WORLDPLACES

workplaces working with migrant women

Design Thinking Course Material

Draft version 1.0

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This document is a working document. It collects the content being developed in the framework of project Worldplaces. These materials, in its final version, will be eventually utilized as resources to develop Action Toolkits and a multimedia course.

Preface

This working document collects the course materials developed in the framework of Worldplace's work package 2 on Engagement and Design Thinking for Migrant Women Integration. This work package aims to provide an inclusive, women-focused methodology to support and foster the barrier-free engagement and participation of migrant women in structured exchange events leading to the design of concrete workplace-based integration projects in the 4 action hubs and EU-wide. For this, Design Thinking will be utilized for the implementation, piloting and fine-tuning of workplace-based services, tools and processes that can facilitate the integration of low-skilled migrant women, leveraging on 4 key areas: training, teaching and leadership, life and community skills, language and culture, body and identity.

Eventually, the outcomes of this work package are intended to facilitate and streamline the implementation of partners' workplace-based tools, best practices and processes for the integration of migrant women and their replication or customisation for both public or for-profit employers.

To achieve the objectives above, Design Thinking learning and teaching materials will be produced to promote participation and collaborative work. These materials will be targeted to Worldplace's action-leading partners, as they will engage the relevant stakeholders (migrant women, employers, social workers, etc.). They will be produced in digital and printable form, but in some cases (e.g., static content) will be designed to be easily reformatted as printed materials. Eventually, they will be organised and packed according to popular learning content sharing standards (e.g., SCORM) to be seamlessly integrated in popular learning platforms (e.g., Moodle) and be utilized as self-learning materials.

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1 Introduction

Design thinking includes a set of approaches and techniques originally used by designers of physical objects and devices, but is organized and structured in a way that facilitates innovation. Unlike other problem-solving strategies where the domain is content-based, the knowledge domain of design thinking is process-based. This extends the reach of design thinking to many areas of interest and addresses the challenges faced by people and organizations. In this way, Design Thinking has accumulated a broad portfolio of successful applications in various fields such as medicine, law, business, engineering, natural sciences, social sciences, arts and education. [1].

Design thinking methodologies are iterative, adaptable, and fast. This has a very important feature. This methodology needs to be applied adaptively or flexibly through five well-defined steps. That is, it does not always have to be applied sequentially. In addition, the five phases of empathy, definition, idea generation, prototyping, and testing need to be part of an iterative process to improve the proposed solution to the problem. These iterative steps make it easy to manage the risks of your project.

1.1 The Design Thinking process

Design thinking puts the user at the center of the process. Utilizing the heart of human-centered philosophy, this empathic mission is associated with different ways of sensing, observing, engaging and immersing in the lives of others. Empathy plays a dual role. It brings a "human" vision to human-centered design. It also emphasizes the dual side of complex issues. It can be a technical issue in nature, but it also has a social dimension. [1].

The development of activities along the design thinking process is like a series of waves of divergence and convergence that guide design thinkers to propose solutions to their problems. The branching phases creates several options that expand the possibilities of project development. The convergence stages, on the other hand, is intended to materialize and focus in the direction selected as a result of discoveries from previous stages. Figure 1.1 graphically summarizes this idea, which is in the core of the Design Thinking methodology.

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As mentioned earlier, there are five steps to applying design thinking in a continuous divergence and convergence solution design process. The empathy phase aims to gather as much information as possible by observing and interviewing possible users. This is a divergence phase to move from ignorance of the user's life and emotions to immersive knowledge and open up a wide range of information for the next phase.

The definition stage, the second one, aims to converge from the information gathered during the empathy to the explanation of the problem to be solved, providing a point of view, which is no more (and no less!) than a sentence that summarizes the problem indicating who needs something, what they need, and why this needing arises. It is more than describing the problem, it goes into its roots to provide the deepest reason. Then, this stage begins with a lot of information about the group of users and ends with a clearly stated definition.

Next one, the third stage is called ideation. It is again a diverging time, as different ideas for solving the problem will be its result. Using the point of view as inspiration, the DT-team provides a collection of ideas that could help in solving the problem being partial or global solutions.

The fourth stage consists of prototyping a solution based in one or more ideas generated previously. The result of this stage is a mock up or a simple prototype, which could be fully functional or descriptive depending on the available time and materials. Again, the result is one element, so the process has converged from a collection of ideas to one proposed solution. The prototype is then given to the users during the last stage, the testing one. The DT-team observes the interaction between users and prototype, getting feedback on its usability, utility and goodness to improve the users experience and to solve the detected problem. This stage is not clearly divergent or convergent, as depending on the gathered insight its consequence could be the end of the process (when the DT-team considers that the prototype is a good response), or could move to go back to some of the previous stages.

Figure 1.2 depicts the process of Design Thinking in a graphical way, including some defining activities performed during each of them, which are explained in chapters 2 to 6.

The successive phases of a closed process appear to follow a linear path, but the application of design thinking actually goes back to the previous phase to refine the results and redefine the evolution of the process. Ultimately, design thinking does not have to be an inflexible and rigorous problem-solving methodology. Otherwise, it will be a more traditional methodology and the essential elements will be lost. The sequence of phases should be used as a guide to the natural progression of the event, but you can complete, return, run at the same time, or repeat multiple times for each particular project in a different order. You can broaden your horizons, address the problem and finally find the best possible solution. The information that circulates during the stage helps us better understand our audience, the original problem, and the solution we have planned.

Design thinking understands that the process of creating innovative products, services, and experiences is inherently vague and confusing. This methodology is based on accepting even non-linearity and chaos through open and flexible thinking and an unrestrained attitude towards experimentation and play. Excessive control of the innovation process is not only useless, but also counterproductive. If you want to regulate the innovation process, the solution obtained may be solid, interesting, and even effective, but it wiill not be a breakthrough. Therefore, design thinking promotes a positive attitude towards uncertainty and improvisation, as well as trust in instinct. We do not take ourselves very seriously, but we take what we do very seriously.

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To sum up, the ultimate goal of each Design Thinking project is to design a solution that meets the following conditions:

- The focus is on people, on human-centered design. The solutions created must appeal to the needs, emotions and behaviors of the people for whom we are creating such solutions.
- Its technological feasibility must be guaranteed. Is the solution technically possible, or does it depend on a technology that has not yet been invented or developed? Our solutions must be practical and workable without incurring unaffordable costs.
- Its social viability must be guaranteed. Will the solution work when we want to put it into practice in the real world? Is the solution environmentally friendly? Is it inclusive? Is it accessible? Design Thinking is a long-term process that should ideally continue to be supported and improved beyond the completion of the original project. Solutions must be viable and sustainable over time.
- Economic viability must be also guaranteed. Will the revenue we get from any source offset the financial resources needed to implement the solution? Have we identified a sufficient flow of funds to ensure its timely maintenance? Is the project economically sustainable? In the case of a commercial product, is there an appropriate business model behind that product?

In summary, Design Thinking structures a collection of methods, tools and techniques in a way that facilitates the innovation in providing feasible solutions to problems using a human-centered focus. The process is flexible but not chaotic, it is serious but not sad, it is innovative but not mad.

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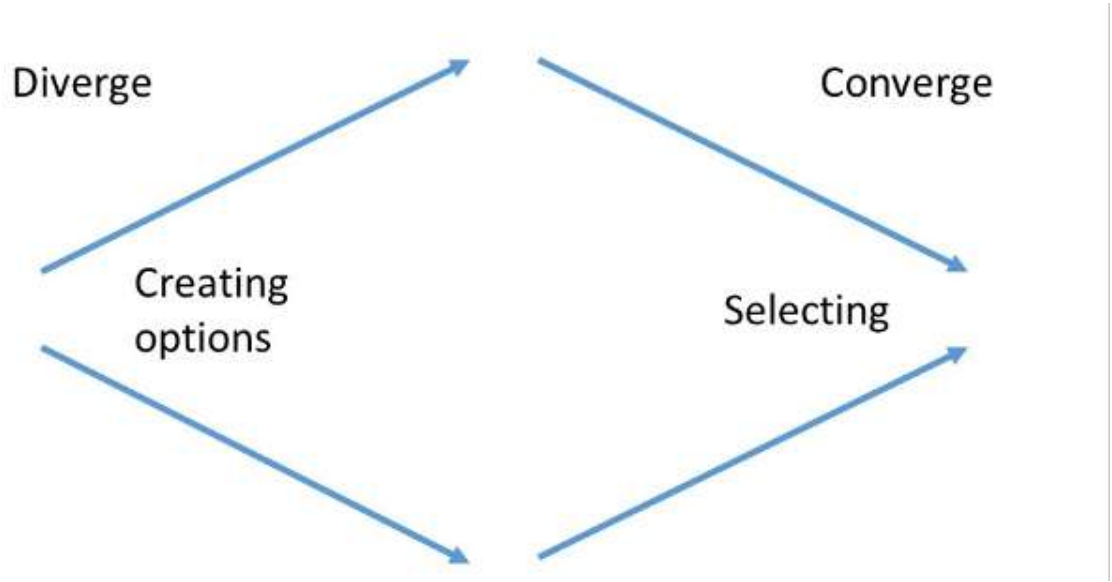

Figure 1.1: Diverge and converge process.

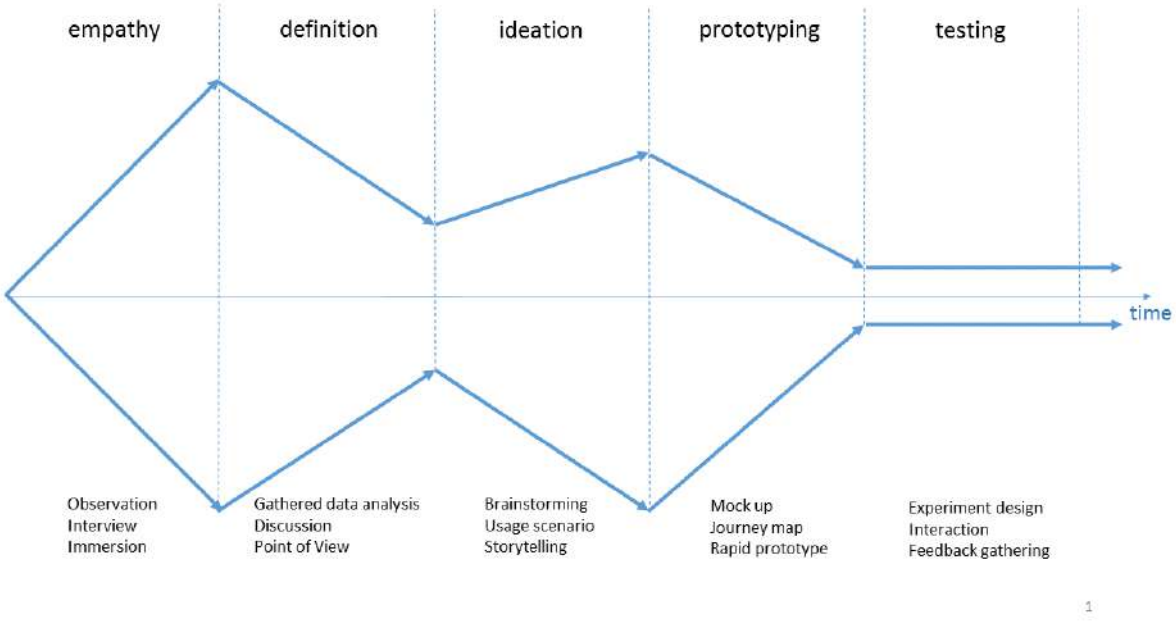

Figure 1.2: Design Thinking stages.

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1.2 Design Thinking path along its development

The first reference to Design Thinking comes from 1934 when John Dewey proposed to integrate the principles of engineering and aesthetics in the making of a new generation of machines (i.e. electrical devices) based on traditional materials and old-fashioned machinery [2]. In the 40's, the term "design thinking" is applied to define the state of the art in mechanical engineering as a reference in the creation of new motors [1].

But the interest was not limited to mechanical engineering and, in 1957, the American Ceramic Society published a manifesto regarding the interest on improving the skills of designers learning Design Thinking proposals, considering the need of carrying design from the formation of the idea to the production line as a full "design action" with all the steps connected [3].

However, it was not till 1959 when John E. Arnold coined the term "Design Thinking". He taught classes at Stanford University and at the Massachusetts Institute of Technology, and developed a course on creativity on engineering in which he began using the term that now gives the name to the methodology [4].

Another important milestone was established by L. Bruce Archer in 1965, when he defined the methodology, providing a procedural approach to training designers to add different knowledge to their original specialization: ergonomics, cybernetics, marketing and management [5]. The generalization of the usage of Design Thinking in different ambits was also supported by the book of Bryan Lawson on the way of thinking of the designers [6].

Also in the early 80's, Bill Moggridge led the design of the first notebook-style computer for GRiD Systems. The design team incorporate a new practice of observation of users interacting with the computer's software that they called interaction design. The know-how of the companies these visionaries, Kelley and Moggridge, was merged in 1991 into a new company that incorporated also Mike Nuttal firm, creating IDEO, which is now the paradigm of Design Thinking-based development. IDEO success, and their innovative designs, increased the interest for Design Thinking from many engineering and technology sectors in later 20th and early 21st centuries.

Besides this industrial awareness, academics provided additional support and research on the Design Thinking proposal. The same year when IDEO was born, a workshop meeting was held at the Faculty of Industrial Design Engineering, Delft University of Technology, The Netherlands. This was the first symposium fully dedicated to research in Design Thinking, and its contributions are available at a book published in 1992 [7].

There were a succession of interesting research papers linking the new proposals of Design Thinking with those original ideas of John Dewey, as the well-known work from Richard Buchanan in 1992 which frames the challenge for design thinking: the contribution of design to the modern world. Buchanan connects design thinking, wicked problems and Dewey's theory: "What Dewey defines as technology is not what is commonly understood in today's philosophy of technology. Instead of meaning knowledge of how to make and use artefacts or the artefacts themselves, technology for Dewey is an art of experimental thinking" [8].

In 2005, the Stanford University, which was leading the Design Thinking movement, erected its Hasso Plattner Institute of Design (better known as the d.school). This institution, the d.school, created and offered courses on Design Thinking. Besides, its full-time staff is researching, improving and promoting Design Thinking at different education levels [1].

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Different people at Stanford University and IDEO contributed to popularize Design Thinking as a valuable method to be learned at many different fields outside professional design, social sciences among them. Design Thinking is useful for innovating in business, universities, and organizations of any type. The idea that anyone, form different fields of knowledge, can become a design thinker happened to be dramatically democratizing [9].

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2 Empathy

The first thing we need to do to apply Design Thinking is having or describing a challenge. That challenge should be defined in a broad way in order to open our minds and it is commonly a problem related to people. Many times, the challenge is proposed or defined by the institution, the company, or the people that asked us to find a solution. What is important as a start point is to have a challenge, which is not exactly a problem: from the challenge we have to define the problem to be solved, and then to look for possible solutions.

2.1 Definition and elements of empathy

Empathy is the ability to put ourselves in other people's shoes, to feel how they feel, in order to interpret their needs, their concerns, their tastes and their interests. As the American educational psychologist Carl Rogers would say, "to be empathetic is to see the world with the eyes of the other, and not to see our world reflected in his eyes" [10].

The objective of the empathy phase, also called research or collection of information in an empathetic way, is simply to identify what is really important about the target persons or users, what their daily problems are, how they interact with the environment, etc. The activity of looking at people around us gives us insights into what they think and feel, and provides us an idea of what they need and what their most important problems are. The best solutions are provided by human behavioral understandings. Those insights represent a very important concept in the Design Thinking methodology that will arise later, in the explanation of the definition phase. They are defined as a need, a desire or a belief of a well-differentiated person.

The point is, it is not so easy to carry out empathy. Taking the words of Alfred Adler, "to look with the eyes of another, to listen with the ears of another, and to feel with the heart of another" must not be an easy task [11]. Besides, it is a time-consuming activity, even this time should be identified more as an investment than as a waste, considering the benefits the project development will obtain.

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In order to do this, first of all we must put ourselves in the place of the other persons, knowing what their problems are in the day to day, observing their environment and what they need to solve, and secondly feel them as ours, that is, be one more of them.

We have to understand the reasons why people do what they do. And we must be clear that empathy is a divergent phase, and that implies being able to open the mind. To achieve this, it is necessary that we adopt an open minded, without making judgments of what we hear, see or feel, and this is the only way to be able to empathize. Not making judgments is an empathetic action, and we know how difficult it is, to be present, to listen and not to give an opinion. It is one more challenge in this first phase. Remember that this phase is a phase of divergent thinking, this means that you have to open the range of possibilities and always keep in mind the open minded mentality. It is not a phase to express an opinion or say what needs to be done. If in this phase some solutions arise to you, you should write them down for other phases, but looking for solutions is not the objective of this phase. We have to adopt the mind of an inexperienced.

Another aspect to take into account as a key in empathy, according to Daniel Goleman, is to capture both verbal and non-verbal messages from the other person [12]. The rational mind is transmitted through words, and the emotional mind through body language. It is very important to know how to interpret the signals that the other person emits unconsciously and usually non-verbally. Recognizing these emotions is the first step to understanding them and identifying with them.

At this point, we can talk about two types of empathy: affective and cognitive empathy. In affective empathy, I feel what you feel. It has to do with the ability to feel another person's emotions, feelings, and sensations. In cognitive empathy, I understand what is happening to you. That is, we know how you feel and we understand it. We must develop both of them in this first phase of Design Thinking.

There are people who are empathetic by nature, for them it is something natural and even innate. These types of people have a good stretch done in this first phase of Design Thinking. But also to say, that these people watch that an excess of empathy or hyper-empathy, is not appropriate either, since it leads us to assume the emotions of the other as ours and suffer them, and can prevent them from seeing clearly the person observed. In this case, it means being a mirror and in turn a sponge. As in life, excesses are not good and the ideal is to seek balance For those who do not present a natural empathy, this skill can be worked, like all social skills, and with time and constant training it can be perfectly developed, and even lived.

To start with this phase of empathy, the first and most common thing is to identify the users of the challenge. That is, to identify all the possible people involved in the problem that is being treated. We called them the stakeholders of the project, product, service or process of our challenge. If we want to know what a user thinks, we must first identify the different types of users, who may have different perceptions of view. This identification will be useful to be able to observe them in their environments and then to choose the most representative ones for the realization of the interviews. Sometimes, we are only able to identify stakeholders later, when analyzing the empathy insights during the definition stage.

Then, once the users are identified, it is time to perform the empathy stage. The three most important elements to acquire empathy and put them into practice in this first phase of Design Thinking are: observation, empathetic interview and immersion, in growing order as graphically described at Figure 2.1. These are the topics of the following subsections in this chapter.

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2.1.1 Observation

Observation is a user-centered technique. It is also called covert observation since we immerse ourselves in the user's ecosystem going totally unnoticed. It is one of the oldest techniques used in research, and yet it is very useful. It aims to get to know a person or a group of people and understand the situation they are in. It is not about seeing around, but looking at the persons carefully and their environment, and for this we use a method, which will allow us to learn to observe.

To do this, it is good to ask yourself three basic questions: "what...?", "how...?", and why...?. Moreover, within the question "why...?" it is highly recommended to use the 5 why technique, which is one of the most widely used problem-solving techniques introduced by Toyota Motor Corporation in the 50s [13]. What do we get with these three questions?

What? It allows us to get closer to what an observed person does. With this, we realize what happens in the scene. We must not forget to write down all the details, trying to be objective. We do not want to create a story around what we observe, so we should not assume anything, just see what is happening. This means that the response of this question is pure description of the situation.

How? It helps us understanding the scene. We ask ourselves how the observed person acts, we see if that activity requires any effort, if he seems happy, hurried, hurt, if the activity impacts him or her positively or negatively. In this phase it is good to write with descriptive phrases and with many adjectives.

Why? With that, we interpret the activity of the person observed. Do we know why he does what he does? Why does he do it in that way? It is the time of riddles and presumptions, based on the motivation or emotions that the observed person seems to have. It is about adding meaning to the observed situation.

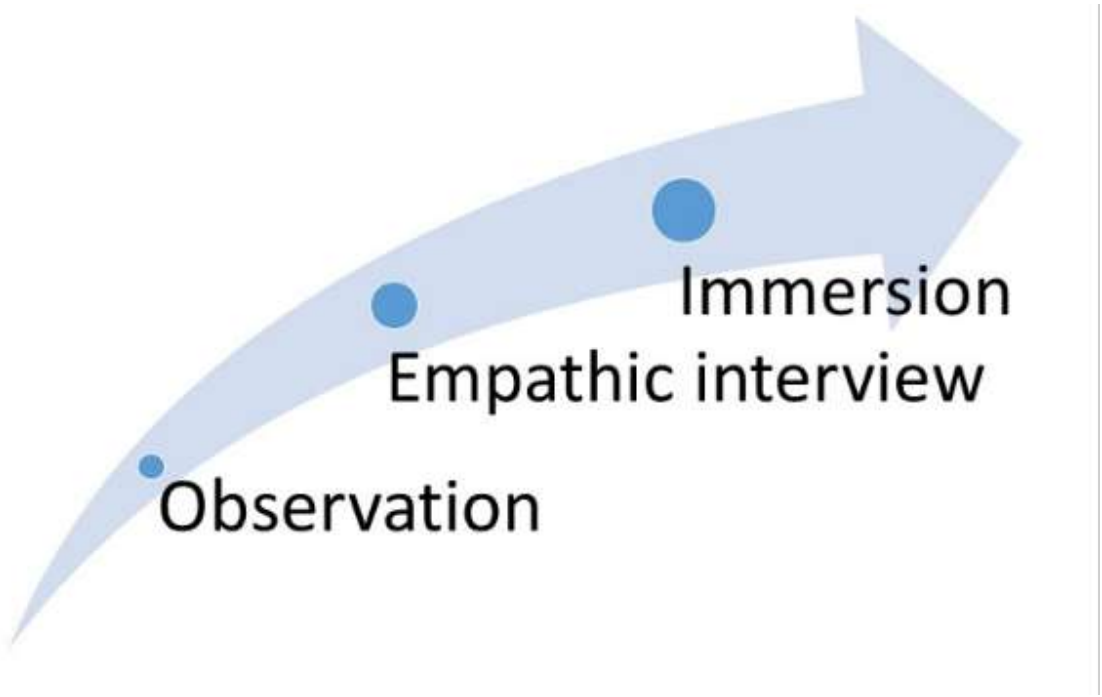

Figure 2.1: The three main elements of Empathy stage.

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Sometimes, if it is possible and you have authorization, you can use the camera study technique, which allows you to see the day to day of the user through their own eyes. In this case, it would no longer be a covert observation. With this proposal, the person under observation carries a camera which records his daily activity.

In this phase, it can also be interesting to obtain information about the challenge or topic that we are dealing with through experts or looking for different types of information of interest. This type of research is what we call documentary research.

2.1.2 The empathetic interview

After the phase of observation of people, in which we see their behavior and attitudes, it is time to establish contact and interact with them. It is very important that at this moment we are aware of the value of the time we share with those people in the interview. Since time is a very precious and limited element, we must make the most of it, since in many cases we will no longer be able to be with those people and interact with them. That is why it is very important to prepare for interviews. Below we name a series of recommendations or tips.

- It is necessary to prepare the questions, but in addition to know how to ask questions, you have to know how to listen. How many times do we string one question after another and not listen to the answers? Silences are also very important, so that the people interviewed take their time. Listening to the silences, and to the answers, is a first step to concatenate adequate questions: we are doing an interview and not a survey. Doing an interview goes further than asking successive questions. This means that we should change the order, omit, or add questions with the aim of keeping the attention of the interviewee and to maintain the tension of the interview.
- Remember to use powerful questions like “What?”, “How?” and “Why?” as if it were a mantra. Also, the question “Why?” is very important as we will see later, and pay attention to “technique of the 5 whys?” as a way to find the deepest root of people feelings and needs.
- Never use targeted questions, such as: Do you think this...? Be aware that interviews are not to validate your hypotheses, but serve to understand what people think.
- We must at all moment make the interview natural, and nothing forced. Let it seem spontaneous, even though we have previously worked on it and we have clear the objectives. Remember that our goal with the interview is to get to feel what the interviewee feels in his environment.
- Try to get people to tell you their story, apply the technique of active listening: nodding your head and looking into their eyes makes the interviewee feel heard, and important.
- Do not forget to capture the results and if you have permission to video recording the interview, much better, since you capture all the non-verbal language that in an interview sometimes you are not able to capture.
- Make a summary report of each interview. From here will come the insights of the second stage of Design Thinking, the definition.

Interviews can be approached in different ways, but the usual thing at the beginning of the interview is to start with more superficial questions thus creating a more relaxed atmosphere. Throughout the course of the interview, and once we reach that degree of confidence, we can move on

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to deeper and more detailed questions. In general, we can talk about three types of interviews: structured, semi-structured and open.

Structured interviews are very rigid research tools. Standardized interviews can be considered and have a quantitative approach. Previously, a planning of all the questions and the order in which they are going to be carried out is defined. The questions are always closed, so the people interviewed do not make comments or appreciations about the questions, and are limited to giving a concrete answer. They are useful for getting information for large amount of people, although you can lose part of the freshness of the process.

Semi-structured interviews are based on a script with the issues that we want to deal with the person interviewed. But, although we follow a basic structure in the interview, it gives some leeway when probing the interviewees. The questions will be of an open type and the interlocutor can show opinions, nuance answers even deviate from the script when unplanned topics that are of interest appear. It is necessary to have an ability to naturally introduce important themes, linking topics and answers, which needs a bit more experience than structured.

Open or unstructured interviews , also called in-depth interviews do not start from a script, nor from a list of questions. They are more like a conversation, but having an objective along the chat. The person conducting the interview has a great responsibility to identify at each moment what you have to ask and how to do them, and get the best answers. They are usually interviews conducted in several sessions. The success of this interview is the ability of the interviewer to achieve a climate of trust or harmony with the interviewee. This type of interview already requires a certain practice. We can consider them as an art.

Analysing these three types of interviews, we can say that, in the case of our empathetic interviews, we will not rely on very structured interviews with totally closed questions, but we are more inclined to semi-structured interviews or even open ones, when the interviewer already reaches a certain degree of practice in this task.

What should the questions look like? They must pursue to create that climate of trust, seek proximity to the interviewee, and thus the interviewee can feel free to respond openly. Remember that it is necessary to plan the interview, creating a list of possible questions, and organizing their rhythms and their depths, starting with superficial questions until we reach the deepest ones.

All this selection of questions is obtained after previous studies, from the results of the previous observation process, or by performing a question brainstorming technique among the participants in the Design Thinking process.

Once we have that list of questions, we will organize them by topics and redefine the statements to create a natural communication, so that the interviewees do not feel questioned. You have to prepare how to link some questions with others.

Now we are in the step of analysing if we have enough questions, we have questions of the type what, how and why or a new question that we will talk about later, which is for what? We have enough direct questions about how the person we interviewed feels for breaking the ice. Never ask multiple questions at once. The key is to perform them one by one, and wait for each response. If it is not clear, ask a counter-question. Once this previous work is done, it is time to start the interview. We have previously selected the people we are going to interview, after analysing what kind of people are involved in the project and choosing the most representative.

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Before starting the interview, we need the agreement of the other part, hence the importance of that first contact with the interviewee, which is crucial in creating a receptive environment.

We already have the agreement of the people we are going to interview and we already have a possible list of questions organized by topics and superficial questions to create that climate of trust at the beginning of the interview, so we only have to choose suitable place and time.

Check-list (Interview preparation phase)

1. Analyze the information obtained in the observation phase
2. Select interviewees (representative of stakeholders)
3. Seek the agreement of the interviewees (it is the first contact with them, and we look for them to be receptive)
4. Create list of questions by topics. Check if you have:
    a) Superficial questions for the beginning (objective to break the ice)
    b) Questions like What?
    c) Questions like How?
    d) Questions like Why and For what?
    e) Open questions
5. Redefine the list of questions (to transform into natural conversation, spontaneous, connection between questions)
6. Select interview location
7. Select the time of the interview
8. Select interview material
9. Select the way you dress

It is important to select a suitable and quiet place where both interviewer and interviewee are comfortable and relaxed. And as for the selection of the moment, it is important to emphasize that an interview requires time and full dedication if we want it to be successful, so we must look for a time when it is not conducive to interruptions due to the work of the interviewee. When an interview is initiated, the interlocutors should be focused on it and have nothing urgent to do next as it can make or lose mindfulness in it. In addition, the interviewee must know the agreed time that the interview will take, it is even good to finish a few minutes before.

For what? vs. Why?

Let's talk about these two types of questions. They are two ways to ask when we want to know more about the motivations of doing something. And we usually ask them in these two ways: "For what?" or "Why?" When preparing an interview is it good to make a small reflection about what you feel when you are asked a question that begins with "Why?" and what do you feel if that same question starts with "For what?"

Why? questions are usually related to the more theoretical motivation that explains your actions and your feelings. It is something more descriptive and more passive.

On the other hand, For what? questions generate action, it is something more active and motivating, as responses indicate what you intend to do with your actions or feelings.

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About the material we need for doing an interview, at least a pencil or pen, a field notebook and the script of the interview. In the case that we have authorization to record the interview, a voice recorder, although a video camera is always more advisable, which will allow us to analyse posteriori, in addition to the conversation, the non-verbal or body language of the interviewee.

Another aspect that we must not forget is to select the way of dressing, because we must adapt our clothes to each interviewee and each specific situation: i.e. dressing in a suit and tie to talk to a student can create distancing. The goal is to create a climate among equals, allowing a success interview face to face.

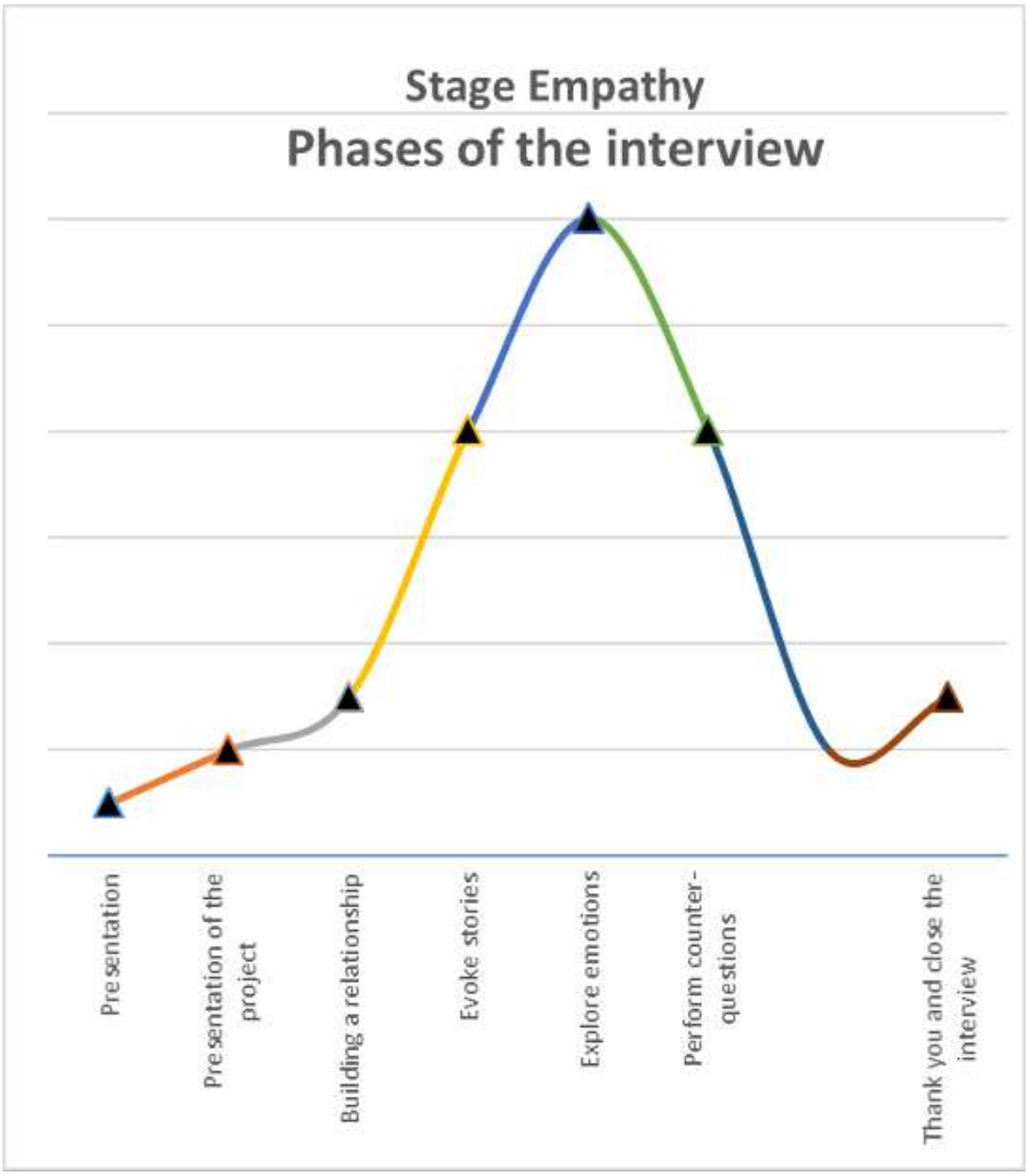

Figure 2.2: Phases of an interview.

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Once we have everything ready to start the interview, we analyse the different phases through which the interview must pass. To do this, we can observe Figure 2.2 in which we represent on the horizontal axis the duration of the interview, and on the vertical axis the degree of attention and emotional intensity of the interview.

Presentation The first thing we have to do is introduce ourselves. Saying who we are is the first step to building trust and stopping being a stranger. It is very important these first minutes, which make the interviewee make a composition about you. Hence, it is essential to do it in a relaxed way and with a smile, and always in a natural way. The attitude we must adopt is assertive, respectful and open. Our goal is to promote communication and initiate that relaxed climate.

Presentation of the project Then, although in the preparation phase of the interview, we had a first contact with the interviewee, seeking his or her agreement to participate in the interview, and you have already explained the reasons for the interview, it is very important to reinforce the objective of the project. It is necessary, therefore, to explain to the interviewee what you do, what you are working on, why we need their answers and, what they will be used for. At this time, the language we use must be clear, without much technicality by which you can be overwhelmed, and adapt it to the profile of the interviewee.

Building a relationship This phase is essential. From it begins the highlight of the interview in terms of the degree of confidence and arouse interest in the interview. But how do we create that climate of trust? For this, we use questions and counter-questions. Mention again the importance of going to the interview with a way of dressing according to the interviewee and the specific situation, to ensure that there is no distance between the interlocutors.

Evoke stories What is sought is to identify situations in the life of the person interviewed that have to do with the objective of the research.

Explore emotions At this moment, in addition to telling us their experiences, it is necessary to get their feelings out of him, when making them.

Perform counter-questions During the interview, when listening to the answers, we will have doubts. In this case, it is important to ask counter-questions to make sure that we understand everything that the interviewee answers us.

Thank you and close the interview Finally, it is very important to convey to the interviewee the importance of their answers, thanking them for their collaboration. We will close the interview by saying goodbye to him or her, but perhaps it will not be a definitive goodbye, if we have a second session planned. At this time the conformity of the date, time and place of the meeting is sought. Sometimes it may be required by the interviewee to read the transcribed interview to complete nuances to certain questions. That's something, that we have to agree on and it can be very interesting.

As we can see in Figure 2.2, at the beginning of the interview the degree of emotional intensity of the interview is very low. The first questions are of the closed type, to collect information of the demographic type, such as gender, age, work activity. But as the interview progresses, we change the type of questions to questions of the open type, as the ambient is more relaxed and it is at this time when the degree of emotional intensity rises until it reaches its maximum in the exploration of emotions. Then there is a small phase of decay with the counter-questions and questioning, to go back up slightly with the final thanks.

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Interview's goal

Our goal in the interview is to keep the person interviewed emotionally active, seeking their maximum involvement and complicity in the interview.

During the interview you should instil comfort, asking open questions that allows the interviewee to extend. Questioning him the reasons for his story, encourages him more to tell his story, to delve into it and by continuing to show your interest in it, the person ends up showing how he felt.

Your body language is also very important: you have to show that you are totally dedicated to the interviewee. It is required be mindfulness and practice active listening. The world has stopped, and in this moment, nothing distracts you. You are focus on taking notes and listening every word and every gesture or expression, nodding your head, expressing that you are fully attentive. You have to convince yourself that the key person in the interview is him, and not you, the one who asks, and we must demonstrate this from minute one.

Active listening

Active listening is a very powerful tool and above all, highly recommended in interviews. It consists on listening to the interested party with the five senses, totally focused on what they are telling you, with full attention. It is not about passively listening to the interviewee; it is feeling him in your body.

A good practice would be to observe a person in active listening and see and analyse what they do. What will we observe?

The person who actively listens conveys interest in the interviewee, and we can see that through verbal and non-verbal messages that he performs, such as maintaining eye contact, nodding with his head and smile, showing agreement with affirmative expressions (yes, aha, ok, …). That feedback we give to the interviewee (verbal and non-verbal) will make them feel more at ease, feel important, and will make the person interviewed communicate more easily, and the communications will be more open and honest.

Non-verbal language is very important in this stage of active listening:

- The sincere, natural and invisible smile shows gratitude by making us participate in his speech
- Eye contact, which involves listening with the eyes
- Body posture, tilted slightly forward while sitting listening, shows interest towards the person But all these expressions must be natural, never forced, since they can have an opposite effect than expected. Verbal language is the perfect complement to active listening. The most effective would be:
- Remembering things during the conversation such as the name of the interviewee, some confidence, details of previous conversations
- Asking for relevant aspects or asking for clarifications that show that we are interested in what he say
- Repeating paraphrasing what we just heard to show that we understand it

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- To summarize the idea you have transmitted. Summarizing involves identifying the main points of the message received and repeating them in a clear and logical way, and allows the interviewee to correct any necessary aspect.

Remember to avoid any sign of distraction on our part, such as looking at the phone, the clock, doodling in a notebook, showing restless attitude or showing be in a hurry.

As an activity in order to practice these skills, it is proposed that each person be interviewed by two other members of the team, so that while one asks the questions, the other notes both verbal and non-verbal answers. Body language or non-verbal language transmits much more than we imagine. There are gestures and emotions that we usually go unnoticed while we maintain a conversation, and they have a lot of information. The idea would be: "listen to what is not said and observe what is not done".

Another very interesting option is to record an interview between two people, and then see it again in a group and write down each person, the verbal and non-verbal language. Put it together, analyse it and propose points for improvement.

Once the interview is over, start working on it as soon as possible to have recent impressions and sensations, and not forget about them. If the interview is recorded we will listen to it again, and we will retouch and put in order the notations made in the field notebook during the interview. This fieldwork also allows us, in the case of a second interview, to analyse aspects that were not clear and some issues to deepen.

2.1.3 The cognitive immersion

It is one of the most powerful techniques used along the empathy phase, in which you now become the user. With all the information previously gathered in the observation and in the interviews, we are already prepared to live the experience of putting ourselves in the shoes of the people we have just interviewed.

Its potential is due to the fact that it places us in situations lived by the user, and thus we will understand him better. Imagine that we are involved in a challenge to improve the experience of blind people, so I will have to experience how a blind person lives. I will have to blindfold my eyes and experience what he lives in his day to day.

There are two ways to apply cognitive immersion. The first is to experience what a user lives spontaneously. From the annotations made in the observation stage on the day to day of the user, we will replicate them and discover the eases and difficulties that the user lives, generating a great impact on us, because we live it and we feel it. The second could be called a planned cognitive immersion, through a journey. This is done after the interview with the user, and identify those parts of the day that produce the most important moments. Thus, we create a calendar of experiences to live those most important. Thanks to this technique we will be able to detect the problem and the insights that surround the user in next phase.

Therefore, immersion is not simply collecting the information gained in observation and interviews. Immersion requires a deep analysis, in order to get into the skin of our target audience. For example, in the immersion in the shopping centre that we have just described, we need to study in depth the movements of all the people through the shopping centre, to define that planned

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circuit, which is really representative of all the people who use the shopping centre, and thus be able to make that representative route and experience what they feel.

2.2 Am I empathetic or can I become empathetic?

Reminding the definition of empathy, it is the feeling of identification with someone or the ability to identify with someone and share their feelings. It is one of the pillars of emotional intelligence and is related to compression, support and active listening.

With empathy, we understand a person's feelings and emotions even when he is having a hard time. We should not confuse it with other emotions such as compassion, since in the latter case the person, in addition to putting himself in the place of the other, also tries to put an end to his suffering. That is, to be compassionate you need empathy, but having compassion also implies ending the suffering of the other, while in empathy this does not happen.

Empathy is one of the most important social skills in our daily lives, and like any social skill, there are people who bring them as standard or at least have more predisposition to have them at birth, and others who need to work them continuously throughout life.

People who are empathetic identify with the following characteristics. Do you identify with them? That means you're empathetic.

- They are sensitive and have the ability to feel what others feel.
- They like to listen actively.
- They are able to interpret nonverbal language.
- They are respectful and tolerant of issues or responses they disagree with.
- They don't believe in extremes. When they listen they don't position themselves with the extremes, they try to look for the middle ground.
- They presuppose the goodness of people until proven otherwise.
- They try to express themselves without causing negative impact on the other.
- They consider each person different, and they act according to their circumstances.

But you shouldn't be worry if you don't consider yourself an empathetic person. There is a solution to this. As we know, these kind of social skills do not appear in the curricula, and are increasingly demanded in all areas, so it is highly recommended to work on them at all time, and whenever we have the opportunity. If you do not have empathy, this will not imply that you cannot participate in a creative Design Thinking process, but with constant work you can develop this skill and become empathetic. So it doesn't have to be a limitation to work with the Design Thinking methodology. Here are some tricks to be empathetic:

- Develop active listening.
- Temporarily pause your own judgments and criticisms. Don't make judgments.
- Follow healthy guidelines. Be aware at all times of the other person's verbal and nonverbal expressions. Answer properly and show interest in what he is telling you.
- Remember that empathy takes practice. Look for moments and situations where you can practice empathy on a daily basis: friends, co-workers, family and even people you don't know.

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The following section provides some tools to develop and train empathy, which could help in this training.

2.3 Empathy tools

In order to develop empathy, we have to train it. Thus, in this section, we present some activities that will help you to develop empathetic behaviours. We will divide them into three sections: observation, interaction and interview. To carry out these activities, it is very appropriate and advisable to develop them as a team, or at least as a couple.

2.3.1 Observation

In this first activity we propose draw someone from the team. It will be done in a limited time. That is why we will get in pairs. Firstly, this activity will allow us to break the ice and create a climate of trust with the rest of the team members and secondly to start working on observation. It gives very good results when starting any course and allows to create a relaxed climate.

Activity 1. Depict your partner

We divide the group into pairs, and ask them to draw each other for a time of 2 or 3 minutes. If it is possible, divide couples in such a way that they do not know each other, or do not know each other well.

Once the pairs are made, they are asked to make a quick sketch of the person they are paired with, using a pencil and paper we give them. Tell them not to worry about making a work of art, because this is not the goal. Try to reflect what they see.

After the appointed time, we ask participants to sign their drawing and give it to the person they drew. Next, we ask participants to comment on their drawing and why they did so and, we ask the people drawn to give their opinion on how they look drawn, whether they look represented or not.

This first activity creates a very positive environment in the team, in addition to breaking the ice in the group, its main objective is to convey the need to practice the observation, to look at the details, to feel comfortable observing and above all to be observed by a person who does not know us. This is a very important aspect to be able to master the technique of empathetic interviewing. It is very good to share the results of the activity; share how they think about the picture and, it is also good to seek the opinion of the rest of the people in the group, who although they have not drawn that person, can give their feedback on some aspect that they would have drawn. Feedback is a very useful tool, which in addition to seeking the participation of the team and creating a relaxed atmosphere, serves to learn to listen opinions of others and be proactive. It teaches us to know how other people see things, that is, it teaches us again to be empathetic.

The second activity that we propose will serve us to practice the three big questions that we use in observation and that can also be used in the empathetic interview. In this case, the activity takes place in observation. To do this we take a photo of several people doing some activity, or

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observing one of them (Figure 2.3). We propose to make an observation in stages, starting with a superficial observation until we reach a deep or emotional observation. And for this we propose to use the three main questions: What?, How? And Why?.

This activity can be done first individually and then by teams.

Figure 2.3: Watch these people carefully: What? How? Why? (Helena Lopes on Unsplash).

Activity 2. Observing by means of the three big questions: What? How? and Why?

We show the participants a picture where there are people who are doing some activity. Following an order, we ask the participants to explain to the audience what people in the photo are doing, how they do it and why they do it. Before starting we must explain what we intend to obtain with the corresponding answers.

The answer "What?" is related to the pure observation of photography. Responding it, we will describe what the people of the photograph are doing, writing down all the details. At this time, you must be objective and not assume anything or explain anything, but narrate what you see.

Once we know "What?", what happens in the scene, we move on to the next question: "How?", which is directly related to understanding the scene, that is, how the people in the scene do what they do. We look at whether it requires any effort, whether they seem happy, in a hurry or in pain, whether the activity they do impacts them positively or negatively. At this stage it is recommended to write descriptive phrases, with a large number of adjectives.

Finally, do we come to the most empathetic part of this activity, the question "Why?" With it we try to interpret the situation, to get into the skin of each person. Do we wonder why the

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people in the scene do the things they do? And why do they do it that way? At this moment, we move onto the motivation of the action, to the feeling or to the emotion that moves the subject of our observation. Now is the time when you can guess, make assumptions of the scene, based on motivation or emotions. Try to get into the scene, to project on you the situation you are observing, to live it, and then to analyze the conclusions… some of them may be unexpected!

As in activity 1, we share the story created by each person or group from the observation work. It is very good to verbalize the story of each one, and contrast it with other people, starting from the same photo. This makes them understand that there may be different points of view, that they learn to listen and ultimately work on empathy. It is very good to ask them the question of whether they managed to get into the skin of the people in the photography. Have they felt and lived that story as if they were there?

The third activity that we propose is always very groundbreaking. It is done in pairs and requires concentration, a great job of observation and sincerity. This activity makes you end up connecting totally with your partner.

Activity 3. Looking into your partner's eyes

The activity is carried out in pairs. Try to sit in front of a person, silently, looking into each other's eyes, for a limited time. In this case we propose four minutes. During this time many things happen: there are moments that make you want to laugh, to disconnect and look away, there will be moments when you feel tense, then more relaxed, even after a certain time you feel calmer and finally in connection with the person you look at with your eyes. Is this the empathy we are talking about? Are we feeling it?

This activity can be done in combination with activity 1 of drawing your partner. The proposal is to begin with the portrait drawing, and continue with looking into the other's eyes. After this intense time, it is good to move the group members to talk about their predominant feelings.

2.3.2 Interaction

The activity that we propose in this section (activity 4) can be seen as a game. In this activity we will interact with the rest of the people participating in the course, in which we will all be on equal terms, but we will not have all the information about ourselves. The activity is explained within a box.

The result of this activity allows us to reflect on how we interact with others and how we feel based on how the rest of the participants interact with us. Thus, we learn to address others so that they feel at ease and respected. Then, we continue to work on empathy.

Activity 4. The game of greetings

The activity will be carried out with the whole group of people who attend the course. We will need for this Poker playing cards or similar. Once the cards are mixed, one is dealt to each participant, who will not see it and will place it stuck on the forehead. Thus, each person can

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see the cards assigned to the rest, but they will never know their own card.

The dynamics of the game are as follows: all participants will walk around the room, and at each time they meet a person face to face they will greet them based on the range they have on their card stuck on their forehead. So if you find someone from the face cards: the valet (knave or jack), the dame (lady or queen), and the roi (king), the greeting will be very ceremonious and give an elegant salutation. And to the numerical cards, a less effusive greeting is intended that will decrease until you reach number one or two, which can almost be despised.

For a limited time, we will see all participants wandering around the room, and receiving greetings from the other participants.

At the end, each participant will be asked to be sorted by the social rank they believe each one has, based on the greetings perceived by the rest, based on how they felt. There will be those who have felt Kings, and there will be those who feel the last vassal. Before starting the game, the people who are going to energize it, can prepare the cards, depending on the number of participants, to ensure that there is that social variability and avoid very close cards (for example, that there are ones and twos together).

2.3.3 Interview

To practice how to do interviews, we present a series of questions that we have chosen from those proposed by the psychologist of the State University of New York, Arthur Aron to create proximity between people. In the box below, there are the questions that we have considered of interest to practice the empathetic interview [14].

Activity 5. Practicing the empathetic interview

The objective is to carry out this questionnaire in pairs, in such a way that a person A asks a first question to person B, and then person B will ask that first question to person A. For the second question we change the order of the person who begins to ask. You can agree at the beginning of the activity a number of questions that a person can refuse to answer, in the event of feeling invaded his privacy, or the couple does not he has achieved an empathetic climate.

These would be the proposed questions:

1. Given the choice of anybody in the world, who would you want to have dinner with?
2. Would you like to be famous? In what way?
3. Before making a phone call, do you ever rehearse what you're going to say? Why?
4. What would constitute a "perfect" day for you?
5. When did you last sing to yourself? To someone else?
6. If you could live to the age of 90 and keep either the mind or the body of a 30-year-old for the last 60 years of your life, which one would you choose?
7. Do you have a secret hunch about how you will die?
8. Name three things you and your partner appear to have in common.
9. For what in your life do you feel most grateful?
10. If you could change anything about the way you were raised, what would it be?

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11. Take 4 minutes and tell your partner your life story in as much detail as possible.
12. If you could wake up tomorrow having gained one quality or ability, what would it be?
13. If a crystal ball could tell you the truth about yourself, your life, your future, or anything else, what would you like to know?
14. Is there something that you've dreamed of doing for a long time? Why haven't you done it?
15. What's the greatest accomplishment of your life?
16. What is your most treasured memory?
17. If you knew that in one year, you'll die suddenly, would you change anything about the way you are living now? Why?
18. Share 5 pieces of information about your partner that you consider positive characteristics.
19. Make three true" we" statements. For instance:" We are both in this room feeling…"
20. Complete this sentence:" I wish I had someone with whom I could share…"
21. If you were going to become a close friend with your partner, what would be important for them to know?
22. Tell your partner what you like about them, this time saying things you wouldn't typically tell a stranger.
23. Share with your partner an embarrassing moment in your life.
24. What, if anything, is too serious to be joked about?
25. If you were to die this evening with no opportunity to communicate with anybody, what would you most regret not having told someone? Why haven't you told them yet?
26. Your house, containing everything you own, catches fire. After saving your loved ones and your pets, you are able to save ONE item. What would it be? Why?
27. Share a personal problem and ask your partner's advice on how he or she might handle it. Also, ask your partner to reflect back to you how you seem to be feeling about the problem you have chosen.

The following activity (number 6) will allow us to train the team of interviewers in preparing relevant questions in order to extract people's knowledge. The duration of the activity will be 15 minutes. More time could lead to mental fatigue. The people who direct the activity will be able to participate depending on how the questions arise, and facilitate the deduction of the object they are discovering in this activity.

Activity 6. What is in the box?

This activity consists of discovering a hidden object that is in a box. So that it is not something intuitive, something strange to the normal work scenario is recommended. That is, if we are in a classroom, then we select an object that has nothing to do with office supplies or something that is normally in a classroom.

Each team member asks the person leading the exercise a question about one and only one feature of the object inside a closed box. Questions will be asked on a rotating basis. At the beginning of the activity it is good to agree on a mandatory minimum number of previous questions, before any member of the team launches a possible deduction of the object. As a recommendation, it is suggested that the agreed number of questions should always be greater than twice the number of team members, to ensure that at least each participant can ask at

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least two questions.

Each team member should write down the questions that are asked, and the answers of the person who directs the activity. The objective of this is that they can rely on these questions to build a new one that can be more revealing than the previous question asked, and that can complement them, that is, as if the same person was asking. This is what we call the technique of concatenated questions.

2.4 Conclusion

In this first phase of Design Thinking, called empathy, the main objective is to identify what is really important about the target people, what their daily problems are, how they interact with the environment and what they need to solve. That is why the development of empathy is a key point in the Design Thinking methodology: it provides the insight needed to define the problem and to build the rest of the project.

Empathy is defined as the ability that people can have to put themselves in the place of others and feel them as our own. In order to be empathetic, we must work on a series of steps: observation, empathetic interview and immersion.

Observing people in their environment provides us insights into what they think and feel, and gives us an idea of what they need and their important problems. For this we have to ask ourselves three big questions: “What?”, “How?” and “Why?” users do what they do.

With an empathetic interview we make a first contact with the target people and interact with them. Our goal in the interview is to keep the person interviewed emotionally active, seeking their maximum involvement and complicity in the interview. To successfully conduct an interview, we must take into account the different phases through which we must pass: presentation of the interviewer, presentation of the project, construction of a relationship, evoke stories, explore emotions, perform counter-questions and finally thank and close the interview.

And finally in cognitive immersion, with all the information previously collected in observation and interviews, we are already prepared to live the experience of putting ourselves in the shoes of the people we have just interviewed. In this phase, we feel what the user feels.

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3 Definition

Unlike other project development methodologies, Design Thinking does not start with a problem to be solved, given as starting point for the task: the problem has to be defined first in the context of a challenge with real world implications, considering the users concerns. Thus, the project needs to be considered from its roots, and this involves the objectives and needs based on the results of the previous empathy stage, to identify the essential problem that we are going to solve.

Beyond the identification of the essential problem, the definition of the problem involves other two key issues as part of the Design Thinking methodology. Firstly, when considering the development of innovative solutions, the definition of the problem offers us new possibilities for innovation. The problem definition can provide a fresh start towards the provision of a solution for a new problem, rather than a new solution to an already known problem. A new view about the problem is an opportunity for innovation with fresh ideas from the Design Thinking external team, different from those enunciated by members of the company or institution that is looking for a solution. Secondly, after the empathy stage, when we have listened to our users and clients and have a clear idea on how they think, how they feel, how they act and what their concerns really are, we have so much information that we need to process and condensate it in a suitable way for the further stages of the Design Thinking process. Of course, the correctness of the problem diagnosis depends on how capable we were of observing and understanding our users in the empathy stage, but now we need to synthesize all that information in a more manageable construct. Therefore, we need to capture all this knowledge in a proper definition of the problem to guide us towards the achievement of suitable solutions.

At the end of definition stage, the aim is to have a good Point of View (PoV) that defines the problem in a motivating way. The next section is devoted to this concept, which should inspire the team to provide ideas to solve the defined problem along the following Design Thinking stages.

There are several tools that support the process in a structured way, and they are also explained in this chapter. Processes like empathy maps, efforts and results maps, affinity maps and some others are proposed in following sections as the way to go from individual responses to group ideas that define the users/clients profiles and needing.

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3.1 How to identify the essential problem?

The identification of the essential problem is a special key point because many times the problem that we established at the beginning is different from what the clients or companies assume that it would be their main problem. To get a better understanding on this, let's look at the following example, regarding a cosmetic company. A shampoo maker is suffering a sales crisis: its customers are not buying his product anymore. The board thinks that a new shampoo formula will help win back those lost customers, and so they assume that a new product needs to be brought to market. The company says, "we have a problem with the shampoo formula". Thus, we could define the problem as: "the formula of the shampoo may be outdated compared to the competition, so it needs to be improved". The next step would be costly for the company: they need to buy new patents, introduce new solutions, try new ingredients, etc. Each of these actions costs large amounts of money and takes a lot of time. But what if the problem is not the shampoo formula? The company must be very sure that this is the real reason why customers stopped buying the product. In other case, the company will spend a lot of the money, although it may happen that users still do not buy their shampoo.

If we take this example and apply the process of Design Thinking, we would begin with the empathy stage observing the shampoos the customers buy at the shops, and interviewing to get answers from them through questions such as "Why did you stop buying this shampoo?". Doing this, we can realize that the obtained answers point to another real problem. In this case, users answered that they still liked the formula of the product, its smell and its texture, as well as its results on the hair, but the bottle was poorly designed, and it leaks staining the entire bathtub. That was the actual reason they stopped buying the product. Then, the new definition of the problem could be: "users of our flagship shampoo need to keep their bathtubs clean when enjoying the smell and texture of their fresh and clean hairs because they do not want to make the shower up each time they use it due to the leaking bottle". Therefore, the bottle design was the real problem and instead of spending time and money on patents, ingredients, and so on, the company should focus on the bottle design. Besides, publicists could use this insight to design a campaign for launching the new bottle design of their best valued shampoo, remembering how good the shampoo is and how it has been modernized and adapted to new times.

This example shows the main function of the problem definition stage: finding the real problem based on the answers, experiences and views from customers, which we get during the empathy stage. The definition comes from the empathic research with users, not from preconceived ideas. Thus, the definition of the problem to be solved gives meaning to the effort made during the empathy stage.

3.2 How to define the problem properly?

To define the problem properly, we need to synthesize the significant information obtained about our audience so that in the next stage we start the ideation stage in the right direction. A good definition of the problem is key to guide us throughout the rest of the project. We begin with a lot of information gathered during the empathy stage, and we must concentrate all its insight into a sentence defining the problem to be solved. It is like performing a contraction procedure after an expansion process (the empathy), as depicted in Figure 3.1, to focus the learned knowledge.

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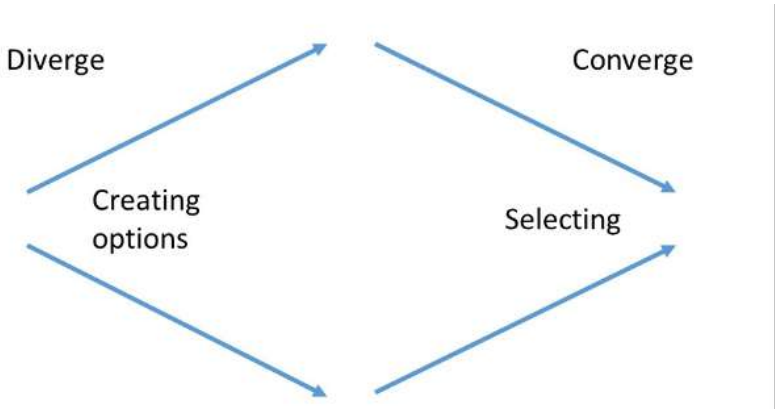

Figure 3.1: Divergence-convergence process.

A good definition of a problem must be meaningful. The end users and their needs should be at the front and centre, ensuring the capture of the key issues involved in the problem.

A good definition of a problem must be open and focused on the need, not on the solution. At this stage of the Design Thinking process, we should not worry about how we are going to solve the problem, but about identifying the problem itself. That is why the definition of the problem should not include any implication about the possible solution to it. For example, if we need to improve children's oral hygiene, perhaps a solution could come through an awareness program. However, such a possibility should not be considered at this stage. At this stage we must deal only with the problem.

A good definition of the problem must have an adequate level of specification, neither too broad nor too specific. On the one hand, if it is too broad, we may not have enough resources to cover it and offer an effective solution. We would not have enough time, or enough people on our team to cover all aspects of the problem, or enough money to cover the costs of the project. On the other hand, if we are too specific, our impact in responding to our users' concerns could be very partial. We are probably only solving a small part of a larger real problem.

A good definition of the problem should also be actionable, offering us criteria to evaluate the eventual solutions. This element is very common in the engineering field. In order to be able to assess the possibilities of the different potential solutions, we need to be able to compare them based on a set of criteria that are in accordance with the definition of the problem. A good definition of the problem must also help us increase confidence and optimism in the design team. It must have a meaning that motivates us to solve the problem, because it seems important and significant to us and to the people we are working to. In this sense, the empathy phase should serve us not only to get informed about our audience and their problem, but also to connect with them and, then, to motivate us to solve it. Being perfectly clear about what our objective is, helps us to convince ourselves that this problem has and deserves a proper solution.

3.3 The outcome of the definition: the point of view

The Point of View (PoV) is a meaningful and actionable problem definition, which will allow us to work in the next Design Thinking stages in a goal-oriented manner. The PoV is the "light at the

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end of the tunnel" or the "Holy Grail" of the definition stage and aims to find meaning from the endless information collected during the empathy stage (understanding and observation).

A PoV involves rephrasing a challenge as a well-structured problem statement. To do this, we articulate a PoV combining the knowledge about the audience and their needs that we have obtained previously. At the end, it is a motivating sentence that enlighten the problem-solving process that will be the next step.

If you are aware of what the real problem is (define the problem, based on the previous phase of empathy) and who the project is aimed at (define the "Persona", based on the group of stakeholders we have found) then we are ready to define the PoV. To do it, we need to answer the following questions:

- WHO?..... (persona).
- WHAT is needed? … (solve some problem).
- WHY?.... (insight).

3.3.1 Structure of the point of view

To articulate the point of view, we combine three elements: the user, their needs, and the information we have, into one inspiring sentence. Then, the structure of a PoV is as follows:

> [Persona] needs [necessity] because [insight]

Persona Because Design Thinking is user/human centred, the human is the central part of the process and therefore the starting point of PoV for any specific problem. However, because PoV is intended to refocus the design challenge into a problem statement, it targets users with specific problems. Therefore, the description of the users, even if it is short, must include key personal characteristics that make them unique. Obviously, we need to clearly define the type of person for whom we are going to solve a problem.

Need In addition, we must select the essential needs, those that are a priority to satisfy, and those that motivate the person. In this case, we will extract and synthesize the needs that we discover during our observations, investigations, field work and interviews. The necessity has to be captured as a verb, because this moves to a dynamic action whereas a noun could be felt as something more static, and even worse, as a solution. Again, as Design Thinking intends to solve problems, the solution will be carried out to satisfy the needs of the users. However, the needs are not shown in terms of specific tangible requirements, but instead express an emotional/mental/physical state that the future solution promotes, unconsciously, through its use. Therefore, it is recommended that the "need" part start with non-continuous verbs (e.g. abstraction verbs, possession, emotion). For example, I do not need a car to go to my work, what I really need is to enjoy the commute from my home to my work: as this is an activity I must do every day, having some kind of satisfaction is important to be motivated in order to find the best mobility solution.

Insight Finally, we need to express the perceptions associated with the needs that motivate them. These insights will not be the reasons for each need, but rather insights that we can leverage to enrich our solutions. The PoV ends with the proposal of a supposed "surprising perception". In general, if a person has a PoV, it means that some justifications must be given to support the proposed opinion. In the case of the PoV, the insight is seen as a statement that

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reflects a clear and meaningful perception of human behaviour in a particular context. In other words, it is a justification made to support the needs of the user that is based on adductive reasoning that intends to propose the best (hypothetical) assumption or the reason why an observation is taking place.

Table 3.1 collects some PoV examples. The user must represent someone of flesh and blood person and not a typical or generic user. He/she must have the characteristics of one of the members of the interest groups that we have identified after analysing the information captured in the empathy stage. The need must always be given by a verb, since this allows us to abstract ourselves from concrete solutions. In the third column, we can clearly see what those perceptions are like that will guide us towards the solution. In the case of the elderly man who lives in a rural area, it was observed that the underlying motivation of older people to stay active is not something as abstract for them as being healthy or fit, but rather to guarantee their independence. In the same way, the beekeeper does not want a suit so that the bees do not sting him (that would be the apparent need), but to catch the honey without being punished. This will guide the design of the solution (e.g. a suit) to ensure its ergonomics taking into account the precise movements that are made when collecting honey from the hives.

3.3.2 How to find the point of view?

Along the process to find the PoV, we must consider the following issues, which can be linked to tools explained in the following section:

Specific user In general, it is linked to a person, that is, a fictional character whose profile reflects the characteristics of an existing group. This comes from the analysis of the observation made during the empathy phase and the state during the definition phase. Thus, the person should reflect features taken from this group that, for example, are related to socioeconomic/demographic factors, needs, wishes/hope, or cultural background.

The needs of the user What the user needs can be seen through the empathy map, the affinity map or the relationships that have been found between the observations and the construction of thoughts of the conceptual map. Also, this can come from the observations and discoveries of the group.

Surprising insights To find a perception we can use deductive reasoning like detectives do. If the assumption that comes from the observations is known (it can be the result of the affinity map or the concept map or simply what was defined as the user's need), it is possible to

Table 3.1: Examples of PoV.

User	Needs to	Insight
College student living far from campus	Go to campus 1-2 times a day and return to his home using clean transportation	It is important for her to think and live ecologically
An elderly man who lives alone in a rural area	Do physical exercise	He prefers to remain independent than having to live in a seniors' residence
An amateur beekeeper	Approach his hives	He wants to collect honey and take care of his hives

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interpret or answer each one of the following questions: "WHY?" WHAT?". If the answer is short, or if it is not satisfactory in the way it is formulated, use the *five whys* technique (cf. Sect. 3.5) to get to the bottom of the matter.

The PoV will be a reformulation of the explanation with which you will have to fill in the following six criteria:

Authentic It must be born from your own personal analysis of the experiences. This means, the PoV is the result of the work performed by you and your team, and it is not a consequence of preconceived ideas provided by others (your boss or your contractor).

Not obvious Not simplified, presenting itself as a simple caricature. We are not looking for a simplification of the problem, or for a small piece of problem. At this point, we have to focus on defining the full problem. When dealing with solutions, it will be time to limit, if it is the case, to partial solutions, or just mitigations, but not at this time.

Provide information Make it revealing when read, and make sense of things. The PoV should be descriptive for any reader, even for those that were not involved in the empathy stage. Nothing must be assumed as known by the reader, and PoV has to be self-contained.

Report Especially providing information about human behaviour in a given context.

Inspire As the PoV is also the starting point of the ideation stage, its formulation has to promote creative thinking. The writing should be motivating, boosting you to an active response.

Make it memorable Concise and easy to remember. This is important as the creative team must have in mind the PoV during all time they are providing ideas to solve the problem.

The PoV is like the end point of a long and difficult process of empathy, and at the same time, it is the starting point of the solution that is going to be carried out in the next Design Thinking stages. Finally, it is difficult but very important to end PoV even if you are not sure it is correct. It is necessary to continue advancing in the Design Thinking process, taking into account that, as an iterative process, we can return to the Definition stage at any time, when needed.

3.3.3 Individual work and group sharing

Keep in mind that a PoV requires reflection, so it's a good idea to search for it individually. Also, organizing your information from the empathy stage by means of pieces of paper or post-it notes would help you in moving from the world of the ideas (your mind) to more tangible elements. A good strategy to integrate your search within teamwork is to organize group sessions where each member presents his/her PoV to the whole group explaining it in a detailed way, all participants paying attention by active listening, and then discussing together towards a definitive PoV for the project is agreed upon.

As indicated, the PoVs are the goal of the long and laborious process of empathy-definition, and at the same time, the starting point for the creation of a new solution. During the time invested in this task, you should take in mind that this is a real important stage in the Design Thinking process. Thus, it is not worth saving time or resources by formulating the PoV in a shallow way. A badly formulated or too simple PoV would probably lead to a bad or simple solution, which could not satisfy users needing. A PoV can be laborious and difficult to formulate, but it is essential to move to the next stage. It is important not to give up until you have found it.

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3.4 Definition tools

The definition of the problem is greatly facilitated when we identify the different stakeholders related to it, and then we classify the users according to these groups. Our goal is actual people, and the identification of groups of interest helps us to characterize these people better and to keep away from the more typical users. It is worth noting that the stakeholder identification is made after the empathy stage, once a collection of users has been observed and interviewed: this is not an a priori classification. After the identification of the groups of interest, the Empathy Map will be drawn up, which will allow to capture the ideas that the team of interviewers has obtained from the answers noted to be grouped in an orderly manner. This tool is especially useful to organize the gathered information. Efforts and Results Chart is another tool that can be used to capture the empathy results. Then, the Affinity Map is a good tool to arrange ideas and to find key associations.

All these tools (empathy map, efforts and results chart, and affinity map) are supporting methods to arrange the knowledge obtained at the empathy stage and to unlink that from specific individuals to reach insight applicable to the collective of target users. Finally, we elaborate the PoV, which will shape the definition of the problem based on the *five whys* technique.

Along all the process, the proposal is to manage physical written ideas (in post-it notes or pieces of paper) because, as Jon Kolko indicates, we must put data out of the cognitive sphere (our mind) and the digital sphere (our computer), to make them tangible in the physical world (the wall, a paper fixed on that) with a coherent visual structure. By doing that, we liberate the memories from natural limitations of our brain and from the artificial organization of technology. It means that ideas are no longer connected to a specific person or situation. Thus, we can freely move and manipulate the contents, and all data set can be observed at the same time. This allows us to concentrate on the facts and feelings, and not on who generated these facts or who felt these emotions. Then, we discover the implicit and hidden significance, connecting pieces of data among them that in other way they were unconnected [15]. This process opens the door to a more creative way of analysing and organizing the collected information, and it is a constant along the definition stage.

The following sections introduces those different tools, most of them integrated in that philosophy of putting the ideas in physical support for liberating our brains from memories, and for being then free to manipulate all the information, creating new and inspiring connections.

3.4.1 Stakeholders and persona

Taking into account the information obtained during the Empathy stage and our observations, a good strategy is to define stakeholders among all the agents involved. For example, in a touristic destination, different groups of people can be established based on their interests in the place. Thus, we could identify the government interesting in promoting its places, the tourism sector looking for attracting clients and doing business, the NGO's wanting the preservation and protection of the environment and historic places and buildings, and the tourists expecting some days of fun, action and cultural visits. A correct classification of the people involved in the project in groups of interest will also help us to better organize our work and to better allocate our time (cf. Figure 3.2).

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Figure 3.2: An example of stakeholders' map in a touristic destination.

Once we have defined the stakeholders map, we have a visual idea of the distribution of the interviewed people. At this point, we could realise that some of the groups are not conveniently defined, or it was underrepresented during the empathy stage. If necessary, we can re-interview users to complete the information we have about them from the perspective of the group of interest to which they belong. For example, we can prepare a specific interview for each group with the aim of confirming their needs, detecting unexpected attitudes of their agents, and characterizing situations not initially foreseen that allow broadening the definition of the problem. In this case, we will introduce new questions incorporating all the relevant ideas that can be considered within the various groups of interest. These ideas will be structured by fundamental areas or themes that allow the interview to be oriented in a comfortable sense for the interviewee, and effective for the purposes of capturing relevant data in the definition of the problem.

In the problem definition process, it is very important to select the right group of users once we know them. Why? Because you need to know who you are going to solve the problem for. Thus, correctly defining the "Persona" is very important. Go further and, for example, ask other people if they try to solve problems related to playgrounds. Consider all groups of interested people, those who have things in common or who are influential for a place like this, for example, mothers, fathers, children, grandparents, and any other type of people who come to this place and use it. However, there are surely many other groups that may be affected by this problem, such as the city council, since it is the owner and decides on the changes that are made and the money that is invested, or the nursery that is nearby from there and their children use that park every day at the same time. It is clear that all these people will influence the decision that is made for this place and may be interested in the changes that your project will make. Therefore, it is very important that the process takes into account all stakeholders and puts them on a stakeholder map (Figure

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3.2). This tool will allow you to recognize and/or consciously decide for whom and for what group (group=person or organization that, with a set of characteristics and needs, represents this particular set) you are going to solve the problem you have defined, that is, for who you will create the solution. You must add characteristics about your "Persona" such as: age range (for example, children between 5 and 12 years old), nature, needs, financial wealth, tastes, restrictions, etc. Sometimes some aspects such as nationality or gender can also be important.

Figure 3.3 depicts two examples of Persona. Both examples are related to travellers (in an airport or in a hotel), but after the empathy stage, the Design Thinking team was able to identify different stakeholders in a group that could be simplified as “travellers”. Some details make important differences: the way for planning the trip, the main sensitivity to decide the destination or the mode of transportation, the anticipation in selecting the dates, or even the temperament during the trip. All these are represented in the two clearly different examples of persona at Figure 3.3.

Figure 3.3: Persona examples.

3.4.2 Empathy map

The Empathy Map is a tool that facilitates the organization of the ideas obtained from the analysis of the verbal and non-verbal languages of the interviewed users. It helps us to better understand people through a deeper knowledge of them, their environment and their unique vision of the world and their own needs.

We can prepare the empathy map from a large sheet of paper, divided into four sectors, which is glued to a wall for greater convenience (cf. Figure 3.4). Each sector represents a collection of ideas obtained by the team from the responses of the users. For a better interaction between team members, each sector offers the following perceptions, which in the team’s opinion the real user has manifested in the scenario of interest:

- What does he/she think and feel? What tensions between the users can we capture? What contradictions do we see? What are their concerns? What are their aspirations? How are they surprised?
- What does he/she see? What does the environment look like? Where do people work or study? What audio-visual information is there? How do they interact with each other (friends)? How is the body language?

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- What does he/she say and do? How is the attitude in public? What messages do they convey? How do they talk to each other?
- What does he/she hear? What messages do they hear? How do they access knowledge and/or information? Where do the challenges come from?

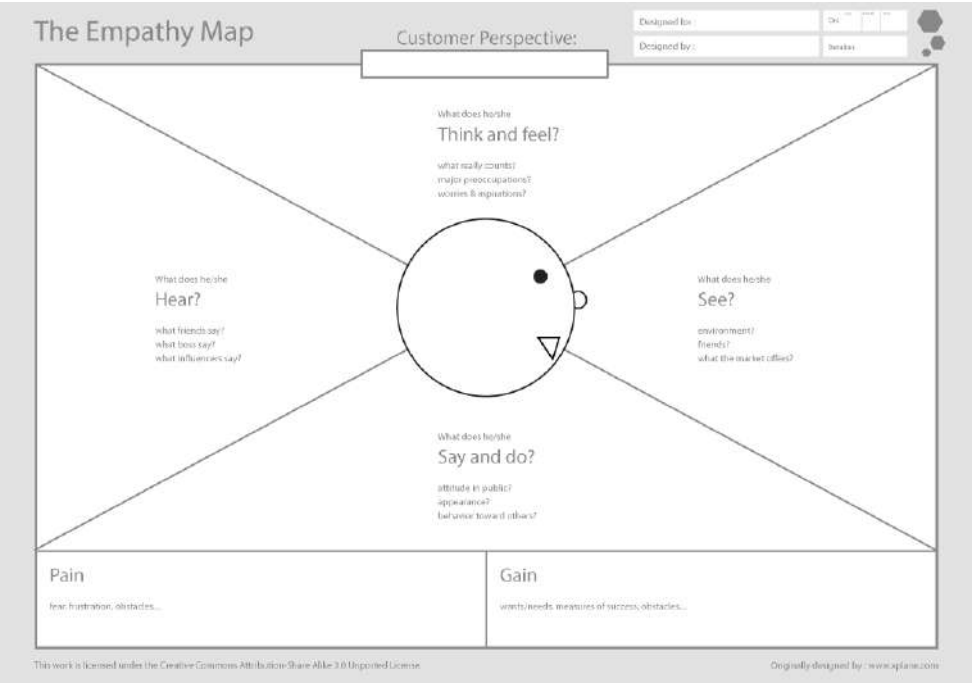

Figure 3.4: The empathy map [16].

The dynamics that the team must follow to build the empathy map in the definition scenario is as follows:

- All team members must stand near the empathy map. Each idea, in a very few words, is written on a post-it note and stuck on one of the four sectors of the empathy map. At this stage, the only rule would be to read out loud what was written so that the whole team knows what the others are perceiving and not to repeat the same ideas. This process should be dynamic, but respecting that only one participant is reading one idea at each moment and only one post-it is stuck on at a time.
- All ideas must be original, and the team must strive to maximize the possibilities of data extraction offered by the interviews.
- No one should make judgments about the ideas of others. There are no leaders who point to the absolute truth, and all ideas are equally valid. There are not stupid or secondary ideas or knowledge, as even the smallest detail could be interesting for the problem definition.
- It is essential that the comings and goings to the empathy map be fast. No one should sit down at the table to agree on what the interviews are supposed to say.
- There is no consensus process. Concepts must flow intensely. There will be time and methods to refine, and future Design Thinking stages to look for ideas and solutions. Now the advantage is that everything is raw, and there is total freedom to delve into the data obtained from the interviews.

From that immersion will emerge the best concepts to build the definition of the problem. Once ideas have been obtained and the empathy map covered in its four sectors with notes, each and

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every one of the sectors of the empathy map is reviewed again, and the labels are reordered, in a process of collective refinement, in that all team members try to refine the set of ideas noted down.

3.4.3 Efforts and results chart

The empathy map can be complemented with the efforts and results chart. Basically, it is about compiling in two columns the fears, the possible frustrations, the challenges and the obstacles that our audience will have to face (this would be the column of efforts), and what our audience wants to achieve, their desires and objectives, as well as those indicators that our users consider a measure of the success achieved (the results). For this we also use post-it notes and proceed in the same way as with the empathy map.

Table 3.2 shows an example of an efforts and results chart related to tourists that come to a specific destination. They have different preferences for the activities to do and also different motivations for those.

The efforts and results chart could be valuable to have additional information on what is really important for the target users, and it also provide some insight on the roots of the problem we are trying to define.

3.4.4 Affinity map

Affinity mapping is the process of grouping notes into similar topics or categories. It is about creating groups of ideas, categories or relationships between them in a way that helps us organize and simplify all the issues that we have put on the table.

The process is simple. You will need post-it notes and space to post ideas (a wall or board of some kind). It is important to have room so that everyone in the group can move freely and interact with the notes and post space. It is also important to create an environment where attendees feel open to sharing ideas. Use a marker pen so notes can be easily related or grouped together. Group post-it notes that are the same and those that are very similar. Put peripheral notes into their own categories and then continue grouping until you have a series of separate groups in place.

Table 3.2: Example of an efforts and results chart.

Efforts	Results
He loves to taste local food in good places	He doesn't want to lose his good health
He loves to play sports and to do active plans	He keeps him fit and relieves stress
He loves to visit artistic or historic sites	He learns a lot on local culture and history

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Figure 3.5 depicts an example of affinity map, related to a new way of managing the clients in a hotel. This map groups the advantages and disadvantages of the hotel characteristics, the possible offers (upgrades) at different services and the requirements for the personnel at reception desk.

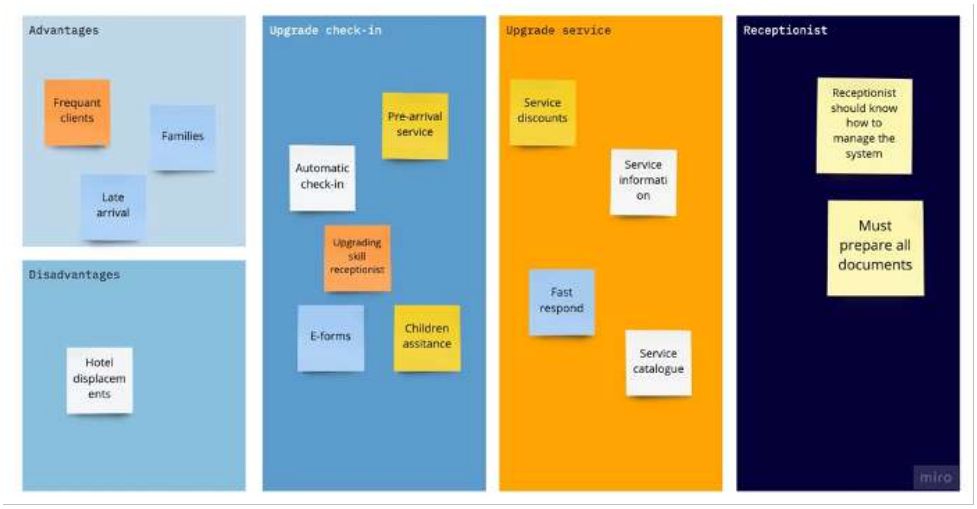

Figure 3.5: Example of an affinity map in the tourism sector.

This tool helps in moving from the results of the interviews (which were the bricks of the empathy map) to the roots of the problem we aim to define. It could be identified as a step to jump from the persons to their problems.

You may want to take pictures to remind yourself of key points after the session. The collaborative approach should create a level of enthusiasm and excitement, but it can be approached differently depending on your organization and group.

3.5 The five whys technique

A possible way to identify insight would be through the typical deductive reasoning of detectives. For this we can apply, for example, the technique of the five whys [17]. This is a technique to explore the cause-and-effect relationships underlying a particular problem through iterative questions, and more specifically, repeating the question why? Each answer forms the basis for the next question. The five in the name of this technique follows from an empirical observation: the number of iterations normally required to solve the problem is five. In any case, we can continue asking ourselves the reason for the last effect in order to find a new cause as many times as necessary. An example can be observed in the sequence below.

The girl's five whys

The girl looks sick.

1. Why? She is sick.
2. Why? She lacks basic nutrients.
3. Why? She eats badly.
4. Why? She refuses healthy food.
5. Why? The boys and girls around her always eat junk food.

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This method is a good strategy to refine the point of view phrasing, improving the value of the definition by going to the roots of the problem instead of being satisfied with the first enunciation.

3.6 How to be sure that we have defined the problem properly?

You will never be 100% sure that you have defined the problem properly, but you can do some activities to find out if you have really done it right.

First of all, spend as much time as necessary to carry out the empathy stage. Ask suitable open questions, conduct the interview according to the most appropriate rules and immerse yourself in the environment, if possible and necessary. Having as much information as possible is fundamental for constructing a good definition of the problem.

Secondly, build the empathy map with the information collected, as explained in previous sections. The empathy map can be made as it appears in Figure 3.4 or in another way. The most important thing is to collect all the information obtained during the empathy stage and write down what the interviewees think, how they feel, what they hear, see, say and do. Some additional information can also be added that can be grouped: efforts and results chart is a useful tool to collect these additional insights that are not easy to introduce in the empathy map.

Next, group all responses (focus on ideas, too) and put them on the affinity map. The names of the groups are not pre-set (the team will name them depending on the type of information it receives and put them on the empathy map). For example: infrastructures, fears, aspects related to transport, perspectives, financial issues, etc. In fact, you can be as creative as you want during this process.

You have to solve the most important problem considering which problem is the most serious for the largest number of people, that is, the most important problem whose solution satisfies the largest number of customer needs. And this decision must be supported by the analysis based on the explained tools and procedures.

Then, when you have a PoV, you have to evaluate its goodness and improve it, in case you consider that it could be improved. Thus, some tips on the characteristics of a good problem definition are useful. It should be:

Focused on people To do this, the problem must take into account specific users and their needs, and the knowledge that we have acquired about our audience in the empathy phase. The problem must be directly related to the people we are trying to help, instead of focusing on user-types. Thus, using “personas” is better than using standardized groups.

Wide enough to allow creativity We should not focus on specific methods or techniques regarding solution development. This would unnecessarily restrict our options when looking for solutions, and would prevent us from exploring areas that could generate added value to our project that was not originally planned.

Authentic As it is based on real-world people observations. During the definition stage, the opinions of the team members or the ideas for solving the problem have not floor. Now, it is the time for analysing the responses of the interviewees, not for thinking in following stages.

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Specific enough to be manageable As we explained before, we must face problems that we can solve taking into account the capabilities of our team members, the resources available to work on the project, or the time needed to obtain a solution.

Non-obvious Thus, we could have new views to face a new problem. If we look for canonical problems, we will probably provide canonical solutions.

Revealing It offers some new or previously hidden view on how people feel and live some specific situation.

Inspiring The definition of the problem must generate the team members feel something that moves them to do something to solve it.

Memorable The wording of the PoV phrase must be done in a way that is close to you and is easy to share with others (and to be understood by them).

Besides, the definition of the problem should not take into account the technology, the monetary benefits or the specifications of the final product. These aspects are the subject of later phases of the process of building a solution.

Considering the first two Design Thinking stages in conjunction, empathy and definition, we can see that the definition of the problem is done according to a process of analysis and synthesis. Namely:

- Analysing is basically breaking down something complex into simpler components, and therefore easier to handle and understand. Basically, this is what we do in the empathy phase when we observe and document users and their interactions, or when we seek information about the problem, classify it, and relate it to our observations.
- Synthesizing, on the other hand, consists of creatively selecting elements from the result of our analysis to build complete ideas with them. This is what we basically do in the definition stage when we select, classify, interpret, and make sense of the results of our analysis to create a definition of the problem.

Also remember that the process of Design Thinking is not linear and iterative. If you are still not sure or if you discover that you have not carried out the right problem, you can go back to the previous phase, empathize again, get new information, facts, perceptions and redefine the problem. It is okay to fail, but the sooner you do it, the better!

Although the process of analysis and synthesis is key in the empathy and definition phases, it is not exclusive to these stages. Most likely, we will encounter situations where it is necessary to analyze a situation before synthesizing new insights, and then analyze the synthesized findings once again to produce more detailed syntheses.

As discussed above, the definition of the problem with the characteristics described eventually materializes as a Point of View. Revisiting our PoV about tourism, we could think that the challenge at a touristic destination is to provide a variety of activities to the tourists, but this would be a very simplistic vision. A better definition would be achieved by referring to the PoV: a tourist travelling alone needs to do activities involving local people because this way he could know more about the destination and he would feel accompanied.

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4 Ideation

In the ideation stage we search for possible solutions to the problem satisfying the needs of end users. Sometimes we do not have a clear idea of the possible solution, but simply an intuition or a vision that can work. In other cases, we have many different options that we can consider. Whatever case, the purpose of this stage is to identify some solutions to be developed and experience in the next two stages, namely: prototyping and experimentation.

Ideation is a creative thinking process that involves the creation of new ideas and solutions. It is a fundamental moment where it is decided about how to use the knowledge about a problem that arose for the user in the Empathy phase and how to respond to the problem already defined in the Definition stage, and for which solutions are being sought.

In the ideation stage, cooperation within the team is a fundamental element. There is no other time in the Design Thinking process that allows team members to cooperate with each other so closely. In addition, it is fascinating to observe the process of generating ideas when they come out of nowhere. Several ideas can appear at the same time. Ideas can be based on other ideas. Sometimes new ideas arise from a word that is pronounced or by a coincidence. Sometimes, if we speak randomly, a word can be the beginning of a chapter and, therefore, everything that came before ceases to matter because the project has just found a new path, a new route on the map. These are some of the most valuable moments in the Design Thinking process: when a new path is found that leads to the destination point.

The work environment that helps to find the moment (the Wow! moment) is only generated when there is a mental and personal commitment from each member of the team.

In the ideation stage we can use a very popular tool: brainstorming[18]. In general, brainstorming is carried out in a very free and open way, but for this stage we propose a much more structured and disciplined version of it, trying to avoid non-productive situations and improve results. Another key tool in this phase is concept development. Based on the results obtained in the brainstorming, this tool guides us to organize the ideas into coherent sets and present them in the form of a robust "concept". An "idea" can be collected in a post-it note, while a "concept" usually requires a panel in which several post-it notes are collected and grouped in a more or less organized way. Finally, a polling or some kind of contest is needed to select the concept to be developed in the next prototyping stage.

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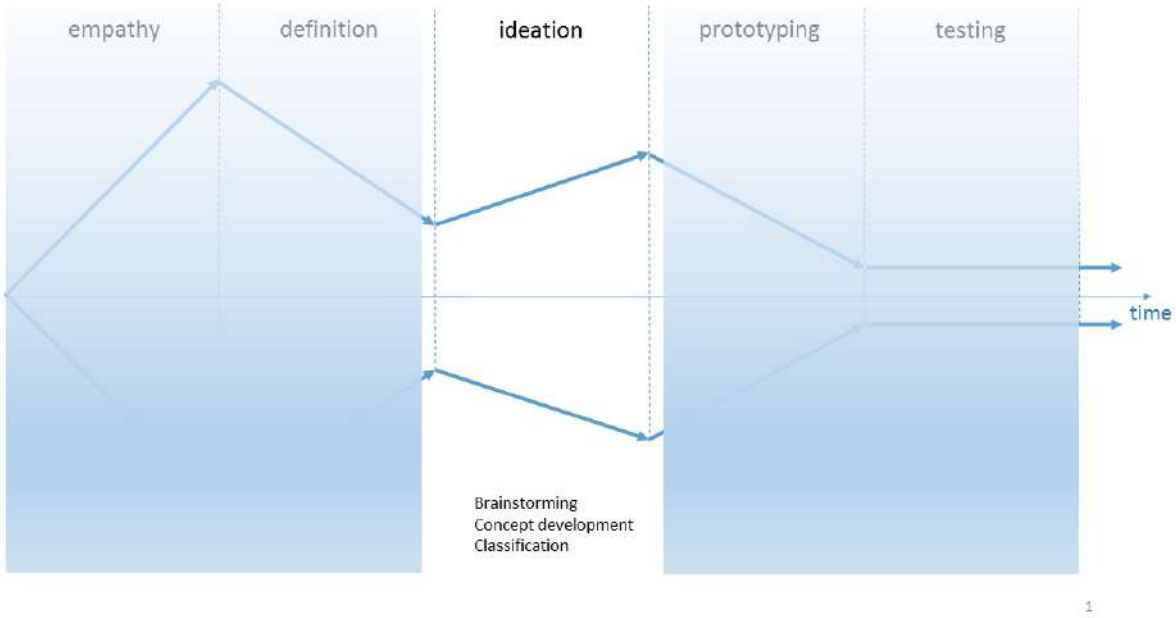

Figure 4.1: The project progresses through expansion and concretion stages. Once we have specified the problem with a Point of View (PoV, cf. Sect. 3.3), a new phase of creative expansion begins.

In the previous stages, empathy and definition, as we get to know the end users in depth through empathy and understand the problem through definition, in many cases, it is inevitable that ideas of possible solutions will arise. If this happens, stop, do not think about ideas before reaching the ideation stage. The ideas that occur to us during the empathy and definition phases should be written down in a notebook where they must be forgotten. Failure on this can prevent us from giving our creativity a chance and not addressing the really important problems. Basically, we can be doomed to define solvable problems with the ideas we already have. In other words, the canonical method of solving problems by applying what we already know is not the best method to meet the challenges of a constantly evolving world.

4.1 How to ideate?

The ideation stage should start with the PoV as the key reference. The PoV defines the problem or the needs to be satisfied, identifies the end user to address the solution and, through the insight, shows the main issues to be considered in the solution.

In addition to the definition of the PoV, as it is usual in engineering projects, a set of design criteria should be considered. For example, the solution may be made available for use on mobile devices, or it should work properly even without an Internet connection, etc. Of course, criteria should not determine how the solution has to be, but rather frame it within certain constraints.

During the ideation stage it is important to keep in mind that in the Design Thinking process there are no simple algorithms or strictly defined tools that ensure that if we start from point A, we can get to point B. It would be nice to present the activities as if they were on a map, with information about the different routes that take us to a destination point or, sometimes, to several points that can even go beyond the limits of the map itself.

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Different paths can lead to a variety of solutions for a given problem. To show this, we can take the example of the problem of how to transport food from one side of the river to the other. There is no single way to solve it. Food can be transported in a wooden boat or by swimming with a waterproof bag, crossing with a rope or even creating a wooden bridge that would allow us to use a car. Moreover, we can build a steel bridge over, allowing us to drive a truck full of food or a highway for hundreds of trucks crossing every hour. We could also transport food by using a helicopter or a plane if two landing strips were built on each side of the river. All these examples show that there can be an endless number of solutions.

In the first approach, a large number of ideas and solutions are desired, some of them can be crazy ideas, but as we move forward in time and deeper in the search of a solution, we will begin to be more realistic, and ideas will show a better quality. Based on the example of transporting food across the river, it is important to consider funding, amount of food required, feature of the river, time, and the possible needs of people on both sides of the river. Thinking about this information leads us to discard many of the solutions we have considered and perhaps to consider new ones. We could think that the solution is that the family could settle on the other side of the river and, therefore, there would be no transport need.

4.1.1 What is important to ideate?

To avoid the possible problems of the Ideation stage, it is necessary to look at technical and physiological aspects that guarantee comfortable and efficient work. For this, there is a list of requirements that must be considered, but this list is not closed since each team should adapt it to its particular project.

Three important requirements should be taken into account for the ideation stage:

- The end user (persona), for whom the solution is being developed. We must refer to the information collected about the end user in the Empathy stage. Never forget that our ideas are intended to solve a specific problem, changing the life of a particular user.
- The problem, as it has already been defined by the team in the Definition stage, synthesized in the PoV.
- The whole Design Thinking process. The Ideation stage is a part that should include and refer to all the information that has been obtained previously and to the activities that are going to be carried out in the next stages.

4.1.2 Technical aspects

- An appropriate workplace: the size will be important, as it has to be adapted to the team and the type of project. Access to fresh air is preferable.
- Natural or artificial light: it is desirable that the room has natural light, but if you work late, you will also need an artificial light source. It should not tire your eyes or interfere with your concentration (for example, by making noises or blinking, which can be very annoying).
- Comfortable furniture adapted to needs: something that can also be inspiring.
- Technical support materials: such as bulletin boards, blackboards, markers, pens and pencils, sticky notes of different colors, sizes and shapes, tape, etc.

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- Elements that influence inspiration: such as photographs, colorful magazines, small devices, or things that do not have much to do with the theme of the project but that can help us find solutions to a specific problem.
- Access to a social area and an equipped kitchen: we have to remember that thinking consumes a lot of energy, so the equipment needs to compensate for the energy that your body uses.

4.1.3 Psychological aspects

- Provide work comfort to each member of the team, having equal access when speaking.
- Establish common work rules.
- Create a schedule that is not interrupted but is flexible to carry out the creative process. For example: during the process, creativity cannot be interrupted and, sometimes, it is necessary to increase the time dedicated to a stage. Other times, the time of another phase is reduced because, for example, we are tired.
- Present the tools that the team will use.
- Adapt the individual role of each team member according to their characteristics to achieve a higher level of comfort and efficiency.

4.2 How to promote the generation of ideas?

Sometimes it seems that ideation is one of the easiest and simplest things, the most creative and sometimes even an insignificant part of the puzzle. However, it is not what it seems. To perform the ideation the team has to be very creative and not have certain restrictions on their work. In addition, it is necessary to build a specific atmosphere that can encourage both individual work and teamwork, as it will guarantee the freedom to create solutions. It is also important that the project team feels that there are no limits in the creation process and that even the most exorbitant idea can be real and essential to the process in which we try to find a solution to the problem.

4.2.1 Think out of the box

To generate truly creative ideas, it is very important to start by considering new possibilities. On many occasions, restrictions are considered before possibilities, and sometimes unnecessary restrictions that are not really part of the problem at hand. The exercise of "thinking beyond the limits" shows us how, on top of the specification of an apparently simple problem, we introduce new restrictions that complicate its resolution.

The lines and dots puzzle consists of drawing lines that go through a set of 9 circles arranged in a 3x3 grid (cf. Figure 4.2). In a first step, with four straight lines, drawn without lifting the pencil from the paper, it should be possible to go through all 9 points with no problem. In a second step, we must be able to do it with only 3 straight lines, and in a last step, the most difficult, with just one line. The key to the solution is to think "beyond out of the box", in this case literally: “out of the box implicitly delimited by the outer dots”. Such a box is a restriction that we set to ourselves,

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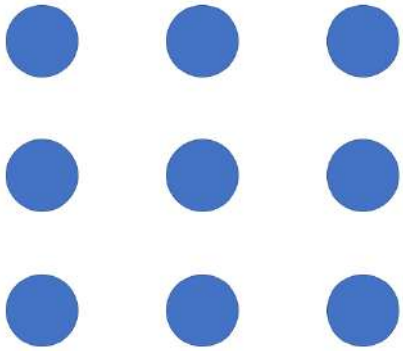

Figure 4.2: Print this figure on a piece of paper. It's easy to get through all the dots without lifting your pencil from the paper with 4 straight lines, but can you get through all the dots with 3 straight lines? and with one?.

but in this case, it must be removed to achieve a valid solution. Moreover, when we are faced with solving the more difficult problem, with just one line, other kinds of "boxes" also appear, despite not so evident because they cannot be represented as a physical box, and have to be removed.

Similarly, when we try to solve problems in the technical field, we also tend to consider constraints that limit or condition possible solutions. This is fatal for creativity and disruptive thinking. If we start by accepting all the things that don't allow us to do better, the solutions we can come up with will inevitably be very similar to what we already have today. At the initial step of ideation, it is preferable to ignore constraints. In this way, we will be able to achieve new solutions. Of course, such solutions may not be feasible, but that should not be the concern at the initial step. Moreover, from a technical perspective, the fact that current technology does not allow a solution to be put into practice, does not prevent technological evolution from making it feasible in the more or less near future.Once we have a new idea, we can start to be creative and think about how to get rid of the constraints we've ignored.

Ignoring unnecessary limitations that we consider essential is not a skill that we can get easily and may require a great effort and practice.

4.2.2 Lateral and combined thinking. Cross-pollinating ideas

This type of thinking consists of thinking about solutions that we know to problems different from ours, but that we can relate as a metaphor or analogy with ours. The best ideas, those that have the greatest impact on people and endure over time, even resisting technological advances, are usually transferable. In many cases, a certain innovation in a certain field can be exported to transform another different field. In any case, the greatest impact is achieved when the ideas, in addition to being interdisciplinary in their application, are also interdisciplinary in their origin. Here are a couple of examples:

- Pharmaceutical company Pfizer had a line of products to help people quit smoking. However, they realized that only with medicines the real success they had was very little, so they looked at the gyms where people who want to get in shape go. Combining their products with exercise-based group support practices, their results improved considerably.

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- The *accordion house*. To solve the need for space and different rooms that small houses pose, the use of mobile walls that open and collect like the bellows of an accordion is proposed. This way, mobile walls[19] were able to transform small houses with small rooms into small houses with big rooms, despite not all the rooms big at the same time.

This type of thinking also helps us explore different technological scenarios and trends. Most of the productive sectors are undergoing changes derived from the introduction of technology, and these advances in certain sectors can lead us to propose new ideas in others. An example of this would be the so-called *uberization* of some sectors[20], where ideas from the collaborative economy are applied to resources that we have but that we do not use all the time.

The silly cow

This activity may seem a bit silly, but it encourages people to think creatively outside the box. Its power is precisely in its simplicity.

The objective of the exercise is to prepare three ideas or business models based on a cow. Participants will need a pad of post-it notes and colored pencils or markers.

The activity is organized in three steps:

1. We ask participants to think of associations with the cow concept and the typical characteristics of a cow (e.g., does moo, eats grass, provides milk, has spots, etc.). They are given a time of 2 minutes.
2. Next, we ask the participants to come up with three original ideas about the cow business. It doesn't matter how crazy those business ideas are. They should draw each idea on a separate post-it note. We prefer simple graphic presentations to words. Better visualizations of ideas than textual descriptions of them. Time: 3 minutes.
3. Time to defend business ideas. Everyone has to have the opportunity to show their ideas and explanations. We may allocate more or less time to present ideas depending on the time available.

This activity is usually quite common in courses or workshops on innovation in the business world. It allows us to see things differently, from another perspective.

4.2.3 Question assumptions

This is about questioning assumptions that we take firmly and that determine the solutions that are adopted. For example, successful low-cost airlines proposed scenarios that were believed difficult for users to accept: secondary airports, non-conventional schedules, on-board payment services, etc. However, despite all these assumptions, these companies have succeeded, and their model has been taken over by traditional companies in the airline sector[21].

4.2.4 Explore the extremes

Extreme scenarios often generate new thoughts and ideas, sometimes impossible, but that can guide us towards new points of view. For example, there are countries in which, in addition to

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food delivery services, there are also ingredients and recipe delivery services, so that it is oneself who prepares the food, although with help to make the purchase and specific proposals for dishes, for example to support you following a certain diet[22]. This may sound a bit strange to you, but it is something that is working in countries like Sweden of Japan.

Linas Matkasse

This is a very popular online service in Sweden. Those who subscribe to Linas Matkasse receive a delivery to their home that consists of a box of food to cook a specific meal for a certain number of people. You can choose to receive a delivery every week, every two weeks or once a month. They offer a variety of food boxes for different dietary options and for a very wide range of tastes and needs. There are offers for 2, 4 or 6 people, proposals for children, gluten-free or lactose-free meals, vegetarian bags... For example, the Linas Originalkasse box offers familiar flavors and delicious ingredients for people who like classic dishes, but they want to try flavors that they may not have tried before. This box is also offered as an ecological alternative.

4.2.5 Change who does what

Many times innovations come as a result of changing the key roles in the value chain. A well-known example of this kind of change is IKEA, where customers were transformed into furniture assemblers. Another example can be observed in self-service restaurants, where the staff serving customers directly at the tables is dispensed with, or online banking, where customers become their own bank managers [23].

4.2.6 Inspiring questions

A good way to promote the generation of ideas is to ask ourselves motivating questions about the problem we want to solve. For example, suppose a family is designing their new house. Some questions that can be asked are: how could we unify all the family requirements in just one place? What will the family space be like in 20 years? We can also consider being someone different from ourselves, assuming a different vision of things. For example, we can think that we are Steve Jobs, or Lara Croft. From that position, think about the solution that we would give to the problem that we are addressing.

4.3 Ideation tools

Below we describe some tools that can be used for idea generation, classification and selection.

4.3.1 Active brainstorming

Brainstorming is a group work tool that facilitates the emergence of new ideas on a given topic or problem in a relaxed environment. Basically, it's about generating as many ideas as possible, however crazy they may seem, as quickly as possible. The quantity is very important.

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This is one of the most popular resources for brainstorming. Nevertheless, brainstorming sessions should be performed in a specific way, probably different to your actual idea, as shown in the diagram below. The session should begin with the explanation of the rules and the familiarization with the workplace. Please make sure that team members stand up and each participant has own material, post-it notes and something to write on. Standing up is important for the development of ideas as it provides greater quality and quantity in the members of the work team. The position will provide better blood flow and better body communication when explaining ideas to other members of the group. In addition, when we are standing up we get tired faster, and this moves us to conclude the brainstorming on a certain time, not keeping it for too long.

The development of brainstorming has an eminently group character. We can all come up with ideas individually but doing it as a group makes it a more effective and relevant process. Nevertheless, as in any group activity, it is important to approach it from an initial individual work. It is key to have individual time for each member of the group to think and reflect internally on the task. After, we need to establish a group time to allow each participant sharing his/her ideas and discuss them with the rest of the group members. Underlying this approach is a basic premise of group work: everyone contribution is valuable. Therefore, to facilitate good results in brainstorming, we must offer the opportunity for everyone to share and discuss.

There are certain rules for good brainstorming:

- The right number of people. The maximum number of people that could be involved in a brainstorm is twelve. If there are more people, a good approach might be to divide the group into several smaller groups. On the one hand, groups should not be very small, since then the opportunities for collaboration are reduced. On the other hand, groups should also not be too large, because this would extend the duration of the process too much. In any case, brainstorming can be opened up to people outside of the development team. These people can help improve results by providing a more diverse view.
- The right approach. The challenge to be addressed must be clear. The PoV plays a key role in this aspect since it allows us to focus the objective of the brainstorming in a synthetic way. Particularly, it is important to make the PoV visually present in a clear way, for example, writing it in large letters on a blackboard or even on cardboard. If possible, it is also good to promote empathy. Having evocative images of the stories that have caught the most attention, or photos of the problem you are trying to solve, or the people you are trying to help would contribute to have the right approach and help improve idea generation. Use catalytic stories. For example, the case of a person who makes a mess with his medicines can be understood quite well, but if the story is about the father of a friend and he makes us part of all the problems that this causes, we will probably feel more involved and awaken, with a greater empathy.
- The right frame of mind. Successful brainstorming requires an active, participatory, and positive frame of mind. It is important that the participants are committed to the activity and the objective. It is a good practice to do an activation exercise at the beginning of the session. This exercise involves all the participants moving, acting, and interacting in some kind of funny game. This is very recommendable, since in addition to activating blood circulation and improving brain activity, it helps to disinhibit the participants. For example, having a rock-paper-scissors contest involving all participants is often very effective. First, each member competes with another for the best of three wins. Once the initial duels are resolved, each winner looks for another winner to play with, and the loser support his/her

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respective winner by chanting their name and encouraging them to win. The necessary rounds are repeated until only two players left, each one having their respective “hobbies”. After this final game, the least important thing is who wins or who loses. All the participants will have a completely relaxed and participative attitude.

- The right attitude. Related to the state of mind, an open, polite and positive attitude should be shown. There are some key issues: (i) any criticism or prior evaluation is prohibited, both to others and to ourselves, since every time we self-censor we associate in our mind “idea = error”, putting barriers to ourselves; (ii) quantity versus quality, every idea is welcome, and the more ideas we generate, the more we will open our minds to generate new ideas, and seemingly absurd ideas can help us come up with brilliant ideas; and (iii) seek association and development of ideas, building new ideas on the ideas of others, combining and mixing them. There are some phrases that collect these issues in a synthetic and clear way: "Do not judge the ideas of others", "All ideas are good", "There are no stupid ideas", "Only one speaks at a time", "Listen to others”, “Built on the ideas of others”, “Have fun”, etc. It is a good practice to make some posters with these slogans and paste them around the space where we brainstorm ideas, to reinforce this open and positive attitude.

One object and thirty uses

This is an activity that shows the power of group ideation. The objective of the exercise is to prepare as a team a list of at least thirty possible ways of using a common object (bucket, brick, shoe, etc.). The activity generally proceeds in three stages.

1. At the beginning, the participants are asked to give simple examples of using the object. For example, in the case of a bucket they could be containing water, making sandcastles, cleaning the floor, improvised case, toy ship. . .
2. After a few seconds or minutes, participants often run out of ideas.
3. In the last phase, the aim is to overcome participants’ own mental barriers that limit their vision of objects in accordance with the most common expectations. Participants are encouraged to provide more ideas by trying to change the characteristics of the object (e.g. its dimensions, color or material it is made of). New uses will surely appear. In the case of the bucket, we have that a cube with many holes can act as a watering can, painted with white and red stripes it can act as a traffic separator, a fountain can be created from several cubes, etc.

It must be remembered that there are no good or bad ideas in this exercise. If any group gets stuck in phase 2, try to encourage them to think of possible ways to use something common in extraordinary situations, such as on a desert island or as the basis for a gift to a loved one.

Note that some people are not very supportive of brainstorming sessions, since there are cases in which the experiences obtained in the application of this type of session have not been good at all. In fact, several undesirable situations can occur that we must try to avoid:

- Overly active participants vs. passive participants. In some cases, participants assume two types of extreme participation in brainstomings, both of which are undesirable. On the one hand, there are those who have many ideas and do not stop talking, proposing new questions that in many cases have little to do with the problem to be solved. On the other hand, there are those who say nothing and just listen. Perhaps the worst thing about these people

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is not that they do not say anything, but that they do not think about anything related to the object of the session. As a results, they completely nullify their possible contributions and also their "empathy" with the work.

- To each his own. Sometimes in the brainstorming sessions each participant assumes a certain position and dedicates himself to defend it tooth and nail, without considering other options and denying any other possibility. Many times, in the case of companies, this situation becomes more serious since it is combined with the position or department of the person. It occurs as a typecasting that makes communication between the team very difficult.
- Lack of control in coordination and time. In some cases, brainstorming sessions take place without any type of control over participation. Each one intervenes at will and contributions follow one another freely. The duration of the session is also not limited. As a result, imbalances usually occur in the participation of different members and sessions can go on for hours and hours with no apparent progress.
- New ideas are not feasible. There are times when the new ideas that arise during brainstorming are not feasible with the means available to the team or the company. This tends to condition some people, who tend to filter their ideas based on the conditions that they consider probable for their development. However, as will be seen in the following stages of the Design Thinking methodology, there are techniques that allow us to develop an idea and test it with end users without having to build a complete solution. Prototyping allows you to test most ideas. Therefore, considerations about the feasibility of ideas should be avoided.

The blue cards

This is an activity that shows the power of group ideation. The objective of the exercise is to prepare as a team a list of at least thirty possible ways of using a common object (bucket, brick, shoe, etc.). The activity generally proceeds in three stages.

This exercise was originally developed by Stan Gryskiewicz, co-founder of the Center for Creative Leadership[24]. It is about organizing the brainstorming session in three rounds:

- First round:
  - 3 minutes. Each member of the group works individually, in silence, trying to find ideas. Each idea is annotated on a different (blue) card.
  - 5 minutes. Ideas are shared with the group. Each participant introduces his/her ideas in turns. No one comment others' ideas, just listen.
- Second round, participants are invited to propose new ideas or ideas based on the ones already present in the previous round:
  - 3 minutes. Each member generates new ideas individually again. Write down new ideas on cards.
  - 5 minutes. Share the ideas again as a group.
- Third round:
  - Continue working as a group. Now you can propose new ideas in a more open and collaborative way. Everybody can create and share dynamically.

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In general, after the first round, many ideas that were already known come to light, so it is crucial to give way to a second round in which new ideas are generated from the "echo" and feedback of existing ideas. This gives participants the opportunity to reflect on what has happened and generate new ideas, perhaps by combining existing ones. In addition, this way it helps everyone to participate. Incidentally, the blue color of the cards is not important at all, the key is in the development of the activity, combining individual and collaborative work and limiting the time slots to perform each round.

4.3.2 Mind maps

Initially proposed by Tony Buzan in 1974[25], mind maps are widely used both in the field of education and business to represent ideas or concepts related to each other by means of a keyword or central idea.

Mind maps are built around a key idea that can be a word, phrase, or short text. This idea is placed in the center of a sheet of paper or a board. Taking this central idea as a reference, other ideas are added in a clockwise direction. Then, ideas are linked to the central one using lines.

According to its creator, there are ten key elements to consider when developing mind maps:

1. A blank sheet with an horizontal layout must be used. It facilitates the overview and the arrangement of ideas.
2. The central idea must be represented by means of a drawing or color image. Pictures often provide more information than words, and they contribute to keep the map concise.
3. As far as possible, pictures should also be sued for the rest of the ideas.
4. Uppercase letters are used to write down keywords.
5. Each concept must have its own branch within the map. This helps exercise creative memory by preventing the brain from reading sentences.
6. Branches flow and become thinner as moving away from the center, like the branches of a tree or the neural networks in the brain.
7. The size of the branches should be compensated.
8. Colors should be used as far as possible.
9. The relationships among concepts and ideas with arrows and lines should be highlighted with arrows.
10. Empty or white spaces shall be utilized to provide clarity.

Basically, to create a mind map we place the central idea in the middle of a blank sheet of paper. Next, we jot down individual ideas around this central idea, placing them in whatever order and arrangement we wish, using colors and drawings. Finally, we join all the elements with lines and arrows. With this, we organize the map and provide a hierarchy to the information contained in it, which in turn will allow us to assimilate and memorize its content more easily. There are several computer applications available to support mental mapping[26][27].

Ultimately, mind maps help organize our memory, and improve our ability to retain information and use memory more effectively. As visual instruments, they are very convenient for transmitting a large amount of information in a concise way, while facilitating its understanding. They also help us organize our thoughts and express them clearly and effectively.

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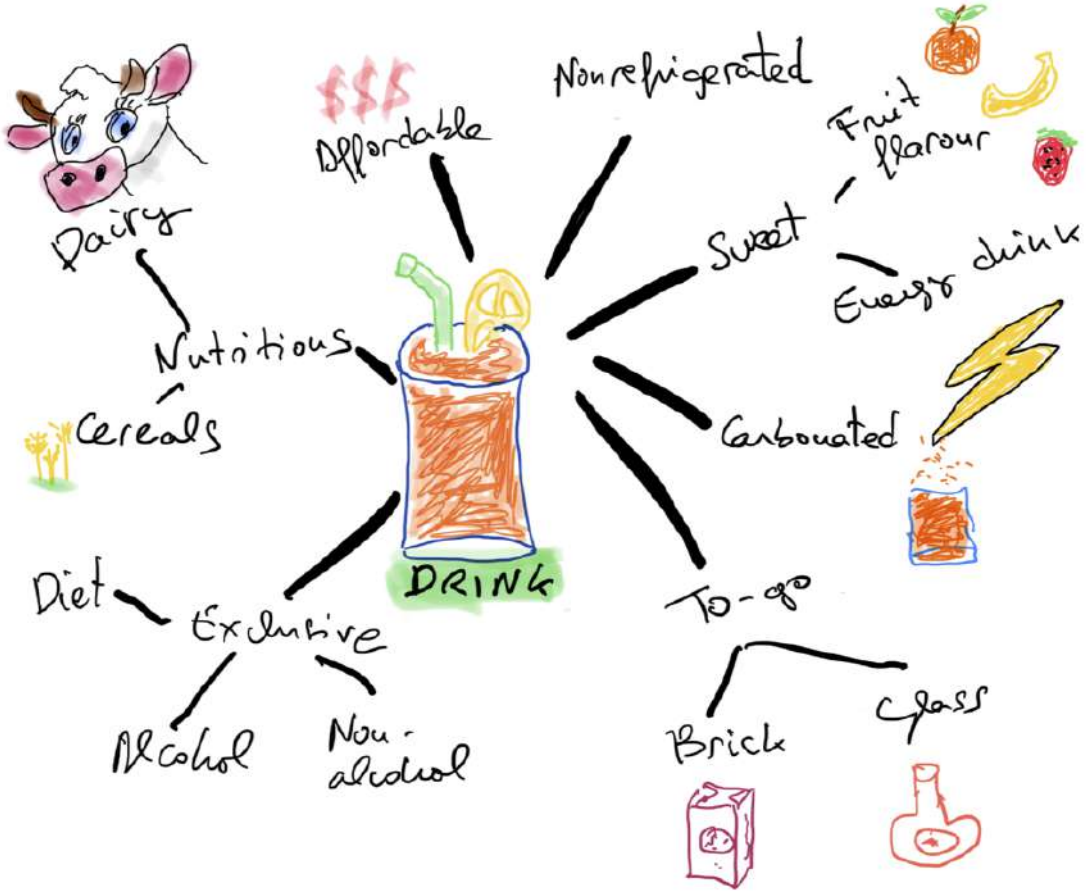

Figure 4.3: Example of a mind map

Mind map example

Figure 4.3 depicts and example mind map. After brainstorming for a new attractive drink for adults, ideas such as “sweet drink”, “carbonated drink”, “fruit-flavored”, “alcoholic drink”, “alcohol-free drink”, “energy drink”, “glass container”, “brick-type container”, “attractive container”, “non-refrigerated”, “cheap”, “nutritious”, “dairy drink”, “very exclusive”, “portable”, etc. From them, the mental map of the figure was elaborated.

4.3.3 Concept development

The ideas generated in the brainstorm, especially in the conditions that we indicated above, are usually not worked enough to show them to potential end users or clients and expect positive validation of them. Before doing so, it is usually necessary to elaborate these ideas. The concept development activity consists of choosing a set of ideas (e.g., from those that have been generated in a brainstorm) and combining them to build a concrete solution that can be presented and validated. This is a kind of consolidation activity where ideas are evaluated, compared, ranked, clustered, and even discarded to achieve a set of great concepts to work on. Our goal is to achieve the concept of a product or service that meets the needs captured in the PoV.

As a first step, we need to build a concept that may be of interest for the end users. This involves grouping and organizing the ideas, considering issues such as their viability or their degree of

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innovation, but also their ability to provide a solution to the problem, or their complementary or supplementary nature.

It is possible that some ideas are not included in any of the concepts considered. Don't throw those ideas to the bin basket. They may be useful in future ideation sessions as idea triggers. In any case, the aim is to focus on the potential winners from a number of ideas.

Concept development example

Starting from the mind map in Figure 4.3 and focusing in some of the ideas colleced in it (which ones?) we can develop the concept:

> *Dairy-based drink with additional ingredients to enhance its flavor, packed in a small brick container*.

Concept development is an activity somewhat opposed to brainstorming. While in brainstorming we try to generate as many ideas as possible, without questioning them in terms of their possible real utility or assessing whether their real application is more or less feasible, in concept development an opposite approach is followed. We must combine the ideas in a product or service that we are going to test.

While the participation of people outside the development team may be possible and even desirable in brainstorming, only the development team should participate in concept development.

The way in which concept development is done can be quite similar to the way in which a jigsaw puzzle is solved. First, we can classify the pieces following different criteria. For example, in the case of the jigsaw puzzle according to the color of the pieces or the shape. A good strategy is to start by laying the edge pieces. Another good strategy is to group the pieces by color, such as putting together all the blue pieces of the sky, the green pieces of the field, etc. In the case of concept development, the way of proceeding is similar: we put together the different ideas taking into account relationships among them, looking for some criterion of affinity. Once we have made this classification (cf. Figure 4.4) we can start putting the pieces together looking for some reference element that gives us an anchor point on which to continue working. In the case of the jigsaw puzzle, it is usually a piece with a distinctive element that allows us to place it in a certain position. In the case of concept development, it can be a clear and central idea. In both cases, this reference element is an anchor point on which to continue building, adding more tiles to the puzzle, and incorporating more ideas into the concept. In both cases, our construction will grow and consolidate until we have a result that is clear enough to be able to present it to test it and thereby validate it.

As suggested above, ,ind maps may also be created to drive concept development. Once and initial classification of ideas is completed, we can start putting the pieces together looking for some reference element that serves as an anchor point. In the case of the puzzle, it may be a piece with a distinctive element that allows us to place it in a certain position. In the case of concept development, it can be a clear and central idea. In both cases, this reference point serves as an anchor on which to continue development, adding more pieces to the puzzle, or incorporating more ideas into our concept. Our construction will grow and consolidate into a result appropriate to be introduced to stakeholders and be validated.

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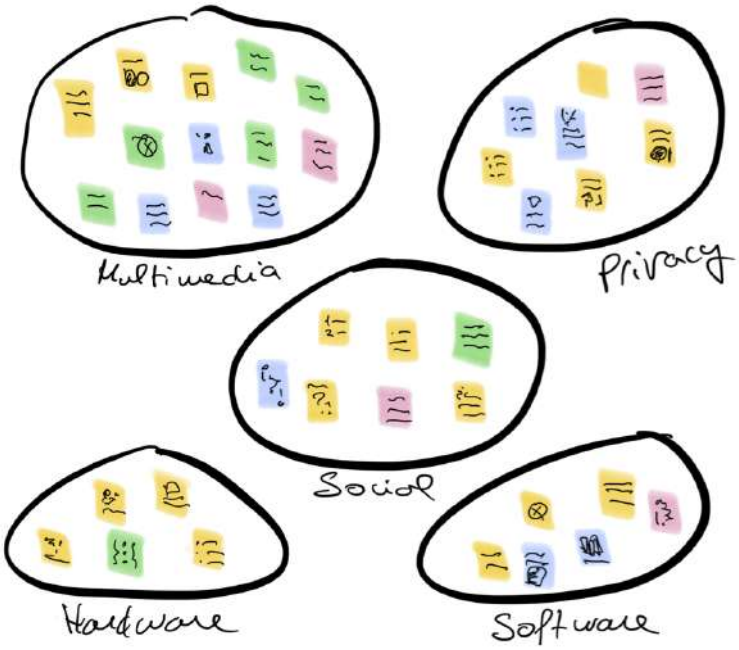

Figure 4.4: Concept development example: ification.

4.3.4 Now Wow! How? matrix

Once we have one or several concepts developed, or even with the basic ideas, we can classify them according to a Now Wow! How? matrix (cf. Figure 4.5). This diagram has two axes, the horizontal axis the degree of innovation, from a boring and already known end to a complete original idea, and the vertical axis represents the difficulty of implementation, from a very easy end to an impossible end. This diagram provides an easy-to-follow method of evaluating the feasibility of ideas or concepts and their innovativeness. By arranging the ideas in relation to these two axes, we can visualize which are the most attractive ideas and those that are more feasible, while promoting group participation and consensus on them. Group members can use colored sticky notes, each representing one of the categories, on which to write ideas to arrange them on the diagram in turn.

Other kinds of diagrams can also be considered to classify concepts or ideas. The Four Categories Method enables us to classify ideas along a rationality axis, ranging from the most rational choice, to the most delightful, to the darling and finally to the "long shot". A best practice in this case is to decide upon one or two ideas for each of these categories. As a result, the team ensures to cover all grounds, from the most practical concepts to the most innovative solutions. Another method is the Bingo Selection method, where concepts have to be arranged in accordance to a variety of form factors, such as their potential applications in a physical prototype, a digital prototype, and a experience prototype.

4.3.5 Idea selection

Once we have done all the ideation process, it is time select some of the concepts to continue with the next stage of the Design Thinking process: prototyping. A good way to proceed is following

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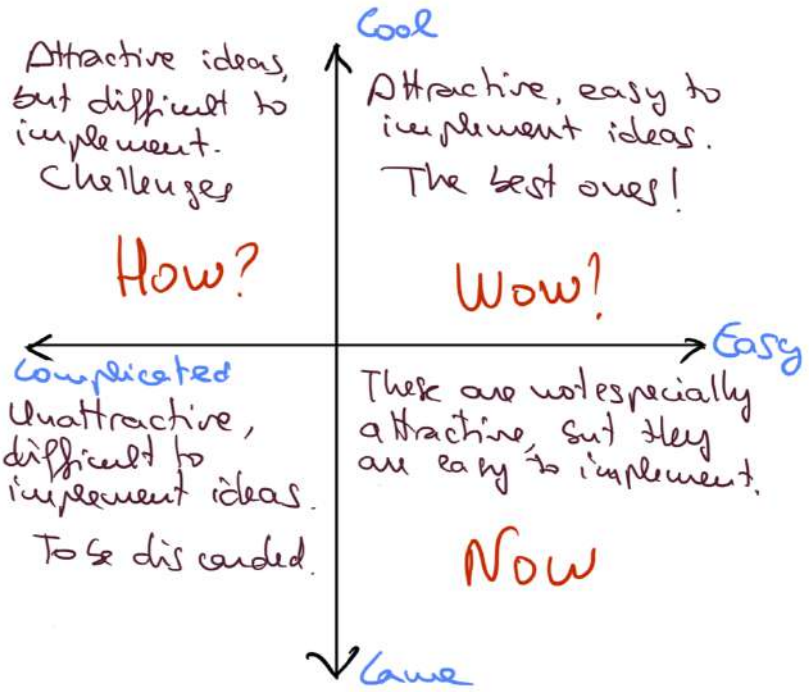

Figure 4.5: Now – Wow! – How? matrix.

a democratic election of the wining concepts or ideas, following a post-it or dot voting.

First you need to write all the concepts on individual post-its. Then, each participant is given a number of votes, around 3 or 4, to vote for their personal favorites. Votes can be provided in the form of stickers or using a marker to make a dot on the post-it. This process allows every member to have an equal say. In case of a tie, a second round of voting can be held after a debate among representatives of the confronted ideas.

4.4 Conclusion

Ideation is a process to generate a large number of ideas and concepts to solve a problem, to satisfy a need or to face a challenge. For this, tools such as brainstorming, mind maps or concept development can be applied. The more ideas we obtain towards a solution, the better will be the chance to find the one that meets all our needs. To get a truly innovative idea, the ideas we generate have to be rich and imaginative, so initially we should not judge them. At this point, we look for ideas without questioning ourselves about the most suitable or brilliant one. The process should be inspiring enough to generate a large number of proposals from which we can select the best idea or a combination of several ideas. To finish this process, one or two candidate solutions will be selected and, based on them, concept or concepts that will serve as the basis for an innovative product or service will be developed.

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BRAVE NEW WORK(PLACE)

IT TAKES GUTS

5 Prototyping

Once we have completed the ideation stage [28] and we have at least one solution to the problem originally posed, in the form of a product or service, we are going to design and produce an object, the prototype, that allows us to visualize the final system and reason about it, together with the people who will eventually enjoy that solution.

A prototype is a concrete representation of all or part of the expected outcome of our project, a tangible artifact and not a simple abstraction. It is an early, inexpensive and limited version that serves to reveal any undetected problems and facilitate our path towards a final solution. The prototype will allow us to evaluate the results as soon as possible, and thus detect any design problems or any misinterpretation of the initial needs or requirements.

Ultimately, prototypes allow us to make an idea come true, check whether or not it is viable to turn that idea into a product or service, and investigate how people think and feel about that product or service.

5.1 The role of prototypes

From the perspective of Design Thinking, prototypes are very important because they will serve as a common ground for talking with the the people involved in the project about the solution we propose. The prototype is an object about which to talk, discuss, argue and make new proposals. To paraphrase the well-known adage, a prototype is worth a thousand images.

A prototype, especially when we can introduce it at an early stage of the project, also allows us to limit the cost of our mistakes. With a prototype, even when built as a preliminary representation of the final solution, a *low resolution* representation, we can quickly detect unwanted issues that we do not like or correct false assumptions or misinterpretations.

Prototypes may also lead to the development of new ideas in an incremental design process. They allow us to visualize the solution or final product at an early stage, and serve to build upon them what will be the next version, more advanced or more elaborate, of that solution.

Some keys to make good prototypes would be:

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Start building something The most effective way to start prototyping is by making a sketch. They are a fast and efficient way to organize concepts and ideas. If the prototype is a simplified version of the final solution, the sketch would be a simplified version of the prototype.

Do not get attached to the prototype Prototypes a preliminary representation of the target product or service of our project are after all. They are just something to help advance towards the ultimate goal. Prototypes are discarded once they have fulfilled their mission, so they cannot become a burden that conditions our subsequent work.

Identify the relevant elements Be clear about what you want to show with the prototype. What actual questions do you have to answer? What specific part or functionality are we displaying with it?

Do not complicate yourself unnecessarily The goal of a rapid prototype is not perfection, but to get something good enough to do its job at this point. It is not necessary to invest resources or time to go beyond that.

Do not lose sight of the user We must always keep in mind the people for whom we are designing our solution. A prototype should always be tested with the target audience of the project in mind.

In the prototyping phase of an evolutionary and incremental design process, intermediate solutions are generated to address issues that will get us closer and closer to a final solution. In the early stages of a project, these questions can be more general, such as, “What impression did my proposal for an induction hob for a high-tech kitchen make?” At this stage, you have to produce inexpensive prototypes that are easy to make, but nevertheless will provide helpful and insightful feedback. In later stages, both the prototype and the questions can be a bit more elaborated. For example, in the final stages of our kitchen project, we can create a prototype that aims to discover whether users prefer to use voice commands or traditional control knobs.

A prototype can be anything with which users can interacted, or at least that is capable of provoking reactions that indicate the perception that people have of our work: a panel with sticky notes, a physical object, a role game activity, a video clip simulating a commercial, a comic book storyboard … Prototyping is about building something that allows users to somehow experience what they will experience when the project is complete.

If we think about a red vehicle, we can interpret these two words in multiple ways. *Vehicle* can refer to many different objects, such as a car, a motorcycle, an electric scooter, or even a spaceship. *Red* can indicate many different shades of a color, or even a political option for some audiences.

On the other hand, if we look at the image in Figure 5.1, although this sketch was drawn in a few seconds and can be interpreted in many different ways, it reveals an important number of specific aspects of this particular red vehicle such as, for example, that it is a car, that it has an antenna, that it is not a minivan, that it does not have a bicycle rack, that its lines are more those of a sedan than a sports car … In turn, depending on how a specific person reacts to that sketch, we can obtain relevant information about that person, such as their preferences regarding vehicles, that there are people who carry their bikes on the car, etc.

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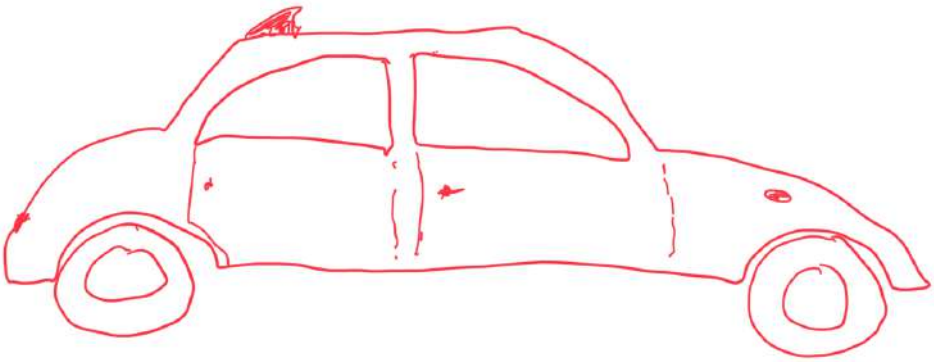

Figure 5.1: A red vehicle

5.2 Aspects of a prototype

We can study the prototypes from four different perspectives [29]: form, fidelity, interactivity and evolution.

5.2.1 Form

Depending on the nature of the solution that we are developing, such a solution can materialize in different ways. It can be a physical object made of metal, wood, plastic . . . It can also be a computer program, a sketch, a video clip, a publication, etc. It can be very small, such as a prototype of a jewel printed in plastic with a 3D printer, or very large, such as a life-size model of an airplane.

On the other hand, prototypes can be materialized with the same formal elements as the solution that they represent, or with different formal elements. We speak of offline prototypes when their shape does not match that of the final product, and online prototypes when they participate in the same reality. For example, a paper sketch of an application using the *wireframing* [30] technique, a cardboard mockup or a computer-generated video of an object [31] are offline prototypes, and a simplified version of a program, a showcase, or a demo version of a product are online prototypes.

5.2.2 Fidelity

This aspect indicates the level of detail and functionality of a prototype. It reflects the balance between the relevant details that the prototype aims to show and the irrelevant details that the prototype leaves open to the imagination of the people who interact with it.

The fidelity of a prototype is usually related to its form. For example, sketches tend to be low-fidelity as they offer an overview with virtually no functionality, whereas demo versions or product pre-series are often high-fidelity, showing all or part of the final functionality in some detail.

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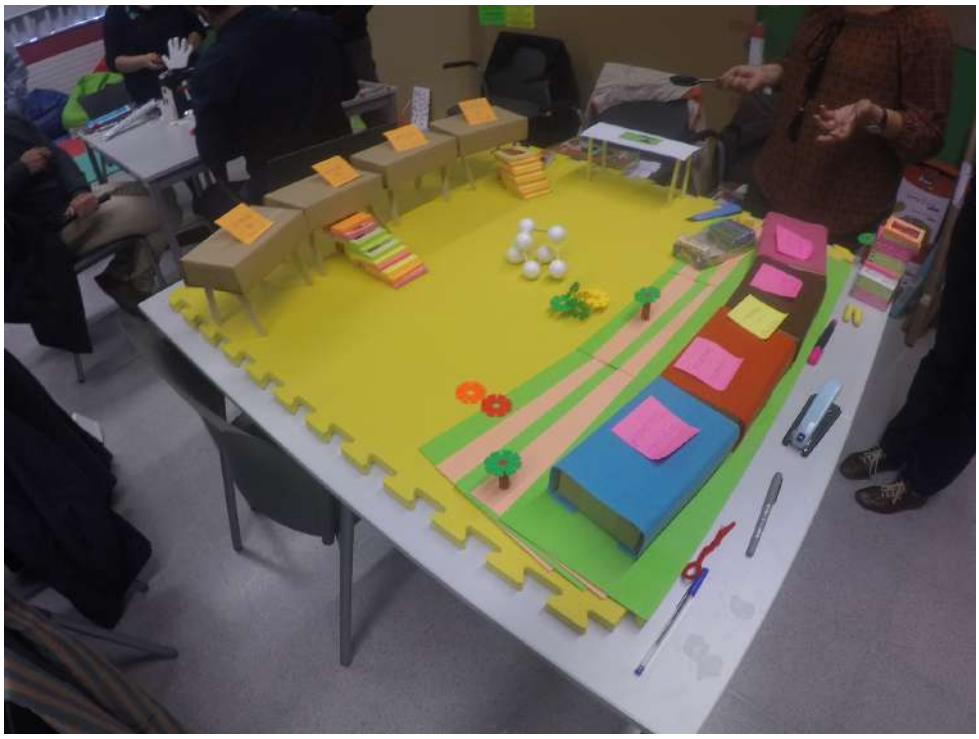

Figure 5.2: Model of the commercial area of the Vigo University campus made in just one hour with office supplies. It is an offline prototype.

In general, we talk about low-fidelity prototypes when they implement general aspects of the system without going into details, and about high-fidelity prototypes when they represent more specific aspects. Low-fidelity prototypes show general aspects of the system, while high-fidelity prototypes serve, for example, to detail the entire interactive process of one or more specific tasks.

For example, a life-size model of a car made of clay is a low-fidelity prototype that expose general aspects such as the attractiveness of its lines, or its aerodynamic properties, while a prototype of a web page with the entire structure but with no actual content (e.g., populated with *Loren Ipsum* paragraphs) is a high-fidelity prototype when it comes to structure and a low-fidelity one with respect to the page content. Still, we can get an idea of what the final page will look like even without the prototype displaying the page's final content.

The advantages of high-fidelity prototypes are that they usually provide a lot of detail in terms of the functionality they expose, they are usually interactive, and they can serve very well as a marketing or market research tool. However, they are expensive because they are often time-consuming to develop, difficult to modify, and may create false expectations. A high-fidelity prototype may be easier to understand for people who do not come from the world of design or have less technical knowledge, since they are visually closer to the final product.

On the other hand, low-fidelity prototypes are usually inexpensive, can be created quickly, and it is usually easier to interact with them. They are very useful for interface design and for identifying software requirements. However, they have significant limitations in terms of interactivity, and their perception is highly conditioned by the skill or style of the designer. They are usually offline prototypes. Low-fidelity prototypes are appropriate, for example, for showing a concept design solution during the early stages of product development.

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Figure 5.3: Prototype of a can of mussels. It is an offline prototype (i.e., a graphic design with no real existence) and it is low-fidelity (i.e., it only shows the external shape, although in high detail)

Depending on what we want to expose at a given stage and how advanced the development process is towards the final solution, a prototype may be a blend of low-fidelity and high-fidelity aspects. We can apply two strategies when building such a prototype. On the one hand, we can focus on a few characteristics of the final solution with a high level of detail (i.e., high fidelity), to evaluate a limited part of the final system in depth under real circumstances. In this case we would be talking about vertical prototyping. On the other, we may identify all the basic features of the system, but without detailing the underlying functionality. In this case, we would be talking about horizontal prototyping. The latter is typically applied to the (high-fidelity) prototyping of user interfaces, whether of software programs or any other type of device or system (cf. Figure 5.4). For example, a prototype of a Web page can represent the structure of menus and navigation with a great degree of detail, but without allowing or supporting navigation through the different options, doing it in an erratic way or with broken links.

5.2.3 Interactivity

This aspect illustrates the ability of the prototype to support interaction. Based on this capability, prototypes can be classified into fixed prototypes, fixed-path prototypes, and open prototypes.

Fixed prototypes do not support any type of interactivity. They simply tell a story, they illustrate the operation of a system under certain previously established conditions. For example, a video presenting a new coffee maker or an animation of an engine's operation are fixed prototypes.

On the other hand, fixed-path prototypes support guided interactivity, limited to certain functions. For example, the prototype of a web page where only the registration process is active

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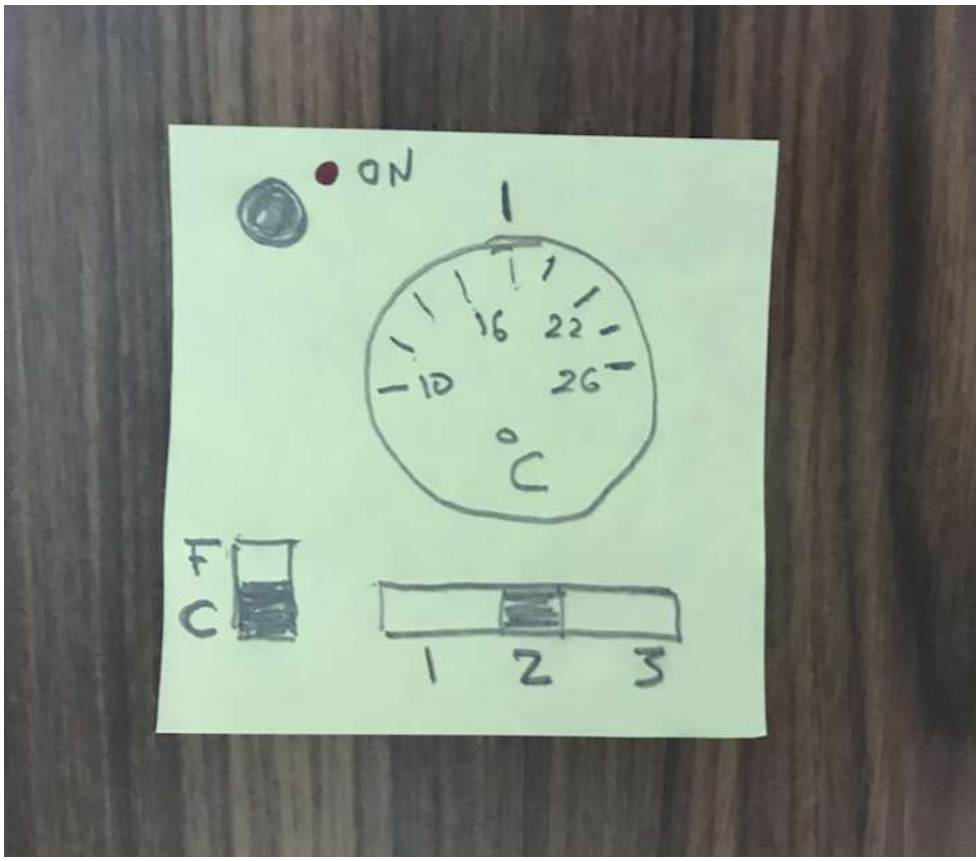

Figure 5.4: Horizontal prototype of a life-size wall thermostat. It is low-fidelity insofar its functionality is concerned, but the user interface has all the details. Do you find it comfortable to use? Does it seem intuitive to you? Are you missing something?

would be a fixed-path prototype. The only possible interaction will be that to carry out the sequence of steps that allows registering on that website.

Finally, open prototypes support interactivity in a way similar to the final system, but with the limitations of a prototype with a given fidelity. For example, a prototype of a vending machine may faithfully display all the options available on the exterior control panel, but not include any of the interior mechanisms necessary to sell products.

According to this classification, we can see that a system is not more or less interactive because it is more or less dynamic. A fixed-path prototype or a video clip can be very dynamic, but not interactive.

5.2.4 Evolution

The evolution of a prototype refers to its path from its inception and across its development and use until it is finally discarded. Rapid prototypes are made in the early stages of a project, they are constructed relatively quickly and they utilize few resources. These are usually offline, low-fidelity, and are usually discarded after they fulfilled their purpose. Examples of rapid prototypes would be sketches, mockups, or wireline prototypes of computer programs, sticky notes prototypes or programs written in scripting languages.

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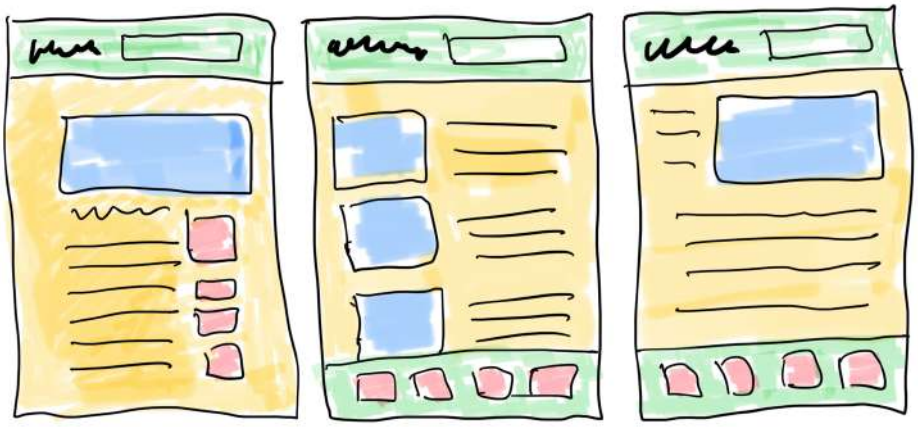

Figure 5.5: Software application prototypes. These are offline prototypes where interactivity is supported by moving sticky notes around when someone selects the options illustrated by the prototype.

On the other hand, iterative prototypes often require more resources and more time to complete. Normally its fidelity increases with each iteration. A special type of iterative prototypes would be evolutionary prototypes, which are characterized by evolving to become a part of the final system or the final system itself. As a consequence they never are completely discarded.

5.3 Rapid prototyping techniques

The objective of the prototyping phase is to build a representation of a candidate solution that allows us to visualize and reason about it. In other words, we move from an idea to something concrete and real that, although it is not yet a final solution ready for delivery or commercialization, it does allow us to interact with aspects of the real system within the limitations of the prototype discussed in the previous paragraphs.

In fact, one of the key benefits of prototyping in project development is that it gives us the ability to test the results of our work early. Consequently, within the Design Thinking methodology, testing is an integral part of the development process, and the techniques used in the testing stage are not something to apply only at the end of the process, but are part of the development process itself.

In the following paragraphs we collect three of the most popular and effective rapid prototyping techniques. We begin by discussing sketches, already introduced above, and then describe models as an evolution of the former. Finally we describe the *Wizard of Oz* technique, as an approach that encompasses all the techniques described.

5.3.1 Sketches

Especially in the early stages of development, in most cases the best approach to prototyping is a low-quality, low-fidelity prototype, a prototype that is made quickly and with few resources to show a general idea, a sketch. No complicated technological devices or state-of-the-art materials

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are necessary. A pencil and some paper, a piece of clay or expanded polystyrene foam (EPS) and a blade is more than enough.

In case that we are developing a computer application or a protocol or service, it is also possible to apply a similar strategy. For example, we can use sheets of paper and sticky notes to prototype navigation through a computer application, wire-framing techniques, or simple diagrams and graphics to illustrate the deployment of an application or service (cf. Figure 5.6). It is easier for a person to focus on images than on text descriptions. In a typical software development case, a design team may produce a series of paper prototypes that can be gradually worked on to demonstrate how certain tasks or problems are addressed. In the case of developing tangible devices, such as a computer mouse, the design team may use a number of different materials and ergonomic shapes to allow them to test the underlying technology.

5.3.2 Mockups

Mockups or models are another very popular rapid prototyping technique, as they address the aesthetics of the final system, its ergonomics, and even help to identify possible production problems of the final product. Mockups are an instrument to explore the form, composition and functionality from an idea to detailed design.

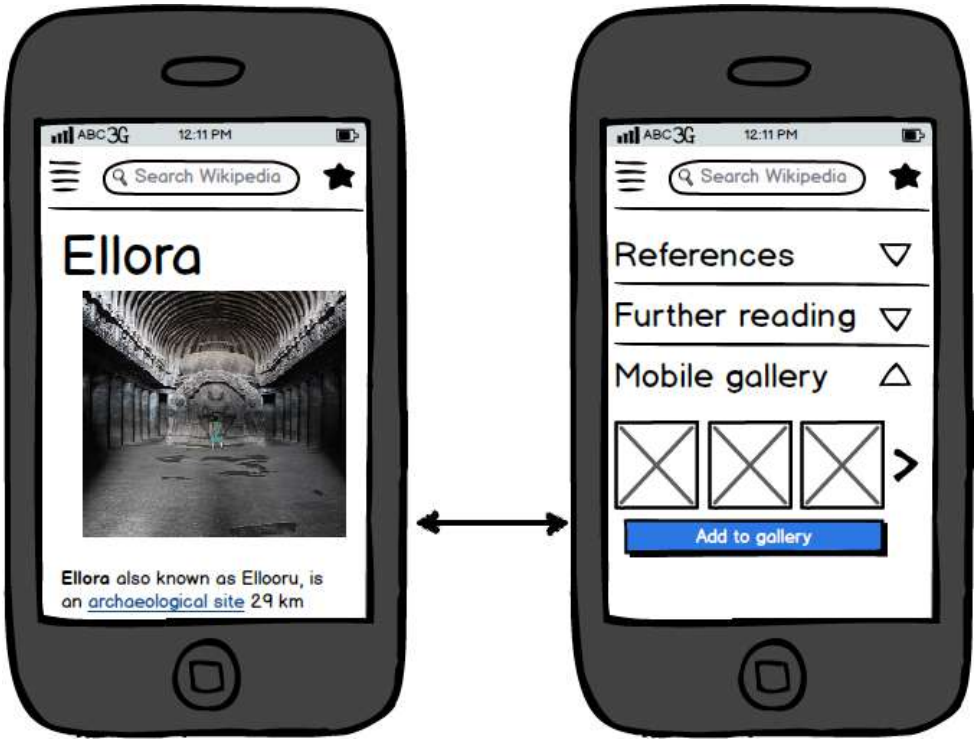

Figure 5.6: Mockup prototype of a mobile application of a virtual art gallery (Maryana Pinchuk y Jon Robson).

The systematic introduction of models or mockups as a prototyping technique started in 1947, when Chuck Yeager was designing the Bell X-1 supersonic aircraft. For this, he used 50”-caliber projectiles to emulate that aircraft and thus study supersonic flight. Interestingly, the Bell X-1 became known as *the bullet with wings*. After this historic event, designers and engineers introduced model making as standard practice to bring their sketches to life in the three-dimensional world.

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Although computer design has become widespread and 3D rendering and virtual reality technologies have evolved dramatically, physical models are still essential in many fields, especially when physical interaction is required to fully understand whether a product is acceptable or not.

An example that perfectly illustrates the importance of a good prototype on time is the introduction of the new official NBA ball in June 2005[32]. The new ball featured a new design and a new material that, according to the manufacturer, offered better grip, feel and consistency than the official leather ball of previous seasons. It was the first major change in more than 35 years, and the second ball in 60 seasons. In October 2006 the new ball began to be used in official matches. It turned out that the ball caused injuries, and players ended up denouncing the NBA for safety problems at work.

In December 2006, the leather ball from the previous season was reinstated. Most probably, the lack of a mockup or model featuring the new material for players to experiment with it, introduced at the early stages of the design process, was instrumental to the failed introduction of the new basketball.

5.3.3 Video prototypes

Video prototypes are especially suitable when we want to show the characteristics of a system with great realism at a still very preliminary stage in the development of that system [33]. With a good video clip, it is possible to show how people would interact with some physical device even when that device does not exist yet. Through this kind of prototype, it would even be possible to demonstrate something impossible with current technology, or located in an unattainable place (e.g., on another planet, in an inhospitable place, in an artificial environment, etc.), and therefore study people's reactions to it. With this, we can study the reactions of the people interested in our project or of the team members in a very preliminary stage of development, to discover possible usability problems, errors or misinterpretation of the needs of final users.

Obviously, the possibilities of interacting with a video clip are very limited. Video prototypes would be fixed path prototypes, since with them it is possible to show or illustrate how a system interacts, but only for the interaction sequences filmed on video. In addition, the level of detail of the systems represented in a video is usually limited, as the most superficial or visible aspects of that system are the ones represented.

To make a video prototype you do not need too many resources. Most likely, all or almost all team members will have a smartphone with at least one camera capable of recording video in high definition, with basic video editing functionality, and with the possibility to transfer these videos to a laptop or desktop computer, as well as to share them via the cloud or social networks.

On the other hand, we must always keep in mind that we are making a prototype, and therefore it is something ephemeral bound to be discarded as our project progresses. The amount of resources that we dedicate to video prototype production must be consistent with the role that our video prototype will play.

Making a digital video prototype is a process similar to any video production project [34], which can be organized into three main phases, namely preproduction, production and postproduction.

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Preproduction consists of planning our video creation project and getting all the information and resources that we are going to need to make the video prototype a reality. The planning of our video prototype is probably the most important task of all, since the product of this phase will determine the final result in a decisive way. Among the key aspects to take into account at this stage, we have to define the duration of the video prototype, at least approximate. It has to be long enough to convey everything we need to convey, and short enough to hold the attention of our audience. Advertising videos are usually less than 30 seconds long and corporate videos rarely exceed three minutes. If we are able to create interesting, inspiring or provocative content, our audience will tend to stay tuned for longer.

Related to duration, we must also estimate the number of takes necessary to complete the video. We also have to identify all the necessary resources beyond video takes at the next phase, such stock video clips, as animations, diagrams, and the elements in the soundtrack, that is, what music or sound effects will be necessary based on the content and our audience.

It is also very important to write a script or storyboard where it is described in detail what we want to convey to our audience. In this sense, our video prototype can be an evolution of a previous prototype in the form of a sketch or a storyboard.

Production is the process of obtaining the image and sound of our video prototype, guaranteeing that all the necessary elements for it are in available when required. First of all, we must familiarize ourselves as closely as possible with the technical aspects of our audio and video recording equipment. In the case of making a prototype with a mobile phone, the controls for recording and storing videos will be relatively simple, but even so, we must familiarize ourselves with the different supported resolutions, the storage formats for both audio and video, the relationships of supported aspect ratio, methods for sharing and distributing shots, whether there is any way to control lighting, focus, and framing (e.g., whether it is possible to zoom), etc.

In general, our takes should be correctly exposed, well focused, and well framed. We must bear in mind that framing is our means of expression. Everything that is out of the picture frame will not exist for our audience. We must also bear in mind the sources of light and the shadows cast by objects and people. In addition, takes should be as stable as possible trying to minimize or completely avoid vibrations or unwanted camera movements. In terms of sound, the microphone should be as close to the subject or sound source as possible, while avoiding unwanted noise or sound sources. In the case of using the mobile camera, we must assess the convenience of taking sound shots with an additional recorder or with other mobiles.

Finally, we must have the ability to identify the potential of a good shot, although that is something that is acquired with practice. An interesting strategy would be to film more takes than we might initially think we need, or take longer takes to have more flexibility in transitions during post-production.

Finally, postproduction corresponds to editing the video from the resources we have obtained in the production phase, as well as coding and packaging the different elements of the finished video in the appropriate container (image , soundtracks, subtitles, metadata . . .). This is the phase where we will really tell our story. Our audience must understand and assimilate what we want to convey about how we are going to solve a certain problem. Therefore, clarity takes precedence over artistic experiments. Using all the material obtained in the production phase, we select everything that is relevant to illustrate the operation of the system or service that we are prototyping, and we arrange it according to a temporal order that effectively transmits that.

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Editing takes as a reference the script or storyboard created in the preproduction phase. With that initial outline, the takes that will be part of the final prototype are selected and edited in case it is necessary to adjust their duration, framing, etc. We will eliminate anything not relevant, focusing on those takes or segments that will best reflect what we want to convey. In the same way, we will select the appropriate audio cuts (i.e., music, voice-overs), additional resources (i.e., stock material, animations or diagrams) and we will arrange them in the corresponding place in the final video prototype. It is also the time to integrate other elements such as titles, special effects, transitions, etc.

The requirements or limitations related to the dissemination of the video are also identified here, as well as the tools necessary to convert or transcode the material to its final format. For example, we will have to take into account whether the video prototype will be broadcast in streaming over the Internet, whether it will be distributed on a physical medium, whether it will be displayed on a large screen or on a mobile device, etc.

It could be argued that conveniently completing the three previous stages will most likely provide a good video prototype. However, it takes good training and some experience to master the various phases of making a video. In fact, there are many training programs and professions that focus on very specific aspects of the process (cameras, sound engineers, editors, producers, filmmakers, scriptwriters, illuminators, etc.). However, with some basic notions covering the fundamental aspects of the digital video creation process, would be enough to face the challenge of producing a video prototype suitable for the prototyping stage of a Design Thinking project.

5.3.4 Wizard of Oz prototypes

Finally, there is a technique that combines all the rapid prototyping techniques described in the previous paragraphs named after the 1939 movie *The Wizard of Oz*. This name is attributed to the usability expert Dr. Jeff Kelley, who was inspired by the scene in that film in which the dog Toto opens a curtain to discover that the Wizard is not actually such a wizard, but a man who is operating a set of buttons and levers to bring to life a representation of a magical character. This technique, called also WoZ after its acronym, is widely used for low-fidelity prototyping of systems that interact with human users, especially natural-language interaction systems [35] [36].

WoZ prototyping is based on a sketch or a rudimentary mockup of the final solution. The prototype can be quite simple and be based on everyday or widely available objects to represent specific parts or functions of the final solution. After the prototype has been created, role-play is used to illustrate how the prototype is interacted with. In addition to the sketch or the mockup, a WoZ prototype requires a script with the instructions for the *wizard*, that is, the person who will perform the tasks that will simulate the behavior of the final product. The person interacting with the prototype may or may not be aware that the assistant's tasks are performed manually by a human being rather than by a machine or computer application.

For example, to develop a WoZ prototype of a paddle court telephone booking service that allows clients of a sports center to make or cancel a reservation, we would first build a tree with all possible requests of the caller and the responses of the system, trying to take into account all possible scenarios (cf. Figure 5.7).

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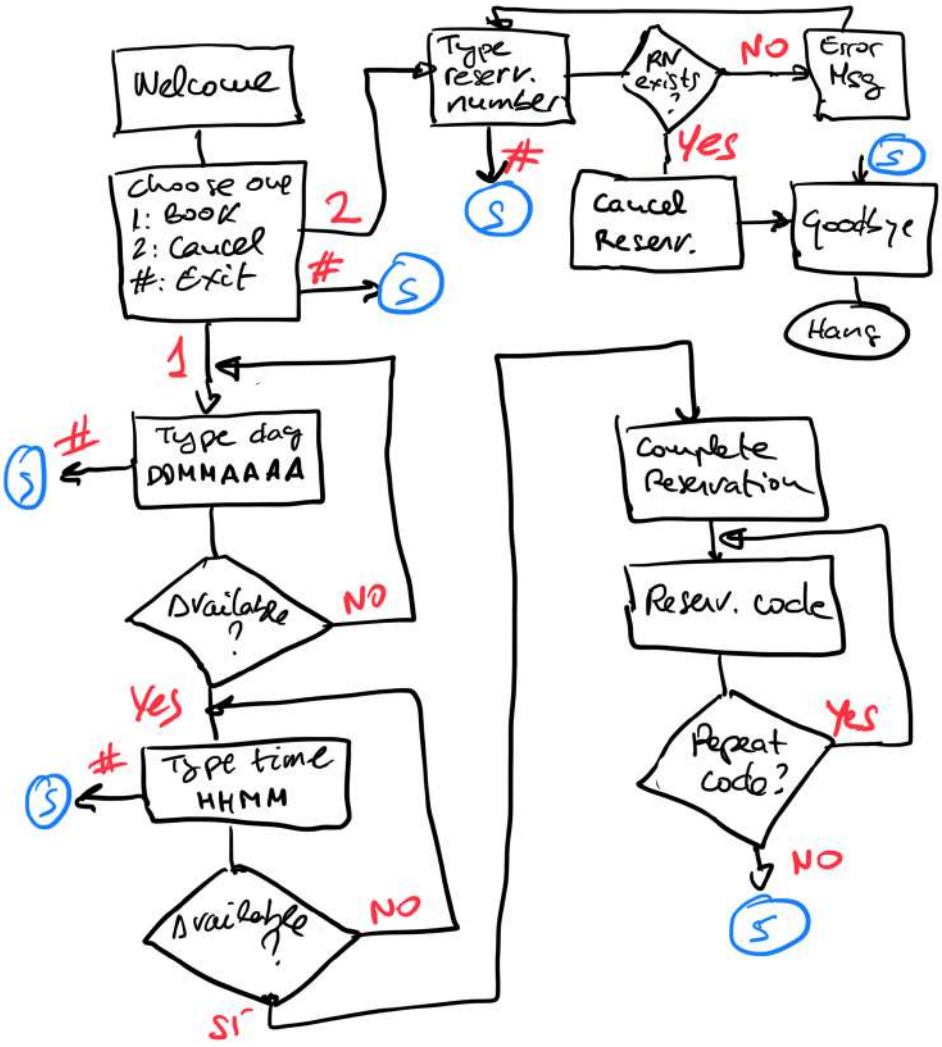

Figure 5.7: WoZ prototype of a telephone booking service. The system produces vocal cues, and users interact through the telephone's numeric keypad.

Once the questions and answers tree is built, that is, the actual WoZ prototype, we would invite the target users of that service to test it. To do this, the person who acts as the wizard would start the conversation by simulating the service's welcome announcement, and would react to keypad interactions from users according to the script.

We can see that there are several elements to be considered when developing the prototype, such as the level of exposure of the wizard (i.e., what does the person who interacts with the booking service know about the hidden assistant? Does they know their existence?), or its role (i.e, what part of an application does the hidden wizard emulate?) We can also utilize this prototype to study aspects such as the acceptability of the assistant, to streamline the handling of most common situations, or to address issues not identified during the system's development.

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5.4 Team challenges

We discuss below a collection of prototyping activities designed as competitions among teams of people. Although these are essentially rapid prototyping exercises, they are really appropriate for other phases of the creative process, such as, for example, as instruments to promote creativity and the generation of innovative ideas. They can also serve as interesting exercises in team building processes, for example to identify aspects of the personality relevant to teamwork that serve as a basis for assigning roles.

In addition, these exercises demonstrate that even the simplest tasks may have multiple solutions. They help to convey the idea that making mistakes is not a bad thing, and that many times you have to experiment with multiple alternatives until you reach a final result.

These challenges are based on the manual construction of a structure with the materials provided, based on the ideas developed within each group. The *challenge* nature implies that participants are facing a competition, and that therefore there must be a reward for the winning group, even if it is a symbolic one (e.g., a diploma, a bag of candy ...). The reward also serves to express that you are aware of participants' commitment to the task at hand.

Each challenge most be adjusted to the characteristics of participants and the selected venue. All proposals can be carried out outdoors, but sometimes an indoor alternative may be more convenient due to unexpected weather conditions, such as rain or gusts of wind.

5.4.1 The paper tower

The challenge is to make the tallest tower possible using only newspaper or similar. Participants are provided with a certain amount of backward press or wrapping paper, and are instructed to design the tallest tower possible using that paper as the only material, and build it. The use of any other construction material or joining elements (glue, tape, clips, etc.) is not allowed.

The time available to complete the challenge can vary depending on the specific context in which the challenge takes place. A reference duration could be 30 minutes.

The team that makes the tallest tower wins. In the event of a tie, the team that uses the least paper wins.

Generous, but not unlimited, amounts of paper are important for this challenge. The idea is that participants do not feel conditioned by the availability of materials to develop their ideas, but do not try solutions based on brute force, such as towers built simply by stacking paper.

5.4.2 The flying egg

The challenge consists of dropping an egg from about three or four meters and get it to land without breaking. For this, the teams must build a means of transport for the egg that guarantees a descent without incidents.

The team that manages to land the egg safely wins. In the event of a tie, the team that makes the trip slower wins, that is, the team that makes the egg stay in the air the longest. In the event that

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there are no surviving eggs, additional time can be provided for teams to improve their means of transportation.

To build their vessels, each team has to choose four items from a bill of materials, such as:

- Two rubber balloons.
- Two plastic cups.
- Five rubber bands.
- A block of modeling clay.
- Five toothpicks.
- Five wooden paddles.
- Five erasers.
- Eight clips.
- One meter of rope.

In the example list above, each item counts as one. Thus, a possible combination would be a kit consisting of two balloons, two plastic cups, five rubber bands and a meter of rope.

Also, a generous amount of chicken eggs is needed. You may limit the number to two or three per team, or give out unlimited eggs. Alternatively, the challenge could be performed with only one egg per team, limiting the total time of the challenge. In this case, if there are no surviving eggs, the team that manages to keep the egg in the air the longest wins.

You also need a stopwatch to measure time (e.g., the timer of a smartphone) and a blackboard to record times and failed attempts.

Minimum rules must be established to avoid distorting the challenge such as, for example, that at least 50% of the egg should be clearly visible, and thus avoid solutions that involve wrapping the egg in shock absorbent material.

This challenge should be carried out abroad. In addition to issues related to cleanliness - this exercise tends to be a bit messy due to debris generated by unsuccessful attempts - other factors such as wind, orography or soil characteristics can make it more challenging. In addition, it is easier to find places with enough height to complete the drops.

5.4.3 The tennis ball

This challenge consists of building a structure to guide a tennis ball from a high point, such as a table, to a box or bucket placed on the ground. The challenge is completed by achieving an additional objective, such as putting the ball in the bucket as many times as possible in a given time, or achieving a given number of repetitions as fast as possible.

The time provided to build the structure can be around twenty minutes, and the additional time required to complete the challenge will depend on the specific challenge that we define. For example, if we set a maximum time of one minute and the competition is based on achieving the highest number of repetitions in that time, the total maximum time will depend only on the number of participating teams.

As in the balloon challenge, there are no strict rules regarding the materials needed to accomplish the task. Among the appropriate materials for this challenge we may propose:

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- Adhesive tape.
- Corrugated cardboard.
- Wooden or plastic sticks.
- Aluminum foil.
- Cardboard boxes.
- Cardboard or plastic tubes.
- Drinking straws.
- Rubber bands.

There are several ways to distribute the materials: each team receiving the same kit; that each team may choose a limited number of items from the list as in the previous challenge; each team may use each item exclusively for a limited time, and then return the surplus to a common deposit …This last option promotes more diverse constructions, but you must be prepared to mitigate conflicts that may appear among teams. The absence of adhesive tape or some other bonding element greatly complicates this challenge.

Before the challenge, the bucket is fixed to the ground at the same distance from the table for all groups, and it is not allowed to change the position of the bucket or table. In addition, as in the previous case, rules that help not to distort the challenge should be defined, such as:

- Initially, the ball is placed on the table at a fixed point marked with an X. A member of the team must push the ball from that point.
- No member of the team may touch the ball from the launching pod until it falls into the bucket. The ball must be in motion by itself from the starting point to its final destination.
- Moving does not just mean rolling; The ball is also allowed to position itself by its own inertia on by means of any other object, standing or moving.
- The ball must be brought to the spot marked with an X on the table before the next attempt. It is only allowed to touch the ball during its transfer from the bucket to the table, or from the ground in case of unsuccessful attempts.

The most critical element is to get the ball moving. The above rules ensure the construction of some kind of structure and avoid converting the challenge into a basketball game.

This type of challenges require not only building a prototype, but also testing it in a competitive environment. Some teams focus on construction, while others focus their efforts on the actual competition. The establishment of roles among the team members is also common, such as a person appointed to take the ball from the bucket, pass it to a second team member, and a third one launches it from the table. That way, precious time can be saved on each try.

5.4.4 The candle trip

This proposal takes time, and also requires a lot of resources, but usually it turns out to become a memorable experience. Also, it illustrates the prototyping and testing process very well.

The aim is to build a water transport for a lit candle and make it navigate a channel in the shortest possible time without sinking. Obviously, one or more waterways are required, generally one for every four or five teams. Each channel should be about three meters long and about 30 centimeters wide. A depth of two or three centimeters would be enough. Finally, tabletop fan at one end of the channel is also needed.

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As in the flying egg challenge, we will need a stopwatch and a board and marker to keep track of the scores.

In this case, the kit of materials may include items such as:

- Sheets of paper.
- Corrugated cardboard sheets.
- Adhesive tape.
- Scissors.
- A cutter or knife.
- A bottle of white glue or universal glue, or a hot glue gun/pen.
- A lighter or a box of matches.
- Clips
- A roll of aluminum foil.
- Wooden sticks.
- Drinking straws.
- Bottle corks.
- Small paraffin candles.

To distribute materials among teams we can follow one of the strategies indicated in the tennis ball challenge.

Each group will have about 25 - 30 minutes to build their water transports. The vessels must be capable of carrying a lit candle from one end of the channel to the other. Teams can make as many attempts as they want, or a limit for the number of attempts may be defined. Before each new attempt, minor adjustments are allowed within a limited time (e.g., 1 to 3 minutes).

Before starting the challenge, the fan is turned on. A try begins by placing the vessel with a lit candle on it at the end of the channel where the fan is located. It is not allowed to touch the candle transport after placing it on the water, and the candle must remain lit when the boat reaches the other end of the channel.

Different criteria may be used to assign scores. For example, the winner can be the group that completes the challenge in the shortest amount of time, regardless of the number of attempts. We may also take into account the number of attempts or the total navigation time from the start to the finish line.

This challenge can also be carried out using land vehicles, which eliminates the need for water channels. In this case, a straight race track of about 3 meters can be constructed using paint or adhesive tape. Besides, the bill of materials may include items that can be used to build wheels or elements that enable vehicles to slide on the ground.

5.5 Conclusion

Prototyping in Design Thinking is the iterative generation of artifacts intended to answer questions that get you closer to your final solution. In the early stages of a project those question may be broad – such as “do my users enjoy cooking in a competitive manner?” In these early stages, you should create low-resolution prototypes that are quick and cheap to make (i.e., in the

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range of minutes and cents respectively) but can elicit useful feedback from final users, team colleagues and other stakeholders (e.g., funders, regulators, retailers…). In later project stages, both your prototype and questions posed may get more and more refined. For example, a later-stage prototype for the cooking project may be constructed that aims to find out whether users enjoy cooking with voice commands or visual commands.

Prototyping and testing are tasks that should be carried out concurrently more than two different activities between which the designer transitions. What you will be trying to test eventually and how you are going to do it are critically important aspects to consider before creating a prototype.

However, addressing these two activities together also brings in new perspectives. Though prototyping and testing are sometimes entirely intertwined, it is often the case that planning and executing a successful testing scenario is a considerable additional step after creating a prototype. Do not assume that you can simply put a prototype in front of a user to effectively test it. In many cases, the most informative results will be the consequence of careful thinking about how to test in a way that users are motivated to produce the most natural and honest feedback.

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6 Testing

When you want to determine and understand exactly how people will interact with a product or service, the most obvious method is to test it in a real environment. In any case, it would be very cumbersome to wait until you have produced something completely finished for people to try it out. Take the example of the new NBA balls that we presented in the Prototyping chapter (cf. Sect. 5.3.2, page 60). As we saw then, the most reasonable strategy is to develop simple and reduced versions that can then be used to observe, record, judge, and measure the specific elements of the different components of a solution, as well as people's interactions and reactions. The latter is basically the testing phase.

What we are trying to test, as well as how we are going to test it, are critically important aspects before starting the testing phase. Although prototyping and testing should be interrelated, on many occasions the careful planning of a test scenario is a preliminary step that should be taken into account even during the creation of a prototype. It should not be assumed that a prototype can simply be placed in front of a person for testing. In our opinion, the most informative results will come from careful thought about how to conduct the test in a way that will elicit the most natural and honest reactions and feedback. Moreover, it may sometimes be necessary to make intermediate prototypes during some of the previous stages of the Design Thinking process.

In short, once the prototype has been made, we proceed to rigorously test it, but not before carefully planning this test.

This is the final stage of the Design Thinking methodology to be discussed in this manual. In any case, in the iterative process proposed by this methodology, the results generated during the testing phase are used to go back and redefine the problem, to try to better understand the context in which we develop the solution, how people think, or how they behave.

We can say that we test the prototype with three complementary objectives:

1. On the one hand, we seek to refine the prototype itself to get even closer to the solution that the people for whom we develop our project really expect. In other words, the tests inform and guide the next iterations of the project. Sometimes this means going back to the design board and retaking any of the previous phases of the Design Thinking methodology. Testing can also help to identify previously unidentified problems.

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2. In addition, we use testing to learn more about people. Tests are another opportunity to generate empathy through observation and engagement, as unexpected ideas often appear. See if people experience difficulties with the prototype they are testing, the team should review its list of possible solutions and strategies to establish new ways to solve the same problems.
3. Finally, the tests serve to refine the point of view gained in the definition phase. Sometimes, the tests reveal that not only did we not get the solution right, but we even made a mistake in correctly identifying the problem we were supposed to solve.

The feedback obtained during testing is very valuable. If we do not have a good understanding of people's needs to carry out their activities and tasks, the iterative design process and solution will fail. Just as with each stage in a Design Thinking process, the tests should provide new insights to improve understanding and help define or redefine the various problems we face. Therefore, it is necessary to obtain feedback whenever possible, to test with the people to whom the solution is addressed, and to analyze the results to determine that it is working well and that it is not that is going to cause problems.

As we pointed out before, testing sessions are more fruitful when they are carefully planned and organized. For this we can make use of the tools described in the following sections. In addition, we can use the team challenges introduced in the Prototyping chapter (cf. Sect 5.4) to demonstrate the iterative process by which we refine a prototype using feedback from the testing phase.

6.0.1 Why testing?

The testing phase is the opportunity to present a product to the world, test it in real life and test it in real time. During this phase, the developers have the opportunity to see if they have addressed the problem in the proper way. In this sense, three different aspects are covered while testing:

- The team can generate feedback from users, specific to the prototype, and this feedback in turn deepens the knowledge about the users.
- The team will find new ideas to feed into all stages of the process during iterations.
- Finally, observation during this stage is likely to uncover needs that users have never identified before.

In this phase tests are carried out with the prototypes previously made and users are asked for their opinions and comments based on the use of the prototypes. This is an essential phase in Design Thinking as it helps to identify errors and possible shortcomings of the product. Based on the tests, various improvements to the product can be presented.

Despite being the last phase, the team may encounter several situations that require going back more than one stage in the process. For example, if the team realizes that the problem is not well defined, then it is necessary to go back to Definition and start again from there. Otherwise, the team will most likely go back to the prototyping phase to refine certain details or include new features.

Testing is, therefore, the last phase of a Design Thinking process. It is the "moment of truth" in which we will show the user what we have designed for him. It is the end of a process of

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generating ideas, which have been landed in the form of a prototype. Ideas that have been based on a previous research and definition that included aspects of special value for the user.

6.1 How to do the testing phase

There is a wide range of testing methods available during a Design Thinking project. At the heart of all methods is the need to test the solutions made real through prototyping. The best is to use a natural environment, that is, the normal environment in which people would use the prototype. If testing in a natural environment is not possible, people will not act in a natural way. In this case, we should try to direct the people who are going to perform the test to perform specific tasks or to act out a specific role when testing the prototype. The key is to get these people to use the prototype as they would in real life, as much as possible.

Several aspects have to be covered in the testing phase. Once fulfilled, the team should plan the test, assign roles to each member in the context of the testing and properly define how to receive the user feedback from the prototype.

The main aspects to be covered are:

1. **Context of the test**: Ideally, the prototype should be tested in a real-life context. For example, in the case of a physical object, we could ask people to take it with them to use it within their normal routines. For a user experience, we would try to create a scenario in a location that captures the real situation. If it is not possible to test a prototype on-site, we would look for a more realistic situation by having users take on a function or task when they approach your prototype.
   Performing a test is not as simple as taking the testing subjects and the prototype into the same room and observing what happens. To obtain the most useful information from a test there are several aspects that we must take into account.
2. **Focus on the prototype**: The prototype is to be tested, not the people. The prototype should be designed with a central question in mind, a question that will be tested at this stage.
3. **Plan the context and scenario**: As far as possible, the scenario in which the final product or service is most likely to be used should be recreated. In this way, more information can be obtained about the interactions between the people, the prototype and the environment, and about the problems or new situations that could arise as a result of these interactions.
4. **Correctly inform test subjects**: We have to make sure that the people who are going to participate in the test know what the prototype and the test are about, and understand what is expected of them. If it is impossible to carry out the test in a real environment, we must clearly explain the role that each person participating in the test must play.
5. **Observe and capture feedback**: We have to make sure that we do not interfere with the testing process while recompiling comments or reactions. We must recompile these comments and reactions in such a way that we can observe what is happening without interference.

If we are careful with these five aspects we will be able to extract the maximum possible information from the testing process. Next, we will discuss in more detail the planning process of a test, and then provide some techniques to optimize the capture of information from the people who participate in the test, that is, to obtain feedback about the test.

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6.1.1 Test planning

As explained previously, testing is not simply showing the user our prototype. It implies carefully listening, detached from our own ideas and prejudices, to the user's output. The end of this phase also marks a turning point and a strategic decision point. We will have to decide, according to the feedback collected from the user, what actions we are going to take in order to continue to get closer to the solution that fits their needs and desires.

The moment of testing brings us back together with the user, just as it happens in Empathize. It is important to prepare for this meeting moment. One way to do this is to review with the team how the process has been up to this point. Writing some notes in relation to each of the phases:

- Empathize: Select some of the phrases that the users told us or a feature of their behavior, and see how they relate to the solution we are going to present to them. For example, let's imagine that we have designed an app that allows them to control their expenses, of which we are going to show them some screenshots. Before the interview, we will write down some of the phrases that they told us and that we think have led us to the design of the functionalities that we are going to present to them.
- Define: Take note of the focus of action that led to each of the ideas landed in the prototype. Continuing with the previous example, let's imagine that one of the action points we defined was "I find it hard to save without motivation". Among the functionalities we included in the App based on our ideas, there is one that allows them to choose a "purchase goal". As they save, a bar fills in the money they need to reach that goal. This solution connects with the aforementioned action focus. Having all the Action Focuses-Generated Ideas relationships in front of us in the validation will help us to better analyze the user's feedback in relation to our work.
- Ideate: In this case we will write down the ideas. And how they have been tangibilized in the prototype. During validation we will pay attention to user feedback. Observing if the power of the idea has been increased or reduced. From the way it has been landed or intends to be landed.

Some other important aspects to take into account are those related to organization and tools to keep track and record of the interviews and feedback received from the users. For instance, some useful tips and tricks are:

- Presentations are fundamental tools in the context of testing. They are useful to correctly inform the test subjects of what is expected from them, to present the prototype, or even to perform the function of a prototype. They are also useful to collect and disseminate feedback obtained during the testing process.
- Keeping notes and having a simplified outline of our route can help us to get feedback. In an orderly way, we will have in front of us the logic of the steps we have been taking. And we will be able to compare it with everything the user tells us.
- When talking to them, we must never forget our main objective: to obtain the most genuine information possible to know if we are connecting with their needs and desires. To do this, one fundamental maxim is listening: to understand rather than to sell.
- For this reason, when we show our prototype we must listen. Put aside our desires and expectations. And remember that the user is at the center of the whole process.

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- Selling is on the opposite side of listening and understanding. And we should not do it. Our efforts should be focused on perceiving the coherence between the user's words and his/her actions. In detecting the brakes that arise when interacting with the prototype. And in answering the questions, always looking for them to lead us to more information provided by the user.
- As a last point, the ego is the main enemy of listening. It is responsible for blaming the user when he/she does not respond as we would like. And the one that can lead us to abandon the process. Even in cases where the user is not clear, or contradicts himself/herself, we must put ego aside. And strive to understand the reasons why we are not managing to empathize or connect with the user.
- We should prepare the testing environment so that we can focus on showing the prototype with a neutral attitude about it. As designers, we may be tempted to give our opinion about the benefits of our creation, but we must let people experience the prototype and draw their own conclusions. Avoid over-explaining how the prototype works or how it is supposed to solve a given problem. It is better to let the experience of using the prototype stand for itself. We should limit ourselves to observe without interfering.
- On some occasions it will be convenient to create multiple prototypes, each one with a change in some of the aspects we intend to test, so that the test subjects can compare the prototypes and decide which ones they prefer and which ones they don't. In most cases it is easier to explain the likes and dislikes of the prototypes when you can compare them.
- We have to ask the people participating in the test to express what goes through their minds when they are exploring and using the prototype, to speak through their experience. It may take some time to get them relaxed and adjusted to an unusual situation, so it may be a good idea to talk about an unrelated topic and then ask them questions such as *What are you thinking about right now while you are doing this?*
- We must always bear in mind that we are fundamentally observers. We pay attention to how the prototype is used, regardless of whether its use may seem correct or incorrect. We will try to resist the temptation to correct if we misunderstand how the prototype is supposed to be used. Mistakes are valuable learning opportunities.
- In this sense, the questions we ask during the tests are very important, even if you think that we already know what a specific user will answer without the need to ask. We should ask questions such as *What do you want to say when you say …?* or *How did you feel about that?* and, most importantly, do not get tired of asking *Why?*

6.1.2 Assign roles

In order to prove our prototypes in front of an audience there are several ways, after the careful planning realized in the previous section, to assign roles in the group to conduct the test. Generally speaking, user testing involves selecting users from a segment of the population and achieving insights about our prototype. However, depending on the agenda, deadlines or budget of the project, testing the ideas frequently with as many people as possible is not feasible. Therefore it is also useful to do some prototype testing with people you know, making an effective technique for validating ideas and with minimal efforts. This technique of running a quick test with 5-6 people the team knows and observing how they use, manipulate and deal with the prototype, is a fast, simple and cheap way to learn a lot of insights.

Another important point to take into account is the type of users recruited for the testing (age,

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media channels, social channels, etc.) and if you are planning an in-person test or remote test. Selecting a representative group of the population that will be the final users of your prototype is essential to perform an objective testing. Getting user feedback following carefully the test planning explained in the previous section is the core of this stage of Design Thinking.

In any case, not only final users of our prototype will play a role in testing, we must select others as important as those defined. These basic roles are:

- Host or moderator: Provides a short and concise introduction to the context and scenarios. Without much explanation, the user must also discover by himself/herself all the aspects of the prototype. He/she also guides the questions.
- Players: They accompany the user to create the prototype experience.
- Observers: They just watch and observe the user experience with the prototype and annotate feedback.

The procedure in the test should be strictly followed by the members of the team, each of them adhered to the assigned role:

1. Let the user experiment with the prototype. Show it, don't tell it, just a minimum of information so they can understand it. Don't explain what it does or any reasoning for the functioning of the prototype.
2. Let the user vocalize while living the experience. Ask "*Tell me what you are thinking while you are doing this*" style questions.
3. Actively observe how they use (or misuse) the prototype. Don't correct what the person is doing, just observe.
4. Always ask questions. It is the most important thing in this phase.

6.1.3 How to get user feedback

Compiling information and comments from people is a characteristic aspect of the Design Thinking methodology that is of crucial importance in the testing phase. To maximize the benefits of information capture, it must be carefully planned to avoid making mistakes. We can identify several aspects to be taken into account during the capture of the comments and reactions of the participants in the tests.

How to request comments. It depends on the type of prototype that was built. As we pointed out before, it may be convenient to test several versions of the prototype. This facilitates the appearance of critical comments because people tend to abstain from openly criticizing the prototypes if only one version is available. When users can choose between alternative versions and allow them to compare the different prototypes and say what they liked and disliked about each version, they will get feedback that is more honest.

Choosing the right people. This is necessary to ensure the usefulness and relevance of your comments. If you are in the early stages of a project and only want simple and approximate feedback, testing the prototypes with team members would be sufficient. Towards the end of the project, when the prototypes become more detailed and closer to a final product, it will be necessary to test with a wider range of people to obtain really relevant and useful comments.

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Ask the right questions. Each prototype should have some basic questions associated with it that you want answered. Before testing prototypes and recompiling feedback, you should be sure what exactly you are testing. For example, if you want to find out how easy a product is to use, you should orient the testing session to determine that characteristic and focus on discovering the positive and negative comments related to ease of use.

I like, I want and what if. This method invites the user to provide open comments with three types of statements:

- In the statements *I like…*, it is recommended to the user to transmit the aspects that he/she liked about the prototype. This provides them with positive feedback about your prototype.
- In the statements *I want…*, users are asked to share ideas on how the prototype can be changed or improved to address any concerns or problems.
- In the statements *what if…*, the user can express new suggestions that may not have a direct link to the prototype. This opens up possibilities for new ideas in future interactions.

Keep an open mind. Many times, testing sessions can reveal key points about previously unknown problems.

Remain neutral. We must be as objective as possible when presenting a prototype. Avoid highlighting the positive and negative aspects of the solution or trying to sell the idea. When people participating in the test express negative comments about the prototype, avoid defending it. Instead, do more research to find out what exactly is wrong. We must avoid being attached to our solution, and always be ready to change it, or even abandon it.

Adapt. When testing a prototype, we must adopt a flexible mindset. For example, if we notice that certain parts of the prototype distract attention from its main functions, we should eliminate or change them to refocus attention on the key elements. In addition, if we see that the script planned for the test session does not work well, we should not hesitate to deviate from it and improvise to obtain the best possible feedback.

Comments box. A comment capture table (cf. Figure 6.1) is a structured way of organizing the comments that are compiled from the test sessions. A sheet of paper is divided into four quadrants:

1. If you label the upper left quadrant with the text “I like” or a “+” symbol: this is where the positive comments will be noted.
2. The upper right quadrant is “Criticisms”, where negative comments and criticisms about the prototype will be captured. We can also label it for example with a “-” symbol.
3. In the lower left quadrant there are “Questions”. where you can write the questions asked by the people who participated in the test, as well as the new questions that arose in the test session. We can mark it with the sign “?”
4. Finally, label the bottom right quadrant as “Ideas” or with the sign “!”, and this is where you write down any new idea that provoked the test session.

Let the ideas flow. During the testing session you should allow, and even encourage, the people participating in the testing session to come up with new ideas inspired by the prototype. For example, they can ask how the product or service could be improved. We can also reformulate some of the questions asked by the test subjects and be interested in their own opinion. For example, if someone asks about how to charge a new electronic device, we can turn the question around and be interested in what would be the best charging method for the new device.

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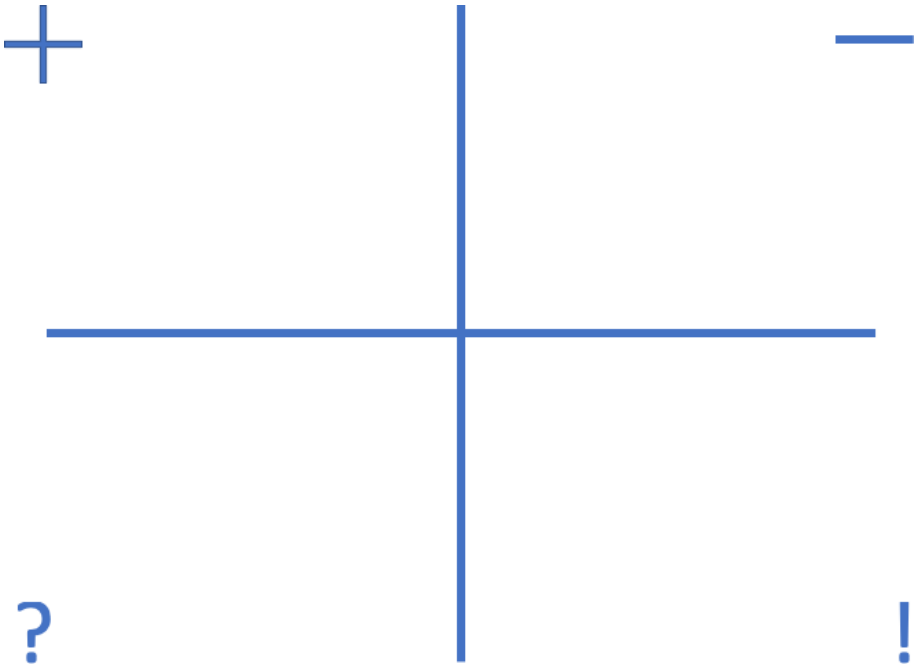

Figure 6.1: Comments Box. The quadrants collect the positive comments (+), the criticisms (-), the users' questions (?) and the new ideas (!) generated during the prototype testing

Inspiring stories. Stories are powerful tools to inspire and think of solutions. In this process, one by one, all team members can share a couple of interesting and inspiring stories they observed when testing the prototype with users. When all participants are finished, they can examine the stories that were shared and look for common themes and possible ideas about the users to translate the inspiring stories into next steps for the project.

6.2 Useful tools

Next we will describe some useful tools we can use in different steps of the Design Thinking methodology, including their descriptions, web pages or software to implement these solutions, and some interesting tips about how to use them.

6.2.1 Presentation techniques

Presentations are a fundamental tool within the Design Thinking methodology because they allow us to transmit our ideas in a structured and very visual way. They are a communication tool that adapts very well to many different contexts, for example to show a prototype to a person or group of people, to communicate ideas, to give arguments for or against, as a support to give a speech, to distribute tasks among the members of a work team, to coordinate activities, etc. During a presentation we transmit a message to our audience, and in many cases this message contains some persuasive element. It can be, for example, a talk about how well our team works, about what a candidate for a job position can offer to a potential employer, why my project should receive additional funding, or how ingenious our prototype is.

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An effective presentation exploits (in a positive sense) the relationship between the person making the presentation and the audience. It takes into account the needs of the audience to capture their interest, facilitate their understanding, or inspire confidence. For our presentation to be more likely to succeed, good planning is essential. To begin with, we have to be very clear about what our objectives are, who our audience is, where we are going to make our presentation, and under what conditions we have to make it.

Some tools for making or sharing presentations:

- Prezi (http://prezi.com). It provides an online tool for making presentations in a very intuitive and visual way that requires little technical knowledge. It allows you to create presentations with animated transitions that unfold in a single space where the action takes place, moving from one element to another until a route is completed. A free version is available.
- Google Presentations (http://docs.google.com/presentation). Like the rest of Google's ecosystem of applications, this free application allows you to create and modify presentations, as well as collaborate in teams and teach them anywhere.
- Impress (http://openoffice.org, http://libreoffice.org). Part of OpenOffice and LibreOffice, perhaps the most popular open source office suite. It also supports PowerPoint file formats.
- PowerPoint (http://office.live.com). Probably the most well-known application for making presentations. Like the rest of the tools discussed here, the new versions also support online collaborative work and the distribution of presentations over the Internet. It also supports OpenOffice file formats.
- Keynote (http://www.apple.com/es/keynote/). Apple's presentation application for computers with MacOS operating systems, very popular among the users of these computers.
- Slideshare (http://slideshare.net). More than a tool to make presentations, it is a social network conceived as a platform to host presentations and share them in public or private.

In all cases, we can use these tools with our laptop or personal computer, and also with our mobile phone or tablet through the corresponding applications.

Objectives

Why are we making this presentation? We need to be very clear about what we want to achieve with the presentation, and what we want our audience to take away with them. What do we want our audience to assimilate with the presentation? What action do we want the audience to take after the presentation?

Once we are clear about this, we will be ready to make decisions about the design, style or tone of the presentation. For example, a presentation to sell our project may require a certain aggressiveness in the presentation of its benefits, and a presentation to apply for additional funding may require a more creative approach.

Audience

In general, audiences tend to be heterogeneous. Even if our presentation deals with a specific topic or a specific project, among our audience there will be people with different experiences, interests and levels of knowledge. To prepare a good presentation we have to ask ourselves if our audience already has some knowledge or experience about what we are going to present.

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Having a certain knowledge of our audience will also allow us to relate the content of our presentation to things they already understand or know, so that the speech will be more attractive and easier to assimilate. In addition, knowing how our audience breathes will give us clues about how easy or difficult it will be to convince them of our point of view.

It is not necessary to know each individual person in our audience, but it is essential to have general information about them to make sure that the material is appropriate. If we do not take into account the concerns and needs of our audience, it will be difficult for us to capture their interest or activate their imagination. For example, we should know our audience well enough to know if we should avoid or use technical terminology, if we should try to explain abstract concepts with practical examples, what effort we have to make to contextualize our ideas, etc.

Location

The scenario where we are going to make our presentation conditions to a great extent the way we relate to our audience. For example, a large theater can create a very formal atmosphere, while a small seminar can create a more informal atmosphere. Making a presentation from a raised platform can give an impression of distance from the audience, while proximity to our audience in a meeting room can encourage trust and participation. It is important to take into account if it is possible to modify the distribution of the furniture or the equipment of the place of the presentation, or even if we can opt for a place that adapts better to our needs.

Conditions

On some occasions there are certain conditions that must be met in order to carry out our presentation. For example, we may be asked for a copy of the material to facilitate simultaneous translation or for later publication, so that we will have less room for improvisation. Other usual conditioning factors are the maximum time available, whether or not questions are allowed from the audience, if there is a maximum number of slides or a graphic style that we must follow.

Pecha-Kucha Presentations

A Pecha-Kucha presentation is a type of presentation in which 20 slides are shown for 20 seconds each. Therefore, a presentation of this type always lasts 400 seconds, that is, 6 minutes and 40 seconds. With the Pecha-Kucha methodology we achieve concise and agile presentations. In case our audience has to attend a session with several presentations (e.g., a proposal evaluation board, an award jury, potential clients of certain products or services, an audiovisual pitching, etc.), this methodology allows us to limit the duration of the sessions and provide all the presentations with homogeneous conditions.

Mastering the Pecha-Kucha methodology requires a certain amount of practice. Anyway, there are some ideas that we can take into account:

- Never forget that the conditions are strict, so organize well what you want to transmit taking them into account. For example, if the theme of your presentation can be organized in 4 ideas, dedicate to each 5 transparencies.
- Try that each transparency transmits a message in itself.

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- Devise an outline for your presentation taking advantage of its format. For example, the outline could be a two-column, 10-row chart, where the first column is videos and the second column is text and/or images (cf. Figure 6.2).
- Try to be visual. Use images to increase the visual clarity of each transparency.
- Write a script for each presentation slide. 20 seconds of narration should be between 30 and 60 words, depending on the speed of the speaker. Copy the script in the notes part of the presentation and/or in the outline.
- If you include text on the slides, this text should support and complement the narration, it should not compete with it for the audience's attention. The audience should listen, not read.
- Practice reading the script out loud until you are confident in your presentation. Don't forget that you have exactly 20 seconds for each transparency! Consider recording your presentation using the media provided by your preferred presentation application.

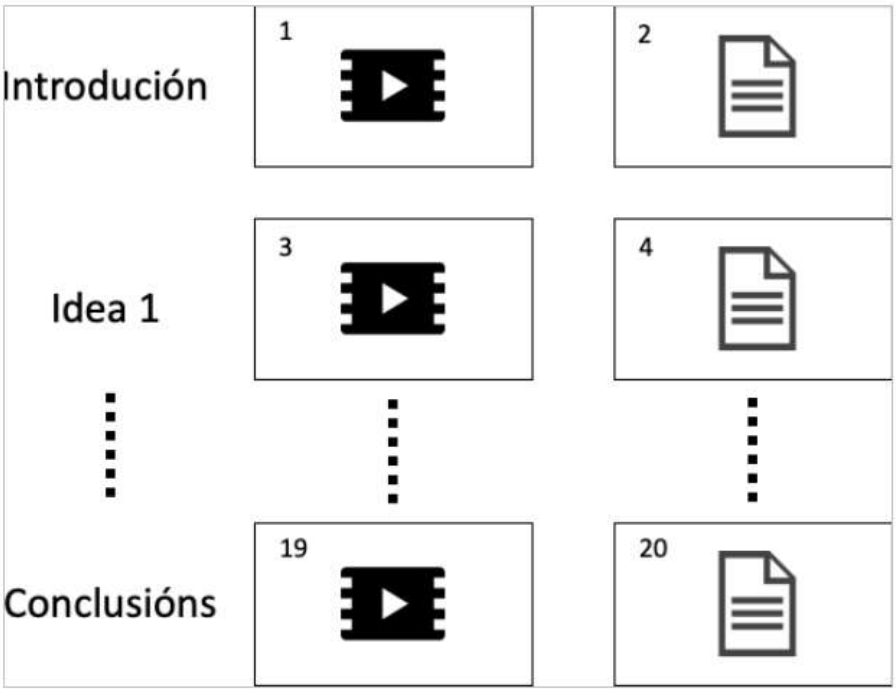

Figure 6.2: Example of Pecha-Kucha

6.2.2 Infographics

The word infographics comes as a compound of the words "information" and "graphics". They represent a graphic and visual way to show information, data, or knowledge with the final objective that the information can be seen quickly and clearly. A typical example of an infographic could be a metro subway map, where we can see graphically and quickly all the information related with the different lines, stops, connections, etc.

Infographics have existed for a long time, first known examples date from the XVII century. But are in recent years, with the extended use of the Internet, where they have become a mass communication method. Tools like Adobe Flash in the early 2000s allowed us to create animations and present information as infographics. Nowadays we can create them using different tools that

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make use of HTML 5 and CSS3. Also infographics can be included in social media sites, like Twitter or Facebook, which has greatly increased their visibility around the world. But they are easily found in other types of media, like newspapers and television, to show the weather, maps with information, graphs with summaries of data, and a large number of other possibilities.

Parts

We can find three parts in any infographic [*]:

- The visual part relates with the colors and the graphics, and deals with the way to visually represent the data.
- The content part is usually based on statistics and facts that can be obtained from different data sources.
- The knowledge part is the insight contained into the data that the infographics are presenting.

Types

The more popular types of infographics are related to different ways to visually represent the data. Next we will briefly explain them:

- Time-series: is one of the most common forms of data visualization, where we usually present the time in the x-axis and the data to represent in the y-axis, and we can see the evolution of a set of values over time. Examples of time-series infographics are:
  - Index charts: mainly used when values are less important than relative changes, like with stock investors as they are less concerned with price and more concerned with the rate of growth.
  - Stacked graphs: represent area charts stacked on top of each other to represent aggregate patterns, allowing to see overall as well as individual patterns, but make them difficult to interpret trends.
  - Small multiples: an alternative to stacked ones, where instead of stacking the area chart, each series is individually shown, making each sector's overall trend easier to interpret.
  - Horizon graphs: they increase the data density of a time-series ones but preserving the resolution
- Statistical distributions: are used to discover trends based on how numbers are distributed by means of calculations as frequency, mean, median, and outliers.
- Maps: are the natural way to represent data associated with its geographical location. In them we can use different shapes, sizes, widths and colors to help encode information, or even create distortions in the shape of a region related with the data variable by redrawing them proportionally to the data.
- Hierarchies: many types of data can be organized following a hierarchy. For example, with node-link diagrams, following the structure of a tree, we can place the data into branches, allowing us the representation of multiple sub-sections.
- Networking: are used to graphically represent relationships, such as friendships. Examples of networking infographics are:

[*] as seen in https://spyrestudios.com/the-anatomy-of-an-infographic-5-steps-to-create-a-powerful-visual/

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- Force-directed layouts: where nodes are represented as repeling charged particles, with links that are used to join related nodes together.
- Arc diagrams: are one-dimensional layouts of nodes linked with circular arcs those who are related.
- Matrix views: have a node in each value in the matrix. By means of color, values associated with the links can be easily identified.

Tools

An infographic can be easily created using paper, ruler, pen, pencils and markers. But we have available different software or several online tools that can facilitate its creation. Here are some:

- venngage.com (`https://venngage.com/blog/what-is-an-infographic/`): this web page provides several examples, templates that can be used and even design tips that can help us create our own infographics.
- canva.com (`https://www.canva.com/create/infographics/`): this online tools allow us to select into a wide range of infographic templates, customize it with images, illustrations and graphics, to finally save it and share it.
- infogram.com (`https://infogram.com/`): this webpage allows us to create engaging infographics and reports in minutes with the idea in mind of design with ease, enhanced with collaboration in real time, and with the final options to download, share and publish online.

6.2.3 Feedback capture grid

Already introduced as a tool on the section of “How to get user feedback”, the feedback capture grids are an amazing tool to record the information and feedback obtained in the testing sessions, allowing it to be presented in a structured way which will help us, as developers, understand what the users are trying to tell us. Also the information must be as detailed as possible. To do so we must encourage the users to explain all their information, feelings and every single detail they consider necessary about the prototypes.

Once the feedback capture grids are obtained, even if we have just one for all the users or one for each user, they will help us to find common ideas, demands or problems from the users, as well as to visualize their priorities. We can even cluster similar ideas or patterns inside them, giving us hints on how to solve the related problems.

How

Next we present a list of steps in order to use a feedback capture grid:

1. To start using one, we should divide a sheet of paper into four quadrants. Any surface to draw on will do, as a whiteboard, or an online document using one of the many feedback capturing grid templates that we can find online.
2. There is no general consensus of what to put in each quadrant, but one generically used could be:
   - Worked (or likes, +): on the top-left quadrant, we will write here the positive feedback, i.e. the things that have worked.

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- Change (or criticisms, -): on the top-right quadrant, we will capture here the things that must be changed, the negative feedback and the criticisms about the prototype.
- Questions (or ?): on the bottom-left quadrant, we will write here to types of questions: 1) the ones that the users have asked, and 2) the ones that the test session raised, the ones that we still have.
- Ideas (or !): on the bottom-right quadrant, we will write here the ideas that the testing session with the users has sparked.

3. It is interesting to write in all the quadrants, at least a few notes. If you see that we are not obtaining enough feedback in one of the quadrants, it is recommended to guide the conversation with users to the corresponding topic of the quadrant.
4. Evaluate all the feedback capture grids obtained with your colleagues and discuss them in order to resume all the information and feedback received.
5. As we have emphasized during all this book, Design Thinking is not a linear path to find a solution to a problem. With all the information received in these previous steps of the feedback capture grid, you should go back to one of the previous Design Thinking phases in order to iterate to find a better solution that addresses the new information received during the testing phase.

6.2.4 Storytelling

Storytelling is yet another of the great tools that we can use in different phases of the Design Thinking process. In the testing phase, we can find use for it in two moments:

1. When introducing the users to the testing phase, we sometimes need to make them understand what they are testing, why they are testing it and where is the test taking place. All these can be done in a more appropriate way by using the storytelling tool, that just simply explaining the situation.
2. When we have done the interviews with the users and we need to share the data with the rest of the team not present in those interviews, an introduction using storytelling can facilitate the team to collaboratively understand the information and insights obtained in those interviews. In it, each team member present in the interviews shares their experience and observations in the interviews as a story, while the rest of the team take notes related to the stories.

Storytelling for the users testing

In the first case, we need to give information to the users that are going to test our products. We must make them feel informed, to know a little bit about the product, as well as comfortable, as if they were testing the prototypes in their location they are designed for.

One way to make the users feel involved in the testing is using a storyboard as visual illustration of the whole process for the users: a little bit of background, a short introduction to the prototype and a sense of information about the location where it is being tested. In this last case, if we have the chance to adapt our location to look like the real location where the product will be used, we should do it without thinking twice. Doing so the users will feel more integrated in the whole testing process.

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Then, continuing with the storytelling, the members of the group can use a little bit of role play, in order to act out the experience to the users that are going to be involved in the testing with the objective of giving them a better understanding of the prototype we are presenting. Apart from the role of the interviewer, we can think in a role of a presenter, which introduces the testing phase, a role of facilitator, which helps the users during the testing phase, and a role of observer, which watches the user experience and annotates feedback.

As the final phase of this storytelling we will have the presentation of the prototypes, to which the users will arrive with a sense of immersion into the process that will improve and facilitate their experience. All this usually means for the team of developers to obtain more information about their prototypes in the interviews, which will lead to a better change to improve them.

Storytelling the interviews with the users

In the second case, storytelling works better just after the interviews with the users, when the memories of such activity are still fresh. This storytelling is going to be based on all the data collected during the interviews. The members of the team present in the interviews recounts each one of them, highlighting the observations and information that stood out. The rest of the team takes note of everything down. Once all interviews have been shared, the team gathers to share their notes and to find groups of them that have something in common. Once we have found those groups with things in common, it is necessary to identify a headline for each of them, as it should give us good insights of the information obtained in the interviews to the users.

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Glossary

D

Design-Challenge A question that frames the problem field and serves as a starting point for a Design Thinking project.

Design-Thinker A person living and working with the Design Thinking mindset.

Design-Thinking-Process Consists of 6 steps: understand, observe/empathize, define point of view, generate ideas, prototype and test. The process is non-linear and iterative.

I

Ideation Is what happens after teams truly understand a user and her needs and generate ideas on how to help her. Any idea or a combination of ideas can potentially become a future solution. In Design Thinking, it is essential to separate the generation of ideas and their evaluation.

Iteration The act of returning to steps in the Design Thinking process flexibly (i.e. in varying order based on needs) and multiple times in order to learn, revise, refine, or experiment, and thus come to a better result.

M

Multidisciplinary-Teams Teams consisting of 4-6 people who differ in such aspects as their professional expertise, job functions, seniority levels, background, gender, and culture.

O

Observe-Empathy The team develops empathy for the user through qualitative design research. Methods such as interviews, observation of behavior or immersion (to put oneself in the shoes of the user) allow deeper access to the user.

P

Point-of-view Defining a point of view is the process of reframing a design challenge into an actionable problem that incorporates and synthesizes key learnings from the research.

Prototyping A craft that transfers ideas and assumptions into a tangible form that both the team and the users can experience and react to. Prototyping in teams is not only a highly creative and generative experience but also a unique way to connect minds in a playful manner.

S

Synthesis Is the art of connecting the dots. Once a design thinking team has accumulated numerous data from observing users, their task is to make sense out of these data by arranging and rearranging them in a meaningful order that inspires them for future solutions.

T

Testing It is crucial for iteration in the Design Thinking process. A prototype is a representation of the current knowledge and assumptions of the team. Testing them – that is, setting up scenarios in which the user can experience and interact with the prototype, as well as give feedback – is a crucial step in learning more about the idea, assumptions, and the user, and is often the basis for further iteration.

U

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Understand The team exploits the problem space with various methods and asks themselves: What or who has what needs and problems with relation to the challenge at hand? What solutions are out there already? Real understanding of a problem comes before the solution to a problem.

User-centric A way of working in which the user with his or her needs, wishes and problems is the focus of (innovation) efforts.

W

Warm-Up An exercise that gets a team into a mental or physical state appropriate for the work phase that follows. It is often used at the beginning of the day or after the lunch break to raise energy levels. In the training context, it can also hint at the training content to follow.

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