20230823)
   SEVT:
      5F. Test workshop, AMS Institute (20230907, cancelled)
      5G. Test workshop, CoForce Energy Commisioners (20230913)
   VST and SEVT validation:
      5H. Validation with Designers, 3 designers (20230923)

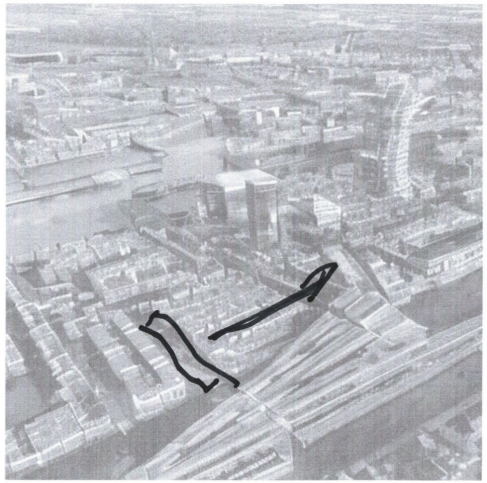
Appendix V - EVT Testing Results

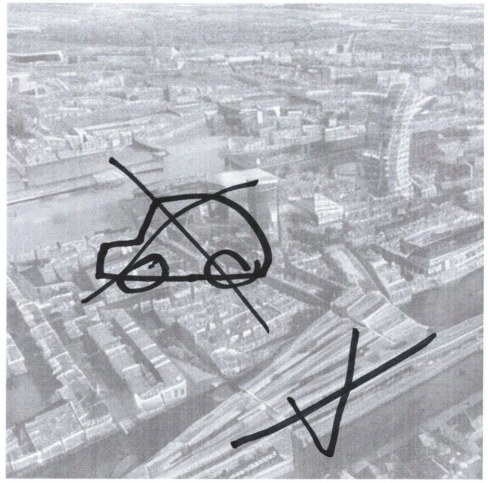


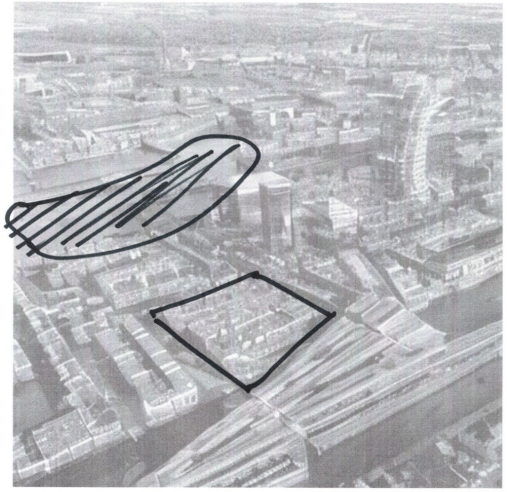
EVT prototype III testing result (designer visual)





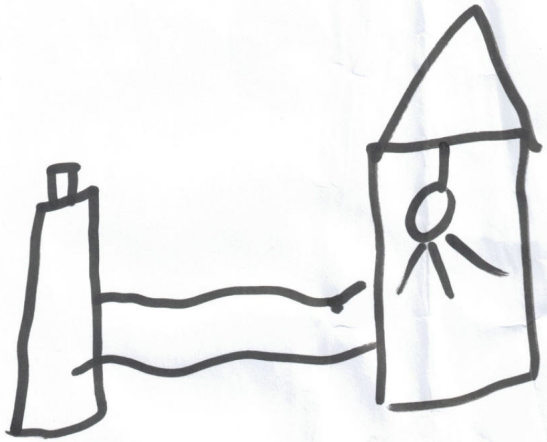




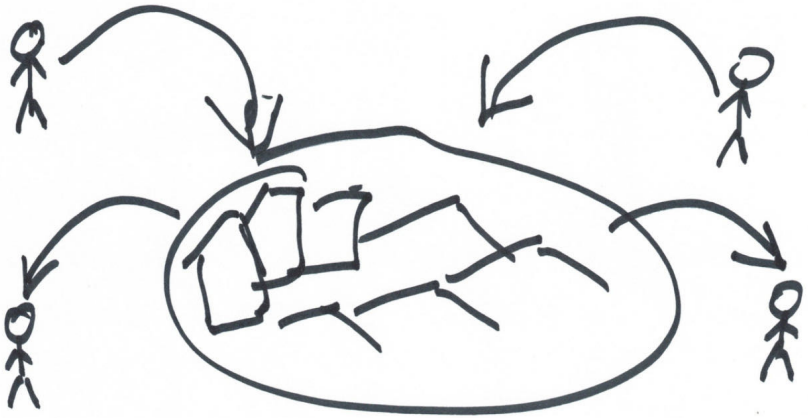


EVT prototype
III testing
result
(Ai visual)

Gemeente Amsterdam



Gemeente Amsterdam



EVT prototype I
testing result

VISUALIZATION FOR BETTER STAKEHOLDER COMMUNICATION

KAI ZHANG 2023

TU Delft