

MEC 313 DESIGN THINKING

LECTURE NOTES



Prepared by

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ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES (A)**

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1. Daniel Ling "*Complete Design Thinking Guide for Successful Professionals*", Emerge Creatives Group LLP, Print ISBN: 978-981-09-5564-9.
2. Jeanne Liedtka, Andrew King, And Kevin Bennett, "*Solving Problems with Design Thinking*" , Columbia University Press Publishers, E-ISBN 978-0-231-53605-9

DESIGN THINKING								
Code	Category	Periods			Sessional Marks	End Exam Marks	Total Marks	Credits
		L	T	P				
MEC 313	ES	2	0	2	40	60	100	3

Prerequisite: NIL

<p>Course Objectives: To familiarize students with design thinking concepts and principles To ensure students can practice the methods, processes and tools of design thinking. To ensure students can apply the design thinking approach and have ability to model real world situations. To enable students to analyse primary and secondary research in the introduction to design thinking</p>

Course Outcomes: At the end of the course the student will be able to:	
CO-1	Explain the design thinking principles & Identify an opportunity and scope of the project and prepare the problem statement
CO-2	Apply the empathy tools to study the user and summarize finding related to problem for define phase.
CO-3	Describe and define the problem specific to the user group and apply Ideation tools to generate Ideas to solve the problem
CO-4	Develop prototypes for test phase.
CO-5	Test the ideas and demonstrate Storytelling ability to present the Ideas.

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	1	1	1						1	2		1
CO-2	1	1	1			1	1		1	2		1
CO-3	1	1	2			1	1		1	2		1
CO-4	1	1	2			1	1		1	2		1
CO-5	1	1	2			1	1		1	2		1

Course Outcomes	PSO1	PSO2
CO-1	1	
CO-2	1	
CO-3	1	
CO-4	1	
CO-5	1	

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

<u>SYLLABUS</u>	
UNIT - I	Periods: 3L+3P=6
Introduction To Design Thinking	
Design Thinking, Need of design thinking, 7 characteristics that define design thinking, comparison of design thinking to other ways of thinking, tools and resources, 5 actions phases of Design thinking, 5 characteristics of action plan. Problem statement. Design principles.	
Activities:	
<ul style="list-style-type: none"> a. Case studies of General, engineering and service applications b. Identify an opportunity and scope of the project and prepare the problem statement. 	
UNIT - II	Periods: 5L+5P=10
Empathize Phases: Design Thinking Tools	
Interview for empathy, Explorative interview, Ask 5x why, 5W+H questions, Stakeholder map, Emotional response cards, Empathy map, Persona/User profile, Customer journey map, AEIOU, Analysis questions builder,	
Activities:	
<ul style="list-style-type: none"> a. Study the user using empathy tools and summarize finding related to your problem for define phase. b. Iterate the process at any stage if required 	
UNIT - III	Periods: 5L+5P=10
Define point of view & Ideate Phase: Design Thinking Tools	
Define point of view :“How might we...” question, Storytelling, Context mapping, Define success, Vision cone, Critical items diagram Ideate: Brainstorming, 2x2 Matrix, Dot voting, 6-3-5 Method, Special brainstorming, Analogies & benchmarking as inspiration	
Activities:	
<ul style="list-style-type: none"> a. Apply the define tools to your problem: Finalize the problem statement b. Apply the ideate tools to your problem: Generate lots of Ideas c. Iterate the process at any stage if required 	
UNIT - IV	Periods: 6L+6P=12
Prototyping Phase: Methods and Tools	
Focused experiments: Critical Experience Prototype (CEP) & Critical Function Prototype (CFP), Crazy experiments: Dark horse prototype, Combined experiments: Funky prototype, Imagining the future: Vision prototype, Prototype with a first function: functional (system) prototype, Solutions in detail: “X is finished”, At the finish: Final prototype, Exploration map, Prototype to test	
Activities:	
<ul style="list-style-type: none"> a. Create prototype for best idea to your problem using any prototype method. b. Iterate the process at any stage if required 	

UNIT - V	Periods: 5L+5P=10
Test Phase: Methods and Tools & Implementation	
Test Phase: Methods and Tools Testing sheet, Feedback capture grid, Powerful questions in experience testing, Solution interview, Structured usability testing, A/B Testing Implementation: Road map for implementation, Problem to growth & scale innovation funnel Activities: <ul style="list-style-type: none"> a. Test the developed prototype by test phase tools and finalize the solution to the problem. b. Iterate the process at any stage if required c. Prepare the complete project report. 	
TEXT BOOKS:	
1. Daniel Ling “ <i>Complete Design Thinking Guide for Successful Professionals</i> ”, Emerge Creatives Group LLP, Print ISBN: 978-981-09-5564-9. 2. Tim Brown, <i>Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation</i> , HarperCollins e-books, 2009. 3. Jeanne Liedtka, Andrew King, And Kevin Bennett, “ <i>Solving Problems with Design Thinking</i> ”, Columbia University Press Publishers, E-ISBN 978-0-231-53605-9 4. Michael Lewrick, Patrick Link, Larry Leifer, <i>The Design Thinking Toolbox</i> , John Wiley & Sons, 2020.	
REFERENCE BOOKS:	
1. Michael G. Luchs, Scott Swan, Abbie Griffin , “ <i>Design Thinking: New Product Development Essentials from the PDMA</i> ”, ISBN-13 : 978-1118971802 2. Beverly Rudkin Ingle, “ <i>Design Thinking for Entrepreneurs and Small Businesses</i> ”, Apress, ISBN: 9781430261827 3. Jose Betancur “ <i>The Art of Design Thinking: Make More of Your Design Thinking Workshops</i> ”, ISBN: 9781522095378 4. Michael Lewrick, Patrick Link, Larry Leifer, <i>The Design Thinking Playbook</i> , John Wiley & Sons, 2018	
WEB RESOURCES:	
1. https://dschool.stanford.edu/resources/design-thinking-bootleg 2. https://www.ideo.com/post/design-thinking-for-educators 3. https://static1.squarespace.com/static/57c6b79629687fde090a0fdd/t/58890239db29d6cc6c3338f7/1485374014340/METHODCARDS-v3-slim.pdf 4. https://www.intel.com/content/dam/www/program/education/us/en/documents/K12/design-and-discovery/student-guide-full-curriculum-session1-18.pdf	

INTRODUCTION TO DESIGN THINKING

“Design thinking is a human-centered approach to innovation that draws from the designer’s toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success.”

—Tim Brown, President & CEO of IDEO

DESIGN THINKING

Design thinking is part and parcel of what goes through a designer's mind in every single design project. It is a powerful thinking tool that can drive a brand, business or an individual forward positively. An example would be to take a gadget and ask, "How do I make this work, better, faster, smoother, and reduce waste and inefficiency?" But it can go beyond product design. You can scale it up and apply it to many things. For example, as more and more people come to cities to look for jobs, these urban areas' consumption of energy, food, water, and other natural resources will steadily increase.

Design thinking can help solve problems with overcrowded living spaces, and minimize stress to our infrastructure. It can be used to utilize our resources effectively, and minimize energy consumption.

WHY DO WE NEED DESIGN THINKING?:

3 key factors why people need design thinking:

1 — For companies to innovate

Companies need to innovate or die. Today's consumers are very aware, are spoiled for choice, and can be very fickle. 3M and Apple were companies on the brink of failure—but they proceeded to adopt an innovative culture through design thinking to achieve amazing records of success. Today, 3M generated nearly \$30 billion revenue selling over 55,000 innovative products, while Apple captivated the consumer electronics market with stylish products like the iPhone, MacBook and iPad.

In a competitive market, companies, big or small, need to innovate to create an advantage over their competitors. Design thinking will allow companies and startups to innovate and explore opportunities, based on unmet consumer needs and understanding of the situation.

2 — For society to solve human problems

People need design thinking to solve human problems (difficulties we encounter in daily life). For example, we face issues like overcrowding at train stations, bad online

banking experiences and traffic jams, which can lead to frustration and social problems. By applying design thinking principles, we identify the best possible options to streamline and make these experiences go better, faster and smoother.

3 — For individuals to compete

Design thinking has already been seen as a competitive advantage for individuals who want to excel in their career or business.

7 characteristics that define design thinking

In psychology, it is believed that the left brain controls the more logical, analytical functions, whereas the right hemisphere processes the imagination, creativity and emotions.

Design thinking is probably one of the few disciplines that utilize both equally. However, it is not a genetic gift that only a few people possess. Just remember:

- 1 — Anyone can use design thinking.**
- 2 — It is fun.**
- 3 — It involves methods that enable empathy with people.**
- 4 — It seeks to define the problem as actively as finding the solution.**
- 5 — It ideates and explores solutions.**
- 6 — It is collaborative and involves iterative prototyping.**
- 7 — It solves problems of many different types.**

Tools and Resources required for Design Thinking

Ensure you have the design thinking tools and resources:

- Good collaborative space
- Paper
- Writing tools
- Cutting and sticking tools
- Camera /Images
- Sketchbook
- Post-its
- Cardboard
- Whiteboard / Wall / Pin board
- Cards
- Materials for prototyping
- Frameworks

How is design thinking compared to other ways of thinking?:

Business Thinking	Design Thinking	Creative Thinking
Left brain	Using both sides of the brain to solve problems	Right brain
Rational and structured	Switching at will between rational and intuitive approach	Intuitive and emotional
Focus on analysis	Iterating between analysis and creation	Focus on creation / expression
Deal with well-defined problems	Deal with ill-defined problems	Deal with no or undefined problems
Target to improve business results	Target to improve user's experience	Target to explore new ideas
Analyze > Decide	Empathize > Define > Ideate > Prototype > Test	Perceive > Ideate
"Let's solve this problem."	"What is the problem we are trying to solve?"	"There is no problem!"

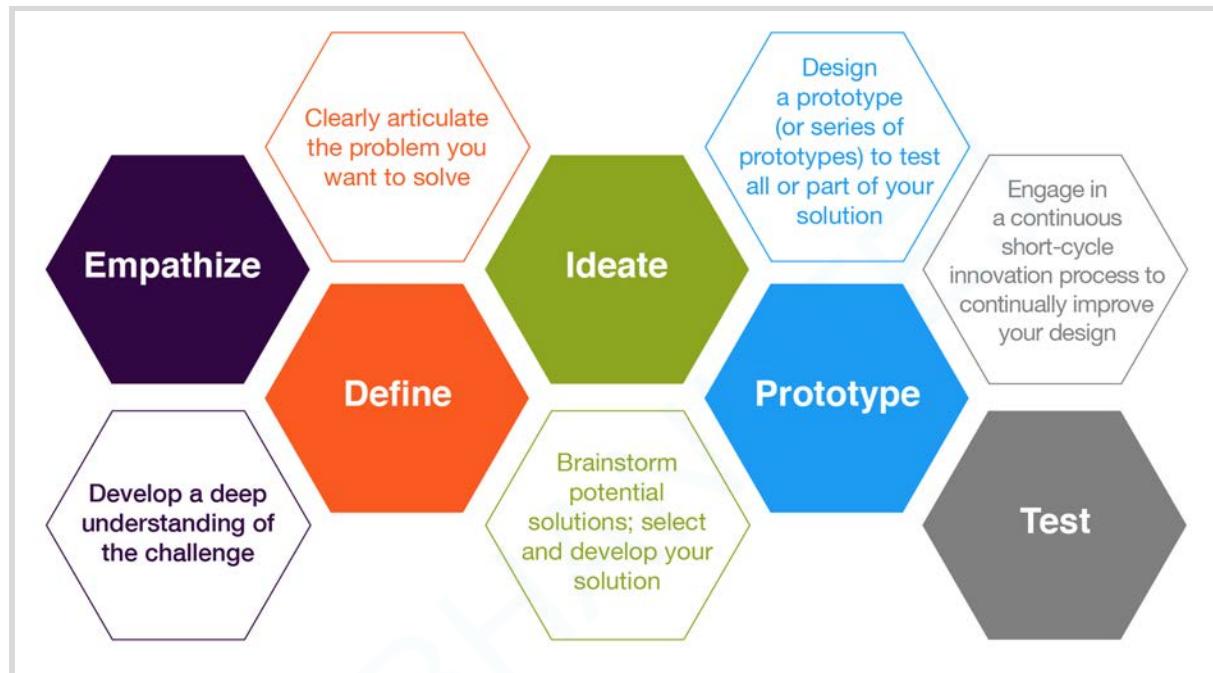
DESIGN THINKING—ACTION PLAN & 5 ACTION PHASES:

“Design” is derived from “Designare” in Latin which means “to mark out and take action”, while “Think” comes from “Cogito” which means “to ponder and consider”. Hence, design thinking is the proper attitude and frame of mind, along with the right series of actions, in order to solve a problem. If the mindset is the train, then the action plan is the track.

A design action plan is a series of action phases that execute the design thinking process. You need both the action plan and mindset in order to run design thinking. One will not work without the other. To use an analogy, imagine a car and a driver. The car will not move without the driver turning on the ignition, and the driver cannot

travel without a car. Similarly, effective design thinking requires both the design action plan (the car) and the mindset (the driver) to function together properly. This is critically important. If the user does not have the correct mindset to begin with, he/she is likely to become frustrated, and waste a lot of time and effort. Even the best action plans are likely to go wrong, under such circumstances.

The design action plan is a framework that contains a series of action phases that execute the design thinking process. It is a roadmap that tells people involved in a project whether they are going to be on the right track.



The 5 action phases are:

Empathize — to understand your customers / users

Define — to define clear project / business objectives

Ideate — to explore ideas and solutions

Prototype — to build and visualise ideas and solutions

Test — to review and decide

Phase:	Activities:	Tools to use:	Deliverables:
1. Empathise	User interview Informal chats Observation Shadowing Mystery shopping Picture-taking Immersion	Interview checklist Observation checklist Writing tools Flipcharts and paper Camera	Personas Empathy Map List of user feedback Problems identified
2. Define	Workshops Stakeholder meetings	Drawing and writing tools Post-its Flipchart / Whiteboard User feedback <i>(from Empathize)</i>	Design brief Stakeholder map Context map Customer journeys Opportunity map
3. Ideate	Ideation activities Brainstorming workshops Mindmaps Sketching / drawing	Drawing and writing tools Post-its Flipchart / Whiteboard Personas <i>(from Empathize)</i> Design brief <i>(from Define)</i> Brainstorming tools	Ideas / concepts Sketches Prioritisation map Affinity map Idea evaluation
4. Prototype	Space prototyping Physical prototyping Paper construction Wireframe building Storyboards Role-plays	Paper Cardboard Construction materials Cutting and writing tools Space Props	Physical prototypes Wireframes Storyboards
5. Test	User testing Observation Picture-taking Evaluation discussion	Briefing checklist Interview checklist Observation checklist Prototypes to test <i>(from Prototype)</i>	List of user feedback Observation Evaluation map Proposed refinement

5 CHARACTERISTICS OF ACTION PLAN:

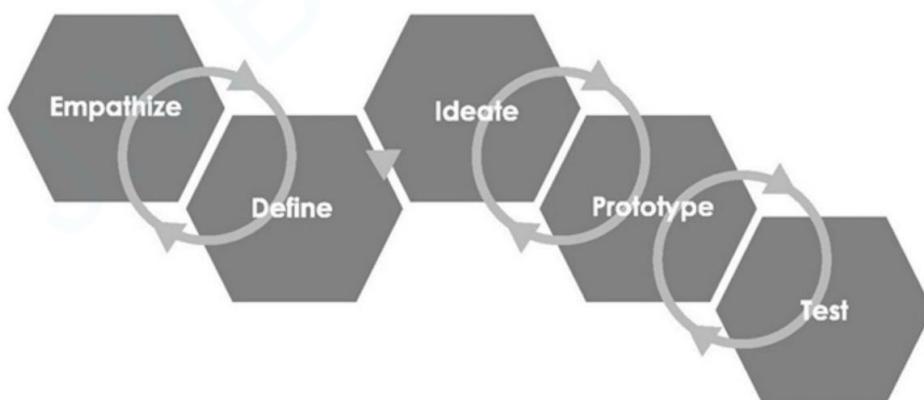
1 — It is not just a brainstorming session or a “one-day” process.

The design action plan is not a process that works instantaneously - it requires time and effort from committed individuals involved with the same objective to make it work. It is certainly not a “one-day” process where problems can be solved in 24 hours. There are phases where you need multiple iterations, testing and checking back with users and

exploration where it would take time to incubate. Some have commercialized design thinking as a “brainstorming” session. It is not. Remember, design thinking is a 5-step process, and not a 1-step Ideate Phase. It seeks to define the problem, even as it finds the solution.

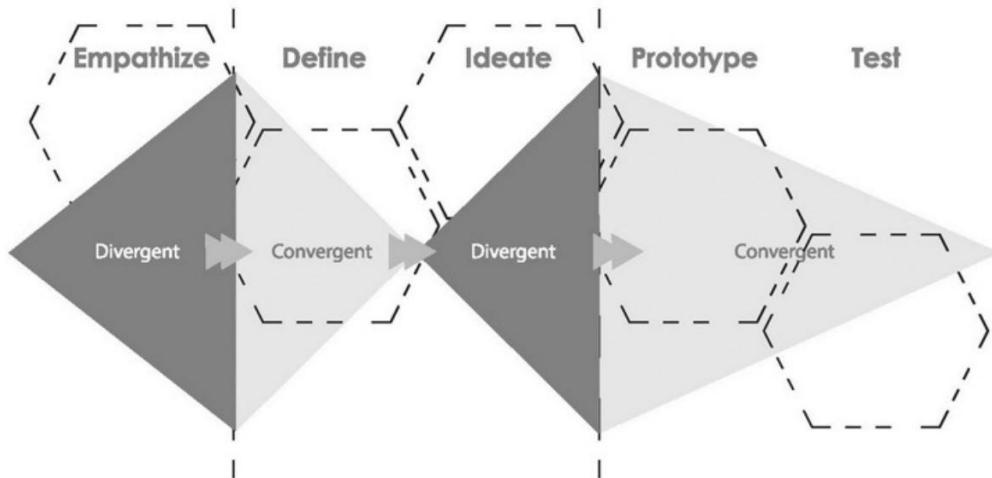
2 — It is an iterative process.

The design action plan is an iterative process. You need to repeat each phase backwards and forwards, and arrives at each decision or desired result, after rounds of discovery. It means to work on something over and over again, until every facet becomes crystal clear. For example, you can iterate between Ideate and Prototype Phase several times - you sketch ideas and immediately build prototypes to make rounds and rounds of discovery of the idea. After that, you may want to go back to Ideate Phase to refine the ideas yet again.



3 — It contains phases of both divergent and convergent thinking.

The design action plan has phases of both divergent and convergent thinking. The Empathise and Ideate Phase requires divergent thinking. Divergent thinking is to create and explore ideas and possibilities, without restraint. Within the phase, you will be encouraged to make guesses, come out with wild ideas and be creative.



The Define, Prototype and Test Phase requires convergent thinking. Convergent thinking means to actively select and decide the right solutions to the problem, based on constraints or feedback. Within the phase, you will be encouraged to analyze and make decisions and constantly ask critical questions to solve the problems at hand. Both sides of thinking are important in order to make this process work.

4 — It requires everyone to collaborate and go through the process together.

The design action plan is made up of phases where everyone, including the design thinking facilitator, collaborates on the process together. Everyone will bring their prior experiences and knowledge about the problem to the table and work on the issue together. The process is not like a hot potato, where you “toss” the responsibility from one individual to another. For example, the researcher in the Empathize Phase might share to the business lead in the Define Phase and define the project, which engages a designer to coordinate the Ideate Phase, and then leave everything to the engineer in the Prototype and Test Phase! But this is not proper design thinking. Instead, all of them (the researcher, business lead, designer and engineer) should be in the process from start to end.

This is because everyone in the team requires deep insight of what the issues are and what are needs of the users-so that everybody is on the same page. Design thinking is a process where everyone collaborates together from start till end with a common objective.

5 — There are deliverables at every phase.

There is a deliverable outcome of each action phase which will give you a point of reference, when you go through the process of iteration. This list of deliverables is

not exhaustive, but you do not have to use them all. Based on the nature of your project, select the necessary deliverable.



Characteristics	What would you expect	What is expected of you?
1. Not just a brainstorming session	Proactive process of action phases over a period of time	Be patient and prepared that the process does not work like instantaneously
2. Iterative process	Repeated rounds of discovery of ideas / concepts until you become crystal clear	Be willing to discover and never stop at the first idea / concept
3. Has phases of both divergent and convergent thinking	Explore ideas & possibilities at one action phase while being decisive in solutions in another	Approach different way of thinking at each action phase
4. Requires collaboration	All stakeholders go through the process together	Be open and accept others into the process- everyone has experience and expertise to bring to the table
5. Deliverables at every phase	Point of reference at every action phase	Advocate to document deliverables at every phase

1. Problem statement

In design thinking, we always start with the problem, never with a solution.

- A design challenge starts with the understanding of the problem statement.
- Before we begin to solve a problem, we must first understand it correctly.
- The problem statement is a key tool for consolidating and capturing the analysis results.
- A problem statement (see also “point of view”) marks the starting point and the end of the relevant problem space and the transition to the “ideation” phase.

Group Size: 3 - 5

- Ideally, in a group of 3-5 from the design team
- Optionally, 1-2 stakeholders or the client (if available)

Typical Duration: 30 - 40 mins

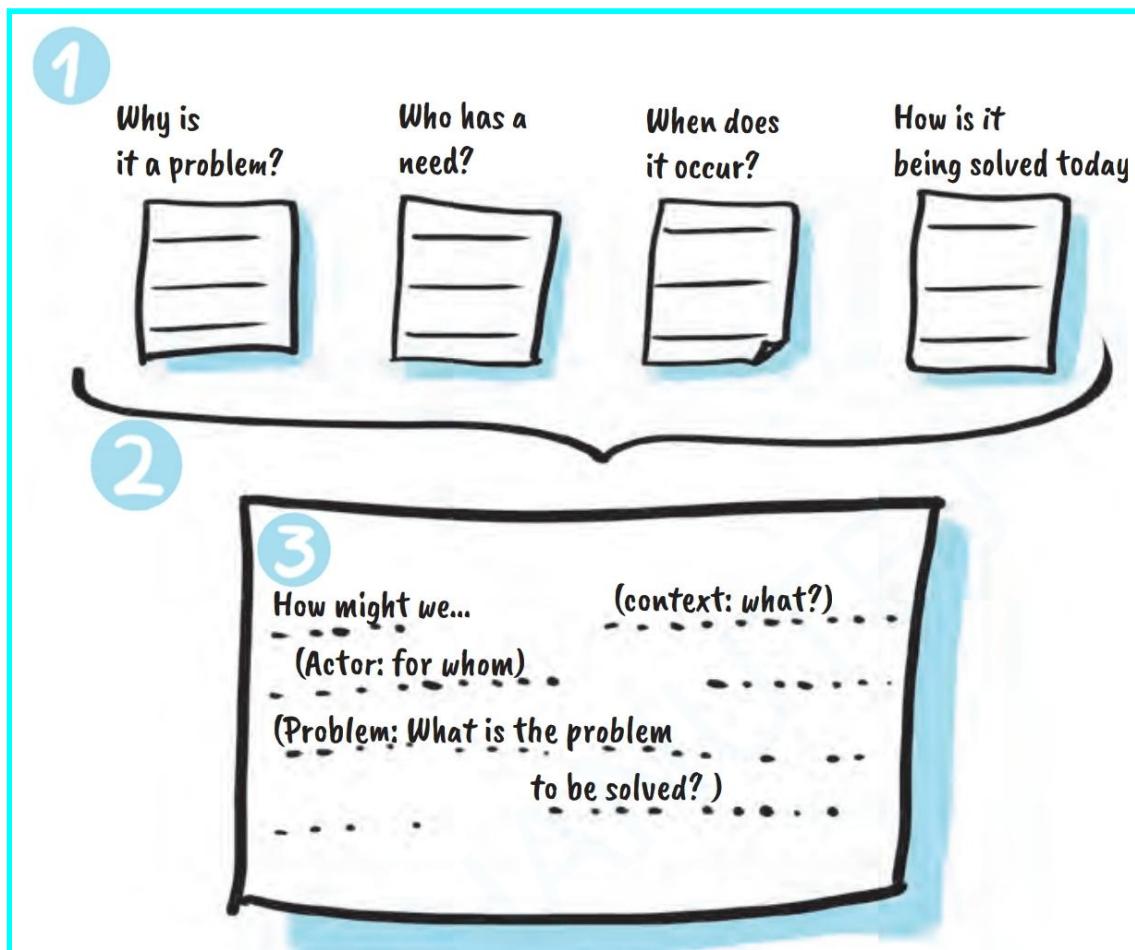
Procedure:

Step 1: The following questions (problem/actor/context) help with the formulation of the problem statement:

- ✓ What is the problem? Why is it a problem?
- ✓ Who has the problem? Who has a need?
- ✓ When and where does the problem occur?
- ✓ How is it solved today?
 - Write down the questions on several A4 sheets (portrait) and leave enough space for answers underneath.
 - Use different colors for the questions and answers and write legibly and as large as possible.
 - Produce at least 10 of such problem definitions.

Step 2: Attach these papers to the wall and put an A3 sheet in landscape layout underneath them. Then consolidate the problem definitions or select the most appropriate statement.

Step 3: Start transferring the individual problem definitions systematically into an overarching problem, for example, in the form: “How might we redesign... [what?] ...[for whom?] ...so that...[his need]...is satisfied?”

Problem statement Template:

2.Design principles

- Across the entire design thinking cycle, design teams get into situations in which decisions must be made. At these critical points, design principles can support the team.
- Design principles range from broad and overarching concepts to project-specific requirements that support the decision on the design direction in each case.
- In addition, the most important features of a product can be communicated to other interest groups by means of design principles.
- Design principles are important even beyond the design thinking cycle since they give the teams in follow-up projects a better understanding of what the guiding ideas were in the design.
- In addition, design principles are like a knowledge base for teams since the principles are based on experiences with products, services, and functions.

Group Size: 5 - 12

- Depending on the design challenge, between 5 and 12 participants, consisting of the design team+selected stakeholders, and the client.
- Usually led by the facilitator or project manager.

Typical Duration: 90 - 180 mins

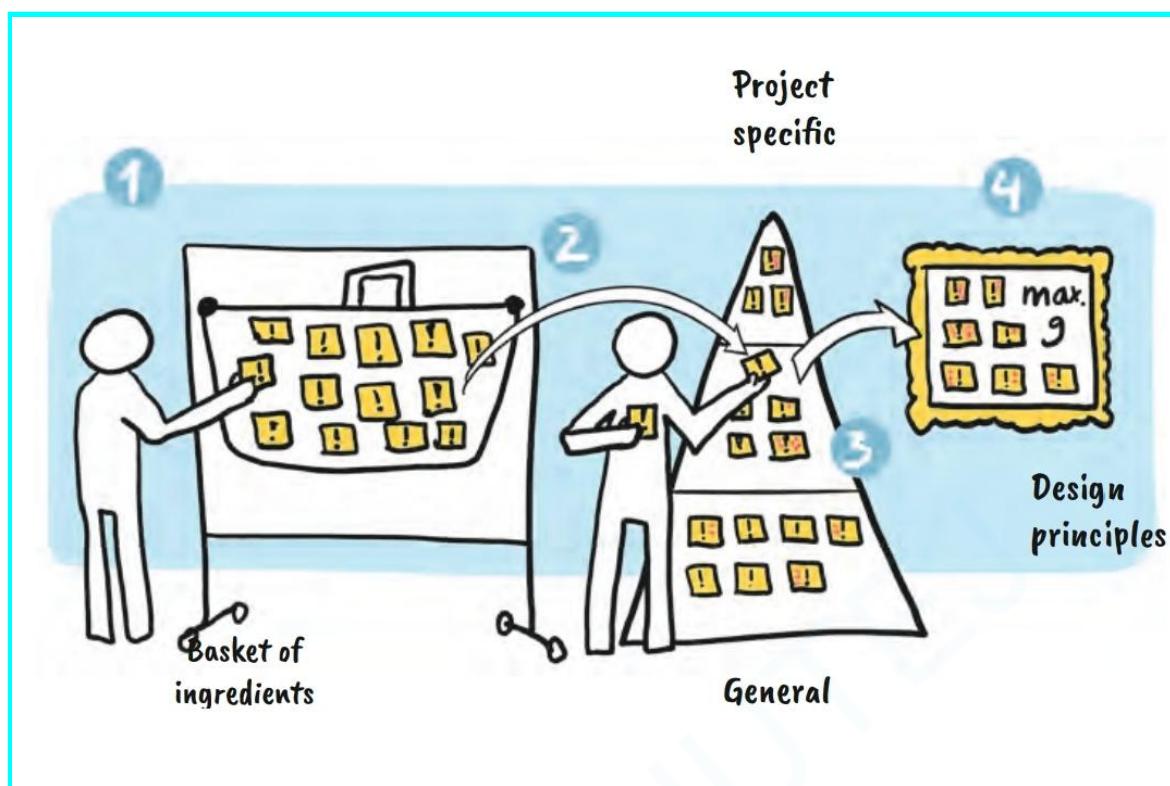
Procedure:

Step 1: Sketch a “basket” and a pyramid on the whiteboard. Then invite all participants to write design principles on Post-its and place them on the “basket.” Whenever a team member puts a principle on the “basket,” he or she is requested to explain why it is a design principle.

Step 2: As soon as the “basket” is full, sort the design principles on the pyramid, for example, by dividing them into three groups. The sorting is carried out according to the rule: the higher up on the pyramid, the more project-specific the principle is. General design principles are located at the bottom of the pyramid.

Step 3: Once the assignment of the design principles is completed, a vote can be carried out (e.g. with glue dots). The aim is to reduce the design principles to a maximum of three per section, that is, a maximum of nine per pyramid.

Step 4: It's best to put the selected and adopted design principles in a place where the team is often confronted with them and to which it has quick access.

Design principles Template:

EMPATHIZE PHASE: DESIGN THINKING TOOLS

EMPATHIZE PHASE:

The Empathize Phase is the first phase of the design thinking process. During this phase, you will need to immerse yourself in learning about others, primarily the end users, and the problem that you are trying to solve. You can also talk to experts and other key stakeholders, or even conduct research and interviews. Your goal is to develop background knowledge through these experiences, and use these insights as a springboard to address design challenges.

The following are some design thinking tools used at the empathy stage for better understanding of the problem from the user point of view.

1. Interview for empathy
2. Explorative interview
3. Ask 5x why
4. 5W+H questions
5. Stakeholder map
6. Emotional response cards
7. Empathy map
8. Persona/User profile
9. Customer journey map
10. AEIOU
11. Analysis questions builder

1.Interview for empathy

- Interview for empathy aims at looking at the world from the point of view of a user.
- The tool is normally used at an early stage in the design thinking cycle in order to understand the context in which the user acts. Only then can the development of a solution begin.
- The tool also helps to overcome existing patterns of thought. Especially if, previously, a more analytical and less human being-centered approach had been applied to problem solving.

Group Size: 1 - 2

- Ideally, in a group of 2
- Always best with two people: One conducts the interview, and the second person takes notes on emotions and body language.

Typical Duration: 30 - 60 mins

Procedure:

- Start by introducing yourselves and then explaining the problem you are trying to solve via the interview.
- Emphasize to them that the interview is not about finding a solution but, rather, to learn something about their motives.
- Successful “interviews for empathy” succeed in building a relationship with the interviewee. It’s most effective when the interviewee feels comfortable and is, therefore, willing to share his story with the design team in the context of the problem.
- If you succeed in having the interviewee tell his story, interrupt him as little as possible and, in general, be cautious about not influencing him with your own previously held assumptions.
- Listen sincerely and use open questions (e.g. W+H questions) if the motives are still not clear.
- Avoid questions that can be answered with yes/no or a single word.
- Ask additional questions that are not directly associated with the problem, or introduce statements that might confuse the interviewee at first but help to consider the problem from different points of view.

- Pay attention to the gestures and body language of the interviewee and, if required, note down and clarify if these signals are contradictory to the answer.
- Use the template in order to describe assumptions, write down key questions, and finally outline the story of the interviewee.

Interview for empathy Template:

Existing assumptions about the persona and the problem: 		
How might we build a relationship with the interviewee in order to give him/her such a good feeling that he/she shares personal stories in the context of the problem?	Key questions for the exploration of stories:	Keywords and topics in connection with the emotions shown:
Outline of the story:		

2.Explorative interview

- An “explorative interview” is usually used in the early phase of the design thinking cycle.
- With this type of interview, our main goal is to learn something about the everyday life of the people for whom we are creating a solution.
- The “explorative interview” is a good opportunity to get away from the focus on the product and show the team that our users have other needs.
- Thus it is suitable to question assumptions made and direct the development to functions and experiences that are actually relevant.

Group Size: 1 - 2

- One interviewer is ideal to establish a deep relationship with the interviewee.
- As an alternative, one person can conduct the interview, while a second person takes notes.

Typical Duration: 60 - 120 mins

Procedure:

Step1: First create an interview guide with the topics and questions to be dealt with. Start with broad questions and zoom in on the topic step by step.

- The interview should take place at the location of typical use or at a location where the participant feels comfortable – the most suitable place may be his or her home.
- Be prepared to depart from the interview guide if questions and topics come up that are important to the interviewee.

Step 2: Ask open questions, such as “what,” “why,” and “how” and avoid yes/no questions.

- Make sure that the questions allow the participant to describe his behavior or his opinions from his own perspective.
- Ask about concrete examples to avoid standard answers and search for specific events, for example, “When did you last....”
- Try to dig deeper, for example, “What does this mean to you...” or “Why did you....”
- At the same time, try to speak the language of the participant and avoid technical terms. Keep in mind that the interviewee is the expert in his life.

Step 3: Complete the interview with questions such as: “What would happen if you had one wish to make?”

Explorative interview Template:

Interview Guide:

1 Introduction:
Begin with general things. What are "broad" questions to open the conversation and break the ice?

What is your profession? _____ Tell me what you experienced recently. _____ Tell me what annoyed you recently. _____

2 Get to know the entire story:
What are the questions that help you to understand the hopes, fears and motivations of the people interviewed?

What are you saving for? _____ What helps you to save money? _____ What was the biggest challenge in this context? _____

What happened before/after/during? _____ Why? _____ Wait..., what exactly do you mean by that? _____ ... (pause) _____

3 Conclusion: Explain what happens with the answers and thank the interviewee for the discussion. Always be appreciative!

"If you had one wish to make...." _____ Thank you very much for the conversation _____

3. Ask 5x why

- We ask 5x “Why?” in order to understand the situation and the true causes of a problem.
- This questioning technique can be used whenever we ask questions and observe a user and want to explore critical experiences and functions of a problem in a more in-depth way.
- The tool is mainly used in the early stages of the design cycle and in the testing of prototypes.
- Asking repeatedly also helps us to identify hidden problems that a user would not mention if only asked once. In this way, we gain insights on a different level and are better able to assess situations.
- If we use this interviewing technique in the “test” phase, it may help us to understand more exactly what functions and experiences work and which need to be adapted or should be discarded.

Group Size: 2

- Ideal are groups of 2.
- One person conducts the conversation and the other focuses on documentation.

Typical Duration: 30 - 40 mins

Procedure:

- Use the template or write the answers on a blank sheet of paper.

Step 1: Describe the problem in as much detail as possible and use photos or sketches to illustrate it.

Step 2: Start with a “root cause” analysis and ask “Why?” as often as possible. Try to counter each answer with a follow-up why question.

- Stop asking “Why?” once it no longer makes sense. Then explore another problem in this way or get into an in-depth discussion with the interviewee on the answers given.
- Integrate simple prototypes and sketches into the solution discussion to obtain first reactions from the users.

Ask 5x why Template:

1	Detailed description of the problem.
1	1. Why is it a problem (problem description)?
2	Consequence
2	What is the problem? What are its symptoms?
3	Direct impact
3	Why does the problem occur? What technology is used?
4	Cause – effect
4	What could be another cause of the problem?
5	Organizational hurdles
5	How could the problem be avoided?
5	Systematic hurdles
5	The systematic approach might prevent the occurrence?

4. 5W+H questions

- Intuitively, the 5W+H questions are question words starting with a W or H: Who?, What?, When?, Where?, Why?, and How?
- Investigative journalists, for instance, use the 5W+H questions as a basis for their research. They use the 5W+H questions since they are open questions that allow a wide range of answers.
- The W+H questions allow us to learn more about the wishes and opinions of the user or a customer.
- The simple structure of the W+H questions helps in the divergent phase to gain a basic overview and in-depth insights. The findings of the team and photos of observations can be analyzed with this tool and guide the team into areas where previously undiscovered needs and knowledge are unearthed.
- During the observation phase, the W+H questions help to explore “what” happens, “where” it happens, and “how” it happens.

Group Size: 3 - 5

Typical Duration: 30 - 60 mins

Procedure:

- The 5W+H questions can be used in all sorts of situations. We would like to introduce two situations.

Situation 1: To understand the problem better

- Objective: to get an initial overview of the problem as well as information about possible hypotheses and starting points
- Try to raise and answer all relevant W+H questions.
- If a W+H question does not make sense in the given context, skip it.
- Look where uncertainties exist or further questions crop up. Find out what questions should be raised in the interview.

Situation 2: Learn more about the needs

- Goal: to provide a basis for an interview with users or stakeholders
- Prepare a list of possible sub-questions (e.g. in the form of a mind map).
- Vary the questions and “play” with them. Adapt them to the situation.
- Create the interview questions or a question map from all this.
- Try to get a lot of information. Ask why even in the context of other W+H questions.

5W+H questions Template:

Who	What	When	Where	Why	How
Who is involved?	What do we already know about the problem?	When did the problem start?	Where does the problem occur?	Why is the problem important?	How could this problem be an opportunity?
Who is affected by the situation?	What would we like to know?	When do people want to see results?	Where was it resolved before?	Why does it occur?	How could it be solved?
Who is the decision maker?	What are the assumptions that should be scrutinized?		Where did similar situations exist?	Why was it not yet solved?	What has already been tried to resolve the problem?

5.Stakeholder map

- The stakeholder map is a visualization that helps to clarify the positions of the various stakeholders. This tool is part of the stakeholder analysis that aims at identifying the interests, the inhibitory and supporting factors, as well as power structures within the system.
- The stakeholder map and the analysis yield information on the characteristics of all interest groups and the relationships among them, and serves the purpose of communicating effectively with all relevant stakeholders.
- Understanding the interest groups and building a relationship with them is an essential part of the process.
- Knowledge about stakeholders is vital, since they are the ones who decide on the “top or flop” of a project; in addition, they are crucial for the implementation of solutions.

Group Size: 3 - 6

- Ideally, the team is complemented by a representative of the respective stakeholder.
- Often, the design team develops a first map and then validates the results in follow-up discussions with the stakeholders.

Typical Duration: 60 - 240 mins

Procedure:

Step 1: Start by defining the use case. It can be a product, project, or the collaboration of different departments.

Step 2: List all stakeholders involved.

- In addition, deepen the understanding of the various stakeholders by asking questions. The questions are defined in accordance with the use case:
 - Who will benefit from the success? Who has an interest in it being a success?
 - Who do we collaborate with? Who provides us with valuable ideas?
 - How can sales and marketing make a mark?
 - Who is blocking the idea, and for what reasons? Who benefits from a failure?

Step 3: First create a stakeholder map and enter the various stakeholders on the map. Then enter the connections of the stakeholders to one another.

- Define and use different symbols for the connections, for example, broken lines for more complex relationships.

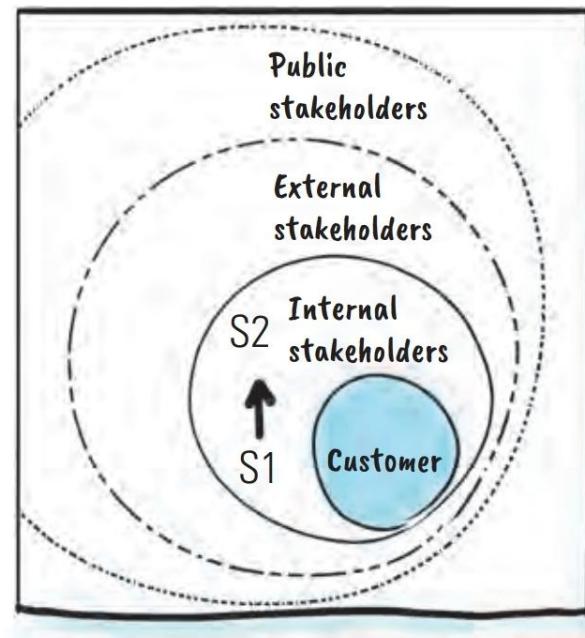
- Reflect on the stakeholder map and determine the next steps, actions, and possible consequences from working with the stakeholder map.

Stakeholder map Template:

- 1 Define use case
- 2 Stakeholder brainstorming



- 3 Draw in connections.



— Close relationship (frequent contact, exchange of information, coordination, mutual trust, common interests).

?? Weak or informal relationship. Question mark shows unclear relationship.

== Institutionally established alliances and cooperative projects.

→ The arrow indicates the flow direction, for instance, of information and values.

⚡ The lightning sign shows tensions, conflicts, or dangers between stakeholders, broken or injured relationships.

6.Emotional response cards

- The emotional response cards are a qualitative tool for empathetic target group analysis. The cards provide the target group with a simple aid that enables them to talk about a situation in a targeted and deeper way.
- As a result, members of the target group are encouraged to speak about their emotions, beliefs, and perceptions. People can remember well what something felt like but they usually need a trigger to start talking about it.
- The emotional response cards are normally used in the early stages of the design thinking cycle to gain understanding and determine the direction of the development.

Group Size: 1 - 2

Typical Duration: 15 - 20 mins

Procedure:

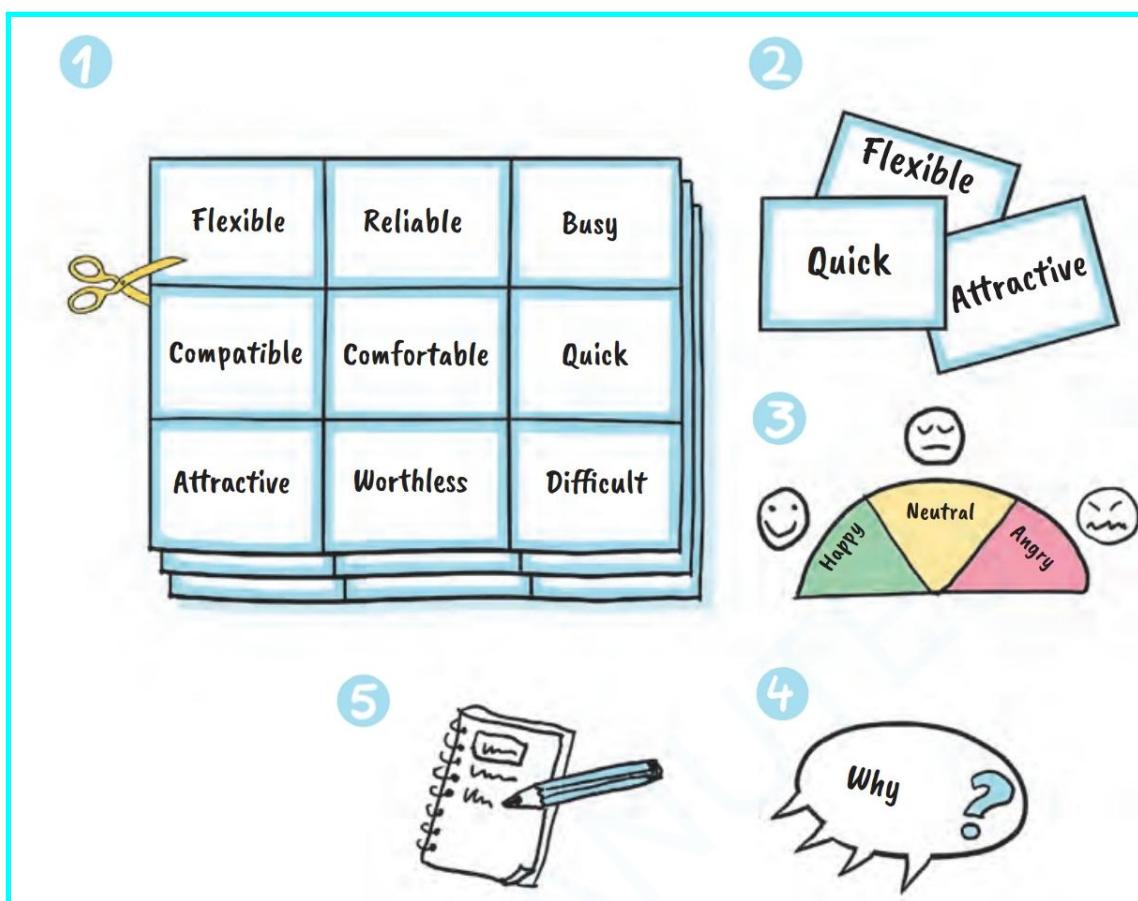
Step 1: Print the 50 cards and glue them on thin cardboard.

Step 2: Lay the cards on the separate table in any order.

Step 3: Ask the users after the test to select 3 cards from the set that best describe their experience with the product. Add that it is not important for the adjective to be absolutely exact and that it is also allowed to be negative! It serves only as a trigger for an emotion. The person is also allowed to show emotions during the selection and talk to himself/herself. Write down anything conspicuous! As soon as the test person picks up a card, put it aside on the table and write down the adjective. Leave a little space with your notes for later insights.

Step 4: As soon as the user has selected the 3 cards, explore (through questions) the adjective for the respective situation in which the user felt like that and deepen the insight by asking “why” questions. Other question techniques yield supplementary information, for example, “What did you expect instead?,” and so on.

Step 5: Also write down the statements as direct quotes. Take a photo of the map situation or record the stories on video.

Emotional response cards Template:

7. Empathy map

- An empathy map is a tool for empathetic target group analysis. It is used to identify feelings, thoughts, and attitudes of existing or potential users and customers and understand their needs.
- The aim is to obtain in-depth insights on the potential user by means of W+H questions.
- In comparison to a customer journey map or a persona, the empathy map focuses more on the emotional state of potential customers.
- We use the empathy map mainly in the “understand,” “observe,” “define point of view,” and “test” phases.
- We also suggest speaking to experts who know the user/customer well and, of course, being active yourself and doing what the user is doing. “Walk in the shoes of the user!”

Group Size: 2 - 3

- A team of 2 per interview is ideal.
- One person documents and records, while the other person poses the questions

Typical Duration: 20 - 30 mins

Procedure:

- In the empathy map, we explore “needs.” We think in terms of verbs (activities) for which the user needs help, not in nouns (solutions).
- Outline the layout on paper or use the empathy map template.

Step 1: Fill in the fields in the template during (or just after) the interview.

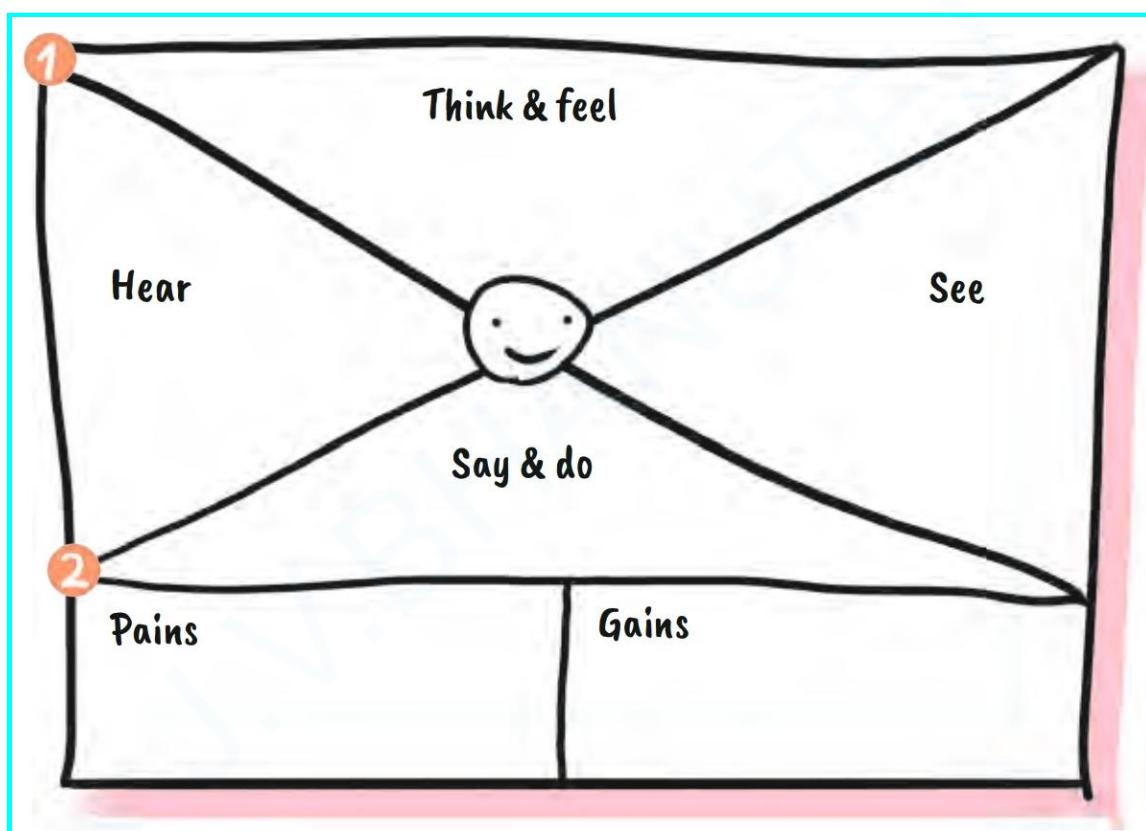
- 1. WHAT DOES THE CUSTOMER/USER SEE?
 - What does his environment look like?
 - Where is the customer? What does he see?
- 2. WHAT DOES THE CUSTOMER/USER HEAR?
 - What does the user/customer hear?
 - Who influences him? Who speaks with him?
- 3. WHAT DOES THE CUSTOMER/USER THINK & FEEL?
 - What emotions drives the customer/user?

- What do the customers/users think?
- What does it say about them and their attitudes?
- 4. WHAT DOES THE CUSTOMER/USER SAY & DO?
- What does the customer/user say?
- What are all the things the customer/user must do?
- Where does the user behave in a contradictory way?

Step 2: Also fill in the fields PAINS AND GAINS

- What are his/her biggest problems and challenges?
- What are the opportunities and benefits he/she might have?

Empathy map Template:



8. Persona

- A persona (often referred to as user persona, customer persona, or buyer persona) is a fictitious character created to represent a user or customer type.
- The persona puts a potential new solution (e.g. a website, a brand, a product, or a service) into the context of the respective needs and the jobs to be done.
- This can refer to individual functions, interactions, or the visual design of a website.
- A persona should be described as accurately as possible. This means it has a name, gender, and the basic demographic data (e.g. age, profession, hobbies). Information on the personality and characteristics of the persona are also recorded. Goals, needs, and fears are inferred from it. Similarly, the biography of a persona may help to draw conclusions about the purchasing behavior from the social milieu.
- The team should be able to meet the persona like a real person.

Group Size: 2 - 5

- The entire design team (2-5members) takes part actively in the discussion and contributes observations and insights.
- The user profile can also be filled in separately.

Typical Duration: 20 - 40 mins

Procedure:

Collect information on a potential user and discuss with the team which type of persona might be representative for the problem statement.

Step 1: Describe the persona. Give the persona a name, gender, and age. Add additional attributes such as social milieu, family, hobbies, and so on.

Step 2: What is the task (job) the user does? Where can he be helped?

Step 3: Describe all use cases in the context of the problem statement (where? what? how?). Where does the user make use of our proposal? What happens before and after? How does he do it?

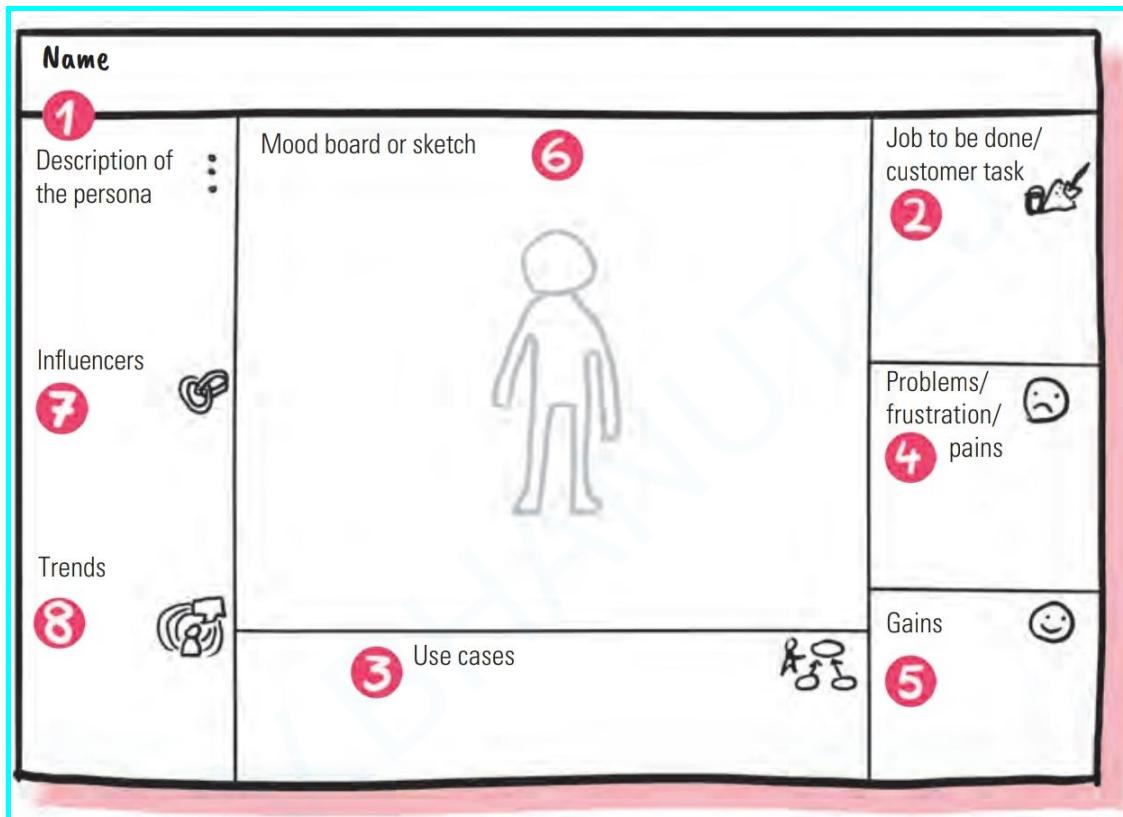
Step 4: What are the biggest difficulties and problems the user has? They can be unsolved problems or difficulties the user has with existing products and offers.

Step 5: Determine the gains (possibilities, benefits) and pains (problems, challenges) the user has or might have.

Step 6: Draw a sketch that visualizes the customer (optional); or supplement the user profile with photos or clippings from magazines, similar to a mood board like the ones designers use for inspiration.

Step 7: Think about who has an influence on the persona (family, children, stakeholders, etc.) and what general trends (e.g. megatrends, market trends, technology trends, etc.) influence the persona (Step 8).

Persona Template:



9. Customer journey map

- A customer journey map allows us to build empathy with the customer by visualizing his actions, thoughts, emotions, and feelings that emerge in an interaction.
- In contrast to a process map, which can usually only map the internal processes of a company, a customer journey map is geared to the human being and his/her needs.
- In addition, a customer journey map looks at the actions that are not directly associated with the product or service (e.g. informing, waiting, ordering, delivery, installing, customer service, disposing of).
- The customer journey map is usually developed and used in the “understand,” “observe,” and “prototype” phases.
- The customer journey also provides a good base for the creation of a service blueprint.

Group Size: 4 - 6

- Mixed teams of experts and people with little experience in the respective process.
- Ideally, 4-6 members in each group.

Typical Duration: 120 - 240 mins

Procedure:

Step 1: Choose a persona to be used in the customer journey map and share the story of the persona with the design team.

Step 2: Then choose a scenario or job to be done. What does the persona do and what is the context? It may be an end-to-end experience or a part of it.

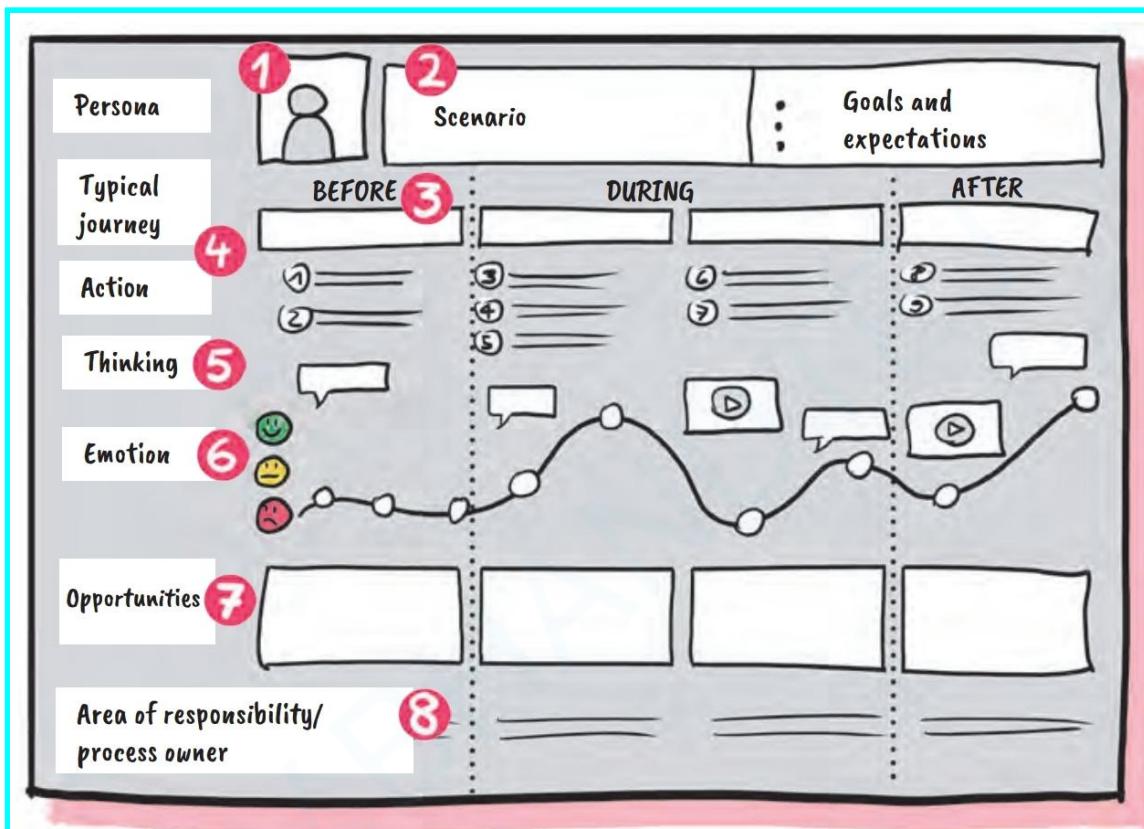
Step 3: Define what happens BEFORE, DURING, and AFTER the actual experience to make sure that the most important steps are included. Mark all experience steps (e.g. using Post-its). It is easier to compile an overview on the meta-level before expanding and elaborating.

Step 4: Decide which interactions should be assigned where and how. The template gives us space for the typical journey and the respective actions.

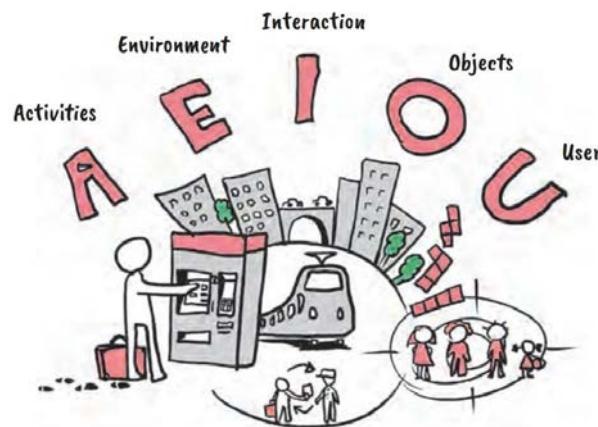
Steps 5 & 6: Supplement what the persona thinks (Step 5) and the emotion he/she feels (Step 6). Capture the emotional status (positive and negative) of each step with colored glue dots or emoticons.

Steps 7 & 8: Define potential areas of improvement (Step 7) and the people responsible for the action/process within the organization (Step 8). Once a clear picture of the experience emerges, the design team automatically comes up with questions, new insights, and potential improvements.

Customer journey map Template:



10. AEIOU



- The AEIOU framework was developed by Rick Robinson, Ilya Prokopoff, John Cain, and Julie Pokorny in 1991.
- In design thinking, AEIOU is used in field observation and as a visualization technique for new insights.
- The aim is to obtain in-depth insights on the potential users by means of W+H questions.
- AEIOU is mainly used in the “understand” and “observe” phases. It can also be a source of inspiration for new ideas.

Group Size: 1-2

- 1-2 people per observation are ideal.
- Depending on the situation, all those involved make observations and do the documentation; or one person interacts with the user, while the other person does the documentation.

Typical Duration: 60 min - 24 hrs

Procedure:

Step 1: Start with the research and find out where the user can be found, at what times, and how to contact him.

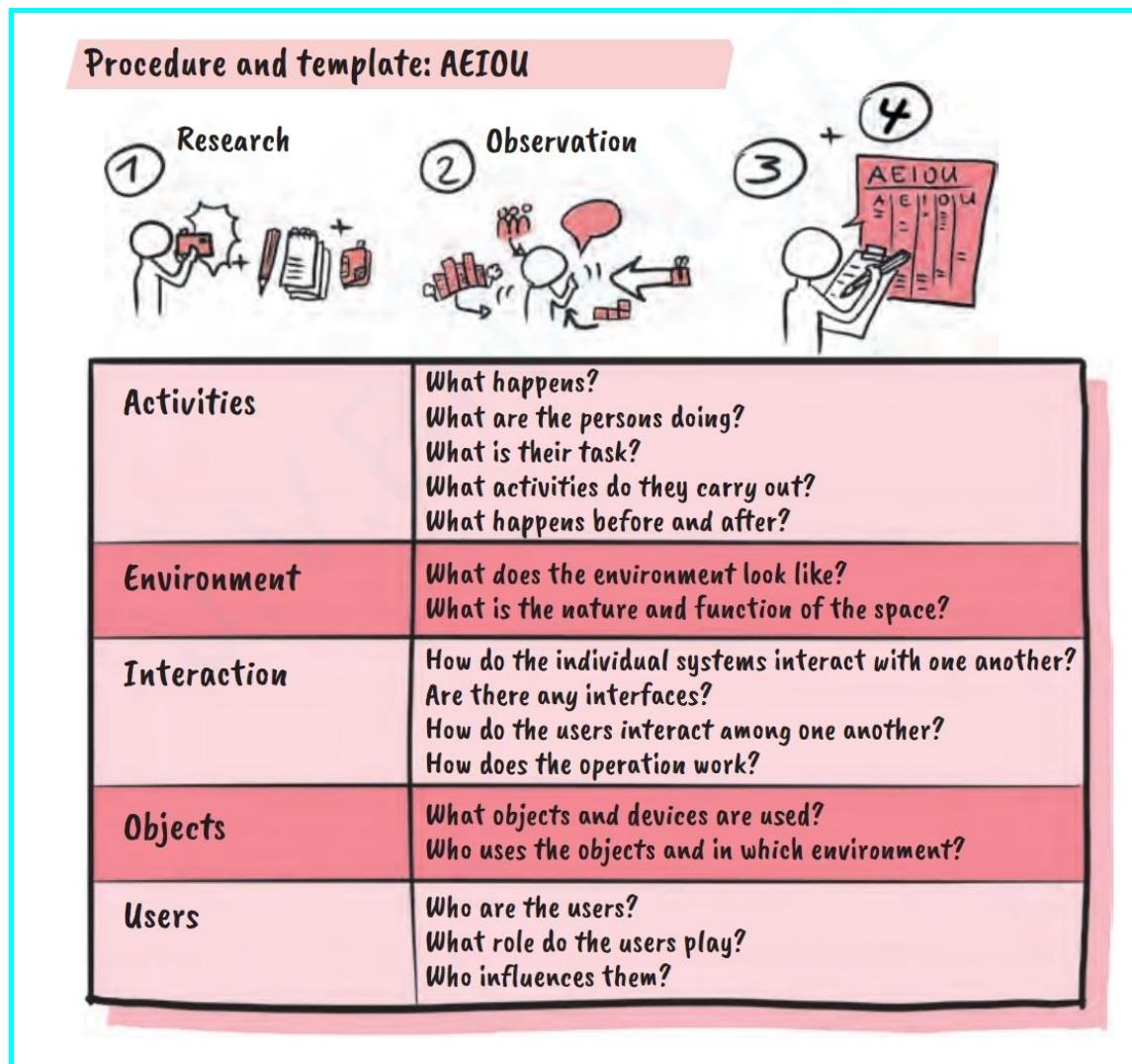
Step 2: Be where the user/customer currently is in the context of the problem statement.

Step 3: Work with the AEIOU template that provides questions and instructions in the individual areas to be observed.

- Each team member is handed a questionnaire for the observation, so everybody can take notes. A smartphone makes it possible to take photos and make videos.

- Collect impressions in the form of notes, photos, videos, interviews, and field observations.
- Especially in the field observation, the AEIOU framework can be used as an entry point for observing the user in his/her environment.
- Lend structure to the records after the observation. It's best to operate within the structure of the corresponding headings.
- Supplement the direct observations with photos or short videos.
- After completion of the field observation with the AEIOU framework, cluster and sort the findings in thematic blocks with summarizing headings so you can identify a pattern.

AEIOU Template:



11. Analysis questions builder

- Data yields many answers, provided the right questions are asked. The analysis questions builder helps us to ask the right questions in order to gain good insights.
- A structured procedure creates freedom for the necessary creativity to identify the relevant factors of influence, because diversion by creativity killers is avoided.
- When we are aware of the factors of influence and then work systematically with the W+H questions, we will develop appropriate questions for the analysis within a short time and quickly gain insights into the actual analysis process afterward.
- We use the analysis questions builder mainly in the “understand” and “observe” phases.

Group Size: 2 - 5

- Mixed teams of experts and people with little experience in the respective process.
- Ideally, 4-6 members in each group.

Typical Duration: 30 - 60 mins

Procedure:

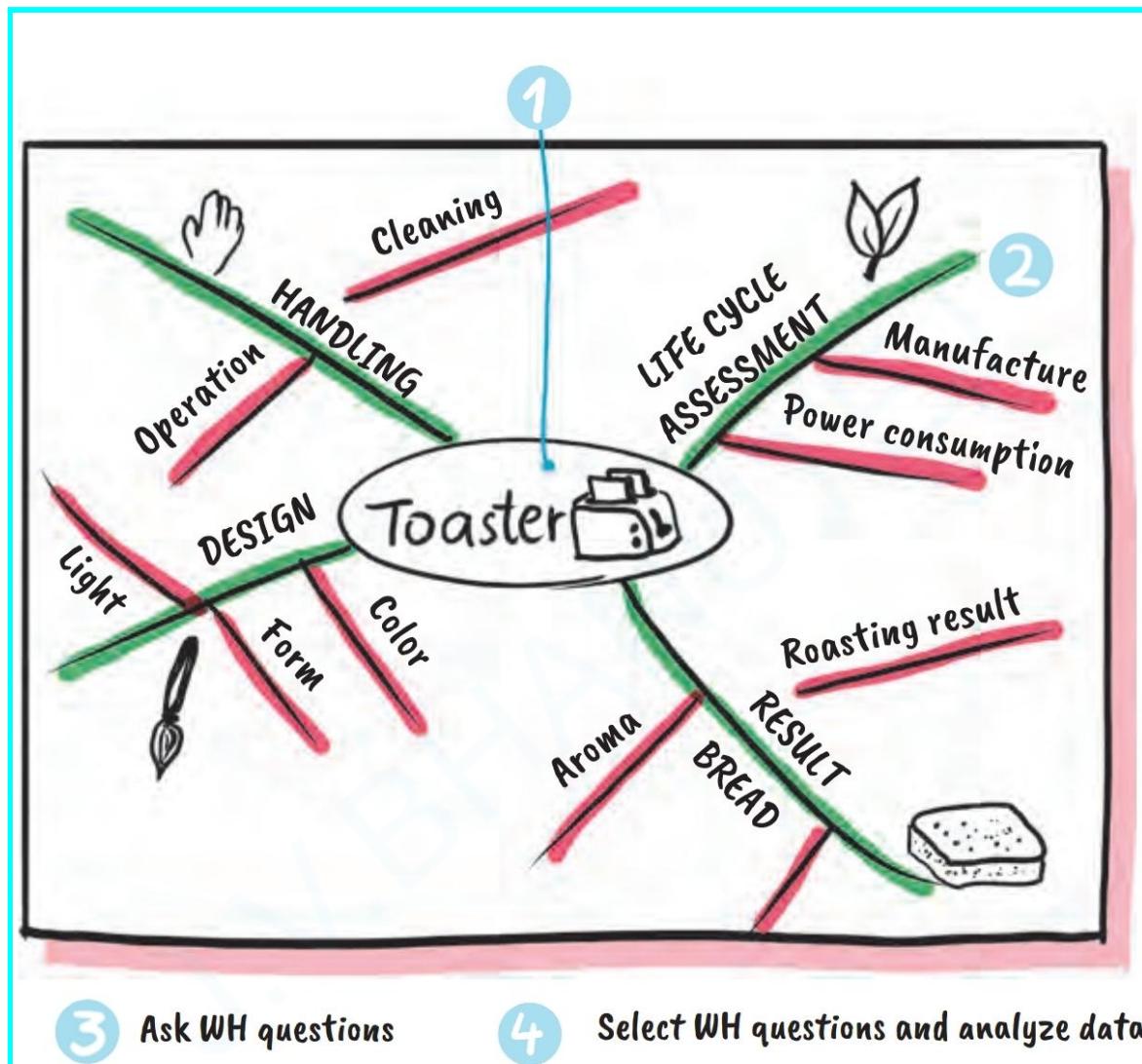
Step 1: Define the center of the analysis questions builder. It can be a new product, offer, or a new process. The needs the product must meet, that is, what it must be able to do, are defined as relevant factors of influence; for example, life cycle assessment (power consumption, resources for production). These ramifications are made so often until it can be ensured that really everything that is relevant is listed. With this procedure, we can often dig up new insights.

Step 2: Next, define the most relevant factors of influence. Either relevant data is already on hand, or ask a focus group and explore whether the design thinking team already has the knowledge.

Step 3: In the next step, the questions are determined. Use the W+H questions for the three to five most relevant factors of influence. Example: the aroma of toast: Who likes toasted bread? How dark is the bread allowed to be so it doesn't taste burned? What constitutes the flavor of toast? When does it have to taste especially good? Where can you buy the best toasted bread?

Step 4: In the last step, go through the recorded W+H questions and think about where data could help in answering them. Only then should you think about where the data comes from. The data is usually available in the company, on the Internet, or it must be collected.

Analysis questions builder Template:



DEFINE POINT OF VIEW & IDEATE PHASE:

DESIGN THINKING TOOLS

DEFINE POINT OF VIEW

At the end of the problem analysis, the results are summarized, clustered, discussed, and evaluated. The team view of the problem is formulated as a point of view. It is used later as a starting point in the search for a solution. Various methods, such as storytelling and “How might we...” as a questioning technique, support this process.

A good POV will allow you to ideate and solve your challenge in a goal-oriented manner – keeping the focus on your users, their needs and your insights about them. Here's an easy formula to keep in mind



POINT OF VIEW STATEMENT		
_____ (user name)	needs a way to	_____ (verb)
because _____		. (surprising insight)

Step 1: Identify Users, Needs & Insights

There are three key components that make up the POV statement:

- **User:** Defines the type of specific user whom you're writing your POV about.
- **Need:** Identifies the users' essential needs/goals.
- **Surprising Insight:** Synthesizes the gathered information into a key takeaway. This statement can be used to design a solution.

Step 2: Create Your Chart

Place your scenario into a template like the example below. This creates a guide for structuring your POV statement.

*Case Study: Citymapper is a public transit app and mapping service. It integrates data for all urban modes of transport, from walking and cycling to driving, with an emphasis on public transport. It operates by free mobile app and a desktop website, in competition with Google Maps and Apple Maps

User	Need	Insight
An adult person who travels in another city/country.	To buy the transportation tickets more easier	The user would want to buy the tickets use less time. When searching the different route option, the user would like to consider the time and tickets cost together.

Step 3: Form Your POV Statement

Mad Lib time! This is the fun part where you combine your user, needs and insight into a concise POV statement. If necessary, condense your statements to create a good story.

POV: An adult who travels need to buy the transportation tickets more easier because they want to use less time on that

After forming POV statements, reframe them to “How might we … ?” (HMW) questions. Consider our earlier statements. Some questions could be:

- **How might we make citymapper shows tickets costs with time together?**
- **How might we make user to purchase tickets on Citymapper?**
- **How might we make citymapper more easy to purchase tickets?**

The following are some design thinking tools used at the define stage for better point of view statements for getting the solution in further stages.

1. “How might we...” question
2. Storytelling
3. Context mapping
4. Define success
5. Vision cone
6. Critical items diagram

1.“How might we...” question

- The “How might we...” (HMW) question is an elementary component in The Design Thinking Toolbox.
- The HMW question uses a special language that helps to switch to a different way of thinking.
- “How” implies that there are more possible ways to solve the question. “Might” creates a safe space in which we know that a potential idea might work. “We” reminds us that we solve the problem as a team.

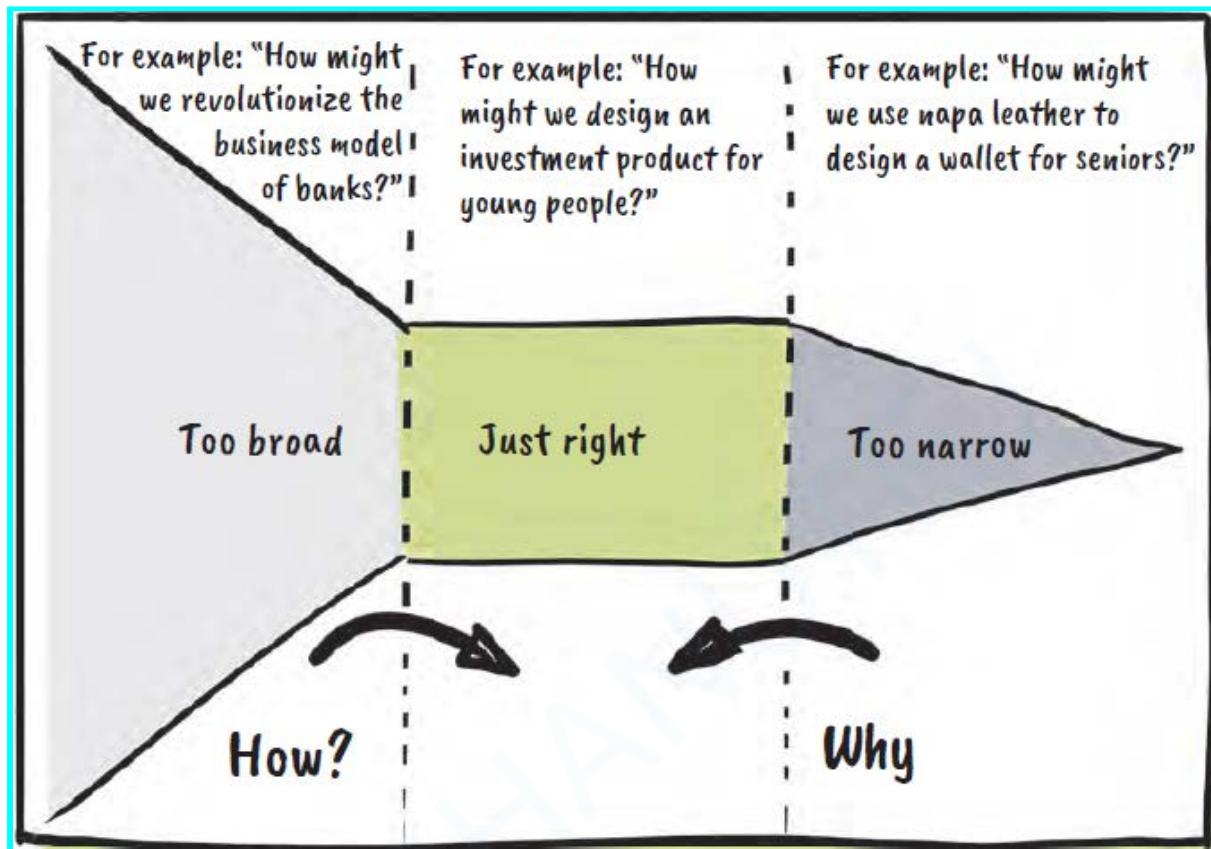
Group Size: 3 - 5

- Develop each HMW question in groups of 3-5.

Typical Duration: 5 - 15 mins

Procedure:

- Reflect upon the findings from the previous phases of “understand” and “observe.” The result is a synthesis of the insights.
- Determine what needs the team should address and what qualifying additional information is relevant in this context.
- Motivate the design thinking team to come up with several “How might we...” questions that address the identified needs or opportunity field.
- Each question should adhere to the logic of “How might we...” followed by a verb (e.g. design), a noun (e.g. investment product), and the type of user (e.g. name of persona).
- Read the HMW question aloud and ask if the team is inspired by the question to find many solutions. If not, the question might be too narrow (e.g. it already anticipates a solution or does not allow for further exploration). Or the HMW question is too broad, that is, the question tries to improve the world, and the team feels lost when confronted with the task.
- In order to counteract this dilemma, there are two question techniques: “WHY,” in order to expand the focus and “HOW,” in order to narrow down the focus of consideration.
- Once the HMW question is rolled out, the ideation phase can begin. Start, for example, with an open brainstorming session that generates initial ideas.

HMW Template:

2. Storytelling

Stories help us to share knowledge in a powerful way.

- Storytelling is a helpful tool that can be used in many phases across the design thinking cycle.
- For thousands and thousands of years, storytelling has helped mankind to share knowledge across generations. In the context of design thinking, it helps us to connect to the team, to focus, arouse motivation, and generate incentives for creativity and empathy!
- You can also tell stories about data. The animated visualization of data can create Wow! effects.

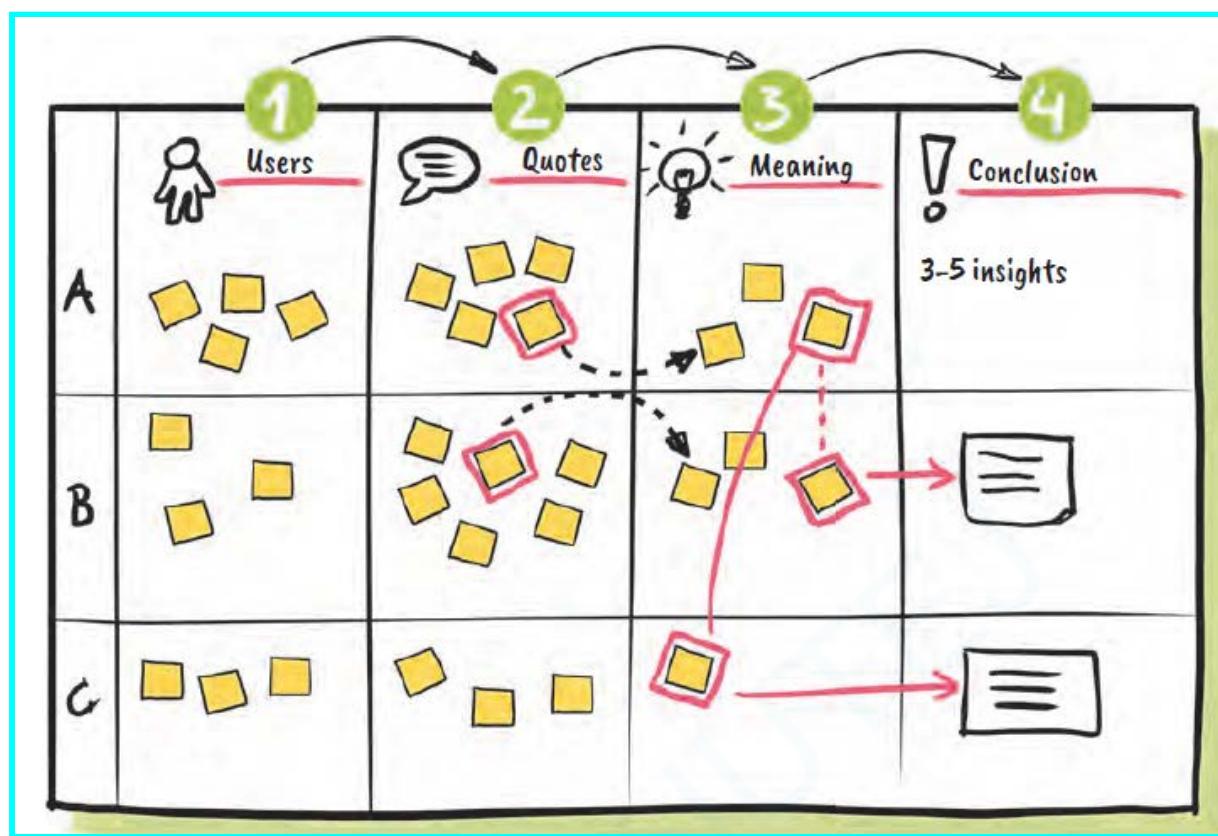
Group Size: 2 - 5

- A team size of 2 - 5 is ideal for using storytelling.
- For the discussion of the findings, each team member recounts the story he/she has observed.

Typical Duration: 10 - 30 mins

Procedure:

- **Step 1:** Print the template or draw the structure on a flip chart or whiteboard. For the use of storytelling in the communication of results from the “understand” and “observe” phases, the following procedure is especially useful.
- **Step 2:** Encourage every member of the team to complete one line (e.g. per interviewed person), and then summarize the highlights and special features of the person or user (column 1). Add important quotes from the person.
- **Step 3:** Interpret the results on the team and define the meaning.
- **Step 4:** Draw a conclusion together with the team and summarize the key findings from the interview. This way, you have created a basis and are one step further toward sharing the results of the story with the team and the stakeholders. Formulate the draft of a story in bullet points, create a storyboard, or produce a short video that enacts the story.

Storytelling Template:

3.Context mapping

- The method of context mapping gives us as designers unexpected insights into a system and sub-system.
- It allows us to observe the user/customer in his/her everyday experience.
- The use of this tool makes explicit what's implicit.
- The point of context mapping is not to gain many insights. The goal is to find out more about how the respective experience is perceived.
- The mapping helps to give structure to the findings from the observation and thus understand the user better.

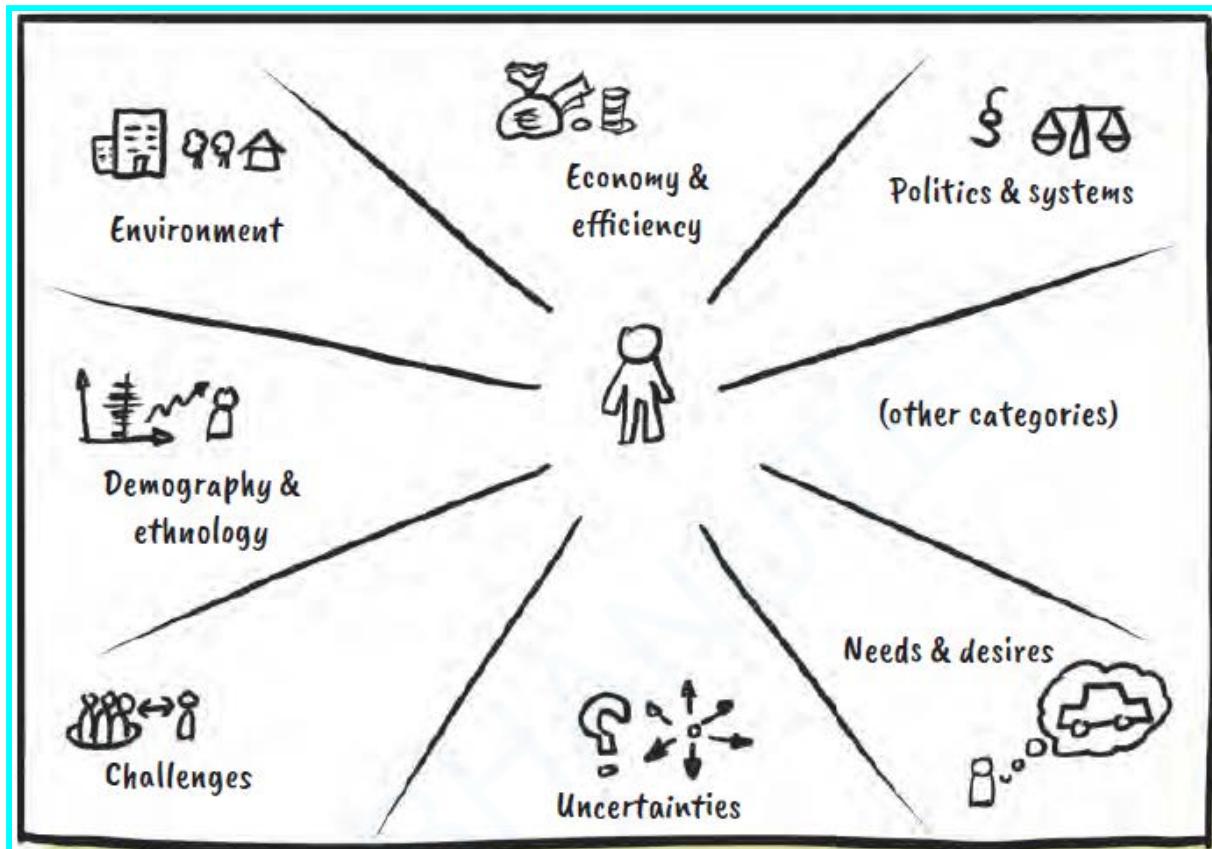
Group Size: 2 - 4

- Depending on the complexity of the design challenge, 2 - 4 people can work on a context map.
- If the groups are too large, the momentum is often lost.

Typical Duration: 40 - 60 mins

Procedure:

- Many findings are necessary to get a good context map, so you should go outside as often as possible in order to observe and understand. There is no substitute for seeing reality from the point of view of the user, seeing it as he sees it. It is important to understand for whom a solution is sought.
- Observe the user and his environment. Typical questions: What does he do? Where does he do it? With whom does he do it? What is the impact of his activities on the environment? Which individuals lend support? Are there shared tools or resources?
- Take pictures of the environment and the user.
- Define areas on which the focus should be. Use your imagination for extensive context or for limited context.
- Determine categories of the respective context, for example, trends, the economy, location, or technology fields.
- If necessary, rearrange these categories in order to find new connections and gain new insights.
- Fill in the categories on the template with the insights.
- Deliberately leave one or two fields empty so the team feels encouraged to add new categories that seem important.

Context mapping Template:

4. Define success

- Define success can be used in different phases in the design thinking cycle for one, as part of the definition of the point of view; second, in the later implementation of the project.
- The questions are similar, but each one refers to a different timeline. What do we want to have achieved in one month? Where do we stand with the business model in 5 years?
- “Define success” determines milestones for the solution of the problem and its later implementation

Group Size: 4 - 10

- Ideally, together with the members of the design team and if possible with the decision makers who will have to approve the project later.

Typical Duration: 60 - 90 mins

Procedure:

- Use Post-its for the “define success” tool, so each team member has the possibility of sharing his or her thoughts.
- Prepare a list of relevant issues (e.g. what does internal and external success mean), in order to ensure that a 360° vision emerges.
- Encourage all participants to write the answers to the questions on Post-its. Then collect all thoughts at once or else individually from the participants.
- It is best to have everybody share their thoughts first; subsequently, discuss and narrow down the elements of success. Then the core elements of success are selected (e.g. by forming clusters).
- Based on this, conduct a vote on the main areas, for example, with dot voting
- Ideally, involve important decision makers (e.g. management, founders, and partners), so you ensure already in the run-up that no time and no money will be wasted. Even more important is that no frustration accumulates during the design cycle or at the end of the project.

Define success Template:

Define questions:	Answers	Evaluate & select
<p>How great might the financial success be (e.g. sales, revenue or market share, requirements of lenders or partners)?</p> <p>What is the value the project will have for the company or the users/stakeholders?</p> <p>What might the success for our users look like? (This means: solving a problem; better than the current solution; offering an answer to a specific new goal.)</p> <p>What might be the success for our key partners and stakeholders?</p> <p>How important might the success be for each team member and the team?</p> <p>How important would the success be for the management?</p> <p>What is the business case for my major stakeholders?</p> <p>What might be the most important milestones?</p>		

5. Vision cone: “Past - present - future”

- The vision cone is a tool that connects current innovative developments with the past and the future.
- It helps to substantiate the overall vision and break it down into actionable steps.
- The vision cone transforms daring uncertainties into positive aspects of innovation projects, for example, reinterpreting a problem as a possibility or Market opportunity.
- The tool invites the design team to create this uncertain future actively.
- The tool allows the mapping of technological and societal developments and linking them to the current project.

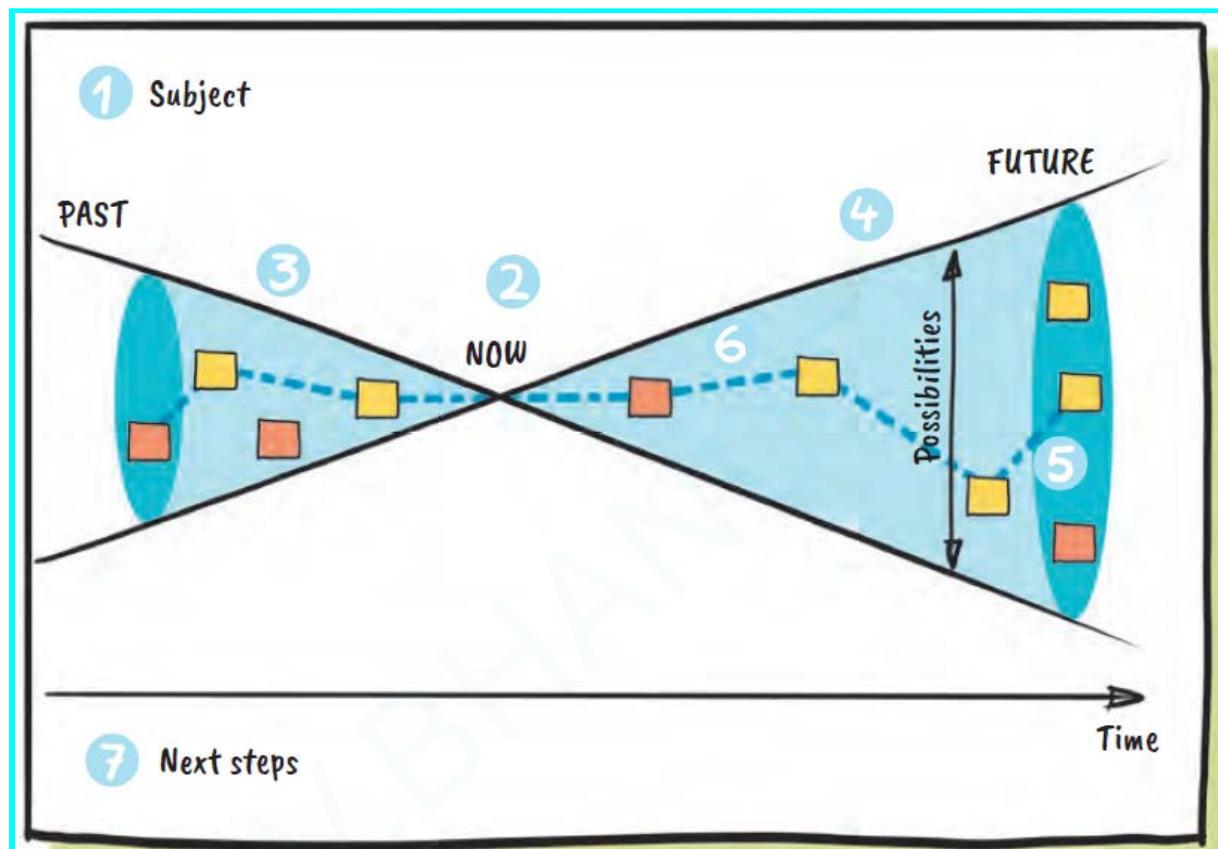
Group Size: 2 - 5

- In the best case, the entire design team works on one vision cone.
- As an alternative, the team members work individually on vision cones and later consolidate them.

Typical Duration: 90 - 120 mins

Procedure:

- **Step 1:** Define a topic that matches the current challenge (e.g. mobility, health). Use the template or draw two connected cones and label them with PAST, NOW, and FUTURE.
- **Step 2:** Start with the NOW and describe the status quo of the project, the state of the art, and the current perception in society (e.g. semi-autonomous driving).
- **Step 3:** Focus on the PAST. Add the findings of research done to date as well as important technological and sociological changes. Try to be as accurate as possible when it comes to dates and link related events (e.g. 1960s, cars piloted by magnetic strips in the United States).
- **Step 4:** Focus on the FUTURE. Write down all of the findings relating to a fictitious future. Nobody knows the probability with which they arrive (e.g. autonomously flying cars).
- **Step 5:** Identify possible scenarios for the future from the findings and give them memorable names for better storytelling.
- **Step 6:** Select a future that is “desirable” in the context of the project. Work back from the identified future and reverse engineer the required steps selected that would have to happen NOW to achieve the desired future.
- **Step 7:** Infer specific next steps from it.

Vision cone Template:

6. Critical items diagram

- The critical items diagram helps the team to agree on the critical success elements for the target group based on the initial findings, the definition of a POV, or building a persona. These elements are the ones that must be solved later with the final prototype.
- The described elements in the critical items diagram can either describe the experience a user expects the solution to provide or present an expected function.
- The elements of the diagram should be questioned after each iteration. However, some will necessarily have relevance to a critical experience or critical function up to the final prototype.

Group Size: 2 - 5

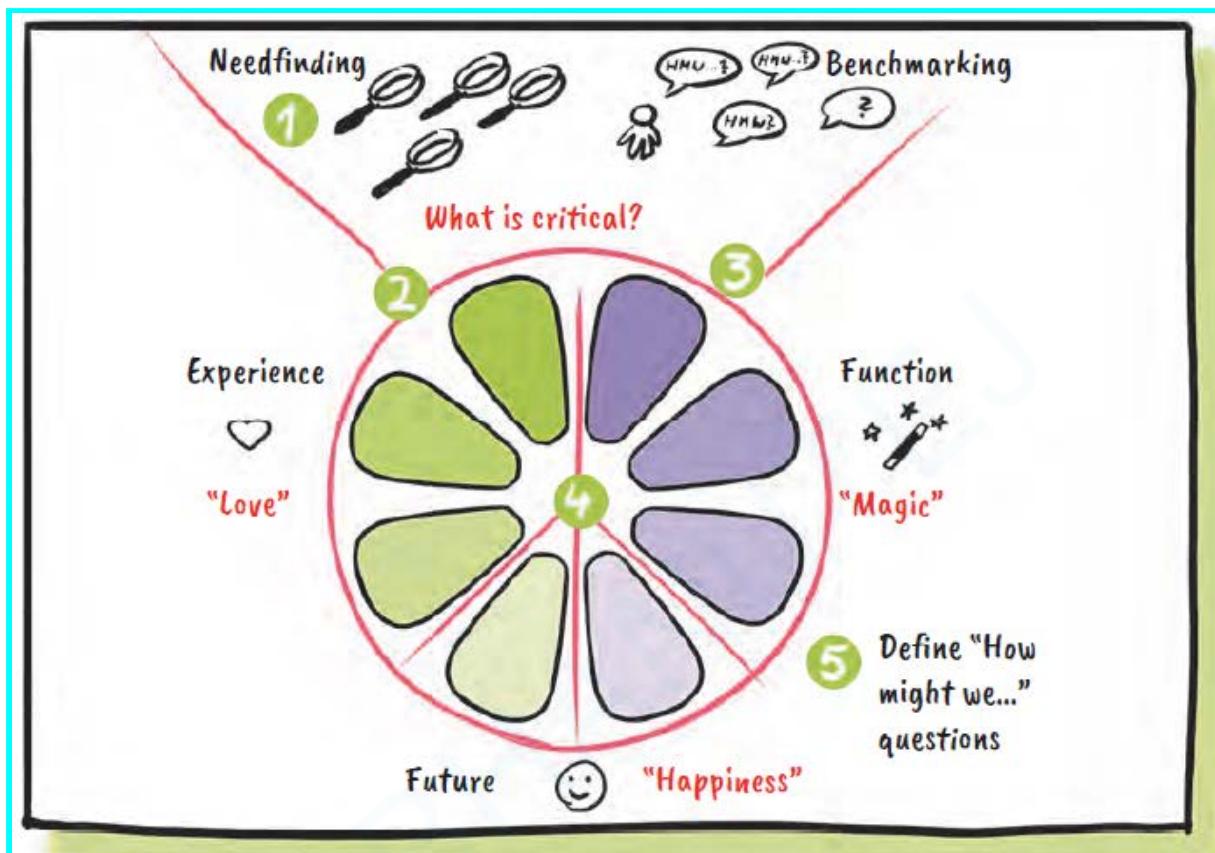
- Ideally, the entire design team contributes to the critical items diagram.
- The presentation also helps in the discussion with clients for defining the problem statement more precisely.

Typical Duration: 30 - 60 mins

Procedure:

Define the critical elements of the problem together with the team and determine from them various “How might we...” questions.

- **Step 1:** At the beginning of this step, ponder the question: “What is critical for a successful solution to the problem?” This is based on the findings from the “understand” and “observe” phases.
- **Step 2:** Sketch a “critical items diagram” on the whiteboard or a large piece of paper and discuss on the team which experiences the user must have/which functions are critical for the user.
- **Step 3:** Each team member writes the eight elements that are critical to them on Post-its.
- **Step 4:** Each member names four experiences and four functions, one of which focuses on completely new or future expectations.
- **Step 5:** Consolidate the results and agree on the team on eight critical elements. On this basis, define “How might we...” questions that are interesting enough to launch the “ideate” phase successfully.

Critical items diagram Template:

IDEATE PHASE

The classic way of ideating is brainstorming. Brainstorming is applied in the “ideate” phase in a variety of ways. It is primarily about generating as many ideas (ideation) as possible before they are sorted, combined, or clustered. The selection of preferred ideas usually takes place within the framework of an evaluation and vote on the team. For this, tools such as dot voting and the decision matrix are used. The selection of ideas is one of the most difficult elements in the design cycle, since the earlier phases are characterized by a high level of uncertainty.

1. Brainstorming
2. 2x2 Matrix
3. Dot voting
4. 6-3-5 Method
5. Special brainstorming
6. Analogies & benchmarking as inspiration

1. Brainstorming

- Brainstorming is an ideation technique in which all participants can contribute their knowledge.
- Very often, brainstorming is used in the “ideate” phase in many different ways and with changing focus.
- Good brainstorming sessions stimulate creativity and allow all participants, regardless of their hierarchical level, to contribute their ideas.
- Before the actual ideation, brainstorming is frequently used as a “brain dump” so that everybody on the team has a chance to make their ideas and solutions known. This procedure helps people clear their heads. In later brainstorming sessions, you can then focus on the respective problem statement or task. Brainstorming has no limits – all ideas are welcome!

Group Size: 2 - 5

Brainstorming sessions are most effective in groups of 4-6. • For large groups or groups with hierarchical differences, make sure that everybody contributes.

Typical Duration: 5–15 min

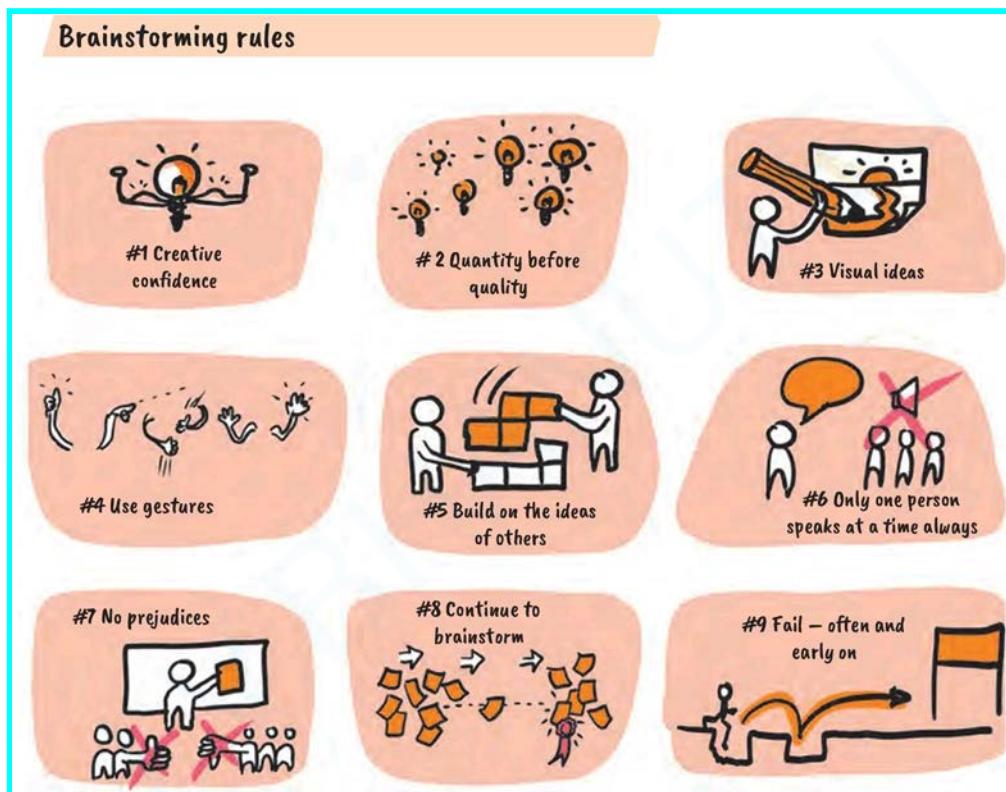
Procedure:

Step 1: Prepare a clear HMW question for the brainstorming session, for example, in the form of “How might we...” or “What possibilities are there...”.

Step 2: Repeat the brainstorming rules before the brainstorming session. Try to motivate the group to give more ideas during the session and build upon the ideas of others. Make sure that all are heard and all ideas are written down. Point out that only one idea is to be written per Post-it and that it should be clear and legible. Instead of words, small sketches may be drawn on the Post-its.

Step 3: Cluster and assess the ideas together with the team at regular intervals.

Step 4: Make a judgment as to whether even more creativity is needed (e.g. to obtain even wilder ideas); or start a brainstorming session in areas where more ideas are sought in general.



2. 2x2 Matrix

- The 2x2 matrix is a visual way of categorizing ideas.
- The matrix is highly modifiable, because any type of meaningful axis attribute may be used.
- The 2x2 matrix can also be used to change the way of thinking from a 100% idea orientation toward the recognition of unfulfilled user needs and strategic opportunities.
- The 2x2 matrix is not only used predominantly in the context of prioritizing ideas but in all other phases as well.

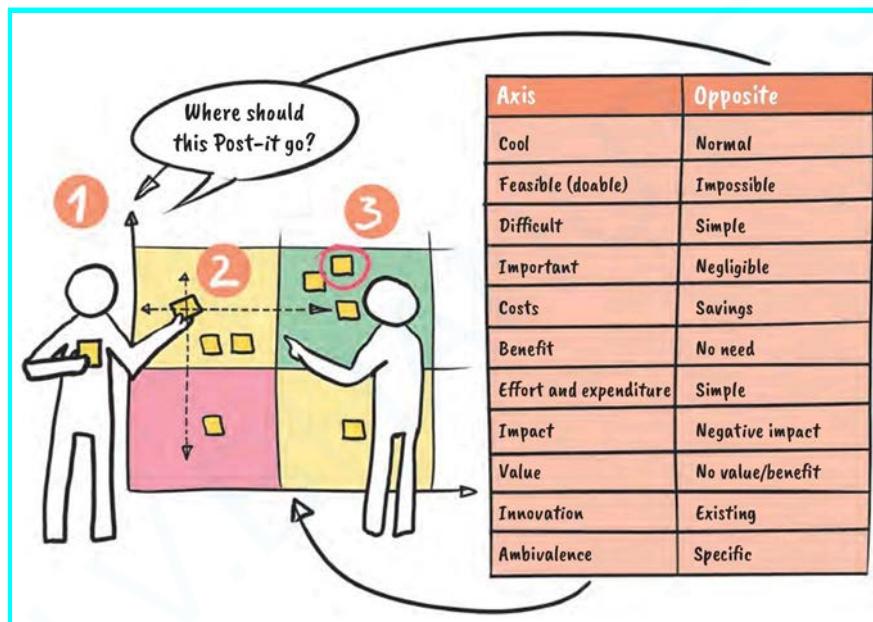
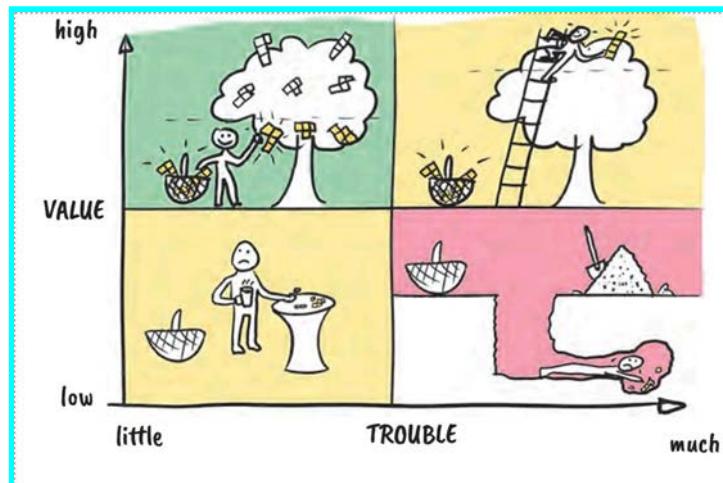
Group Size: 2 – 8

- The smaller the group, the shorter the discussion. This allows for quick evaluation.
- For groups of more than 8 people, dot voting procedures can also be helpful.

Typical Duration: 15–45 min

Procedure:

- **Step 1:** Draw the template and designate the axes according to the requirements wanted. See table on the left as a reference. Use “high” and “low” or opposite attributes. Tip: When evaluating ideas, focus more on the benefits for the user and the feasibility and use measurable and tangible criteria for the opportunity analysis.
- **Step 2:** Start with the positioning by reading the ideas aloud on the team:
 - Start with a broad classification and the question in which quadrant the idea should be placed.
 - Place the idea in relation to the other ideas. Pay attention to the opinions on the team and try to find a consensus.
 - Alternatively, first one axis and then the second axis can be evaluated.
 - Repeat until all the ideas are positioned on the matrix.
- **Step 3:** Select ideas for further processing.
 - If there are several ideas in the field at the top right, select the top 3 for discussion.
 - If there are fewer than 3 ideas in the quarter at the top right, check the development fields for ideas that can be implemented.
 - Also check whether there are empty quadrants; they signify potential for further opportunities and unfulfilled needs.

2x2 Matrix Template:

3. Dot voting

- In addition to a large number of ideas to be developed in a brainstorming session, for example, the selection of ideas is a crucial step.
- There are various possibilities for the evaluation and clustering of ideas. The use of glue dots placed on the ideas by the participants is a simple way to do it. The vote is quick and democratic.
- This tool makes it possible for decisions to be heard and made on the basis of reflection, the difficulty of the design challenge, and how well it meets objectives (and NOT on the basis of power, position, or how extroverted somebody is).
- Dot voting bestows personal responsibility and a clear understanding of the decision-making process on the participants.
- Dot voting is visual, flexible, fast, simple, and thus fits the design thinking mindset perfectly.

Group Size: 2 - 5

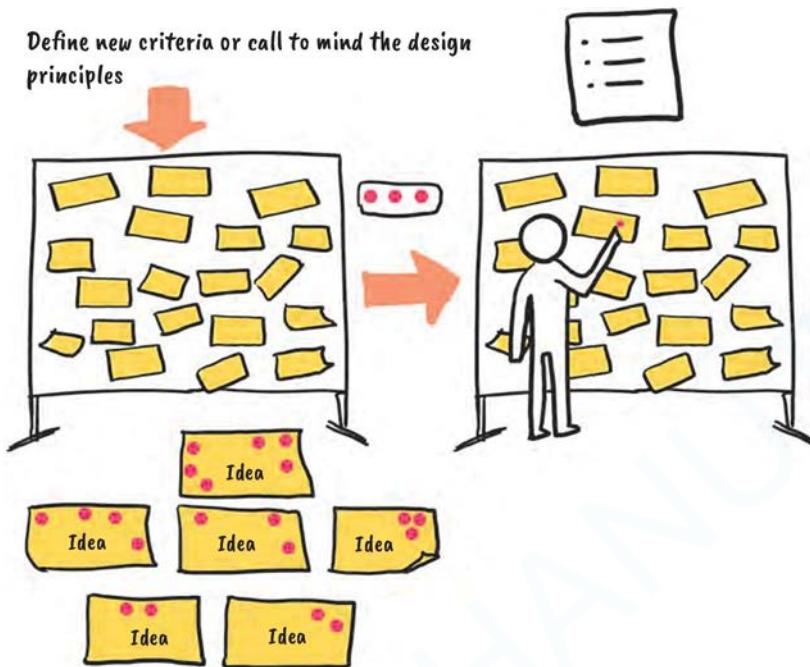
- Ideal for teams of 5-10.
- If the group is larger, it should be split into several smaller groups.

Typical Duration: 5–20 min.

Procedure:

- Initial situation: The participants have already collected ideas on Post-its (e.g. in the context of a brainstorming session).
- **Step 1:** Clarify the criteria before the vote. Example of criteria:
 - best suitability for long-term goals
 - will delight the customer/user
 - supports the vision
 - biggest opportunity for competitive advantages
 - adherence to deadlines
 - greatest impact on customer satisfaction
- **Step 2:** Place the Post-its with ideas on the wall or whiteboard, so that everybody can see them.
 - Give each participant a certain number of votes (usually between 3-5 dots) and prompt them to make a choice. In private, each participant casts his vote via dot voting on the Post-it that best meets the criteria in his opinion.

- Have the participants select whether they want to put several votes on one Post-it or distribute their votes to different ideas.
- **Step 3:** Rearrange and regroup the ideas with the most dots. Make a transparent decision that is based on these priorities, then determine the next steps.

Dot voting Template:

4. 6-3-5 Method

- Brainwriting with the 6-3-5 method allows for structured ideation and further development of ideas in all iterations and across the entire design cycle.
- The name “6-3-5” is derived from an optimal team size of 6 participants who each produce 3 ideas for a problem in the first round. Each of these ideas will then be further developed by the other participants in the next 5 rounds. The technique is particularly suitable for the ideation based on specific problem statements and points of view.
- In a group of 6 participants, up to 108 ideas are collected with this tool within a very short period of time (under 30 minutes).

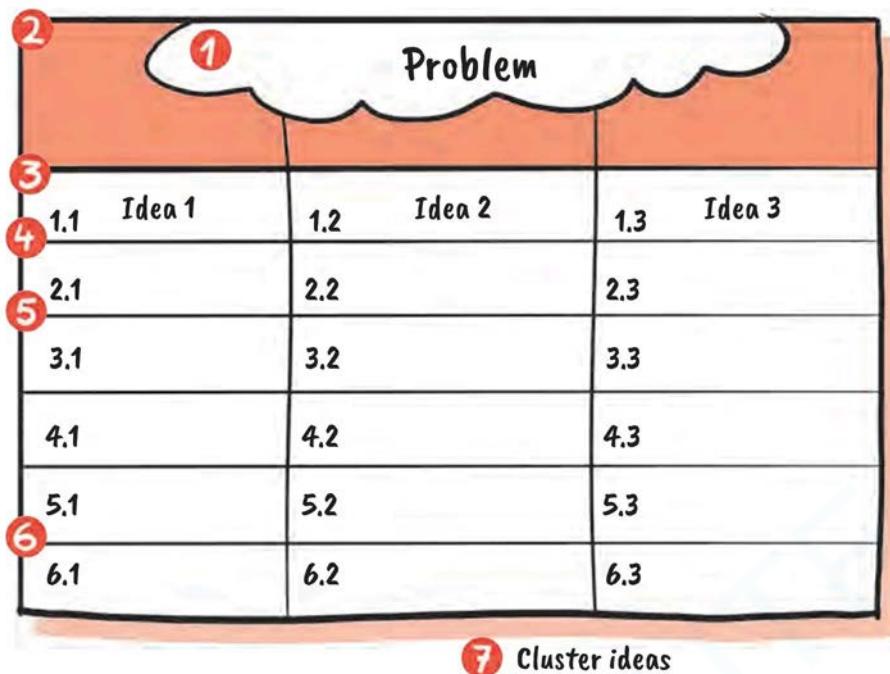
Group Size: 2 - 5

- Groups of 6 are ideal. With adaptations to the template and to the sequence, a different group size also works. 4–6
- In the case of large groups, split them into smaller ones.

Typical Duration: 30–40 min.

Procedure:

- **Step 1:** Form groups of 6 persons each and explain the problem.
- **Step 2:** Give each participant a sheet of paper with a grid consisting of three columns and six rows (18 boxes in total) or have the participants draw the grid themselves. Variant: Take a sheet of 6 columns, so that 6 ideas can be developed, and 6 rows (36 boxes in total); this arrangement allows for the development of completely new ideas.
- **Step 3:** The participants write three ideas in the first row of the sheet within a defined period of time (3-5 minutes). The whole thing is done without speaking. Variant: Ideas can also be written on Post-its instead of on the sheet.
- **Step 4:** When the set time is over, the sheet is passed clockwise to the next group member.
- **Step 5:** Give participants some time to look at the ideas already written down. Then ask the participants to complete the next row on the sheet with more ideas, again within the defined time period. Ideally, the existing ideas are developed further. The ideas may (but need not) build on or supplement the ideas of other participants.
- **Step 6:** The process of passing on and completing the sheet is repeated until all rows, or boxes, have been filled.
- **Step 7:** Cluster and evaluate the ideas with the team and agree on the next steps.

6-3-5 Method Template:

5. Special brainstorming

- Special brainstorming techniques can be used as an alternative to the traditional brainstorming approach.
- They are especially useful when a group gets stuck during ideation or when similar ideas are repeatedly generated.
- The special brainstorming techniques include tools such as negative brainstorming, figuring storming, and bodystorming.
- Which type of brainstorming is to be used depends heavily on the problem statement, the participants, and the goals.
- Special brainstorming techniques are predominantly used in the “ideation” phase in order to boost creativity once more or reach defined goals.

Group Size: 2–10

- Typically, a brainstorming group consists of at least two to three up to a maximum of 10 persons.
- Smaller groups are particularly suitable if the group members are very diverse or practiced in adopting different perspectives.

Typical Duration: 10–20 min.

Procedure:

There are 3 different special brainstorming techniques:

Negative brainstorming

- Negative brainstorming combines the traditional brainstorming approach with the so-called reversal method. Instead of finding a solution, participants focus on • Post-its, pens • Selection of pictures of luminaries (e.g. for figuring storming) Bodystorming goes one step further by placing test persons physically in a particular situation. In this case, the scenario is imitated as correctly as possible by means of a anything that might make the problem worse.
- For example: Instead of finding approaches for improving a traffic situation, the group concentrates on maximizing the traffic jam on the respective road. The results from this brainstorming exercise are subsequently evaluated and reviewed as to whether new starting points arise from it or whether certain aspects, which usually exacerbate a problem, can be eliminated.

Figuring storming

- It is often easier to empathize with a certain person and look at the situation from his/her point of view in order to solve a problem. This approach follows the figuring storming method, that is, the brainstorming is done from the point of view of a third party. It involves asking the question: How would "X" solve the problem?
- For example, Albert Einstein or the president of the United States can serve as celebrities, along with people from our everyday life (e.g. partners, family members, or the boss), and personas that were defined within the scope of the design thinking process.

Bodystorming

- Bodystorming goes one step further by placing test persons physically in a particular situation. In this case, the scenario is imitated as correctly as possible by means of a relevant environment, artifacts, and persons, so as to have the test persons experience it as closely as possible. In this way, the subjects can infer new ideas by means of physical trial and error and testing.
- Example: A team that develops products for elderly people can apply Vaseline on the lenses of glasses in order to perceive the world through the eyes of seniors. One variant consists of being constantly in motion and writing down ideas while walking.

6. Analogies & benchmarking as inspiration

- Analogies and benchmarks help to change the approach to the problem in order to generate new ideas and stimulate ideation. Another industry, animals, persons, or organizations can serve as a benchmark or analogy.
- Analogies and benchmarking can be applied in the early phases of the design cycle, for example, during the definition of the problem. It's normally used in the "ideation" phase, though.

Group Size: 2 - 5

- Optimally in a group of 3-6 persons.
- Larger groups of more than 8 persons can be divided into smaller groups.

Typical Duration: 30–120 min.

Procedure:

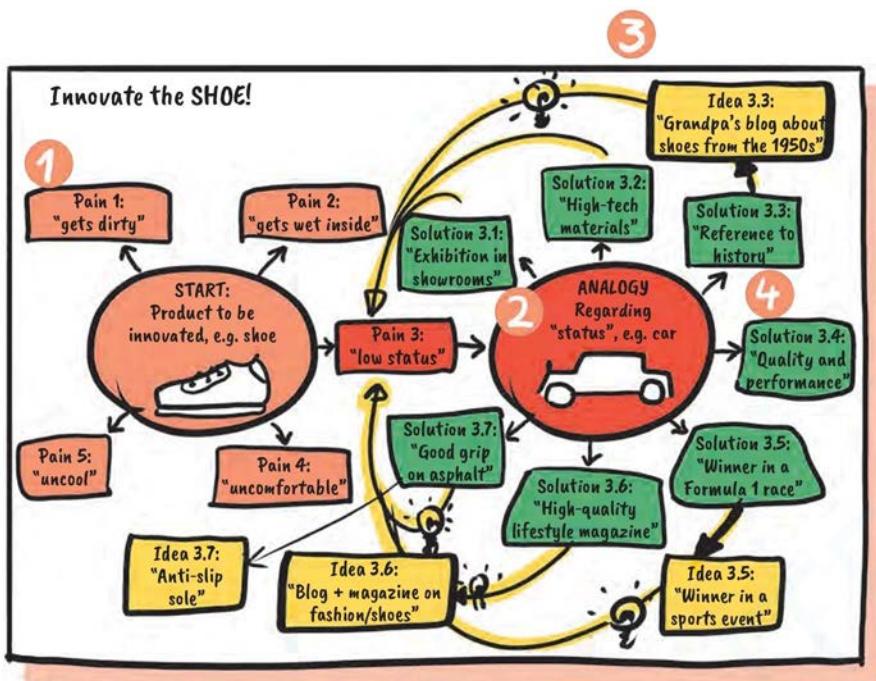
- **Step 1:** List the critical experiences or the biggest PAINS of the problem statement, for example, in the case of shoes, the PAIN: "low status."
- **Step 2:** Use brainstorming or brainwriting methods to search for scenarios, systems, places, or objects that also entail PAINS but seem to have been solved. In the example (left), the PAIN of "status" was successfully solved in the automotive industry and the PAIN of "uncomfortable" in the case of a sofa, and so on. To search for analogies, ask questions like the following:

What do other industries do?

How does nature solve the problem?

Why is it not a problem in other countries?

- **Step 3:** Conduct interviews with experts who know the comparable areas, scenarios, systems, places, or objects well. Create an "analogies inspiration board" and show new insights.
- **Step 4:** List solutions, for example, how the "status" in the automotive industry was solved by "highquality lifestyle magazine."
- **Step 5:** Then transfer the solution of the analogy to the original problem. Some solutions from the analogy can be transferred almost 1:1; others require a bit more creativity when applied.

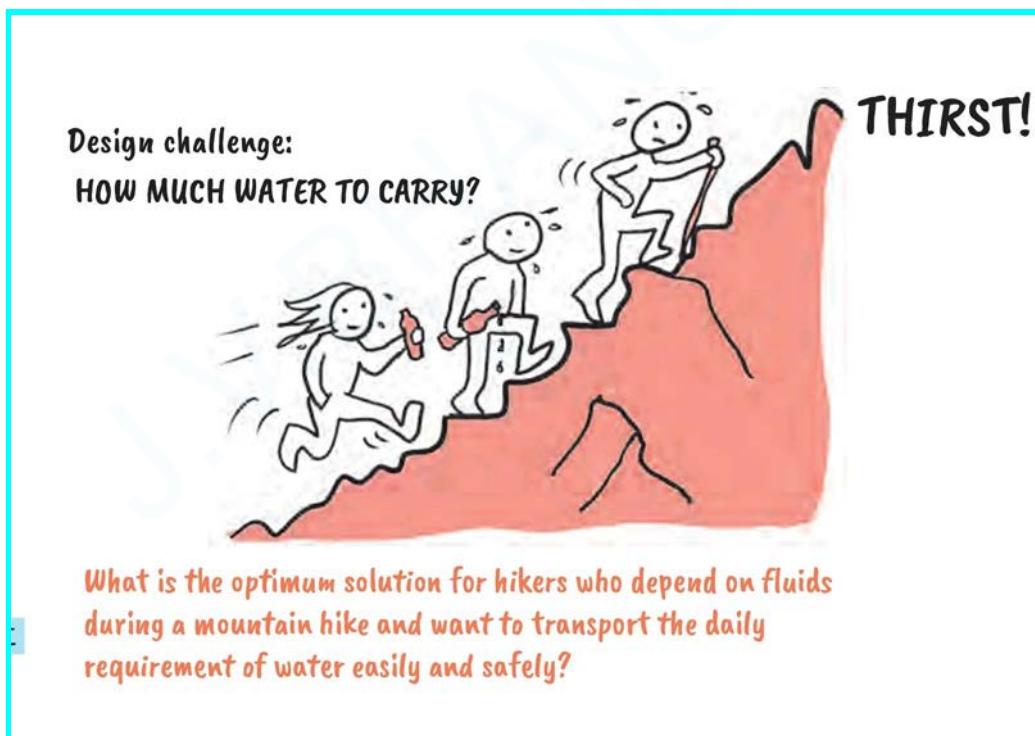
Analogies & benchmarking as inspiration Template:

PROTOTYPING PHASE: METHODS AND TOOLS

PROTOTYPING PHASE:

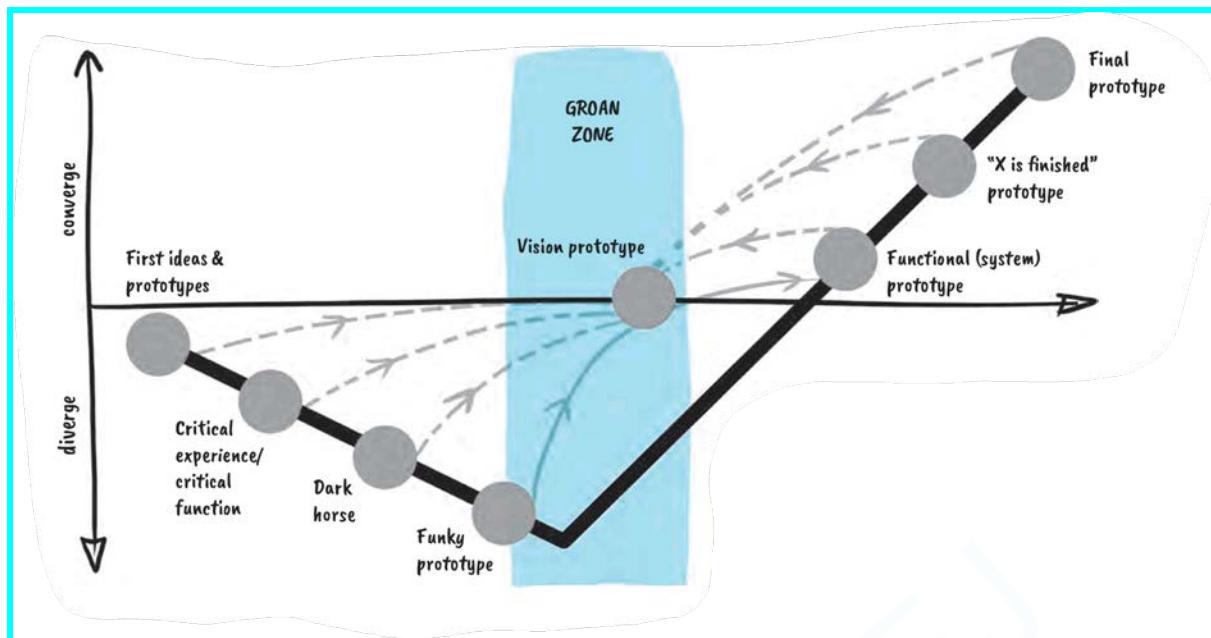
Building prototypes makes the selected ideas tangible and perceptible. Prototypes range from a simple critical function prototype to the final prototype. To build a prototype, we use simple materials that are good enough to test a function or an experience. The “prototype” phase is closely connected to the following “test” phase. The feedback from the tests is used to learn more about the user and to improve or discard the current prototype. This procedure is reflected in the design thinking motto: Love it! Change it! Or leave it! Early failure gives us the opportunity of learning and building a better prototype in the next iteration.

Consider the following simple design challenge as an example. It provides quick information on the focus of the respective prototype and how it changes across the design thinking cycle. As a rule, prototypes get a higher resolution and become more specific over time; initial ideas are usually still just simple sketches.

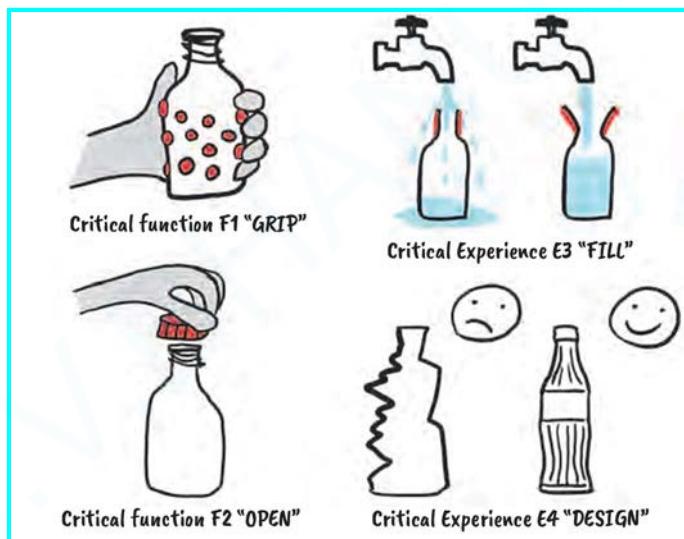


Several prototypes of the same type are to be made in each case. People can switch from one prototype to any other prototype. The exploration map provides good orientation about the previous prototypes.

The level of detail of the prototypes typically increases from low resolution (low fidelity, lo-fi) to high resolution (high fidelity, hi-fi).



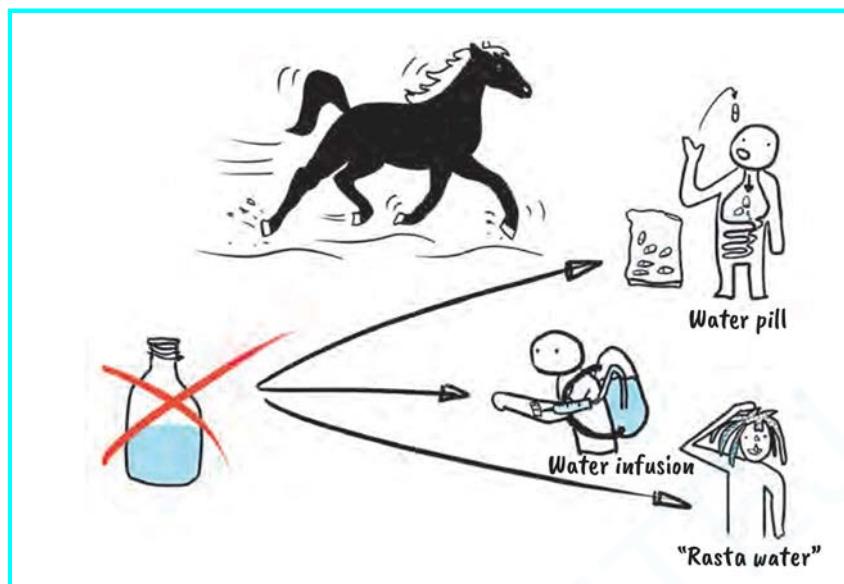
Focused experiments - Critical Experience Prototype (CEP) & Critical Function Prototype (CFP)



- These critical experience prototypes (CEP)/critical function prototypes (CFP) are carried out at an early stage in a project, when the first steps of the “understand” and “observe” phases have been completed, or when initial contacts have been made in the form of interviews and the design team wants to learn even more about the user.
- The CEP/CFP can be performed several times over the design cycle, especially if the whole problem is not yet understood.
- CEPs/CFPs make sense when critical elements for experience or function are still unclear or need to be questioned.
- CEPs/CFPs are little prototypes that allow us to deal with the user on a more in-depth level.

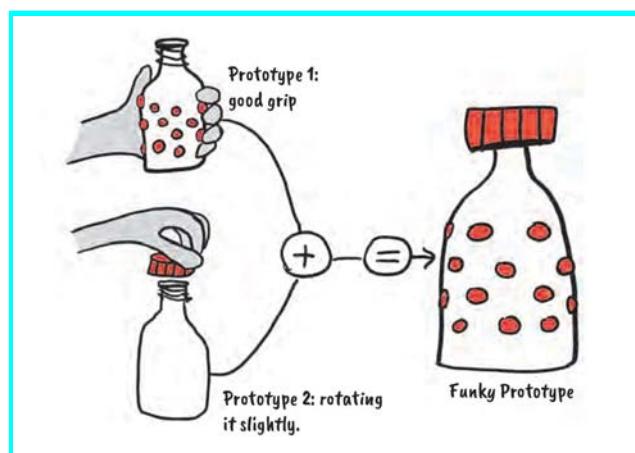
- The direct exchange with the user about individual decisive elements reveals deeper needs and helps, among other things, to prevent misinterpretations of interviews.

Crazy experiments – Dark horse prototype



- “Dark horse” is a term used in athletic competitions or in politics. It describes the unexpected winner, who was not given a chance to win at the beginning, or the participant who is completely unknown.
- These experiments are carried out in the early phases of a project. With a dark horse prototype, you can test the reaction of the user to unusual approaches to a solution.
- For ideation, for instance, you might want to take a peek into the future: “What will the solution look like in 30 years?” Or turn previous assumptions around. The central questions often start with “What if...?”
- With the “dark horse” prototype, ideas can be tested that entail a high risk and have not been in use for the proposed application or have not (yet) been technically feasible until now.

Combined experiments - Funky prototype

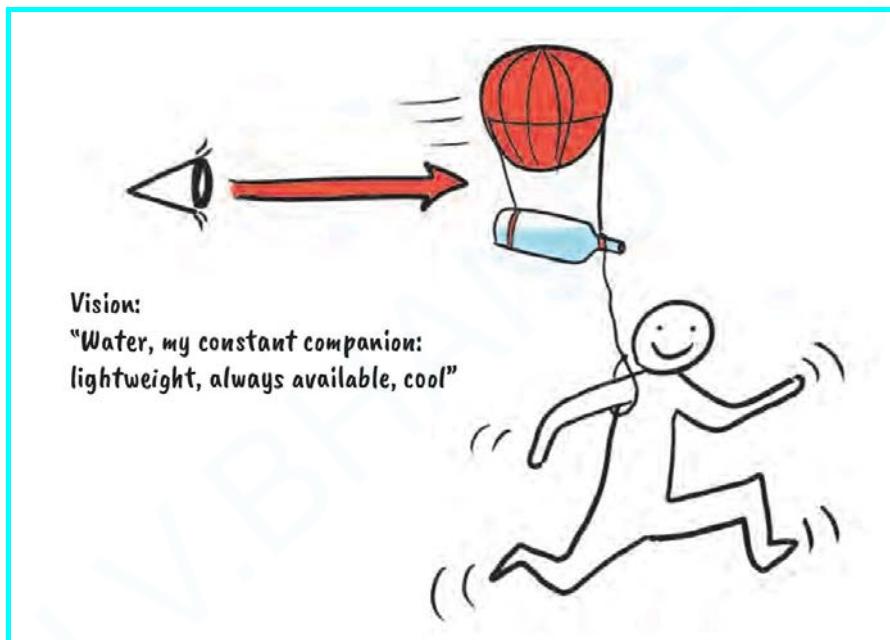


For the funky prototype, the findings and ideas from various previous brainstorming sessions and prototypes (e.g. CEP, CFP, or dark horse) are merged.

These more detailed experiments are intended to remove any remaining uncertainties about the elements that are critical for the solution. The main objective is still the collection of findings in the problem space. Finding a solution to the problem is still of secondary importance.

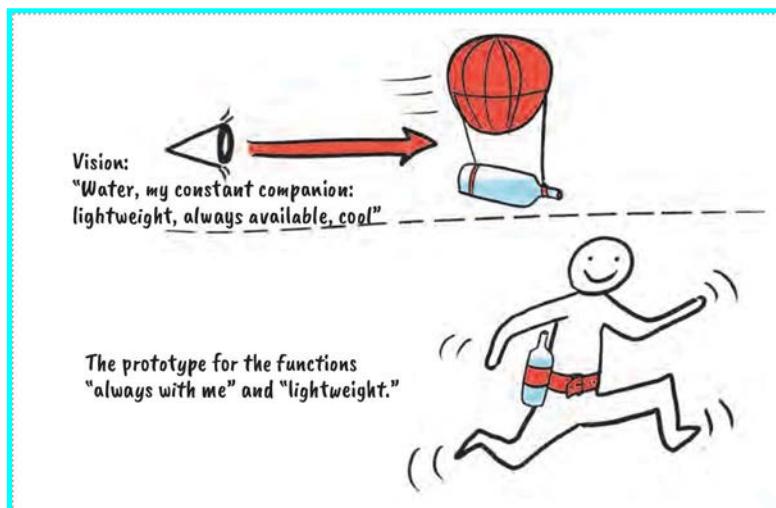
First final functionalities of a possible solution are to be implemented in the most simple way. These experiments or first prototypes are made from simple materials or are based on existing prototypes or existing solutions.

Imagining the future - Vision prototype



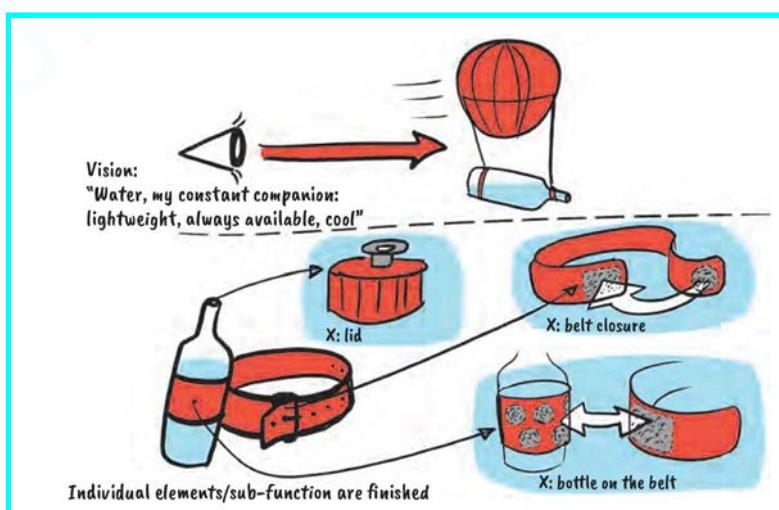
- The vision prototype is the first concept that attempts to solve all identified needs and problems of the user. The sketched vision usually has a rather distant time horizon that can be reached through a series of solutions in the form of products and/or services.
- This concept must also be tested and verified with the users. In this step, it is quite common that new insights about the user and his or her behavior emerge.
- The vision prototype is designed to help the team overcome the “groan zone” – the transition of the divergent phase of problem exploration to the convergent phase of problem solution.

Prototype with a first function - functional (system) prototype



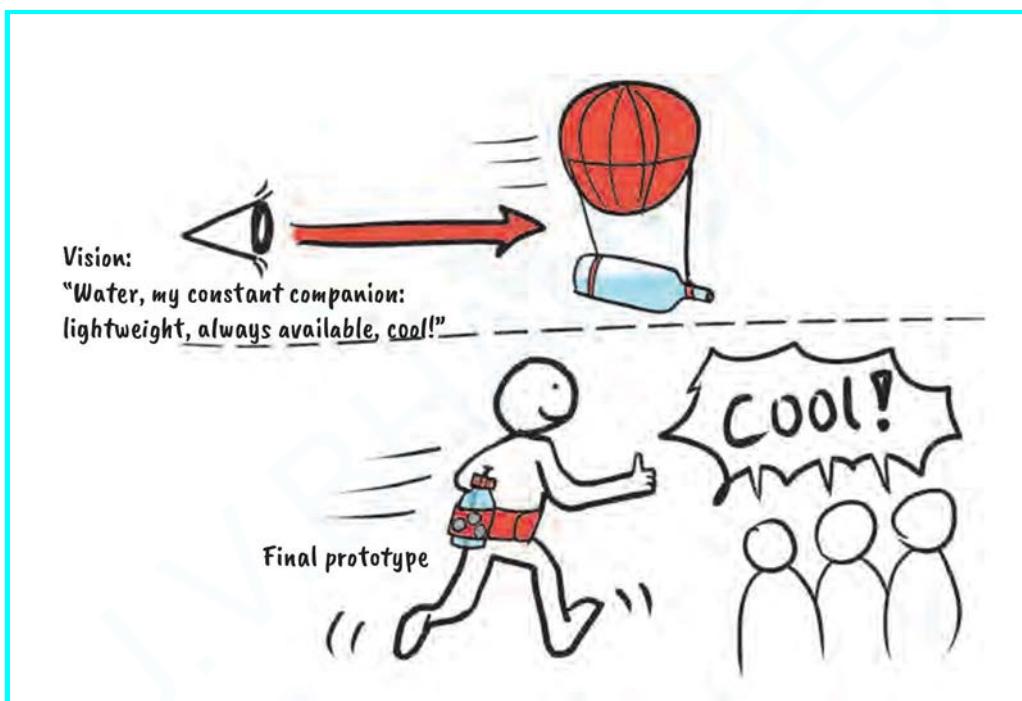
- With the functional (system) prototype, one part of the previously emerged vision is implemented. The focus is on the part of the vision that can be achieved early on and easily. With a system of multiple functionalities to be implemented, it is common first to realize the main function of the later product.
- In the case of solutions with reduced functionalities, a minimum viable product (MVP) can already be achieved at this point.
- The main purpose of the functional prototype is making the main function of the later product tangible and perceptible. This main function should be implemented technically with simple means. The main function should be checked for its technical feasibility.

Solutions in detail - "X is finished"



- “X is finished” is the phase in which the elements or sub-functions required for the overall functionality are implemented and realized. The goal is to have a functional overall system on hand after the conclusion of the phase whose main functions have been specified to the greatest possible degree.
- While both the vision prototype and the functional (system) prototype focus on the solution of the overall problem, more emphasis is put on the detailed solution for the most important elements in the “X is finished” phase.
- Especially for systems with multiple sub-functions, this phase is a crucial step toward a final prototype.

(Hopefully) at the finish – Final prototype



- The final prototype concludes the phase of problem solving. When looking so closely at individual elements, you easily lose sight of the big picture. When the individual sub-functions are developed, there is a risk that they will diverge, become too large, and that the elegance and simplicity of the overall solution will be lost.
- Another thing to be done in this step is to check whether the proposed solution still matches the needs originally determined and the problem of the target group.
- At the latest in this step, the minimum viable product should be achieved. Depending on the complexity of the overall solution, this goal is reached earlier on or only with the final prototype.
- The final prototype shows the “problem/solution fit.”

1.Exploration map

- The exploration map helps to keep track of all the experiments and prototypes already carried out.
- It normally has an experience and a function axis. The two axes symbolize known or existing as well as new or unexpected behaviors and functions.
- In addition, the feedback of the users/customers with respect to the experiments can be entered on the exploration map. This way, it can be determined whether the expected user behavior conforms to real-life experience.
- The exploration map shows – at the end of the entire design cycle – the path the team took to reach the ultimate solution.

Group Size: 4 - 6

- Design thinking core team.
- Ideal are groups of 4-6 people.

Typical Duration: 10 - 45 mins

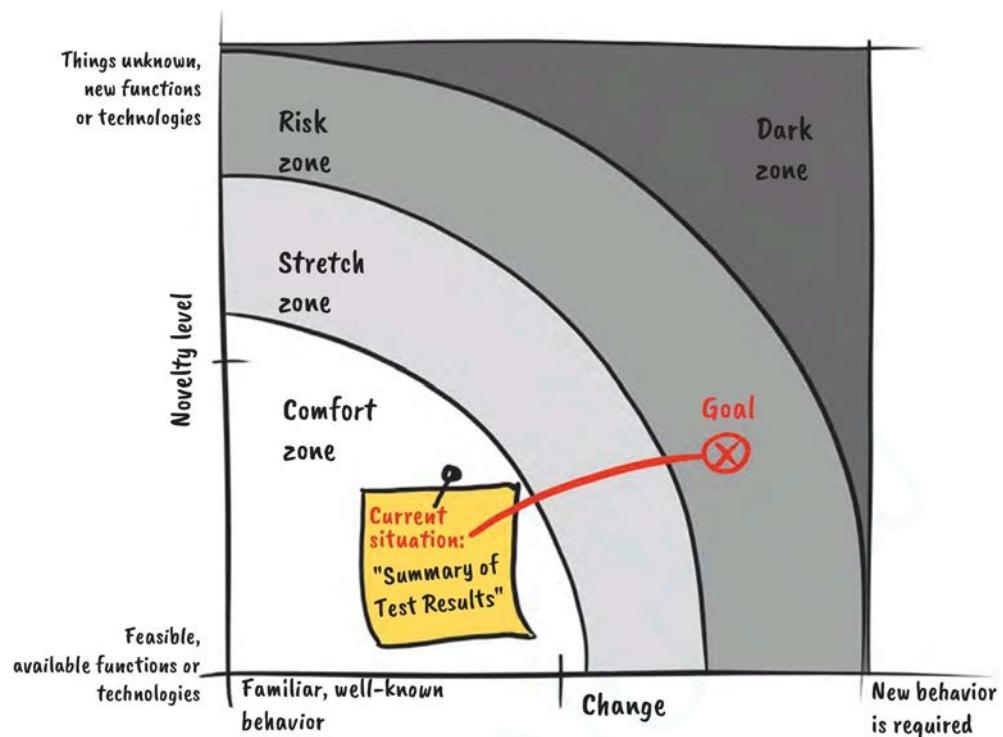
Procedure:

The exploration map gives the team an overview of the experiments carried out and shows the areas in which experiments can still be made. It provides information on the expectations regarding an experiment and its effect on the target group.

- Step 1: Enter the experiments already carried out. They might have to be repositioned. Each experiment is recorded on the exploration map – it is best to do so with a name and an image (e.g. of the prototype and the testing).
- Step 2: Discuss the positioning of the experiment on the team. Have we really left our comfort zone? Based on the previous exploration and the previous experiments, the goal for a new experiment, for example, can be defined.
- Step 3: After the prototype has been built and the expectation regarding the result has been formulated, they are also entered on the exploration map and positioned accordingly.
- Step 4: After the tests, the reaction of the users and the findings of the tests can also be captured. The critical discussion of the feedback may change the position of the experiment on the exploration map.

The exploration map stimulates the discussion among team members, provides the basis for planning new experiments, and helps with the reflection after tests.

Exploration map Template:



2.Prototype to test

- With its focus on direct user interaction and feedback, the prototype to be tested is a fundamental concept of design thinking. After the “ideation” phase, the ideas are translated into prototypes and tested with real users.
- The point is to configure an experiment for the user in order to learn more about a feature or experience.
- There are many different kinds of prototypes. Choose the kind that best matches the phase in the macro-cycle, the idea, and the hypotheses to be reviewed.
- The potential user should interact with the prototype and experience it. This way, basic functional requirements for the solution can be identified.
- The feedback collected during the test is extremely valuable and constitutes the basis for further decisions, for example, the determination of the most promising ideas or of the functions that must be reworked.

Group Size: 1 - Many

- A prototype can be created by one person or by a larger team.
- Experts and additional team members help to check that everything has been taken into account

Typical Duration: 30 - Many days

Procedure:

Step 1: Before prototyping, we should ask ourselves what kinds of insights we want to gain and why we want to make an experiment. Therefore it is necessary to formulate assumptions to be tested and how the experiment is to be carried out.

Step 2: Think about how interacting with the prototype will become an exciting experience for the user (test person) and how the test will result in new insights.

Step 3: Determine the level of resolution and what exactly is to be done. Define different prototypes to be built. Often it makes sense to think in alternatives and then opt for one.

Step 4: Choose a variant and outline the experiment, if necessary. Low-resolution prototypes focus on the insights with respect to needs, practicality, and functionality and are mostly used in the divergent phase. High-resolution prototypes concentrate on feasibility and profitability.

Prototype to test Template:

Prototype to test – preparation

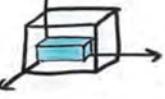
1 Why?
What assumptions do we want to verify?

2 How might we make it tangible and perceptible for the user?

3 What should we do? Outline possible variants

4 Choose the best idea and outline the experiment

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TEST PHASE

METHODS AND TOOLS & IMPLEMENTATION

TEST PHASE: METHODS AND TOOLS:

The test of the respective prototype takes place in the interaction with a potential user. This means we not only receive feedback on the prototype but also refine our view of the problem and the user. In addition, we are reconnected to the empathy phase, which in turn can yield a new point of view. This micro-cycle is repeated as often as desired and characterizes the iterative procedure in design thinking. Tools such as the feedback capture grid and feedback techniques such as “I like, I wish, I wonder” support the testing. In addition, there are different test procedures. Which of them is the most helpful depends on the kind of prototype. Of course, the presented tools for testing overlap in terms of their purpose (testing); nonetheless, each testing approach and each procedure deliver valuable information that helps us to improve the prototype in question.¹

The following are some design thinking tools used at the test stage for better testing the solution of the problem from the user point of view.

1. Testing sheet
2. Feedback capture grid
3. Powerful questions in experience testing
4. Solution interview
5. Structured usability testing
6. A/B Testing

¹

1. Testing sheet

- Among other things, the point of testing is to learn as much as possible about the user and his/her needs by having the user interact with the prototype.
- It is worth planning the test situation and considering what the test sequence is, who has what role, and which key questions should be asked.
- With the testing sheet, we have a tool at hand that allows us to learn a lot in a short period of time and check whether our assumptions and hypotheses are correct.
- A test run is usually performed by two or three people. Not all team members have to be included. Much more important is the documentation of the tests (e.g. with photos and quotes or short videos) that allow us to share the findings with the team.
- It is crucial to observe the user keenly during the test and ask for his/her feedback.

Group Size: 1 - 2

- • One person makes notes and documents the findings; the other performs the test.
- Optionally, one more person can observe.

Typical Duration: 10 - 30 mins

Procedure:

The prototype has already been built. Now the test scenario must be planned.

Step 1: Test planning:

- Think about where the test should take place. It is best to carry out the test in the context of the problem on site on the user's premises.
- Define the test criteria prior to the test. What are the criteria for a thesis to be considered as verified?
- Plan the sequence, assignment of roles, and the key questions of the test.
- Define who will ask the questions, who makes notes and documents the test, and who observes.

Step 2: Test procedure:

- Run the test and observe the user keenly during the test. Ask for feedback. It is very valuable and constitutes the basis for further decisions on the development of the prototype.
- Write down the most important quotes.

Step 3: Test documentation:

- Document the test with photos or, better yet, short videos of the most important statements.
- Summarize the main findings and learnings.

Testing sheet Template:

Test scenario		
1 Brief description of the test scenario	Test criteria	
Procedure	Roles	Questions

2

Test results	
3 Documentation	Learnings

2.Feedback capture grid

- The feedback capture grid supports the testing of ideas using prototypes because it allows us to document test results in a very simple form.
- It is primarily used when it comes to finding out how well an idea solves a previously identified user problem.
- The feedback capture grid aims at acquiring profound understanding as to whether the problem can be solved and how it can be solved and whether the idea actually is the right approach to a solution.
- It can be used in general for obtaining feedback on the process, a workshop, or other things.

Group Size: At least 2

- Tester 1: interviews, observes, and demonstrates the prototype.
- Tester 2: documents the results and asks further questions, if needed.

Typical Duration: 30 - 60 mins

Procedure:

A rudimentary prototype (e.g. a low-fidelity prototype), has already been created. We have developed information about the persona, need, and problem hypothesis over the last design thinking phases.

Step 1: Draw the feedback capture grid on a sheet of paper or print out the template.

Step 2: Always begin a test with the tester seeing and experiencing the prototype.

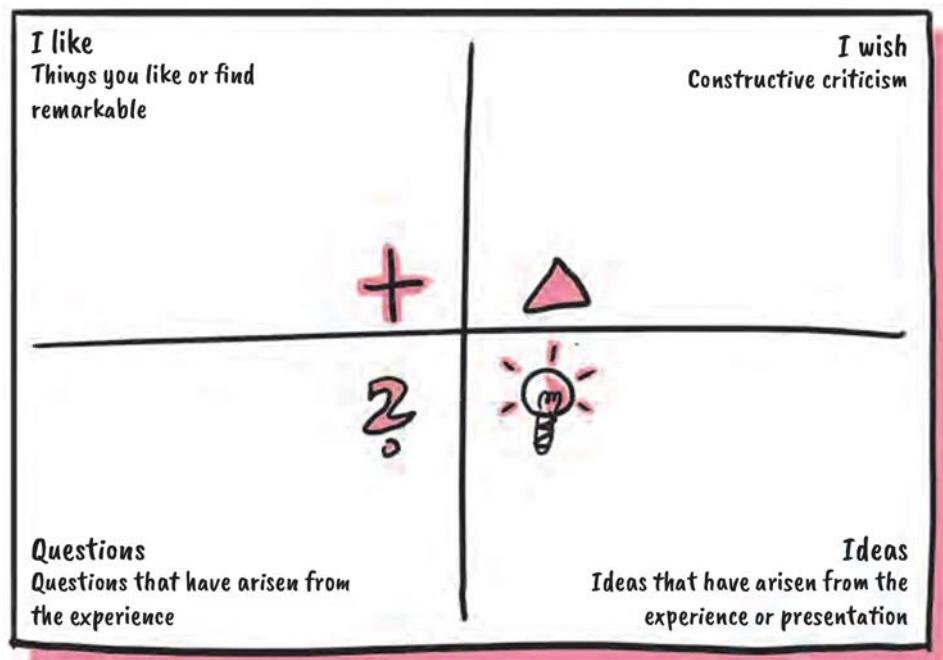
Step 3: Ask the tester (user/customer) to think aloud.

Step 4: Fill in the fields of the grid with these thoughts. They can be written in directly or using Post-its. In the upper left field note what the user liked, on the right what he might not like so much; in the lower left field note the questions that were asked as well as new ideas that the user or we ourselves had while observing.

Step 5: Ask “Why?” to understand the answers of the tester even better. Pay attention to emotions, conflicting body language, and initial reactions.

Step 6: Collect the feedback capture grids from the various interviews and work out similarities or major differences together with the design thinking team; they can be used for the further development of ideas and prototypes.

Feedback capture grid Template:



3. Powerful questions in experience testing

- “Powerful questions” is a great tool for gathering more findings in a test.
- As early as with low-resolution prototypes, we should pose the right questions and develop them for high-resolution prototypes.
- The testing should always be done based on a specific prototype
- During the test experience, the test person should interact as much as possible with the prototype. The observers watch and listen attentively and write down the results.
- A simple test plan with goals, test environment, process, moderation, and test participants is created.
- More exact methods are used in later development, for example, unit test, integration test, functional test, system test, stress test, performance test, usability test, acceptance test, regression test, beta test.
- The heuristic evaluation can be used as an informal appraisal to evaluate or check a product based on a number of agreed-upon best practices, standards, or guidelines.

Group Size: 2

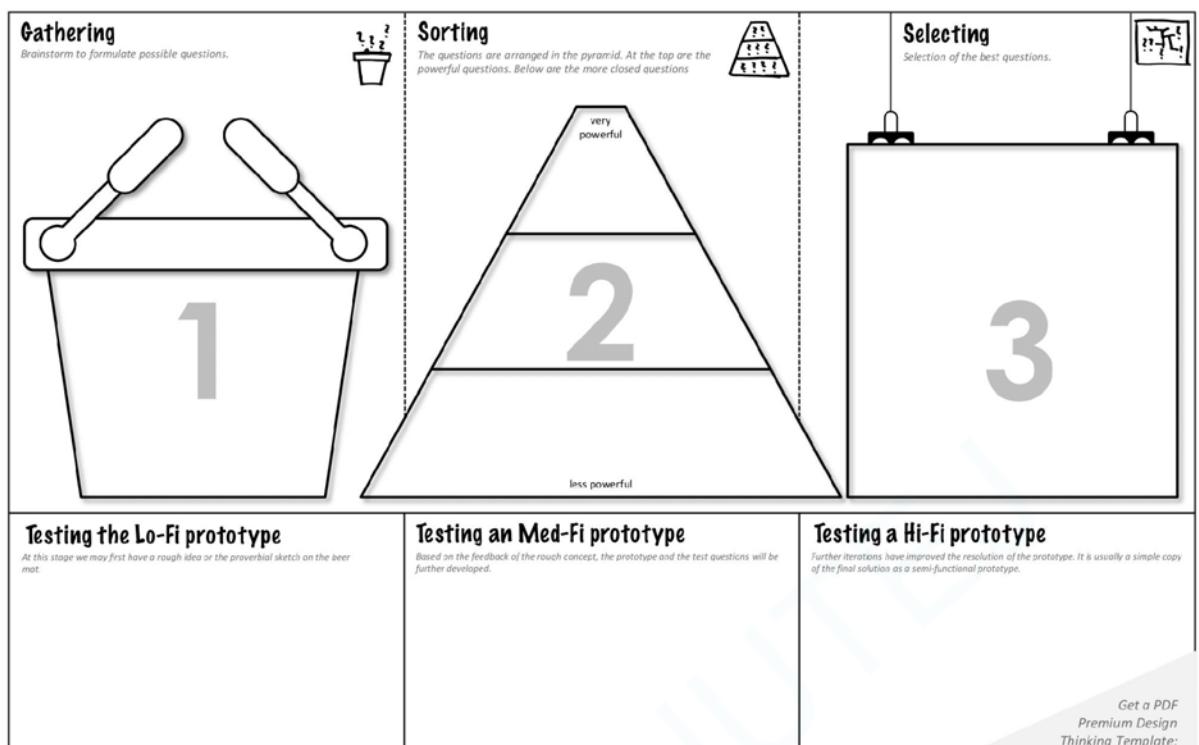
- A moderator and several observers, for example, members of the design team.
- Depending on the setting, not too many observers, though, since it might intimidate the users.

Typical Duration: 30 - 40 mins

Ask the right questions when testing:

1 Test lo-fi prototypes	2 Test med-fi prototypes	3 Test hi-fi prototypes
<p>At this stage, we might have no more than a rough idea or the proverbial sketch on the napkin. For the validation of those ideas, the following questions have proven useful:</p> <ul style="list-style-type: none"> ● What is the problem your idea solves? ● How do users solve this problem today? ● Can the user think of another product with similar characteristics? ● What made other solutions fail? ● Do the users understand the benefits of the product or service? ● How does the user rate the product or service? ● Can the user think of competing products? ● What has the app/website/function, etc., been designed for? ● Does the potential user actually have a need for this product? ● What other objects or interactions does the user himself imagine? ● What use scenarios can he/she imagine? 	<p>Based on the feedback, we designed initial wireframes for our rough concept. They are neither interactive nor functional but they illustrate what should be used and how it should be used. Good questions help steer the project in the right direction and address the sequence and simple elements in the respective experience.</p> <ul style="list-style-type: none"> ● Does the prototype do what is expected of it? ● What is the users' reaction to the product design? ● As soon as we show the prototype, does the user understand what it does? ● How does the prototype meet the expectations of the user? ● What features are missing? ● What is in the wrong place or unnecessary? ● How does it feel to the user when he uses the prototype? ● If the user had a magic wand, what would he change on the product? ● How high is the probability that the potential user will use the finished product in the future? 	<p>Through further iterations, the resolution of the prototype has improved. It is usually a simple copy of the ultimate solution, that is, a semi-functional prototype. The prototype should be interactive and be able to carry out the functions we have planned. What is missing is the glamour and beauty of a final product. Questions:</p> <ul style="list-style-type: none"> ● Does the prototype do what it is meant to do? ● Does the design of the product match its purpose? ● What would the user like to do first with the product? Does this possibility exist? ● Is the user confused when using the product? ● Is the user distracted by something when using the product? ● Are there any functions that are completely ignored by the user? ● Is the navigation sensible and intuitive? ● Do the users feel that the product was developed for them? ● What would prompt the user to use this product more often? ● How likely is it that the user recommends the finished product to a friend? ● How would the user describe the product in his own words?

Powerful questions in experience testing Template:



4. Solution interview

- As the name suggests, solution interviews are a tool used in the test phase with advanced (high-resolution) prototypes.
- The goal is to test solutions that were developed in the project and see whether they are accepted by the users addressed.
- In order to make a clear distinction from the testing tools already presented, the solution interview is mainly used in the solution space.
- This is why we focus on the “acceptance” of a final prototype or MVP.
- In this late phase, solution interviews supply insights on the acceptance of a solution by the user, right up to the pricing.

Group Size: 2 - 3

Typical Duration: 20 - 30 mins

Procedure:

Solution interviews are used to gain knowledge through feedback from the user/customer on an almost finished solution.

Step 1: First define the interview goal. Reflect on the task and the persona that the solution should address.

• • Depending on the current phase in the macro-cycle, the goal is to check the impact of the solution or measure the value of the solution.

Step 2: Determine the interview team, including role assignment.

When selecting the interview candidates, make sure they resemble the persona for which the solution is intended.

Think about what you should take along with you to the interview (e.g. reference points from previous discussions).

Step 3: Plan the interview guide in four phases: warmup, introduction to the context, experience the solution, summary.

Warm-up: Create an atmosphere that allows for uninhibited statements. Check the similarity between interviewee and persona.

Introduction to the context: Define what context information about the usage scenario should be given to the interviewees.

Experience the solution: Let the interviewee work out the solution by himself; ask him to "think aloud."

Summary: Summarize the statements of the conversation partners in your own words. Watch the reaction.

Solution interview Template:

Solution: Solution to be tested		
Context ①		
Task  <ul style="list-style-type: none"> • Design challenge of the project • "How might we..." question 	Goal  <ul style="list-style-type: none"> • Interview goal • Key question that should have been answered after the interview 	Persona  <ul style="list-style-type: none"> • Personas and their needs (focus of the solution) • Point of view statement
Interview planning ②		
Interview candidates  <ul style="list-style-type: none"> • Identify interview candidates that are similar to personas • Determine the number of interviews required 	Interview team  <ul style="list-style-type: none"> • Size of the interview team • Role assignment 	Material  <ul style="list-style-type: none"> • Core equipment • Reference to the last interview • Supplementing materials
Interview guide ③		
Agenda  <ol style="list-style-type: none"> 1. Warm-up (time span:) 2. Introduction to the context (time span:) 3. Experience the solution (time span:) 4. Summary (time span:) 	Content  <ul style="list-style-type: none"> • Discussion points • Specific questions • Form of presentation of the solution 	

5. Structured usability testing

- Anything that is “operable” can be tested; this applies to both physical and digital products.
- With usability testing, it can be checked whether something works effectively, efficiently, and satisfactorily for the user.
- The testing should be as specific, frequent, and as early as possible.
- This requires real users who perform given specific tasks with the prototype at defined and uniform conditions. Observe everything and document it with video or tracking software, whenever possible.
- The uniform structure allows for testing and comparing several ideas or variants on the basis of the same criteria
- Before testing is started, it is important to be aware of what is to be tested and how it is to be measured.
- There are many different variants and versions of the usability testing tool: hallway, guerrilla, laboratory test, field test, and so on.

Group Size: >2

- At least 2 people.
- One person guides and supports the user; another or several other persons observe and document the test.

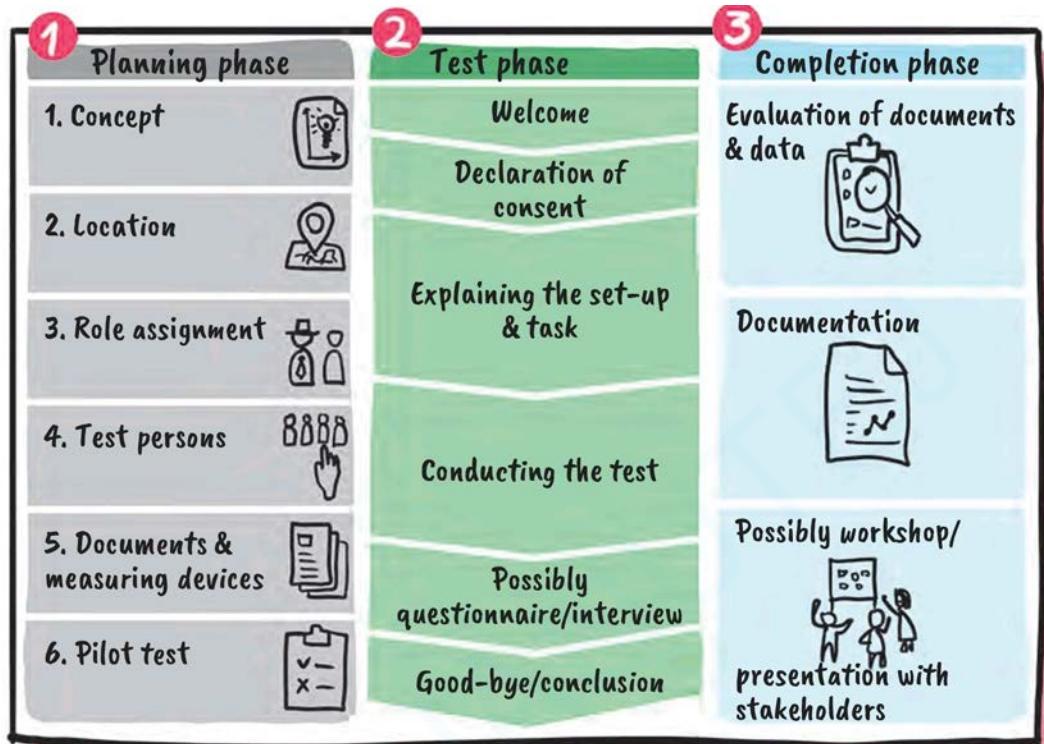
Typical Duration: 40 - 90 mins

Procedure:

- The implementation of a structured usability testing has three phases:
- **Step 1:** Planning phase: Prepare the testing. First draw up a concept that roughly describes what it is all about; what the test object is; what exactly is to be found out; which assumptions and hypotheses already exist; and what the chronological sequence should be. Then choose the location, define the roles (moderator, observers, etc.) and test persons; define the exact test scenarios (tasks). Prepare the documents and finally conduct a “dry run” to verify that everything works as it should.
- **Step 2:** Test phase: Conduct the actual test with users/subjects. Try to stick to the sequence and test scenarios as closely as possible and always provide all test persons with the same information.

- **Step 3:** Final phase: Evaluate the collected findings, document them and, if desired, present the results to the relevant stakeholders. Use the results to continue improving usability.

Structured usability testing Template:



6. A/B Testing

- The A/B test can be used as a stand-alone test or as an expansion of a prototype test.
- The A/B test is a simple tool for testing two variants of a prototype simultaneously. The test of the prototype usually answers a question with different characteristics.
- This test is quite well suited to advance an existing prototype/MVP or to test a new variant in comparison with a basic prototype. It is important to make it very clear before the test what is to be tested and compared (e.g. by means of key figures).
- Most users find it easier to give feedback when comparing two prototypes than when they are asked to comment on one prototype.

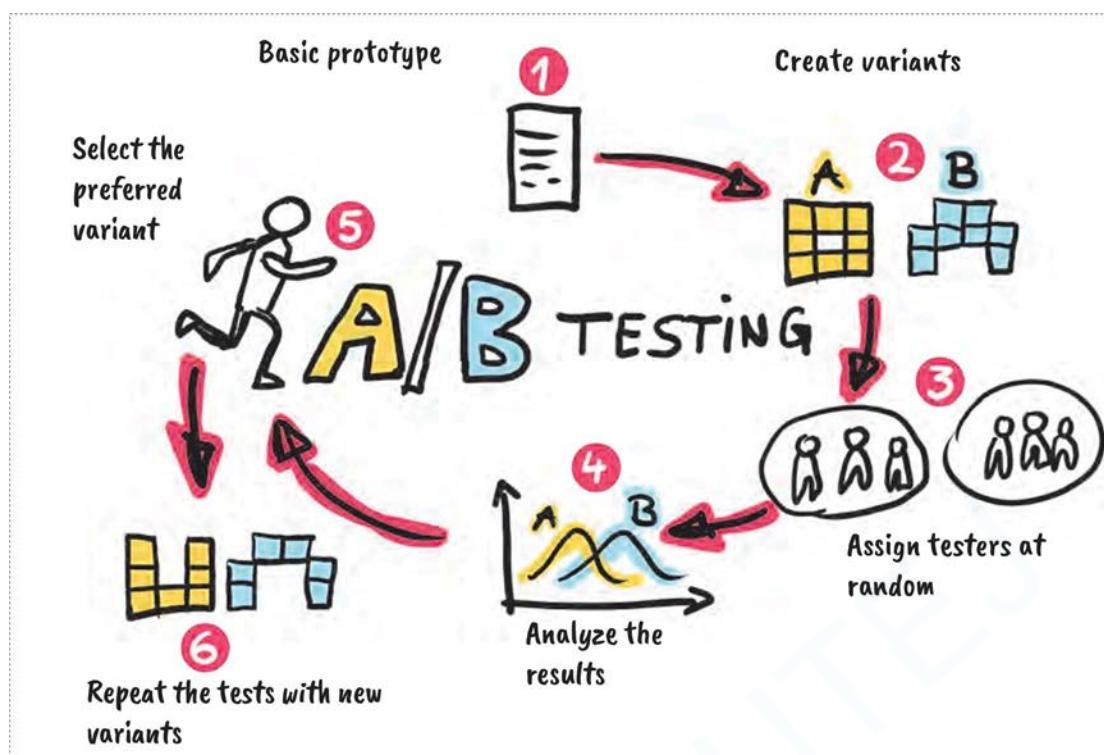
Group Size: 1 - 2

- Depending on the procedure and tool support, at least 1-2 people per test.
- With tools, 1 person suffices; without, at least 2 people. A team of 2 per interview is ideal.

Typical Duration: 5 - 15 mins

Procedure:

- A/B testing is quick and easy. It must be decided at the beginning what is to be tested and how it is to be done:
- **Step 1:** Define the basic prototype and decide who is to be the test group (selection of the target group).
- **Step 2:** Consider variants of the prototype and make a decision for two of them to be compared with each other. Define key figures for what kind of testing is to be done (whether quantitative or qualitative test).
- **Step 3:** For quantitative tests, assign the users at random and conduct the test.
- **Step 4:** Evaluate the results.
- **Step 5:** Use the preferred variant for improving the prototype.
- **Step 6:** Repeat the tests with new variants or perform another test for validation.
- Note: Differentiation of the test procedure: Quantitative A/B test: The user group is divided ($x\%$ variant A, $y\%$ variant B). Qualitative A/B test: The variants are tested against one another (all users see variants A and B).

A/B Testing Template:

Road map for implementation

- The “road map for implementation” is, as it were, the road to success. With the open approach of a complex problem statement, it is crucial to gain clarity about the context as quickly as possible.
- The tool helps determine the critical factors that are relevant to the planning of the implementation project.
- The aim is to get a holistic view of the subsequent implementation as early in the process as possible, to identify the critical path and possible risks in order to determine the necessary next steps.
- The road map is created as early as possible, reviewed after each step, and adjusted if necessary.
- It is our compass, so to speak, for realigning the project again and again to an initially vague and moving target.
- The execution of the implementation plan usually takes place later. Project management methods, as they are used within the organization, help here.

Group Size: 5 - 7

Ideally, the project manager, a designer, business or product managers, representatives of the users or customers, investor or sponsor, developer and challenger, if appropriate.

Typical Duration: 60 - 120 mins

Procedure:

Step 1: First define goals and build a control system; if possible, quantify relevant decision-making criteria (KPIs); determine budget, schedule, milestones, etc.

Step 2: Draw up an overview with all participants. For this purpose, tools such as the stakeholder map are useful for checking the goals for their suitability for implementation and, above all, for putting together the right team.

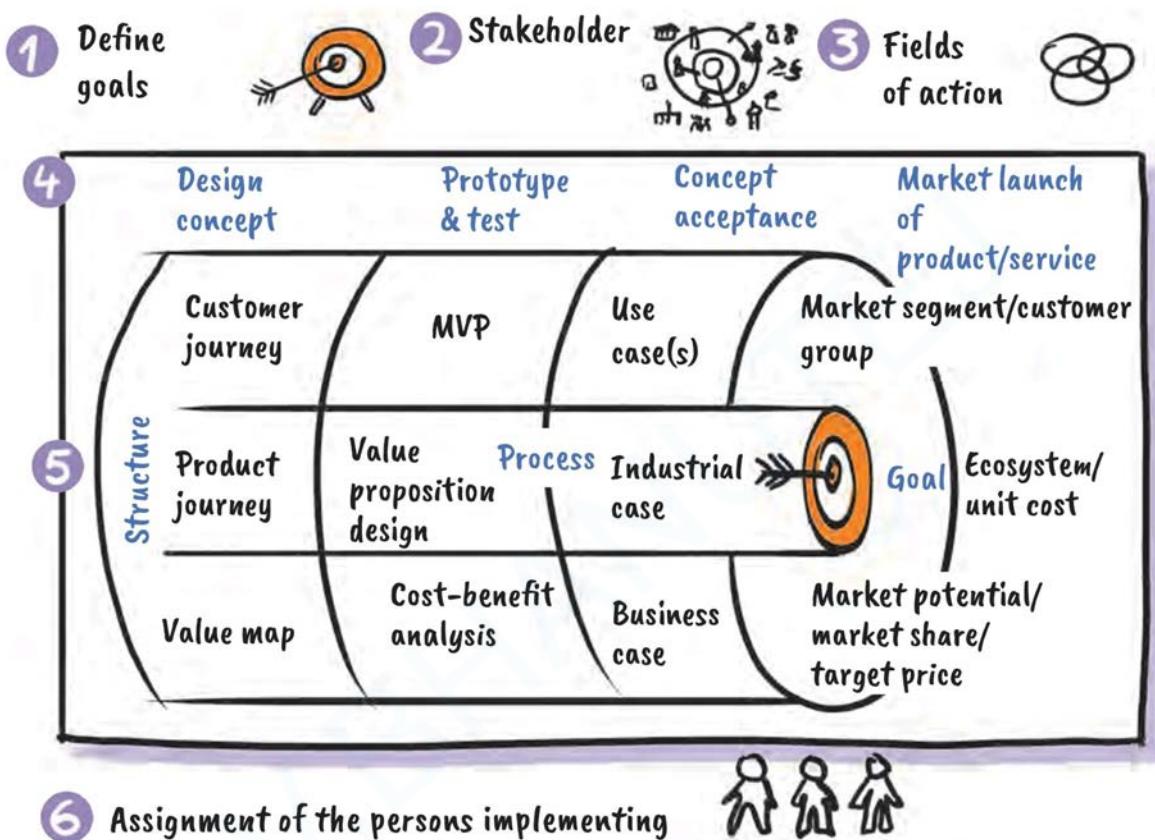
Step 3: Define the structure, the main fields of design, and perspectives. The “standard perspectives” are desirability, feasibility, and viability. Depending on the problem statement, they can be further specified, for example, by dimensions such as sustainability and environmental compatibility.

Step 4: Describe the process steps or phases. Depending on the applied methodology, they may be concept design, prototyping, and testing (iteratively) as well as concept acceptance.

Step 5: Fill in all fields with tasks, first in terms of quality; then enter the results of the individual tasks, for example, by means of a customer journey for concept design usefulness.

Step 6: Here, it is important to position on the map all people implementing the solution or needed for the implementation, since it might be necessary to win them over.

Road map for implementation Template:



Problem to growth & scale innovation funnel

- The “problem to growth & scale framework” constitutes the basis of a modern, contemporary innovation funnel.
- It is not based on many different ideas that are filtered through gates (as with classical innovation approaches); instead, it starts with the “problem identification mode.” The problem identification mode is controlled by two factors. First, by the exploration of existing customers and technologies, and second, by extrapolation, a way of looking at future ecosystems, technologies, and market roles.
- The various initiatives for solving present and future problems are visualized over time and presented in a portfolio.
- Initiatives that are discontinued remain in the funnel. At regular intervals, the causes are examined in the context of a retrospective, for instance.

Group Size: 1 - 2

- The inputs for the topic and the current status come from the strategy, design, and implementation teams in an organization.

Typical Duration: 30 - 120 mins

Procedure:

The funnel is a very good tool for documenting the individual activities and arranging them chronologically in terms of their maturity level. It gives us transparency on current prototypes, MVPs/MVEs, ultimate solutions, and discontinued activities.

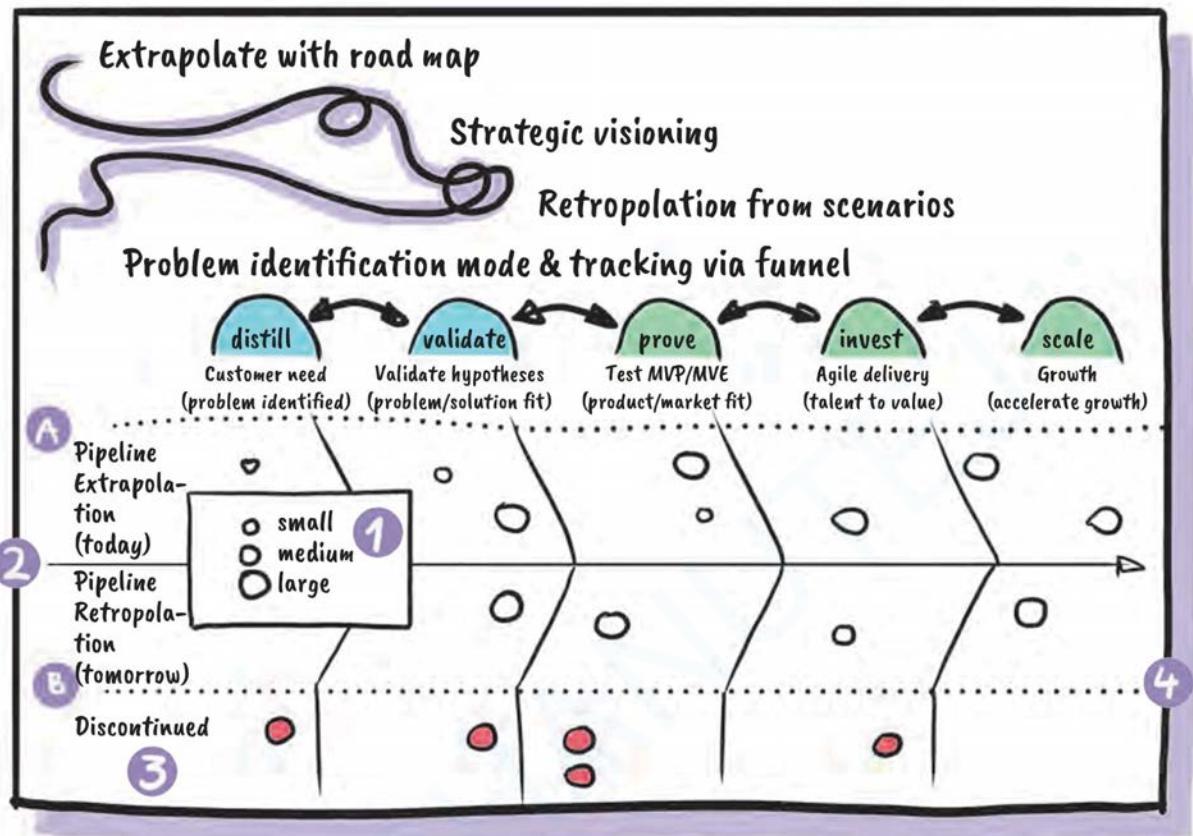
Step 1: Enter a name for all projects and establish a scale for the size or the contribution of the project to the success of the company (e.g. < 5 million, 5-50 million, > 50 million). The things being measured are adapted to the value system of the respective organization (e.g. top line vs. bottom line).

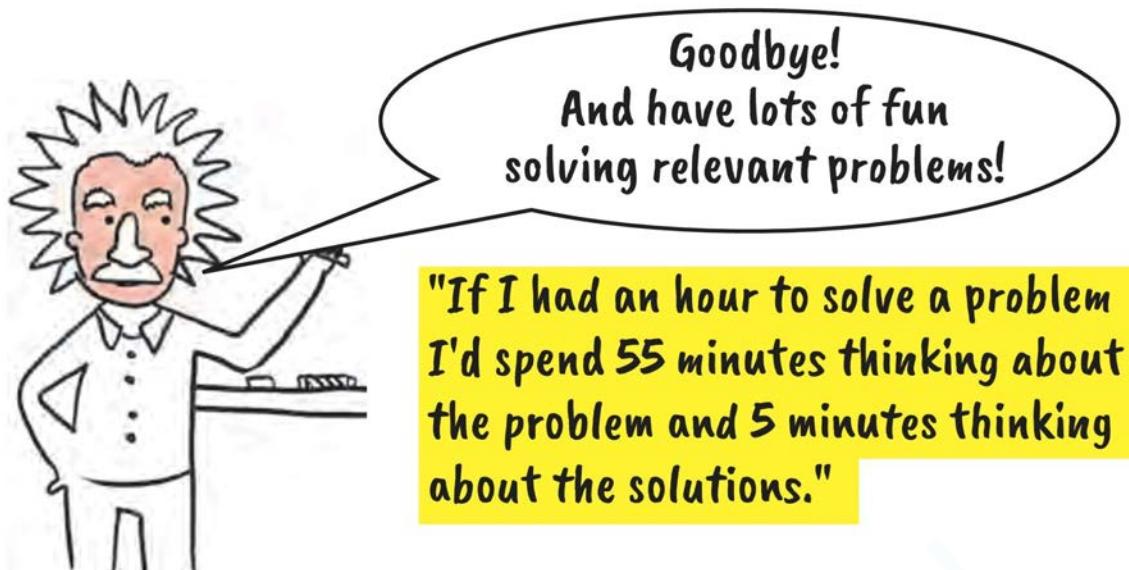
Step 2: Place the current projects on the time axis and differentiate between existing business (A) and future topics (B). This differentiation shows us how much activity is invested in the development of the sustainable future of an enterprise.

Step 3: Projects that were discontinued are also traced, so we are able to examine the reasons for it at regular intervals.

Step 4: Update the funnel through regular control (e.g. on a monthly basis), and discuss on this basis resource allocation and sales and profit targets.

Problem to growth & scale innovation funnel Template:





Model Question Paper

**ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES
(AUTONOMOUS)**

**III /IV B.Tech –I Semester Regular Examinations
**DESIGN THINKING
(MECHANICAL ENGINEERING)****

Time : 3 hours

Max Marks : 60

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the questions must be answered at one place only.

Q. No.	Questions	Marks	CO	BL
UNIT - I				
1) a.	Explain Design Thinking and list out the tools and resources required for the design thinking.	6	CO1	L2
b.	Compare the Design thinking over Business thinking and creative thinking.	6	CO1	L4
OR				
2) a.	Explain the Action Plan of the Design Thinking and its 5 phases	8	CO1	L2
b.	Describe the need of the problem statement in design thinking.	4	CO1	L2
UNIT - II				
3) a.	Explain in detail the Empathy phase in the design thinking and list out the useful tools for empathy phase for better understanding of the problem	6	CO2	L2
b.	Explain the procedure to use “Ask 5x why” tool with a case study.	6	CO2	L2
OR				
4)a.	Describe how “Empathy map” tool is used for better understanding of the user/customer problem in empathy phase and explain the procedure to use this tool with a case study.	8	CO2	L2
b.	Explain the need of the Persona in design thinking.	4	CO2	L2
UNIT - III				
5)a.	Explain in detail the Define phase in the design thinking and list out the useful tools for define phase to define the point of view problem statement.	6	CO3	L2
b.	Explain the procedure to use “Context mapping” tool with a case study.	6	CO3	L2
OR				
6)a.	Explain in detail the Ideate phase in the design thinking and list out the useful tools for Ideate phase for generating ideas.	6	CO3	L2
b.	Explain the procedure to use “Brainstorming” tool with a case study.	6	CO3	L2

UNIT - IV				
7) a.	Describe the need of Prototype in Design thinking and list various types of prototype methods.	6	CO4	L2
b.	Explain in detail the Vision prototype with a case study.	6	CO4	L2
OR				
8)a.	Explain need of Exploration map in design thinking at prototype phase with a case study.	6	CO4	L2
b.	Explain in detail the Functional prototype with a case study.	6	CO4	L2
UNIT - V				
9) a.	Explain in detail the Test phase in the design thinking and list out the useful tools for Test phase for testing the developed solution.	6	CO5	L2
b.	Explain the procedure to use “Feedback capture grid” with a case study.	6	CO5	L2
10)	Describe the Road map for implementation of the solution developed by design thinking.	12	CO5	L2