

**Cyprus University of Technology**

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**MSc Interaction Design**

**INVESTIGATING DESIGN THINKING: A PILOT**

**STUDY ON FRAMEWORK**

**Master thesis**

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Date: 30.12.2020

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## ABSTRACT

The purpose of this study is to investigate the concept of Design thinking.

This study should be seen as a pilot study which had the aim to shed light to a multi-faceted concept that has greatly increased its popularity over the years.

In order to propose a framework and validate a framework a comprehensive literature research has been done exploring how design thinking evolved during the years. Then, Based on the literature review, a framework has been proposed and it has been tested through a mixed method approach. In particular due to the elusive nature of the phenomenon it has been used an *explanatory sequential design* where a quantitative phase is followed by a qualitative one.

A survey was designed to collect design thinking practitioners (n=39) opinion on the framework according to 10 dimensions.

At the end of the survey results analysis a semi-structured interview has been done to an experienced design thinking facilitator coach in order to further explore some notable survey results. The research highlighted how the framework well fits with the phenomenon. From this work design thinking emerges as an alternation of phases where, given a value to achieve, a nonlinear problem (so called wicked problem) is explored until it is framed in a new and original way, allowing then to explore multiple solutions to reach the goal.

Finally, the interview highlighted how design thinking is still a risky concept because its fluidity is often misunderstood as a lack of effectiveness and theoretical fundamentals.

Keywords: design thinking, mixed method, wicked problem.

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## LIST OF ABBREVIATIONS

DT: Design thinking

## 1. INTRODUCTION

Design thinking (DT) in the most acknowledged definitions is *a human-centered approach to innovation* consisting in a succession of 5 steps: Emphasize, Define, Ideate, Prototype and Test (Brown, 2008, 2009).

First conceptualization of DT is from the 50's and it's mostly rooted in the cognitive psychology and decision making (ex. Arnold, 1959; Simon, 1958). Authors like Arnold and Simon for the first time pointed out how for the complexity of modern society problems all the professionals should adopt a creative way to think similar to the one adopted by the designers. Two great examples of DT are the *Ford kick activate tailgate* and the *Amazon product subscription*.

In 2012 Ford in its Kuga SUV model implemented a kick-activated tailgate giving the possibility to open the tailgate without using the hands. The tailgate sensors automatically turn on when the remote key is in its proximity of the car. In order to open the tailgate to just need to do a soft kick under the sensor placed under the bumper. In this way, people who are dragging bags, luggage or other packages can easily open the tailgate without the effort to lay on the ground the packages, search for the key and pick up the packages (see figure 1).



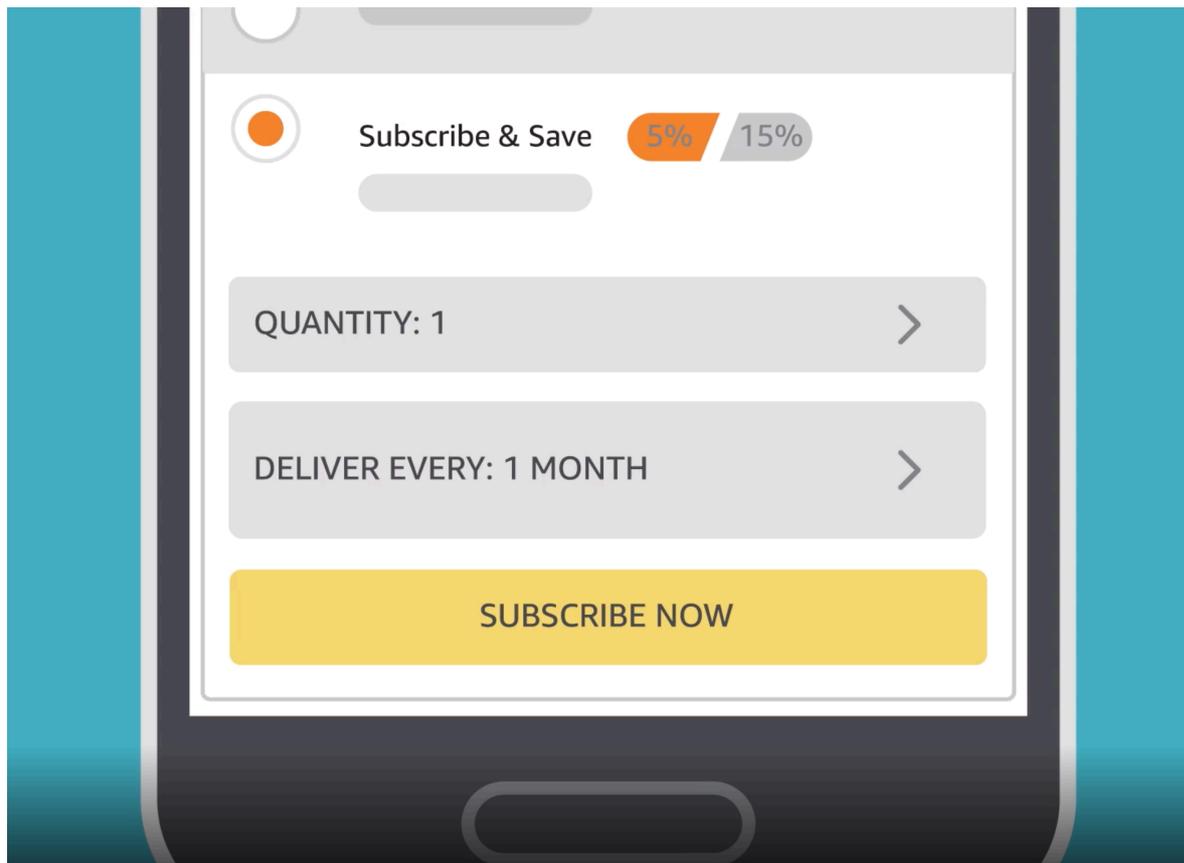
*Figure 1 The Ford kick-activated tailgate (via newatlas.com)*

This idea, in its simplicity, is a good example of innovation applied to human needs.

The second example is even more simple. Thus, whereas the Ford system is an IOT technology the Amazon product subscription is purely a digital system.

Thus, Amazon (and other similar services) implemented the possibility to automatically buy a product after a period set by the user. This is a solution designed to avoid the periodical buy of goods the users constantly need like soap, toilet paper which. In this way the users don't have to be afraid to end a product or to set any reminder to buy it: everything is automatic

(see figure 2).



*Figure 2 Amazon subscription product (via amazon.com)*

Design thinking largely increased in use in the last years. In particular it expanded from a design concept to a general set of best practice used in several contexts and also to a business mindset (ex. Compean, 2016). For example, Abramovich (2017) reported how:

- Design-driven companies have outperformed the S&P Index by 219% over 10 years.
- 75% of organizations self-report that they are engaged in design thinking.
- 71% of organizations that practice design thinking report it has improved their working culture on a team level.

In the following chapter will be highlighted and discussed the phenomenon of Design Thinking and the research questions.

In particular the main problems is that its theoretical foundations are multifaced and now DT is a term used to cover different things.

Thus, moved by the above-mentioned problem the goal of the study is to shed light on this growing concept and propose a framework.

In particular the framework will cover three themes: DT as problem solving approach, DT as a cognitive mindset, DT as the use of tool to enhance the abstract visualization.

The research method for this study was an explanatory sequentially mixed quantitative-qualitative method.

The aim of this following work is to propose a framework which could be a solid basis for further investigations.

## **1.1. Research Problem**

Design thinking (DT) in the most acknowledged definitions is *a human-centered approach to innovation* consisting in a succession of 5 steps: Emphasize, Define, Ideate, Prototype and Test (Brown, 2008, 2009).

The side effect of this popularity is that with the necessity to ride the wave of this hot trend among business, the focus on commercial goals and the tight deadlines lead to take poor attention in understanding what DT is. Thus, several authors are pointing how a lot of people claim to use Design thinking just because the office is full of sticky notes *misinterpreting its theoretical foundations* (Hernandez-Ramirez, 2018; Carlgren et al., 2016). Beside this misuse

of the design thinking, there is also the problem of a researcher confusion in *defining what is design thinking*.

In such frenzy scenario shedding light on DT framework and effectiveness appears fundamental in order to build reliability and trust to the Design thinking practice (ex. Schiendgen et al., 2016). As highlighted by Hernandez- Ramirez risk to be considered a “merely condenses a formulaic and naive view of the design process, using buzzwords and corporate jargon” (Hernandez-Ramirez, 2018, p.45).

In such confusing scenario where DT is used as Passepartout term for different practices and theories it risks losing specificity.

As described by Hassi and Laasko, the origin of these problems seems to be the double discourse of design thinking: the designer and the managerial (Hassi & Laasko, 2011).

According to the authors at the start of the millennium the two discourses became two different thing and started to proceed in parallel. The design discourse is referring the way on how to think for design while the managerial one on how to bring innovation to the company (Hassi & Laasko, 2011).

## **1.2. Research questions**

According to the authors at the start of the millennium the two discourses became two different thing and started to proceed in parallel. The design discourse is referring the way on how to think for design while the managerial one on how to bring innovation to the company (Hassi & Laasko, 2011).

Purpose of this study is to understand the two different discourse and propose a *unique framework* which both visions are integrated. According to the writer design thinking is a

multidimensional concept consisting of a problem-solving approach enhanced through a cognitive mindset and the use of visualization toolkit.

The first part of the following work will be a detailed analysis of the DT definitions and studies. Starting from the origin will be deepened different frameworks. The focus will be on 3 different ways to consider DT: a problem-solving method, a cognitive approach and creative toolbox.

In the second part, starting from the literature review, there will be a proposal of a unitarian framework which accommodates the different views of DT. Lastly this framework will be tested through a mixed method research.

### **1.3. Research Design**

In order to evaluate the framework and gather further information about design thinking conceptualization and the way it is used, a mixed method research has been designed.

Specifically, the author designed an explanatory sequentially mixed quantitative-qualitative method administered to design thinking practitioners.

In the first quantitative phase the following 11 dimensions have been evaluated through a 51 items survey:

- 1. Design thinking conception*
- 2. Design thinking as cognitive style:*
- 3. Design thinking as collaboration:*
- 4. Design thinking and visualization:*
- 5. Design thinking and insight:*
- 6. Practitioners perception on DT:*

7. *Design thinking process*:).

8. *Design thinking and uncertainty in definition*: I

9. *Design thinking effectiveness*:

10. *Design thinking as iterative process*:

11. *Participants experience in design thinking and demographic*:

The second part of the study was semi structured interview where elements with a particular interest has been deepened with a design thinking coach.

This study has to be considered as a pilot study with the goal to gather descriptive data.

#### **1.4. Significance of this work**

This work has to be considered as a contribution to a literature which is growing year by year and to a salient discussion, the one about Design thinking nature and effectiveness, that convey researcher, practitioners and the business world,

Starting from this assumption, the significance of this work is in the attempts to gather all the most acknowledged theories and unify them in a unique and consistent framework. Further, this work offers an analysis of the practitioners' perceptions about the design thinking proposing also insight of important themes (ex. remote design thinking) that will be the next challenges in the sector.

## 2. LITERATURE REVIEW

### 2.1. Introduction

In the following chapter the Design thinking will be analyzed starting from its early appearances in the 50's (ex. Arnold, 1959) till the most recent theories.

What will be evident looking at the literature is how there is no there is no univocal definition. Thus, authors rather than giving definitions prefer to describe the essence of DT or the related open issues. (Johansson-Skeoldberg et al., 2013).

In the first part will be presented and discussed the transition from the old concept of DT as creative way of thinking to the modern conceptualization which sees DT as process rather than a personal threat (ex. Brown, 2008). After introduced the background and modern theories there will be discussed three themes and their relationship with DT: the problem solving, the cognitive approach and the toolbox kit.

In particular in the part dedicated to the problem solving approach will be discussed the fundamental roles of the *wicked problems* (Rittel 1967) and the problem framing in abduction reasoning (Dorst, 2011); a particular reasoning where nothing is known except the *value* to reach (ex. improve social participation in urban communities). These two concepts according to the author represent the interpretative keys of Design thinking.

In the second part dedicated to the cognitive approach. In particular it will be deepened the Schon's work about the reflective practice. In his work Schon (ex. 1983) introduced a type of rationality which learn from the action, and face problem without preassumption, rather than applying critically a set of knowledge.

Lastly, in the part dedicated to the toolbox presented the set of tools which identify the DT practices.

These three themes unified with the Hassi and Lasko (2011) are then used to propose a

framework. In this framework DT is framed as a collaborative problem-solving approach where practitioners using a thinking by through a self-reflective mindset solve wicked problems in human centered innovation in a new way thanks to the insight. This entire approach is enhanced through visualization methods and it is based upon iterative macro and micro processes.

## 2.2. Origin and definitions of Design Thinking

In discussing the historical development of design thinking it is important to point out how there never been an unique definition of the phenomenon. Thus, DT is described and understood in a variety of ways (Johansson-Skeoldberg et al., 2013). For example:

- As a *philosophy* or way of thinking, as a specific process for innovation or problem solving, or as a toolbox of methods inspired by design (Carlgren et al., 2014; Liedtka, 2014)
- As: *mindset*, process, and toolbox (Brenner et al., 2016) or
- As a *cognitive style*, as a general theory of design, and as a resource for organizations (Kimbell, 2011).

Binder et al. (2011) offer a different perspective on the nature of what design is. According to the authors, the design is a valuable thought, aimed at solving problems in a way that allows imagining new avenues for the future. This is summed up as, “*a service through rigorous creativity, critical inquiry and ethics of respectful design*”. These two perspectives above mentioned highlights one of the most frequent elements of design and conversely design thinking: it could be considered both as a process and a mindset and it is a creative problem-

solving act.

Moving on design thinking, its origins are essential to understand it.

The first uses of the term design thinking are at the end of 40's, with an increase in its prevalence in the decades to follow. The roots of DT emerged from an exploration of theory and practice as a means of addressing human technological and strategic innovation (Dam and Siang, 2018). The first to use the term "design thinking" was John E. Arnold in his "Creative Engineering" in 1959. Arnold was a mechanical engineer who dedicated his life deepening the concept of creative thinking and how to enhance the imagination. In the author perspective (1959) design thinking is a creative act which allows a product to:

1. novel functionality,
2. higher performance levels of a solution
3. reduction in production costs
4. increased market value

From the beginning, DT can be applied to all kinds of problems but throughout its history as well as in its current usage, it is always associated with what are known as complex problems. The most important step for establishing the link between complex problems and design thinking was Rittel's application of DT for solving what he defined as "*wicked problems*" (see more in paragraph 2.2) which are problems difficult to solve due to their contradictory and mutable nature (Buchanan, 1992).

As described above, the earlier definitions of design thinking conceptualize it as an inner cognitive characteristic, but from the 2000's design thinking started to become **a process** rather than a personal threat. In particular, responsible for this paradigmatic change is the design consultancy firm IDEO CEO Tim Brown. For the author design thinking is defined as a human-centered approach to innovation based on the ways that designers think and work

(Brown, 2008, 2009).

A detailed definition of DT as an approach is given by M.B. Jensen et al. (2016) which considers only one out of the several distinct definitions/conceptualizations of DT, one which they call “the most domesticated version” of it, better known as, the Stanford d.school style (M.B. Jensen et al., 2016,). This model is characterized by a multi steps approach. These steps are:

1. Empathize,
2. Define,
3. Ideate,
4. Prototype,
5. Test.

“*Empathize*” is the first step and it is the act of understanding the people you are designing for. At the beginning the most important thing is to understand the needs, how and why they act in a specific way. “*Define*” is step where the what you’ve learned in the first step is used to make sense to the whole information you gathered. Narrowing the design challenge scope, it is possible to focus only on the relevant aspect of the problems. “*Ideation*” is the step where ideas and concept are generated. Once these concepts are discussed and approved the following step is “*Prototype*” where the artifact is generated through an iterative process where through early feedback on the lo-fi prototype is possible to modify and improve the concept and the artifact itself.

The last step in “*Test*” where the prototype is shared with the users. This entire circle could be repeated in circled process (d. school Stanford, 2010).

Different definitions rather than focusing on the iterative steps, focus the attention on the characteristics of the design thinking reasoning. Thus, according to Charles Owen (2007)

*design thinking is the obverse of scientific thinking.* There is a fundamental distinction between other types of thinking and the nature of the design thinking, it can be revealed by understanding the two factors: the process and the context which the design field works with. This distinction can be depicted with a conceptual map which shows both content and process factors. In Figure 3, the process is shown on the Analytic/Synthetic axis while and content or realm of activity/field is on a Symbolic/Real axis.

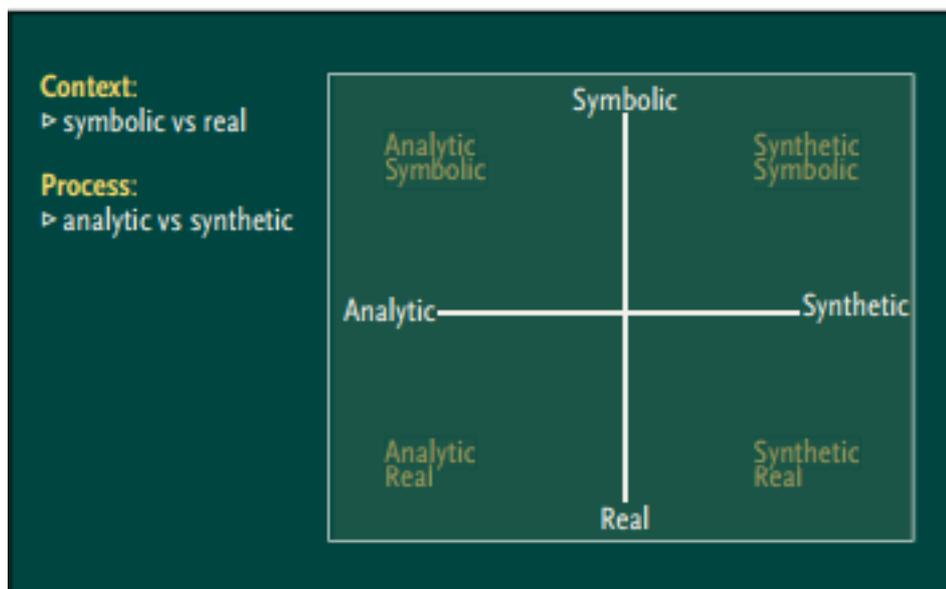


Figure 3 Design Thinking semiotic dial (Owen, 2007)

The figure 4 further explain the distinctions

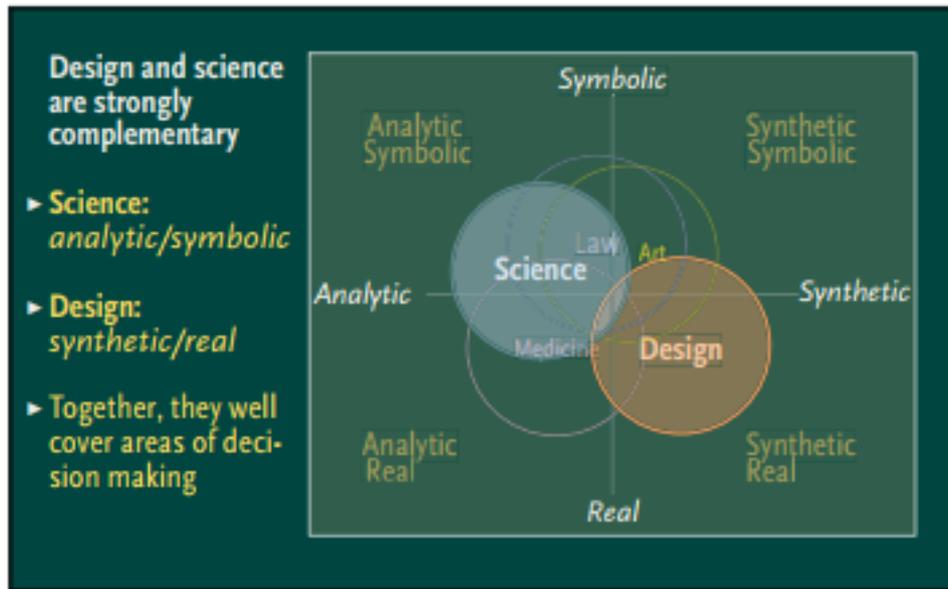


Figure 4 Design Thinking in deep semiotic dial

Design in this map is highly synthetic and strongly concerned with the real-world subject matter, as it deals with communications and symbolism, design has a symbolic component, and because design requires analysis to perform synthesis, there is an analytic component to it too; but design is a field relatively specialized nearly oppositely to science. (Owen, 2007). Moving forward in trying to be simplifying the definition of Design thinking, the approach presented by Jeanne Liedtka & Tim Ogilvie (2011), instead of using complicated words models or process simply relies only upon four very basic questions corresponding to the four *stages of a problem-solving process: What is? What if? What wows? And What works?*

Liedtka and Ogilvie explained that the DT is a systematic approach to problem-solving which has to be built upon the four questions explained as follows (see figure 5);

1. What is? Exploring the current situation.
2. What if? Envisioning alternatives for the future.
3. What wows? Getting users to help make difficult choices.

4. What works? Making it work in-market and as well as in the business. (2011, p.01)

# Process

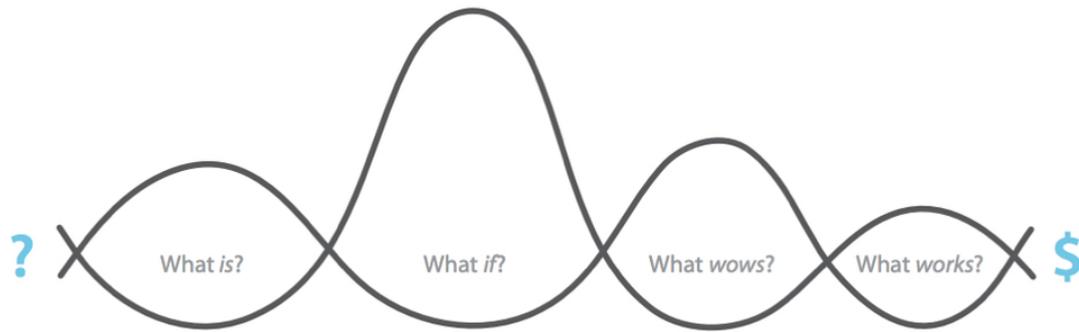


Figure 5 Liedtka and Ogilvie DT flow

In this approach of not to use the complex definition for a such variegated phenomena the most memorable example comes from Tim Brown, the founder and CEO of the consultancy firm IDEO. Thus, due to the practicality and results orientated nature of DT the author refuses any articulated definitions focusing only on what DT is in its core. Thus, Tim Brown defines it as:

*“Design thinking as an approach to innovation that is very powerful, effective, and readily accessible, that can be incorporated into all the perspectives of business and society”.* (Brown, 2009, p.03)

In this sense design thinking is “simply” any approach of innovation applicable to different fields and that uses different perspectives.

As described, DT is a variegated phenomenon with roots in multiple disciplines.

An attempt to clarify its multifaced nature is provided by Charles Owen, (2007) which has delineated following fourteen characteristics or ways of working with Design thinking:

1. *Conditioned inventiveness*: Inventions are optional and complementary to DT as it must be more interested in what question than the why ones, thus it covers more than just inventions.
2. *Human-centered focus*: Design thinking is client-directed and it must continually consider how and what is being created to respond needs of the clients/user.
3. *Environment-centered concern*: Present-day thinking puts environmental interests at the same level with human interests, which intends primary constraints on the design process. However, sustainable design has very noticeable results, that ultimate value of human- and environment-centeredness is a guarantee of the best interests of humankind and environment.
4. *Ability to visualize*: All designers work visually; it is important to have specific skills to work with DT.
5. *Tempered optimism*: Positive attitude is important for creativity. Therefore, the designers are taught to recognize this while establishing an optimal working environment.
6. *Bias for adaptability*: The emergence of adaptive processes in the field has greatly reinforced a historical practice of design which is adaptability i.e. adjusting users' needs with suitable products.
7. *Predisposition and multifunctionality*: Solutions to problems need not be monofunctional, therefore, designers look for multiple dividends from solutions towards problems. Thus, design thinkers are compelled to view/visualize the big picture in critical thinking with a keen focus.

8. *Systemic Vision*: There are systemic problems which need to be solved while maintaining a systemic or holistic vision. This involves varying organizational concepts, policies which are necessary in creating a general wayout. Thus, Design thinking is very holistic.
9. *View of the Generalist*: Design thinking, is highly generalist in preparation and execution contrary to the common view of the need for specialization. Because in the real world there is a greater need for those who can reach across disciplines to communicate and coordinate to bring diverse experts together. Though a designer is a specialist in the field of design, but a generalist in as wide a range of content as possible.
10. *Ability to use language as a tool*: Language is one of the means of communication and for design thinking, it is also a tool. Visual language, mathematical language and Verbal language are used in the design process.
11. *Affinity for teamwork*: Since DT requires collaboration between designers and/or other professionals and communication with the clients, the interpersonal skills are fundamental.
12. *Facility for avoiding the necessity of choice*: Instead of decided one solution for a given problem, design thinkers look deeply into the competing alternatives in order to discover their inner characteristics. Once done this, they try to merge them with the goal to build a creative solution which is the synthesis of all the possibilities.
13. *Self-governing practicality*: Design thinking means mixing fantasy and sense of practicality. Design thinkers use their fantasy while maintaining a realistic approach which always considers costs and functionality.
14. *Ability to work systematically with qualitative information*: DT is a multistep process where it is required use methods to: planning tasks, find information, gain insights,

conceptualize, evaluate results and communicate with the clients. In this scenario the ability to handle this qualitative method is precious.

As clear at this point design thinking seems to be something very hard to define in its core due to a misuse in the terminology. One of the reasons for confusion around the DT is fragmentary regarding the research topic so that researchers often are referring to DT in very different ways. Thus, literature since from the beginning highlights how DT is intended in two different way: a managerial mindset and designers' practice.

For example, Badke-Schaub et al. explicitly name them as the "traditional design thinking approach" and "the new design thinking movement" (Badke-Schaub et al., 2010) while Hassi and Lakso define them the "*Managements discourse*" and the "*Design discourse*" (Hassi & Lakso, 2011). One discourse refers to the early use of the DT as a practice of designer in creating artifacts. The management discourse refers to DT as powerful and effective approach to innovation a method leading to a better and more competitive business (ex. Clark and Smith, 2008; Boland and Collopy, 2004).

Where the design discourse focuses on the cognitive aspects of designing and discusses e.g. "the way designers think as they work", the management discourse is an overarching "method for innovation and creating value" (Hassi & Lakso, 2011).

This creates ambiguity in defining DT framework creating misunderstanding (ex. Hassi & Lakso, 2011; Owen, 2007).

One of the best attempts to differentiate the two discourses is provided by Johansson-Sköldberg et al. (2013). Thus, the authors argue that research on design thinking can be separated into two major streams: "*designerly thinking*", which belong to the design research tradition of studying designers and can be traced back to the 1960s, and "*design thinking*", which belong to the concept that has emerged from more recent managerial debates. Design

thinking is the area where design practice and competence are used beyond the design context, for and with people without a scholarly background in design, particularly in management.

From this perspective the managerial discourse and the design discourse seems to be two separated entities with few points of contacts.

The interesting point is that if design thinking is born as a concept able to describe the particular cognitive style of designer (ex. Schon, 1983; Simon, 1992), and after the IDEO reconceptualization it became a collaborative process and a toolbox for creatives (ex. Brown and Kätz, 2009; Brown 2008), nowadays research is more focus on the roots of ‘designerly thinking’ (the managerial discourse) rather than design thinking as practice (ex. Johansson-Sköldberg et al, 2013).

Finally, another important point that worth to be presented is how the literature in the agreement is how intangible and hard to measure how the DT outcomes.

The most cited measures are the customer satisfaction and feedback (ex. Dosi et al., 2018; Schmiedgen et al., 2016; Rauth et al., 2014).

Other measures of effectiveness are the numbers of projects, immediate results (number of innovations, ratio idea/hour) or traditional KPI (financial performance), reflective measures (workers feedback), Working culture (engagement, team collaboration, effectiveness) or a story based approach (collecting good examples) (Schmiedgen et al., 2016). Standing at the literature review DT is something that have an impact both on the outcomes for the clients (satisfaction and engagement) both for the workers (positive culture). Nevertheless, all these indirect measures testify the problem of the traceability and how it is hard to trace the success back.

A tentative to measure the impact of design thinking in a more structured way comes from Dosi et al. (2018) with their Design thinking mindset awareness self-assessment

questionnaire. This instrument is built to measure, through 84 questions among 19 dimensions, the level of design thinking mindset. This instrument seems one of the few tentative in quantifying DT, nevertheless, it not measures the effectiveness, but it is an attitudinal test.

### **2.3. A problem-solving approach**

Design thinking is often conceptualized as a problem-solving methodology for ambiguous and not clear problems (Owen, 2007). Thus, DT could be considered as a shift from employing conventional problem-solving methods to a modern strategic problem-solving method (Brown and Wyatt, 2010).

The understanding of Design thinking in solution-oriented processes follows literature in which design thinkers take *wicked problems*. DT takes psychological perspectives in analyzing the challenges that stems out of ‘wicked problems’ (Von Thienen et al., 2013 ).

The term *wicked problems* was formulated and introduced for the first time by Horst Rittel in the 1960s. *Wicked problems* was one of the central themes of the first-ever conference held of design in New York in 1974. Where Rittel argued that most of the problems addressed by the designers are the wicked problems indeed.

Rittel (1967) defined wicked problems as social problems which are ill-formulated, the information given is confusing, where there are multiple clients and decision-makers having conflicting values, and where the issues in the whole system which are rigorously very confusing. Jose Berengueres in his “*the Brown Book of Design Thinking*” (2014) defined Wicked Problems are those problems for which neither question nor answer is well defined (Berengueres, 2014). Example of wicked problems are, for example, to restructure a healthcare foundation and help an old organization in understanding its clients, also in shifting a university from conventional to the modern learning environment a few examples

of its application (Brown and Wyatt, 2010). Buchanan (1992) cited Rittel for the remarkable identification of the ten properties of the wicked problem which are given as follows:

1. Wicked problems have no exact formulation yet are equivalent in proposing solutions.
2. Wicked problems are always solution-oriented without rules to stop it.
3. Solutions to wicked problems are not binary opposites (true or false), but good or bad.
4. There are no fully comprehensively acceptable or valid operations in solving wicked problems.
5. The world view of the designer varies with possible explanations for every wicked problem.
6. All of the wicked problems are the causality of the 'higher level', problem.
7. There is a definitive test for a wicked problem in the case of finding a difficult solution or which has no formulation.
8. The wicked problems are always open-ended for learning, but while attempting to solve, the operation needs a 'one-shot framework' with no space for mistakes and errors.
9. Every wicked problem has some unique characteristics which make them unique.
10. The wicked problem solvers are fully responsible for their actions, hence they can not claim to the right when they are doing wrong.

There are many methods or processes which are employed to solve *wicked problems*. it requires a new way other than the analytical one. One of the best attempts to solve comes from Kees Dorst (2011), which describe the characteristic of DT problem solving and its relationship with the problem framing. Thus, the author defines the specific design thinking problem solving process as specific type of *abduction reasoning*. He distinguishes two form

of abduction (form *I* and *II*). The abduction form *I* is the one used in productive thinking. Here the value and the “how” i.e. working principle that will help achieve the value are known.

What is missing is a “*what*” (an object, a service, a system that could bring to the “*value*” by using the “*how*” (see figure 6). This problem-solving form is the one used in the closed problem (the opposite of wicked problems).

**???** + **HOW** leads to **VALUE**

*Figure 6 Abduction form I*

The Abduction *II* is more complicated the only know factor is the “*value*” we want to achieve (see figure 7):

**???** + **???** leads to **VALUE**  
(thing) (working principle) (aspired)

*Figure 7 Abduction form II*

This means that it has to be figured out both “*what*” to use and “*how*” to use it in order to reach a settled goal. The “thing” and the “working principle” have to be created in parallel. Abduction *II* is the problem-solving strategy for complex and open problems and it is the one used in design thinking process (Dorst, 2011).

The necessary condition to arrive to complete the above mentioned problem-solving challenge is to develop or adopt a “*frame*” (Dorst, 2011).

Using Dorst's words a "frame" is the "*general implication that by applying a certain working principle we will create a specific value.*" (Dorst, 2011, pp. 524).

Framing a problem means to see it from a particular standpoint which allows to think it in a different and new way. Every frame is associated with a working principle, so once adopted a particular way to think at the wicked problem a specific working principle will be used and, in this way, the aspired value will be reached.

To be more specific, once defined a frame the reasoning will move from abduction *II* to the simpler abduction *I* where the only remaining missing part of the equation is the "*thing*" (service or product).

As can be guessed, *the framing is the most difficult and important part in the design thinking process.* Thus, the only way to avoid being entrapped by the wicked problem ambiguity is to be able to think at the problem in an original way. According to the author propaedeutic to original solution is seeing the problem situation as a *paradox* (Dorst, 2011). In order to do so designers and professionals have several ways to work.

As pointed out by Dorst, even if the conceptualization of this type of problem solving seems hard in practice it could be easy and a routine work for a people expert in "*seeing*" the situation. The only scenario where the multistep process above described is though also for experienced people is where the situation presents a *paradox* (Dorst, 2011).

A paradox for the author is a conflict between 2 or more statements. A paradox will lead to different frames. The act of solving the paradox and arriving to a consistent frame coherent with all the statement is called *insight*.

The example of this process is explained in "*the core of Design thinking and its application*" (Dorst, 2011, p. 528) as:

*“The problem situation centres on entrenched and seemingly intractable issues associated with an entertainment quarter in a metropolis. This particular area with its bars and clubs attracts about 30,000 young people on a good night. The issues include drunkenness, fights, petty theft, drugs dealing and, later in the night, sporadic violence. Over the years, the local government has been using ‘strong arm tactics’, increasing the police presence and putting in CCTV camera’s. Clubs have been required to hire security personnel. All this visible extra security has made for a grim public environment, and the problems have persisted.”*

In the way the problem is presented it seemed to be a law and order problem where the most accessible solution is related to increase the security and surveillance. Nevertheless, once moved under the surface of the problem presentation the designers understood that the problem was framed in this way from the local governance and what was presented was a vision of the problem biased from their role.

The paradox that merged from the analysis of the problem was that that the people concerned are overwhelmingly young people (non-criminals) wanting to have a good time (the value to achieve), and that they were becoming increasingly bored and frustrated as the night progressed.

Paradoxically, what designers discovered was that young people were not doing acts of incivility because of too much fun, conversely, *because of too little fun*. Thus, they discovered how the young people were not criminals but just triggered by spending nighttime in overcrowded situations, with limited transportation and high surveillance the drove them to get bored and frustrated. Boredom and frustration where the really think to avoid in order achieve the wanted value (night life related problems in the center). The proposed solution itself seemed to be a paradox: organizing a music festival. In order to realize this idea designer proposed solution for transportation, crowd and safety. Thus, the music festival

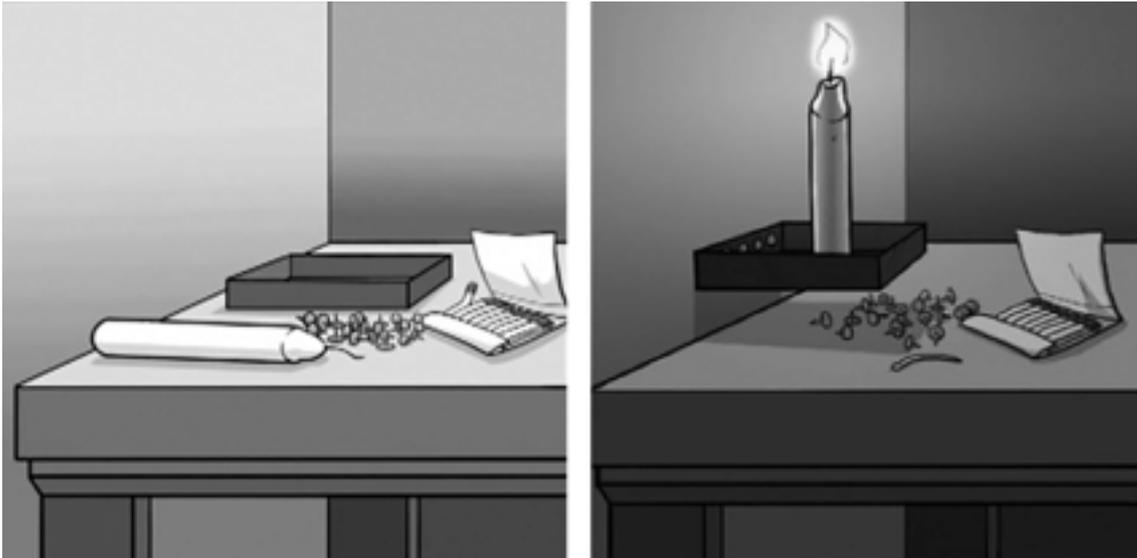
would have a net of transportation for all the night, an app allowing people to quickly check the time the waiting time to enter in clubs and lastly, the city center would have a staff working on surveillance. Differently from the usual security people, this staff would have been not there to limit/punish people but to help them reaching clubs, giving them info, and help in case of necessity. The support staff would have been visible through a colored t shirt with a catchy phrase.

This kind of conceptualization is highly related to the theories of the *insight*.

Insight could be defined as the “*eureka*” moment when a solution to a problem appears in mind in a nonlinear way and without warning. It is also is the phenomena that occurs in the case of ‘Design Thinking’ process of “new problem framing”. Insight is preceded by trial and error attempts. Thus, the most important aspect of the Insight studies is how insight comes from seeing a problem from a new way, overcoming the past experience and the context and getting free from mental impasse (Robert et al., 1996).

Duncker’s (1945) candle problem is the famous instance of insight. In it, it was presented to the participants a box of matches, a candle and some tacks, and were asked to create a ledge on a wall to rest the candle on.

Problem solvers became fixed on the “container” function of the matchbox and thus reached an impasse on the problem. Subsequent insight only occurred if the problem solver realized that the matchbox could be used in a different way (i.e., as a ledge) (see figure 8).



*Figure 8 Duncker candle problem and solution, (Yeh and Chang 2014).*

This famous experiment points out a core concept in understanding insight first, and design thinking problem solving structure accordingly. Thus, the difference between a mental set (Luchins and Luchins, 1959) and insight seems to be essential (Öllinger et al., 2008).

Mental set is the tendency to solve certain problems in a fixed way (Luchins & Luchins, 1959) whereas Insight is when a problem cannot be solved using conventional stepwise methods (and the problem solver suddenly realizes that the solution involves unconventional methods. (Jung-Beeman et al., 2004).

Luchins argued that the repeated application of a successful method makes blind any alternative approach, because of the mechanization of the particular solution method – resulting in what he termed mental set. From a set of procedures that meet a particular condition, the one that had success in the previous experience procedure is always selected. Within this framework, mental set is an artefact resulting from selection processes (Öllinger et al., 2008).

The defined mental set is pivotal to solve repetitive problems, while built on existing experience. A representational change in such a case is a key to solve the occurring “impasse”.

The unconscious processes in the impasse face makes possible a change in ‘problem representation’ results in a knowledge about it (Ohlsson, 1992).

As highlighted by Öllinger (2008) the wicked problem solution begins with an incorrect representation of a problem (due to prior knowledge as described above), only when the change of representation of the problem occurs insights will happen (Öllinger et al., 2008).

The Representation Change Theory (RCT) conceptualized by Ohlsson (1992) suggests that there are at least two possibilities to change a problem representation. First, the relationship between the constituents of a given problem can be changed – for example, a problem entity may be perceived as a whole when in fact it can be broken down into further subcomponents.

This is termed chunk decomposition.

Second, the initial representation of the problem may place unnecessary constraints on the problem itself, and thus constraints need to be relaxed. This process is termed constraint relaxation.

## **2.4 A Cognitive Approach**

The interesting point is that design thinking originally is born as a concept to be able to describe the particular cognitive style of designer (Schon, 1983; Simon, 1992). Thus, DT could also be described as the study of cognition conceived in action (Cross. et al, 1992).

As thinking is a cognitive process, this approach is a blend of cognitive psychology and design, where the major focus is on the thought pattern of designers as professionals which solve sophisticated problems. Its niche is understanding design problems through insights and making connections. Donald Schon, as a pioneer of cognitive design, built a theory where the role of the designers, the design task and the processes are integrated. (Valkenburg, 1998).

Thus, he defined design as a *reflective practice* (Schon, 1938), where reflective practice is an activity by which people (design practitioners) take work itself as an object of reflection (ex.

Visser, 2010).

Schon argues about the difference between the reflective practice in cognition and the technical rationality (Greenwood, 1993). The technical rationality implies that a set of knowledge if applied are enough to solve problems in a systematic way. On the contrary, reflective practice starts to form the point that using the engineering-type problem solving approach in trying to solve human problems is impossible (ex. Thompson, 2012).

The risk in using solely the technical rationality is that practitioners are reduced to the simple function to implement theoretical models or formulas and so becoming “*unthinking followers of instructions and procedures*” (Thompson, 2012, p 313).

In Schon’s vision reflective practice is theory integrated and modified by the practice (the *knowing* and the *doing*). since each human problem is unique the theories and the theoretical framework should fit to the unique circumstances encountered (Thompson, 2012).

It can also be described as situated knowledge which occurs thanks to intuition, deep awareness of what you are doing and past experience.

Moving into more details, Thompson (2012) proposed four sets of factors for the reflective practice:

- *Blending theory and practice*: the reflective practice is a constant dialogue between theory and practice where one influences the other and vice versa
- *Active learning*: reflective practice means always test and validates what you have learnt in order to see if it fits with the problem you are facing.
- *Participative learning*: the reflective practice is enhanced by the cooperation and the group work
- *Challenging dogma*: by its nature doing reflective practice means challenging the prejudices, the dogma and the well-established procedures.

Valkenburg, starting from Schon's assumption defined a descriptive method of the approach of the designers while trying to solve complex problems. For the author the design process is a series of "episodes". Each episode is a series of: Naming, framing, moving, reflecting (see figure 9).

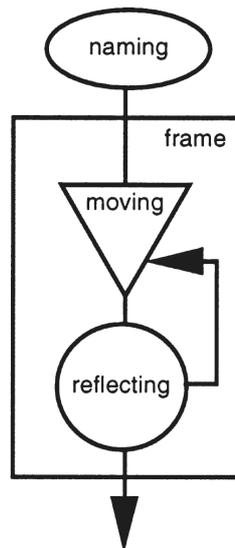


Figure 9 A design episode structure (via Dorst and Valkenburg, 1998, p. 254)

Naming is the act to find possible core point of the task. Frame is the act to code the problem (or subproblem). As described above framing a problem allow to see it in a new way and create a context for further activities or ideas. Moving means starting to generate idea and testing hypothesis. Lastly, reflecting means reflecting of what has been done previously. This kind of interpretation of the design practice is analogue to the Schon's separation of the reflective practice is two elements: *the reflection-in-action* and the *reflection-on-action* (Greenwood, 1993).

Reflection-in-action means think on what you are doing while you are doing it and it is marked by surprise. The practitioner makes sense to the situation by constantly asking herself

question like “What features do I notice when I recognize?” “What are the criteria by which I make this judgement?” “What procedure am I enacting when I perform this skill?”

(Greenwood, 1993, p. 1185). The characteristic of reflection-in-action is that it serves to fluidly reshape what one is doing.

The reflection-on-action is the act of looking back on what has been done in order to understand how she arrived at the solution and in which way.

According to Schon design thinking is the testing experiments where the new point of view are continuously created, problems are framed in new ways and the possible solution are tested and evaluated (Dorst and Valkenburg, 1998).

## **2.5 As a creative toolkit for visualization.**

Design thinking could as be seen as a set of tools and methods for designers to free up their creativity to build effective dialogues with stakeholders.

Due to its multi-disciplinary nature Design tools are coming from varying source like arts, engineering, psychology and other fields. As a toolbox, Design thinking contributes to various applications of the methods and techniques from various disciplines of design. But those applications are widely used in engineering, informatics, and psychology (Brenner et al., 2016).

According to Berengueres (2014) Design thinking could be considered a thinking “*tool*”, which combines ‘empathy’ for the understanding of the problem with ‘creativity’ for the intended insights with proposed solutions through “iterative prototyping”. So, DT as highlighted from Stickdorn (2011) is both a process and a *toolbox*. This toolbox is a sum of sets to use by professionals, for analyzing, synthesizing, to generate insights and to create novel ideas (De, 2019). These collection of tools by the design are for the professionals (Sickorn, 2011), entrepreneurs (Brenner et al., 2016) and academics (Hassi & Lassko, 2011).

In particular, as described by Tschimmel (2012), the most important characteristics of the tool and methods used in DT sessions is the ability to *enhance the visualization*. In this acceptance visualization is linked to the concept of “*perceptive cognition*” which is cognition based on how a person perceives a situation. For the author since the visual perception is the most dominant one among the senses, it plays an important role in design. Thus, with visual perception it is possible to percept “*in and through images*” (Tschimmel, 2011, p. 227).

Graphic representations allow to easily frame an object characteristic and its relationship with other objects. Using visualization help designers to interpret the situation, create analogies and find pattern. Linking the Tschimmel theories with the Schon’s reflective practice, for a designer drawing becomes a tool for thinking process (Tschimmel, 2011).

The visual tools like sketching, drawing and prototyping stemmed subjects like design education. These tools are essential to help to reach designers goals. They also transform immature and abstract ideas into something that has to be created to discuss with stakeholders and other participants (Tschimmel, 2012).

This Design Thinking toolbox or kit is filled with activities people can use to meet common work goals like generating new ideas, gathering data, and aligning with a team. The value in using such toolkit is that it enhances the outcomes because it mobilizes the tools in such a way that reduces the cognitive biases in order to avoid the failure which would have can strongly impact any creative process and represent flaws (De Paula et al., 2019). These methods incorporate the core of the design thinking: they are collaborative creative process based on empathy and abductive reasoning (Chasanidou, 2015).

A great attempt to classify the methods and tool used in design thinking is provided by Alves and Jardim Nunes (2013). The authors mapped 164 methods used by team in order to generate creative solution for wicked problems. Another attempts in providing a list of visualization tool used in DT is provided by Tschimmel (see figure 10 for an example of DT

session).

Following the classic IDEO steps classification (emphasize, define, ideate, test and prototype) in DT process a selection of this could be the following.

Emphasize:

- *Customer Journey Map*: a visualization of user/customer while achieving a certain goal
- *Personas*: after observation the different archetypes of potential users are defined in order to be a reference across all the project

Define:

- *User Scenarios*: Hypothetical stories where user path in achieving a goal or using a service are described
- *Storyboarding*. A representation of use cases put together in a narrative sequence
- *Mindmap*: a systematic organization of information where relations and causality are highlighted

Ideate:

- *Brainstorming and Brainsketching*: A problem-solving where a group of people freely discuss about a topic.
- *Focus Group*: similar to brainstorm but there is a moderator which keep the attention focused on the topic of the discussion

Prototype:

- *Prototyping*: is a rough, low in details and quick to do mock-up of a potential service. It could be done in paper or using web tools

Test:

- *Shadowing*: researcher/design follow all the customer/user steps in using a product in order to notice evidence which could not have been collected in an indirect way (ex. non-verbal behaviour)



Figure 10 A typical ideation session (via userinsight.com)

## 2.6 A framework proposal

Hassi and Lakso did a great review in trying to achieve a framework for DT.

The authors focus the attention to the DT as a mix of “*User focus (empathy building), problem framing (not to solve but to reframe it); visualization (low resolution ideas-mock ups), experimentation (in an iterative way), diversity (collaboration of diverse team)*”.

Furthermore, these elements are supported by: human centered approach, thinking by doing,

visualizing, combination of divergent and convergent approaches, and collaborative work style (Hassi & Lakso, 2011).

Hassi and Lakso Carlgren identificate five characterizing themes: User focus, Problem framing, Visualization, Experimentation and Diversity (Carlgren et al., 2016).

Another interesting temptation is done by Brenner et al. (2016) which frames the dialectic between the three interpretation (Process, mindset, business approach). Thus, according to the authors DT is a combination of a micro and a macro process. The micro process consists of these steps: “Define the Problem”, “Needfinding and Synthesis”, “Ideate”, “Prototype” and “Test”. The macro-process consists of *a convergent-divergent thinking act* that has to be repeated for each one of the micro steps. Moreover, this combination is fostered by the use of visualization techniques (personas, empathy map etc.) (Brenner et al., 2016). At the moment this attempt seems to be the most comprehensive in literature.

The iteration of divergent and converging thinking has its roots in the Double Diamond conceptualized by the British Design Council in 2005. In this approach the design process is divided in 4 steps: discover, define, develop and deliver (see figure 11).

The first cycle of divergent-convergent thinking is Discover-Define. Discover is the divergent phase where the design issue is explored in a broad way. Define is the convergent movement where the team narrows the hotspots and defines a problem statement. The second cycle is Develop-Deliver. Develop is a divergent thinking process with the goal to explore all possible solutions for the statement where, likewise the Define step, Deliver is a narrowing process allowing to reach one or a limited set of solutions to test (ex. Clune and Lockrey, 2014).

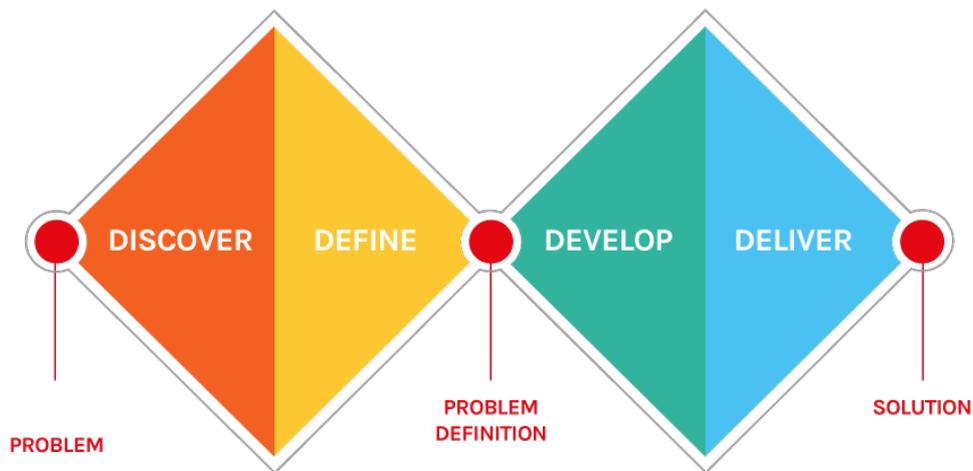


Figure 11. Double Diamond diagram (via <https://www.aton.eu>)

Starting from the above mentioned contribution of Haasi and Laakso (2011) and Brenner (2016) a framework which includes both the designer discourse and the managerial one including a processual approach and cognitive style is here proposed. Before arriving to the framework definition will be discussed the three pillars which the framework is based on:

- Design thinking as problem-solving method with reference to the insight process,
- Design thinking as cognitive approach with a reference to the self-reflective practice,
- Design thinking as use of tool/methods that enhance the visualization.

Taking in consideration the contributions of Hassi and Lakso (2011) and Brenner (2016) Design thinking could be framed as a collaborative problem-solving approach where practitioners using a thinking by doing and self-reflection mindset aim to solve a wicked

problem in human centered innovation in a new way thanks to the insight. This approach is enhanced through a visualization method which help the abstract thinking.

Framing design thinking in this way give is consistent both with the first definition of design thinking (ex. Simon, 1958) as a cognitive style and the later definition (ex. Brown, 2008) which see it as a creative process.

In more details the processual part could be identified as process based on *macro* and *micro processes*. The macro process, covering the all DT session, is a two steps iteration of *understanding problem* and *define solution*.

All design thinking process starts with a “*Value*” to reach which represent the end goal.

Starting with the end goal in mind, understanding problem is the iteration of *user empathizing* phases and the *problem definition*.

The empathizing phase is the part where the practitioners gather information about the problem to solve and about the user needs and conceptualization related to the problem.

The problem definition is the crucial step where the ideas are discussed and scope is narrowed.

The transition from the understanding problem and define solution is marked by the insight which *frames the problem*. As cited in p. 20 using the reference to Dorst (2011, pp. 524) the real problem could be completely different from the starting one. This is the crucial step of the design thinking where it is defined the “*What*” is the real problem. Framing the problem allows to define a statement which will have the compass functionality for all the DT process.

Once the problem is framed the second step in design thinking process is the define solution.

Using the equation provided by Dorst, in this phase it is decided “*How*” to reach the “*Value*” considering the “*What*”.

Problem solution is the iteration of *solutions exploration* phases and *prototyping*.

In the solutions exploration phases the possible solution are discussed while in the prototyping phase the team arrive to define a prototype (or several prototypes) in order to quickly test if the “*Value*” is reached.

The entire process is based on *iterations*. So, within a step, there could be multiple movements from a phase to another (ex. user empathizing to problem and vice versa). Other important point is that both the “what” and the “how” could change as the process progresses. Micro process is an iteration of analytical and synthetical phases which is present in each of the steps.

The analytical one is the phase where the data area analyzed and possible idea are openly explored. Synthetical phases are the ones when 1 or a few of the ideas are deepened.

So, in “understanding problem” he empathizing phases is the analytical one where the problem definition is the synthetical one where in “define solutions” the solution exploration is the analytical one and the prototyping is the synthetical one (see figure 12).

An important point to underline is how the entire process is lead through a collective and collaborative work through the use of creative methods.

### 3 RESEARCH METHODOLOGY

Purpose of this study is to understand the two different discourse and propose a *unique framework* which both visions are integrated.

According to the writer design thinking is a multidimensional concept consisting of a problem-solving approach enhanced through a cognitive mindset and the use of visualization toolkit.

This hypothesis will be tested through:

1. Investigating the origin of design thinking
2. Investigating the most acknowledged DT theories
3. Defining a framework starting from the most acknowledge DT theories

#### 3.1 Introduction

In order to test the framework a mixed methods research was designed. In particular it was chosen an *explanatory sequential design*. In it a quantitative research phase is followed by a qualitative one in order to enrich the date and shed lights on particular topics.

The survey aims to investigate specific assumption of the framework through a quantitative method (see below) while the interview has the purpose to deepen the framework validation through qualitative data.

This study has to be considered as a pilot study with the goal to gather descriptive data.

## **3.2 Participants**

In order to have significant data about the phenomenon it has been decided to involve as participant people with experience in Design thinking.

The participants of the survey (N=39) have been reached through sharing the survey and the research goal in LinkedIn and Facebook groups where practitioners use to discuss and share experience about Design thinking. The survey has been shared via email to all the student enrolled in the Msc in Interaction design.

The participant of the interview was a design thinking coach and workshop facilitator. He was reached asking in the author's network for a design thinking expert. The reason in involving only people who were confident with the phenomenon is to be able to gather valuable insight and phenomenon's nuance.

To all the participants a consent form has been shared.

## **3.3 Data collection**

### **3.3.1 Survey**

The survey has been designed with the purpose to gather opinion from design thinking practitioners.

The survey is composed by 51 items divided in 11 categories (see appendix).

1. *Design thinking conception*: The goal of these categories is to evaluate how practitioners see at the design thinking (cognitive style, problem solving approach, toolkit, business mindset). It is composed 5 items on Likert scale (1= *Strongly disagree*, 5=*Strongly agree*).

2. *Design thinking as cognitive style*: In this category the relation of DT and the self-reflective cognitive practice is investigated. This category is composed by 4 items on Likert scale (in 1 of them 1=*Strongly disagree*, 5=*Strongly agree*; in 3 1=*Never*, 5=*Always*).

3. *Design thinking as collaboration*: In this category the relation between DT and the collaboration is investigated. This category is composed by 4 items on Likert scale (1=*Strongly disagree*, 5=*Strongly agree*).

4. *Design thinking and visualization*: In this category the relation between DT and the visualization methods is investigated. This category is composed by 4 items on Likert scale (1=*Strongly disagree*, 5=*Strongly agree*).

5. *Design thinking and insight*: In this category the relation between DT and the insight (problem reframing) is investigated. This category is composed by 5 items on Likert scale (in 4 of them 1=*Never*, 5=*Always*; in 1 1=*Strongly disagree* 5=*Strongly agree*).

6. *Practitioners perception on DT*: In this category it is investigated what practitioners think about design thinking. It is composed by 3 free answer question items and 1 item in Likert scale (1=*Never*, 5=*Always*).

7. *Design thinking process*: In this category the process as described in the proposed framework is investigated. It is composed by 5 items on Likert scale (in 3 of them 1=*Strongly disagree* 5=*Strongly agree*; in 2 1=*Never* 5=*Always*).
8. *Design thinking and uncertainty in definition*: In this category it is investigated the practitioners opinion about the use of the design thinking term. It is composed by 4 items on Likert scale (in 3 of them 1=*Strongly disagree* 5=*Strongly agree*; in 1 1=*Never* 5=*Always*) and a free answer question.
9. *Design thinking effectiveness*: In this category it is investigated the perception of the design thinking effectiveness with a particular focus on the relation with the wicked problem. It is composed by 5 items on Likert scale (in 3 of them 1=*Strongly disagree* 5=*Strongly agree*; in 2 1=*Never* 5=*Always*).
10. *Design thinking as iterative process*: In this category it is investigated the iterative characteristic as described in the proposed framework is investigated. It is composed by 6 items on Likert scale (1=*Strongly disagree* 5=*Strongly agree*).
11. *Participants experience in design thinking and demographic*: In the last category info about the participants' familiarity with DT and demographical data are gathered. In it 4 items are single choice question items and 1 is multi selection question item.

### **3.3.2 Interview**

At the end of the survey data gathering and analysis there will be planned an interview has been planned in order to enrich through qualitative data the survey results. The interview has been semi structured having so the goal to investigate freely themes of the design thinking conceptualization and practices. The themes have been defined after the survey.

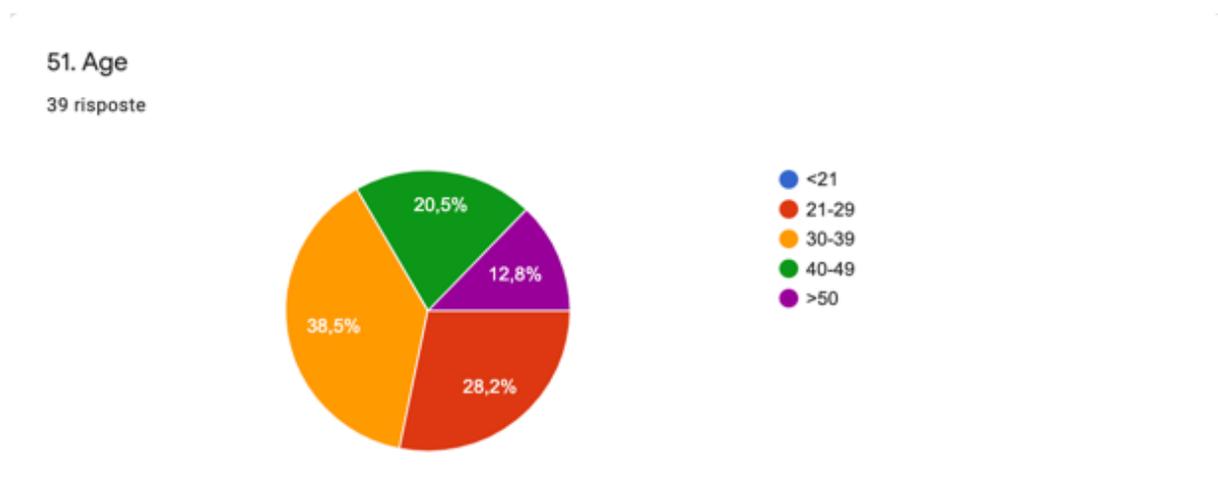
## 4. RESULTS

### 4.1 Survey results

Due to the characteristics of the research, the survey has been shared only where it could have been possible to reach design thinking practitioners. The survey has been shared through Google Form link for 2 weeks. At the end of the administration period 39 participants completed the survey.

The demographic data shown how DT is involving the young professionals (21-39) (see table 1) highlighting once again the phenomenon is new

Table 1. Age distribution



In principle, the results of the survey consolidate the framework proposed in the chapter 2.

Nevertheless, some interesting points emerged that requires a further investigation.

It is reported how design thinking is both a problem-solving methods and cognitive approach.

This vision is in continuity with the framework proposed by Hassi and Lakso (2011) and follows the historical development of the concept described in chapter 2.

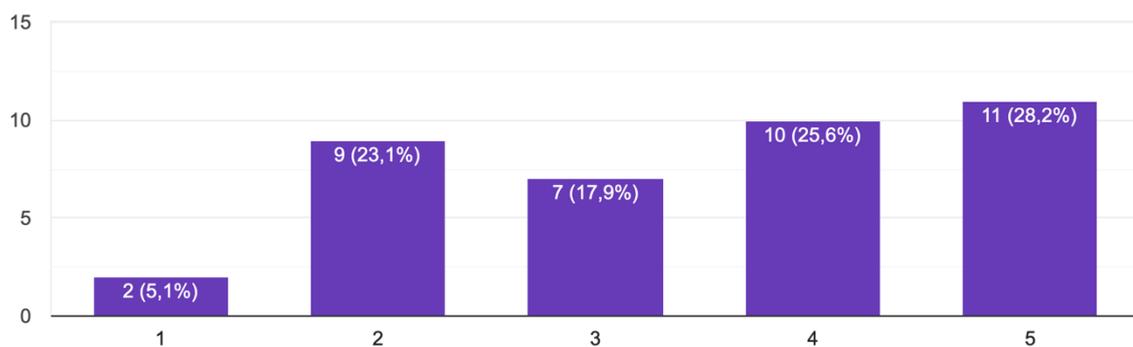
Regarding the concepts of design thinking as a business mindset and design thinking as use of a visualization toolkits the practitioners' perspectives are not so defined.

Thus, the conception of design thinking as a business seems to be polarized. There is general agreement in this statement but the 23,1% reported a disagreement. This result could suggest how that DT is something that could be used to drive business decision but it is not something distinctive of a business mindset (see table 2).

Table 2. "Design thinking is a business mindset" answers distribution.

### 3. Design thinking is a business mindset

39 risposte



In relation with a conception of DT as the use of toolkits for visualization the 33% reported to be "*Neither in agreement nor disagreement*" with the statement. These answers could be considered as an opinion of design thinking fostered by toolkits but not made by the use of toolkits themselves.

The section 2 dedicated to the DT in relation with the Schon reflective cognitive style seems validated. In fact, for the participants DT is mostly a creative act where the experience is more important than the theories and the reflection upon the process is a fundamental component.

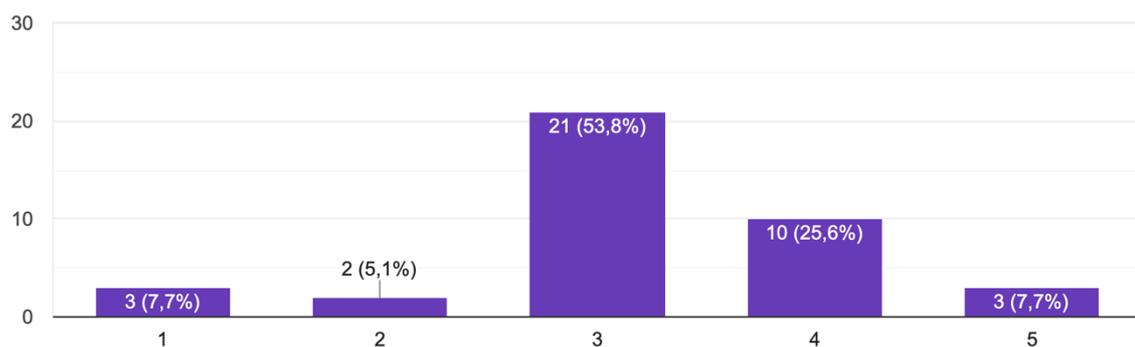
The section dedicated to the investigation of the DT and the collaboration consolidates the

framework and general opinion of the collaboration as an constitutive part of the design thinking. Thus, it is clear how for the participants there would not be design thinking without collaboration. However, for the item “*working on a project using design thinking method could inhibit someone*” the 53,8% of the participants answered “*Neither in agree nor disagree*”. This answer, if taken in consideration with the answers about the most frustrating thing in design thinking, points out an interesting aspect which is not considered too much: group thinking and inhibition in design thinking (see table 3).

Table 3. “Working in a project using design thinking method could inhibit someone”

11. Working on a project using design thinking method could inhibit someone

39 risposte



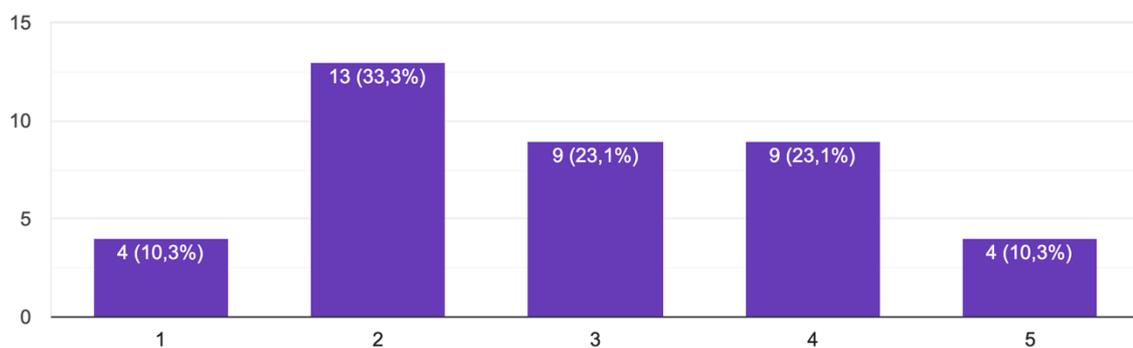
Going forward, the answers of the section dedicated to the design thinking and the use of visualization methods gave back interesting feedback. For the participants using these methods in design thinking session is essential but not fundamental. Anyway, this idea seems to screech with answers for the item 15 “*Good design thinking could be done using imagination without the use of any tool/method*” where the majority of the participants (35,9%) reported to be in disagree with the statement. As already pointed out, it merges a conception of visualization methods as a booster for design thinking but not as core pillar. An

interesting point for further analysis could be to understand which these methods are and which nonvisual methods practitioners are using during the sessions.

Another interesting topic coming from this dimension is how the participants don't think in synchronous remote meeting as a valid way to do design thinking which seems to be something to have value only if done in person (see table 4).

Table 4. "A synchronous remote meeting is enough to discuss and generate great ideas" answer distribution

16. A synchronous remote meeting is enough to discuss and generate great ideas  
39 risposte



The section dedicated to the insights validate the assumption of design thinking as an approach to trigger insights and problem framing. Thus, participants reported how, during design thinking sessions, they experience the “*eureka*” moment. In this section a notable point of discussion is how the 41% participants agreed for the item 20 “*In design thinking the solutions don't come in mind suddenly but it is required time and a scientifically approach*”. This answer seems to be in opposite with the idea of solution as something related to the insight. A possible interpretative key is that solution could be interpreted not as the problem reframe (ex. Duncker, 1945) but with the end product of the design thinking.

The section 6, dedicated to the practitioners perceptions on DT revealed some interesting information.

For the open question about the most exiting in design thinking the majority of the answers could be grouped in empathizing with user, creativity, multidisciplinary approach, reframe problems, overcome biases. These answers underline how DT for the practitioners is mostly a process helping understand user needs and after arriving to a solution.

Table 5. “The most exciting thing in design thinking is” answers distribution

<b>22. The most exciting thing in design thinking is</b>
Coming up with a team vetted solution
Repetitive process
thinking
Multidisciplinary Approach
Creativity
Empathy
Research with real customers to remove our original assumptions and biases
Many people from different backgrounds
Collision of ideas, seeing things from others persoectives
It involves putting yourself in the shoes of the user
The complexity of all involved groups and the challenge to combine all
Ideas can come from anywhere
specifying the goals.
Framing thoughts
Maps building
Explore new solutions
solving user-centered problems
Creativity
Group work
Research
Havign to work with many people and make them discover new things
Iterative approach and the evolutionary results that comes with it
exploring the problem space and finding opportunities that are bigger than the initial
The problem reframing
prototyping
Work collaboration and creativity
recframing the problem
Empathising and co creation
Generating new ideas

Solution oriented, bold and innovative.
collaborative thinking
We try to solve Problems affecting diverse groups of people.
Ideas
Collaboration
Involving users in the process (workshops or interviews)
New ideas
Nth excited me. It is a methodology that has pros and cons.
-
I don't think of design thinking in this manner re. having an exciting attribute about it. I like how it is meant to offer a different perspective

The answers to the question about what are the most frustrating thing in design thinking remark a topic already mentioned in section 3. Thus, the majority of the answers revolve around the themes of struggle for the power and not being acknowledged. The theme of the democracy in design thinking for sure should be fostered with major details.

Table 6. "The most frustrating thing in design thinking is" answers distribution

<b>23. The most frustrating thing when I participate to design thinking session is</b>
Not having a say.
No teamwork
thinking
Multidisciplinary Approach
People shut down my ideas
the struggle for power
Recruiting the right interviewee sample can be difficult. It takes time and expertise to do properly.
It takes long time
Other people have not prepared
spending a lot of time teaching others or constantly explaining every decision in a rational way
When it is not organized and later gets restricted by the industry again
People rarely consider the needs of people with disabilities
not being accredited for the ideas I have.
Too simplistic at times.
The starting point
If I can't express my point of view
when participants get emotionally attached to their beliefs and ideas, when participants don't accept or acknowledge other participants input, and when participants try to be dominative and take hover activities not allowing other people to participate.
Nothing
People not willing to explore

People who think DT takes place in workshops or sessions.
Bias, all the time. An the dunning krugger effect from c-levels... not taking serious the thing.
Clients that doesn't know how to generate ideas and be open.
When someone won't follow the traceability of the research information and tries to base decisions on personal experiences .
Keeping thoughts together, synthesis
getting everyone to collaborate as a team
Different aproches by participants
not prepared mindset
People not being truly present
Reflecting the result
Reluctant and negative attitude of participants.
bringing everyone to same page
When resources and requirements/needs are not aligned.
People who are contentious
Not being able to let go imagination
Feeling stuck in the process
Old ideas
Systematic evaluation
People thinking in solutions too early
Same as above really, I don't think of design thinking in this manner re. having a frustrating attribute about it. Design by committee can be annoying if this is a relevant answer.

The answers for the question about measures for design thinking effectiveness reveal how this is a hard topic. For the majority of the practitioners a way to measure is simply to verify the impact but some of the answers touched an interesting point. Thus, some of the answers were not simply focused on the product results on the market and customer satisfaction but mentioned also the mindset change and the employment engagement. These answers could be seen as a declaration of design thinking as something that could be used also for the team building and as a tool to transform the company culture.

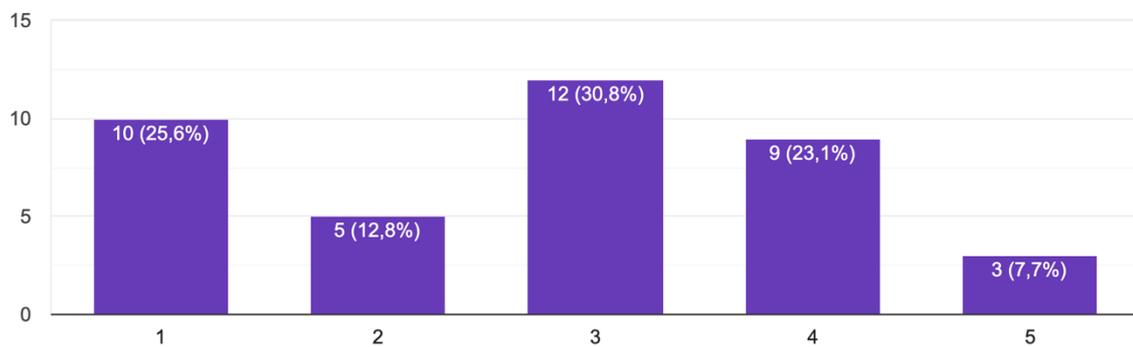
The section dedicated to the DT process partly disconfirm the proposed framework. Thus, participants strongly disagree with the vision of the design thinking based on problem definition and problem solution phases. Another interesting result is for the item *“All the phases of design thinking aim to build a quick and dirty prototype to test as soon as possible”* participants for the most answered *“Neither in agree nor in disagree”* and *“Disagree”*. This

answer could lead to a design thinking which is not only a method to deliver prototypes (ex. Brown, 2008) (see table 7).

Table 7. “All the phases of design thinking aim to build a quick and dirty prototype to test as soon as possible” answer distribution,

29. All the phases of design thinking aim to build a quick and dirty prototype to test as soon as possible

39 risposte



However, it is confirmed the assumption of design thinking as an iterative process where often the reason of the failure in testing the product could be found in the problem definition phase.

Moving forward, without surprises, the participants of the survey in section 8 agree with the statement that there is confusion in design thinking and it is misused as term because it is a trend. Further, they reported how design thinking for them is a clear concept.

The answers to the free question “*For me design thinking is*” revealed how participants mostly reported the theme of empathy, iterative approach and problem statement.

Table 8. “For me Design thinking is” answer distribution

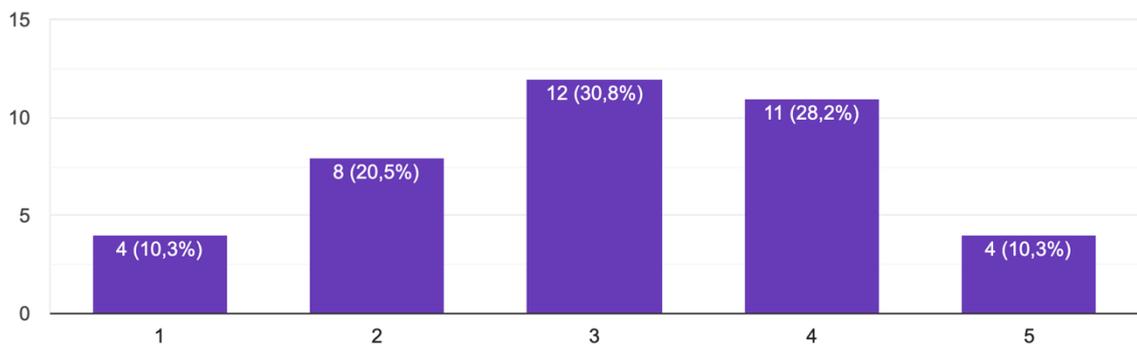
<b>For me Design thinking is</b>
A systematic approach to bringing a concept to market.
Emphatize to others
waste of time
Design Thinking is an iterative process in which we seek to understand the user, challenge assumptions, and redefine problems in an attempt to identify alternative strategies and solutions that might not be instantly apparent with our initial level of understanding.
Passion
a method
One of many ways to solve a complex problem. Like any other approach, it has its strengths and weaknesses.
creativity
The application of design processes and patterns beyond fields typically though of as design.
is a process for creative problem solving
The basis of my working process
an asynchronous iterative process which tries to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test
doing the right thing, then doing the thing right.
A methodology
The better way to design something
An approach to solve user needs
a process for solving user-centered problems that generates solutions that are desirable by users, technologically feasible, and good for the business.
Problem solving approach
An approach
the application of design mindset and practice to non-traditional areas
A framework of tools and methodologies, a mindset a design based process to implement a different way of creating and implementing new products into organizattions
Empathy based way to design new and innovative things in a iteratively
Bringing a designer's approach to challenges for teams with non-designers individuals.
Creative problem solving
generating solutions and prototyping
A mindset
the future of organizational innovation
A co-creative problem solving mindset
Finding a solution together
my way of thinking and doing.
finding alternative solutions to a problem in hand
Is the approach to know how will people use the product. and how product should be accessible to all people.(it should make client happy)
Methodologies for problem solving using scientific method
Define problem, free collaborative imagination, developing, testing, adjusting: Don't think you know it all, ask what people want, use your skills to create, check it it was right, adjust to feedback and deliver.
A methodology
Some strange talk accompanying product or service design
The ways designers work with high emphasis on empathy.
making sure to do the right thing before doing it right
prioritising a design mindset, usually focused on the user or human-centred, in order to build a product, tool, or journey that will be of great value to those who use it.

The section “*Design thinking and effectiveness*” confirm what defined in the framework. Thus, for the participants DT is an approach that fits well in solving complex and nonlinear problem. This is in accordance with the theories of the wicked problems (ex. Rittel, 1967). Despite this consensus the answer to the item 37 “*Most of the problem faced in typical design thinking sessions could be faced in different ways*” shows some confusion. For this item the 43,6% of the participants answered “*Neither in agree not disagree*” indicating a non-definitive position. This opinion is also present in the item 40 “*Problems related to the social world, the people and the innovation could be faced only with design thinking*” where 28,2% answered “*agree*” and the 28,2 “*Neither agree not disagree*”.

The section 10 reinforce what already described. Thus, for the participants DT is not a rigid multistep process (ex. empathize, define etc....) and it is a fluid process. This confirm one of pillars of the framework. Another element of the framework which seems to be confirmed in the survey is the perspective of design thinking as an alternating of analytical and synthetical phases. Despite this agreement in seeing design thinking as a fluid process the participants reported a moderate position (30,8%) to the answer “*The design thinking is something organic and it's useless to define to divide it in stiff steps*”. This answer gives the hint that design thinking in the practice is used with some overall structure to follow but this structure is not rigid.

Table 9. “The design thinking is something organic and it’s useless to divide it in stiff steps” answer distribution

45. The design thinking is something organic and it's useless to define to divide it in stiff steps  
39 risposte



Another point confirmed is the importance of the problem frame. Thus, Participants refer how once the problem is framed solution are generated in an easy way.

For the item “*During the session all the visions of a problem convert in one interpretation in a natural way*” the 48,7% of the participant is in a moderate position. This seems to remark how shown in the previous section. In design thinking sessions seems to be present a dynamic of struggle for power and impasses which are not deeply described in the literature.

## 4.2 Interview results

In order to clarify and have a better understanding of the open point coming from the survey results a semi structured interview was designed. In particular the themes used as compass during the interview were:

- Nature of design thinking
- Design thinking process

- Design thinking and problem framing
- Remote design thinking
- Design thinking and group bias
- Design thinking and toolkits for visualization
- Design thinking as a team building method
- Design thinking as user understanding more than prototyping and testing

The participant of the interview was a UX designer with a large experience as a facilitator in design workshop. The interview has been done in remote and took approx. 1 hour.

The questions started from the themes above mentioned but the topics freely moved as the interview progressed.

About this theme the answer in its core is clear, for him design thinking is

*“a way to solve user centered problem in creative way allowing to build innovative product”*

but the interviewed enriched the answers touching different other points. The first of these is the difference between the design thinking and the traditional thinking in developing new solution in a corporate environment. Thus, according to him design thinking is a method that allow to design solutions which look at the future, where the analytical way of thinking in design solutions is rooted in the past. This difference is remarked several time during the interview; with an analytical way of thinking the decisions are based on the past experience where with the design thinking you stop acting according to the past and the number and do a step further by envisioning a problem and working on a solution never explored before.

According to the author the key value of design thinking is that it matches three lenses of innovation: viability, feasibility and desirability.

In this differentiation seems to be described also the inner nature of the innovation; not more of the same but the tentative to propose something there is not existing yet.

The differentiation between DT and analytical thinking is further explained:

*“if you are doing a project exclusively analytical, exclusively based on data you collected from user using stuff you will never have an innovative product, you will have a better product, but it is still the same. If you envision future product you can envision solution who cannot exist, things that you have never seen before: that’s what design thinking brings. It’s about looking forward instead of looking backward. Ideal is to merge the two. With design thinking you can come up with solution to problems you can’t see in the data and you didn’t know existed before.”*

Regarding the process of DT, the interviewed confirmed what theorized in the framework and shed light on the ambiguous answers of the survey. For him, DT is a process where the use of rigid steps is useless, because the purpose, the participants and the characteristics change every time.

*“What I’ve seen is that some company that sell DT in format of workshops in a number of set activities, in half an hour you have to do this, that is a very prescriptive way to implementing design thinking, I wouldn’t say it is the way to do it. [...]. Design thinking session should craft to the particular problems considering the people and the skills of the people you have; and the designer who is leading the workshop should have the sensibility to define the activities. If you go there with a hard define schedule it doesn’t makes any sense [...].”*

What is present in all the design thinking workshop is a general structure divided in: emphasizing, problem statement, decision and ideate:

*“There is an overall structure, at the very beginning you have to understand what you are doing; you have to start with the problem.*

*First step is identifying what the problem is; you can call it emphasizing or observation.*

*Once you have identified the problems you need to pick the one you want to solve, then you ideate. [...] We pick the solutions and start narrowing down the solutions to one single solution that meets user needs, business needs, the technology and the resources you have.*

*The step you go in this doesn't matter”.*

Another point confirmed is the focal importance of the problem understanding and how it could be revisited in the progress of the session in order to reframe it. For the interviewed, identifying and well define the problem is the most important thing of the entire process. In this constant reflection upon the problem it could happens that the team realize that the problem is not the real problem.

If in the survey emerged a bit skepticism in design thinking session done in remote the interviewed instead remarks how DT session could be done in remote way but with the difference that the time is dilated and that is required more attention by the facilitator in organize the setup. On this topic it is fundamental to remark how the covid-19 pandemic and the consequent lockdowns and forced remote work for millions of people could have influenced this opinion. Thus, the survey has been shared before the 1<sup>st</sup> wave of covid-19 while the interview has been done during the lockdown.

Another sensible point touched in the survey is the possibility that in design thinking sessions could be struggle or inhibition the interview participant agreed that this is a phenomenon that exist. In interviewed's opinion DT in its own nature lead to cooperation and free expression of idea and if this is not happening is due to the competitive nature of the corporation where the session is done and its responsibility of the facilitator to solve the situation:

*“[...] When group bias occurs is because the session is not well formatted, and the team doesn't have a collaboration mindset [...]”.*

Regarding the relation between DT and the use of toolbox the interviewer pointed out how for someone DT is too strictly associated with the use of visualization methods and as consequence, DT itself could be melted with the use of toolkits. The interviewed reinforced the idea defined in the framework where the use of toolkit is something that can foster the session but are not essential.

*[...] The designer has massive toolbox they could pick the tool more appropriate for the people they are participating, sometime there are no tools. It is good to know them, because it helps [...].*

When the interviews touched the theme of the measure of effectiveness the interviewed reported how narrowing down a rigid way to measure DT KPI is almost impossible and the only one KPI that should be taken in consideration is the monetary ROI. That's because it is the main goal of a company and it is an objective indicator. Since DT starts to answer human centric problems, a good solution based upon DT methodology makes everybody happy: the clients which enjoy the new solution that meet their needs and the business which makes money from it.

Discussing further the topic of DT KPI, another interesting theme came out. Thus, the interviewed mentioned how in design thinking sessions there is the possibility (so often rare in companies) to make people of different teams in building a shared understanding of the

problem in first instance and secondly the solution. Doing it, the time, the effort and quality of the outcome improve drastically.

*“There are more things, there are procedural gains, internal gains that you have from design thinking. You have a shared understanding of the problem you are solving. Because you have 3 partners, design people, product people and technology people. And sometimes they think at the same thing, they believe they are talking at the same thing and in reality, they are not. And when it comes the time to start the work things are longer and the solution is disjointed. With DT you build a shared understanding, probably with a solution which is easier, faster to do and with less resources.”*

This aspect highlights how design thinking could be used as *glue* between people with different skills.

The power of DT as a tool that creates bridge between different company branches and people with different knowledges led the interview to also foster the possibility to use design thinking also as an instrument for the team building.

About this theme the interviewed is in open contrast with the use of design thinking session as merely tool to be used in company to make team building. On the other he clarified how good design thinking, for its characteristics, leads to a team building:

*“It’s harmful to do DT with the purpose of team building. It should be respected; it is actual project. Doing it for real it will do it naturally. In my company the division are in silos and sometimes this is the only opportunity this people have to work together. This really increases team building. “*

Since from survey emerged how DT seems to be conceptualized more in understanding people than in doing prototype and test in the last part of the interview it was deepened the relation between user perspective, analytical way of thinking and design thinking. On this point the interviewed remarked how the user centric perspective is present also in analytical thinking and it is not a prerogative of DT.

*“You can still have user centric product using analytical thinking. You can use analytic data and usability test and with that data you improve a solution that already exist. Design thinking is innovation that meets user centricity”.*

Further, quick and dirty prototype is highlighted as a key factor in DT:

*“Best way to validate your solution is through a prototype, it doesn’t have to be a click through prototype, it can be something on the wall or even be just a diagram but some representation of the solution that is somewhat interactive must be done. It doesn’t make sense not to prototype”.*

### **4.3 Results summary**

The results of the research support the framework proposed in chapter 2 based on the work of Haasi and Laakso (2011) and Brenner (2016). In particular it is confirmed how DT is to be considered an iterative problem-solving process with the goal to reach human centered innovation by achieving a value starting from a non-optimal solution.

As supposed and confirmed by the participants of the study DT is fluid, based on the

continuous self-reflection; a particular cognitive style thanks to which practitioners are able to reflect upon the action and do *meta* thinking (Schon, 1983).

Another confirmation is how DT is based upon multidisciplinary collaboration between people with different knowledge. However, the research point how DT is susceptible in group bias thinking, inhibition and scenario for team struggling.

Another point confirmed in the study is how DT could not be fixed to rigid steps or procedures, but it is a fluid and moldable according to the necessities, but it is more general iterative transition between problem understanding and problem solution.

The iterative process, according the participant of the research is an alternation of diverging (analysis) and converging (synthesis) thinking. In this it seems to be largely shared the double diamond approach.

In particular an interesting point is how the turning point from the problem definition to the problem solution is the “*problem frame*”. In the research it emerged how this moment occurs when it is built a *shared understanding of the problem*. This becomes the “*What*” of Dorst’s equation for solve wicked problems (2011).

Nevertheless, the originally theorized insight as a completely problem reframe is not validated by the data. Thus, the eureka moment when a problem is seen in a totally new way occur, but it is not the common practice and seems to be too exaggerated to imply a new problem restructuring in all DT process. Nevertheless, it is verified how the problem consolidation is always present as crucial moment.

In this shared understanding building potential, there is also the underlying side effect of DT as a team builder.

The study also highlighted how DT proposed framework unify the design practice and the business mindset. On this line it is interesting to highlight how the importance of toolkits and visualization method is smaller than supposed.

## **5. DISCUSSION**

As described in chapter 1 Design thinking over the years moved from specialized field and became a transversal concept used by different figures, at different level, with different goals. This led to an approach that should be fluid and iterative. Due to this reason right now the most acknowledged design thinking frameworks are the ones not related to procedural steps (like the Ideo's 5 stages) but the one anchored to a mindset which work around a problem in a fluid way; like for example the Double Diamond.

On this trail, the proposed framework is in line with the modern design thinking vision.

The research results also highlight the above assumption. Thus, both for the survey and interview participants DT is not a series of step or a fixed methodology or a set of tools.

Instead of all of that Design Thinking is a fluid problem solving approach which through the self-reflection and the problem investigation try to solve complex human related problem.

As proposed in the framework and validated in the research it is not linear and it not limited to specific professions. As highlighted by Justin Lokitz (2018) empathy and experimentation are the keys in explaining design thinking.

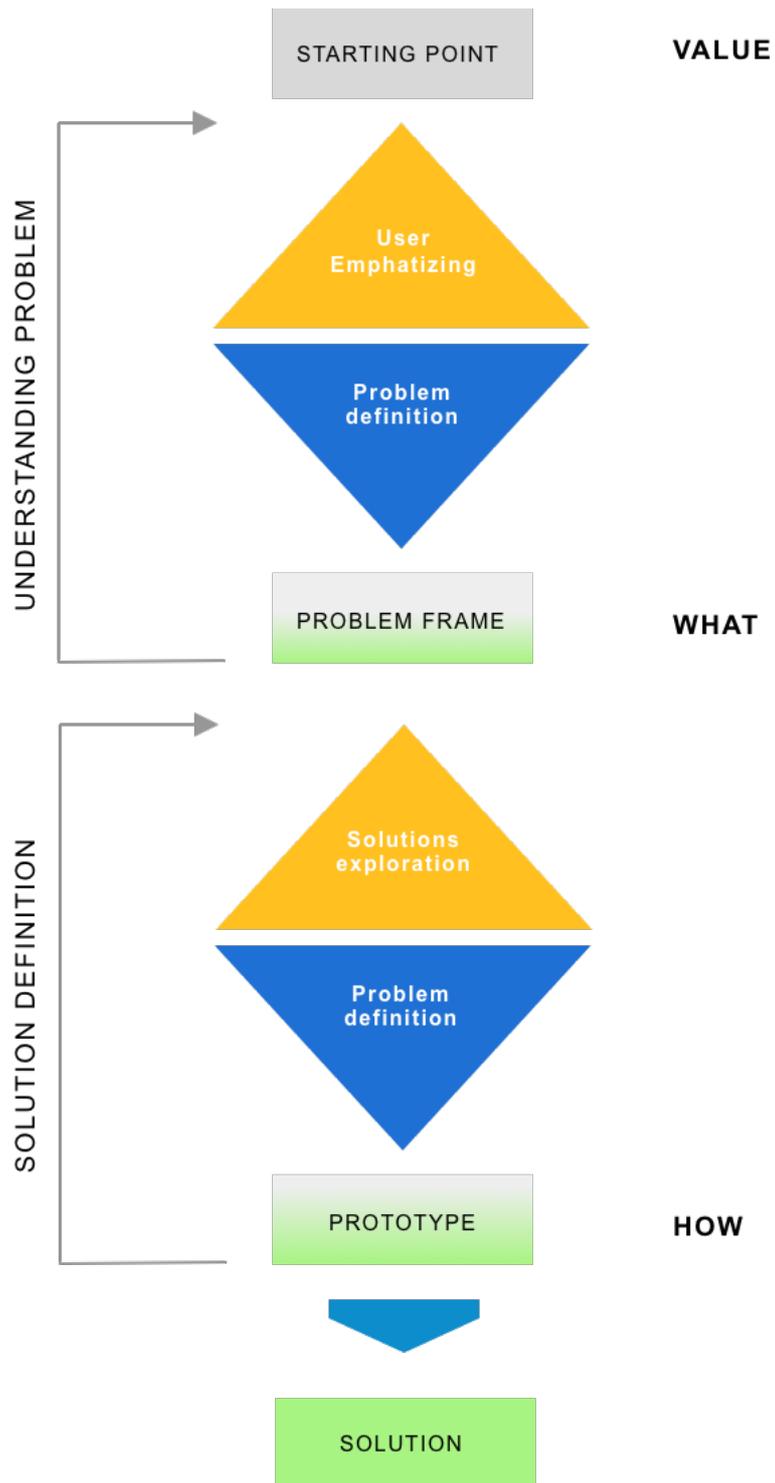


figure 11 A framework proposal

As this research has to be considered as a pilot study in order to understand the core concepts of design thinking it also shown some limitations that could covered in next studies. Thus, due to the heterogeneity of the phenenom a survey, even if necessary, in this first action of

narrowing down the themes, seems to lead to lost richness in the subject of study. Thus, the majority of the insights has arrived by the semi structured interview.

### 5.1 Limitation

It's important to end this work also discussing the limitations and the challenges encountered along this research. The first is that, despite the fact that the recruiting for the survey and the interview has been done mostly via groups on Facebook and LinkedIn dedicated to Design Thinking, only few of them considered themselves as design thinking practitioners. Thus, the majority of them were just “curious” about the trend or familiar with the broad concept and they never did or joined a design thinking workshop. This explains the poor numbers in sample.

Another consideration is that the research has been done during the peak of the first COVID-19 wave and the uncertainty of the period may affected the number of the sample.

### 5.2 Future studies

This work besides shedding light on a way to think to Design thinking brought out some interesting elements that worth to be further investigate.

In first instance emerged how is important to study what *happens within the design thinking practices*. In this sense, a topic which need a deep investigation is the democracy in design thinking sessions. On this purpose it could be interesting to understand which could be the best way to allows everyone to express their ideas and guarantee that these are taken properly in account without struggle or favoritisms.

Another topic is eventuality to do design thinking sessions in remote. With the COVID-19 spread there will be more and more necessity to do activities in remote, so it is important to understand the best practice is running a DT session in remote and which are the risk for the project.

Lastly, another point to be taken in account is how this research reached people who join design thinking regularly and in guise of facilitator. It could be interesting to listen also the people that usually don't have too much confidence with the topic but joined some sessions (ex. IT teams, business units, product managers etc.) to express themselves about it.

All the above themes mentioned appear to be fundamental to be studied because along all this research it is showed clearly how design thinking is becoming a methodology more and more present in any kind of organization, from school to the big corporates and, , how all the people involved in improving what it is existing trying to add value for will need skills in design thinking. Lastly, due to the deep qualitative nature of the phenomenon it is recommended for next research also to do observations of design thinking workshop.

### 5.3 Conclusion

This study examining the history of the Design thinking and its current most acknowledged theme proposed a framework which describes the starting points, the themes, the procedural steps and also the kind reasoning behind it. Framing it contributes to understand what happen in collaborative creative problem solving. Moreover, this study also contributed to point out some grey areas like the remote DT and DT as a glue between different branches in order to create a shared understanding of the challenges, that are not too considered right know but that for sure will be prominent in the upcoming years.

## References

- Alves, R., & Nunes, N. J. (2013, February). Towards a taxonomy of service design methods and tools. In *International Conference on Exploring Services Science* (pp. 215-229). Springer, Berlin, Heidelberg.
- Arnold, John E. (1959). Creativity in engineering. in Taylor, I., & Smith, P. (1959). *Creativity, an examination of the creative process*. Hastings House, New York.
- Badke-Schaub, P., Roozenburg, N., & Cardoso, C. (2010, October). Design thinking: a paradigm on its way from dilution to meaninglessness. In *Proceedings of the 8th Design Thinking Research Symposium (DTRS8)* (pp. 39-49). Sydney: DAB documents.
- Berengueres, J. *The Brown Book of Design Thinking*.
- Binder, T., De Michelis, G., Ehn, P., Jacucci, G., Linde, P., & Wagner, I. (2011). *Design things*. MIT press.
- Boland Jr, R. J., Collopy, F., Lyytinen, K., & Yoo, Y. (2008). Managing as designing: lessons for organization leaders from the design practice of Frank O. Gehry. *Design issues*, 24(1), 10-25.
- Brenner, W., Uebernickel, F., & Abrell, T. (2016). Design thinking as mindset, process, and toolbox. In *Design thinking for innovation* (pp. 3-21). Springer, Cham.
- Brown, T. (2008). Design thinking. *Harvard business review*, 86(6), 84.
- Brown, T., & Katz, B. (2019). *Change by design: how design thinking transforms organizations and inspires innovation* (Vol. 20091). HarperBusiness
- Brown, T., & Wyatt, J. (2010). Design thinking for social innovation. *Development Outreach*, 12(1), 29-43.
- Buchanan, R. (1992). Wicked problems in design thinking. *Design issues*, 8(2), 5-21.
- Carlgren, L., Rauth, I., & Elmquist, M. (2016). Framing design thinking: The concept in idea and enactment. *Creativity and Innovation Management*, 25(1), 38-57.
- Chasanidou, D., Gasparini, A. A., & Lee, E. (2015, August). Design thinking methods and tools for innovation. In *International Conference of Design, User Experience, and Usability* (pp. 12-23). Springer, Cham.
- Clark, K., & Smith, R. (2008). Unleashing the power of design thinking. *Design Management Review*, 19(3), 8-15.
- Clune, S. J., & Lockrey, S. (2014). Developing environmental sustainability strategies, the Double Diamond method of LCA and design thinking: a case study from aged care. *Journal of cleaner production*, 85, 67-82.
- Dam, R., & Siang, T. (2018). *Design thinking: Get a quick overview of the history*. Interaction Design Foundation.

- De Paula, D., Dobrigkeit, F., & Cormican, K. (2019, July). Doing it Right-Critical Success Factors for Design Thinking Implementation. In Proceedings of the Design Society: International Conference on Engineering Design (Vol. 1, No. 1, pp. 3851-3860). Cambridge University Press.
- Dorst, K. (2011). The core of 'design thinking and its application. *Design studies*, 32(6), 521-532.
- Dorst, K., & Valkenburg, R. (1998). The reflective practice of design teams. *Design Studies*, 19(3), 249-271.
- Dosi, C., Rosati, F., & Vignoli, M. (2018). Measuring design thinking mindset. In DS 92: Proceedings of the DESIGN 2018 15th International Design Conference (pp. 1991-2002).
- Duncker, K. (1945). The structure and dynamics of problem-solving processes. *Psychological monographs*, 58(5), 1-112.
- Greenwood, J. (1993). Reflective practice: a critique of the work of Argyris and Schön. *Journal of advanced nursing*, 18(8), 1183-1187.
- Jensen, M. B., Lozano, F., & Steinert, M. (2016, November). The origins of design thinking and the relevance in software innovations. In International Conference on Product-Focused Software Process Improvement (pp. 675-678). Springer, Cham.
- Johansson-Sköldberg, U., Woodilla, J., & Çetinkaya, M. (2013). Design thinking: past, present and possible futures. *Creativity and innovation management*, 22(2), 121-146.
- Kimbell, L. (2011). Rethinking design thinking: Part I. *Design and Culture*, 3(3), 285-306.
- Jung-Beeman, M., Bowden, E. M., Haberman, J., Frymiare, J. L., Arambel-Liu, S., Greenblatt, R., ... & Kounios, J. (2004). Neural activity when people solve verbal problems with insight. *PLoS biology*, 2(4).
- Hassi, L., & Laakso, M. (2011). Conceptions of design thinking in the management discourse. In *European Academy of Design Biannual Conference, Porto, Portugal*.
- Hernández-Ramírez, R. (2018). On design thinking, bullshit, and innovation. *Journal of Science and Technology of the Arts*, 10(3), 2-45.
- Liedtka, J., & Ogilvie, T. (2011). *Designing for growth: A design thinking tool kit for managers*. Columbia University Press.
- Liedtka, J. (2015). Perspective: Linking design thinking with innovation outcomes through cognitive bias reduction. *Journal of product innovation management*, 32(6), 925-938.
- Luchins, A. S., & Luchins, E. H. (1959). Rigidity of behavior: A variational approach to the effect of Einstellung.
- Owen, C. (2007). Design thinking: Notes on its nature and use. *Design Research Quarterly*, 2(1), 16-27.
- Öllinger, M., Jones, G., & Knoblich, G. (2008). Investigating the effect of mental set on insight problem solving. *Experimental psychology*, 55(4), 269-282.
- Ohlsson, S. (1992). Information-processing explanations of insight and related phenomena. *Advances in the psychology of thinking*, 1, 1-44.

Rauth, I., Carlgren, L., & Elmquist, M. (2014). Making it happen: Legitimizing design thinking in large organizations. *Design Management Journal*, 9(1), 47-60.

Rittel, H.W.( 1967) Wicked Problems, *Management Science*, (December 1967) vol. 4

Robert, C., Karasinski, P., Natowicz, R., & Limoge, A. (1996). Adult rat vigilance states discrimination by artificial neural networks using a single EEG channel. *Physiology & behavior*, 59(6), 1051-1060.

Thompson, N., & Pascal, J. (2012). Developing critically reflective practice. *Reflective practice*, 13(2), 311-325.

Tschimmel, Katja (2011). Design as a Perception-in-Action Prozess. In *Design Creativity 2010*. London: Springer Verlag. 223-230.

Tschimmel, K. (2012). Design Thinking as an effective Toolkit for Innovation. In *ISPIM Conference Proceedings* (p. 1). The International Society for Professional Innovation Management (ISPIM).

Schmiedgen, J., Spille, L., Köppen, E., Rhinow, H., & Meinel, C. (2016). Measuring the impact of design thinking. In *Design Thinking Research* (pp. 157-170). Springer, Cham.

Schön, D. (1983). *The reflective practitioner*. New York, 1083.

Seidel, V. P., & Fixson, S. K. (2013). Adopting design thinking in novice multidisciplinary teams: The application and limits of design methods and reflexive practices. *Journal of Product Innovation Management*, 30, 19-33.

Simon, H. A., & Newell, A. (1958). Heuristic problem solving: The next advance in operations research. *Operations research*, 6(1), 1-10.

Simon, H. A. (1992). What is an “explanation” of behavior?. *Psychological science*, 3(3), 150-161.

Stickdorn, M., Schneider, J., Andrews, K., & Lawrence, A. (2011). *This is service design thinking: Basics, tools, cases* (Vol. 1). Hoboken, NJ: Wiley.

Tschimmel, K. (2012). Design Thinking as an effective Toolkit for Innovation. In *ISPIM Conference Proceedings* (p. 1). The International Society for Professional Innovation Management (ISPIM).

Visser, W. (2010). *Schön: Design as a reflective practice*.

von Thienen, J., Meinel, C., & Nicolai, C. (2014). How design thinking tools help to solve wicked problems. In *Design thinking research* (pp. 97-102). Springer, Cham.

## Sitography

<https://thisisdesignthinking.net/2014/12/changing-experiences-through-empathy-ge-healthcares-adventure-series/>

<https://cmo.adobe.com/articles/2017/8/15-mind-blowing-stats-about-design-led-businesses.html#gs.ltyf7z>

Compean S (2016) “*Using Design Thinking to Design Business Models*” via SogetiLab  
<https://labs.sogeti.com/using-design-thinking-to-design-business-models/>

<https://www.amazon.com/b?ie=UTF8&node=15283820011>

<https://newatlas.com/ford-kick-activated-tailgate/21746/>

Stanford university media (2010). An Introduction to Design Thinking PROCESS GUIDE

<https://dschool-old.stanford.edu/sandbox/groups/designresources/wiki/36873/attachments/74b3d/ModeGuideBOOTCAMP2010L.pdf>

Justin Lokitz (2018)“What is the future of design thinking?” via  
<https://www.businessmodelsinc.com/future-of-design-thinking/>

ANNEX 1: The online questionnaire.

1. Design thinking is a problem solving approach
2. Design thinking is a cognitive approach
3. Design thinking is a business mindset
4. Design thinking is the use of toolkits
5. I improvise and try new solutions when I do design thinking
6. In each phases of a design thinking session I reflect if what I'm doing is right or not
7. When I'm doing design thinking I feel that what I'm experiencing could change the theories I learned
8. Design thinking is something impossible to learn theoretically, it could only be learned through experience
9. There would not be design thinking without collaboration
10. I feel uncomfortable in doing design thinking in group
11. Working on a project using design thinking method could inhibit someone
12. I get better ideas when I'm working in group
13. Using methods that help the visualisation is essential (ex. mind mapping)
14. Using manipulative and visualisation tools/methods is the only way to generate new idea in design thinking
15. Good design thinking could be done using imagination without the use of any tool/method
16. A synchronous remote meeting is enough to discuss and generate great ideas
17. How often in the DT session you have joined, the starting problem has been reframed in a new and original way?

18. After a generative discussion how often you think "how did we not think about it before?"
19. When you're alone, after a design thinking session, how often do you experience the "eureka" moment where brilliant idea comes suddenly in your mind
20. In design thinking the solutions don't come in mind suddenly but it is required time and a scientifically approach
21. How often when you are at home the ideas that seemed disruptive in the session become trivial and ridiculous ?
22. The most exciting thing in design thinking is
23. The most frustrating thing when I participate to design thinking session is
24. Design thinking have a valuable impact
25. A way to measure the design thinking effectiveness is
26. Design thinking is based on two phases: problem definition and problem solution
27. The reason of a negative feedback in testing a product is a misunderstanding in the problem analysis
28. When the prototype is not working as expected how often do you do a step back to initial phase of the project (ex. empathizing with the user)?
29. All the phases of design thinking aim to build a quick and dirty prototype to test as soon as possible
30. How often when the prototype is not working as expected the reason is that the problem is not well addressed?
31. There is confusion in defining what design thinking is
32. I feel I don't fully understand what design thinking is
33. Design thinking word is used inappropriately
34. People talk about design thinking just because it is a trend
35. For me design thinking is

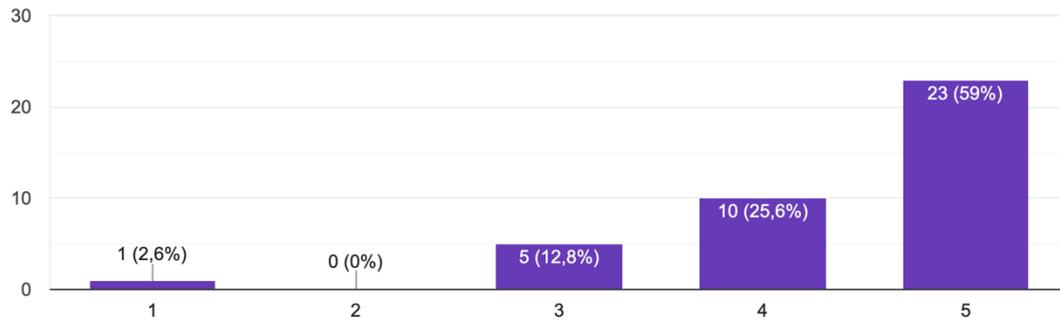
36. Design thinking helps in solve complex and non linear problems
37. Most of the problem faced in typical design thinking sessions could be faced in different ways
38. There are problems that design thinking is more effective in solving than other approach
39. I think that design thinking sessions are a waste of time
40. Problems related to the social world, the people and the innovation could be faced only with design thinking
41. Design thinking is a rigid multistep process (ex. empathize, define, ideate, prototype and test)
42. During the session all the visions of a problem convert in one interpretation in a natural way
43. Once defined the problem a wide number of solutions come to mind
44. In its core design thinking could be defined as a fluid approach to innovation
45. The design thinking is something organic and it's useless to define to divide it in stiff steps
46. For me design thinking is an alternation of analysis and synthesis phases
47. How many times did you have attended design thinking sessions in the last 6 months?
48. When did you hear for the first time about design thinking?
49. For me the main goal of Design Thinking is
50. Please select your profession
51. Age

## ANNEX 2: Survey results.

### Section 1

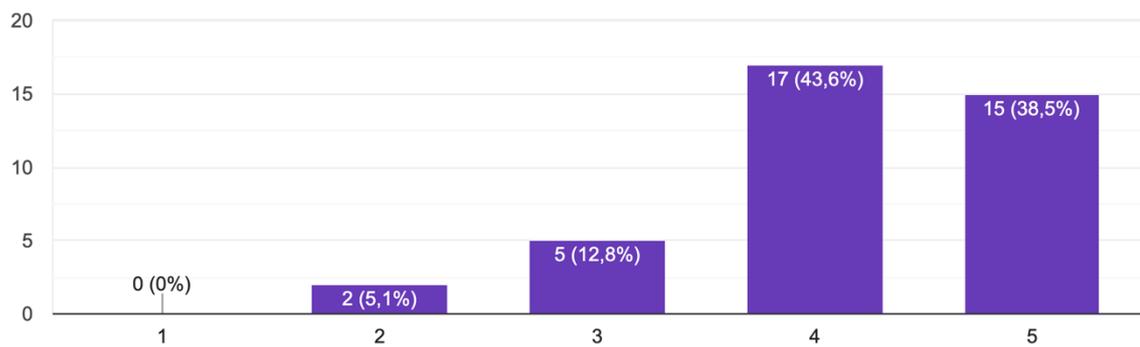
#### 1. Design thinking is a problem solving approach

39 risposte



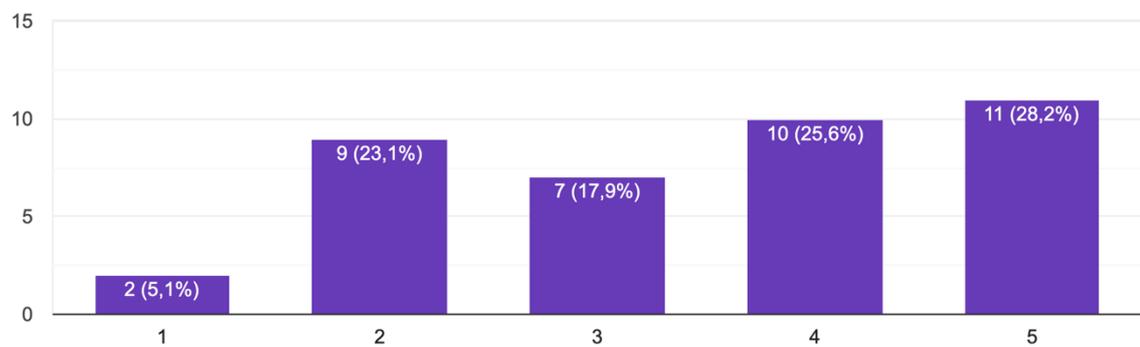
#### 2. Design thinking is a cognitive approach

39 risposte



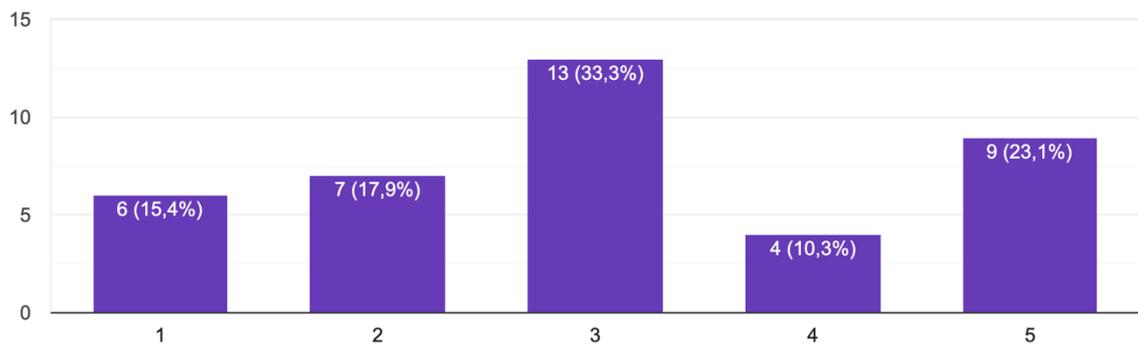
#### 3. Design thinking is a business mindset

39 risposte



#### 4. Design thinking is the use of toolkits

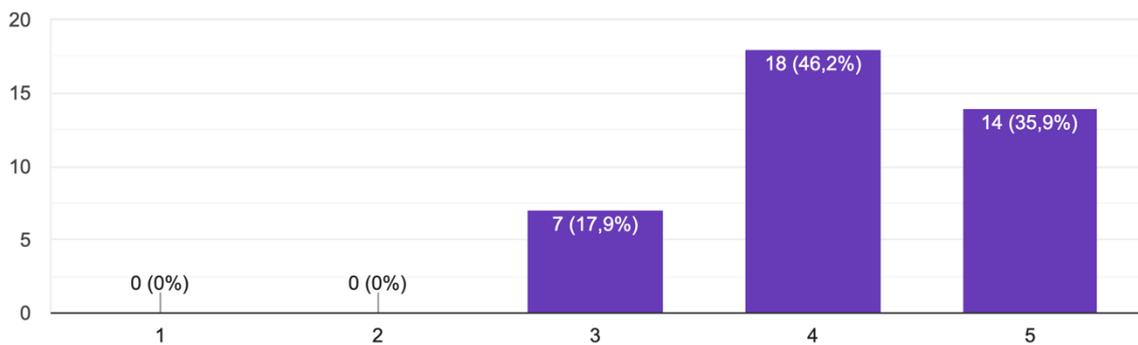
39 risposte



### Section 2

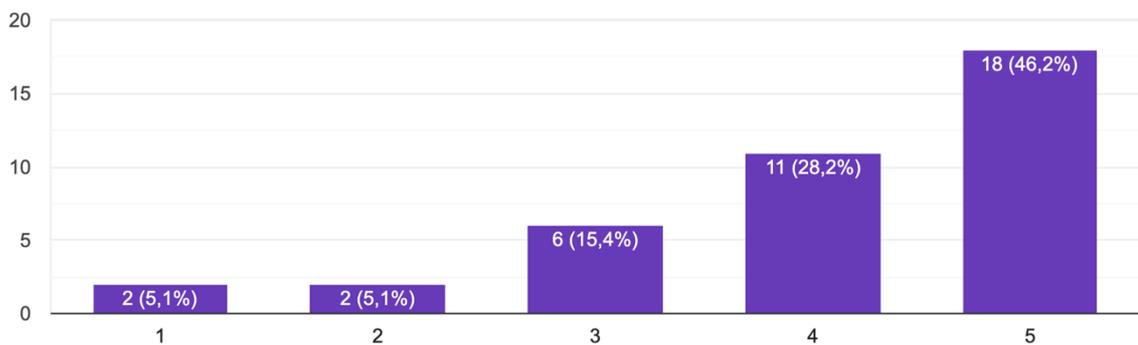
#### 5. I improvise and try new solutions when I do design thinking

39 risposte



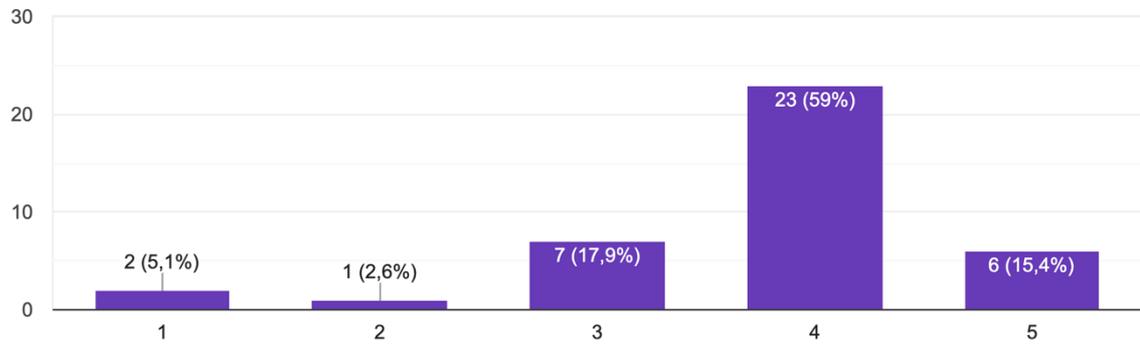
#### 6. In each phases of a design thinking session I reflect if what I'm doing is right or not

39 risposte



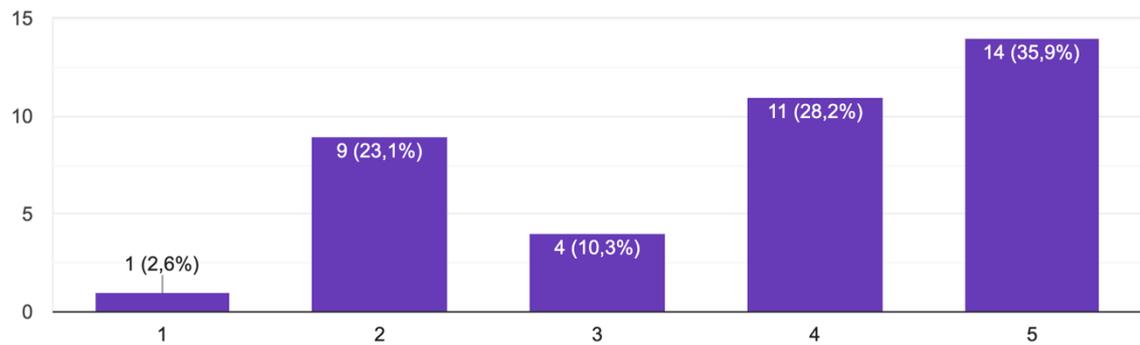
7. When I'm doing design thinking I feel that what I'm experiencing could change the theories I learned

39 risposte



8. Design thinking is something impossible to learn theoretically, it could only be learned through experience

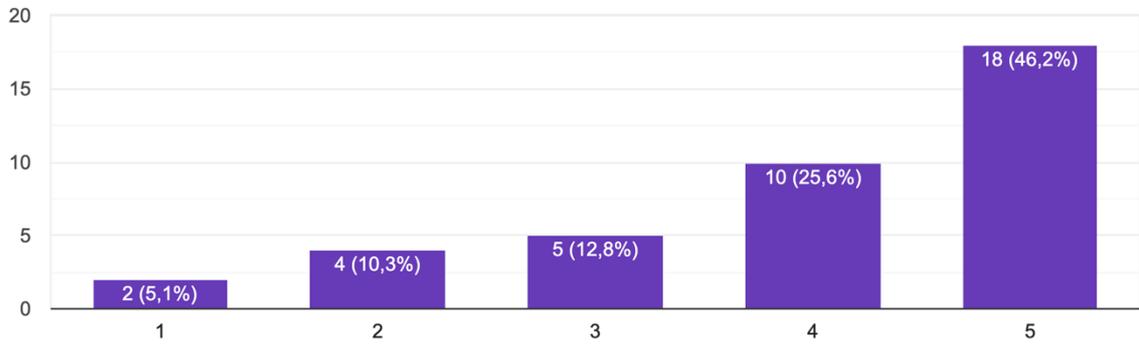
39 risposte



### Section 3

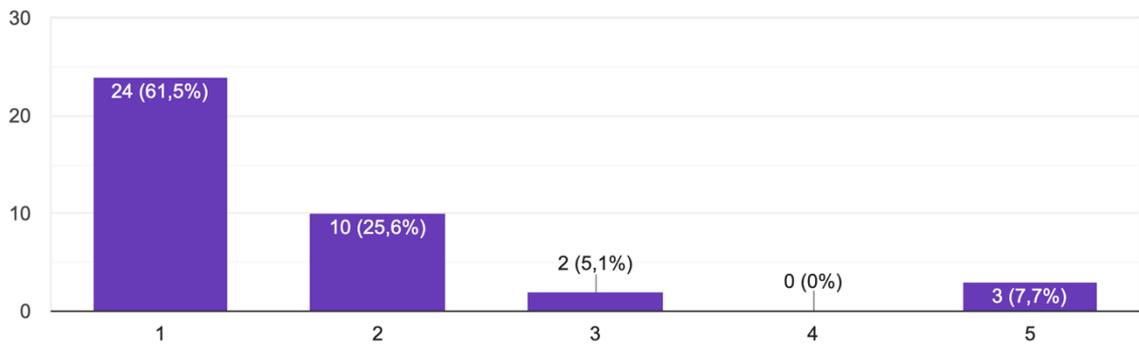
9. There would not be design thinking without collaboration

39 risposte



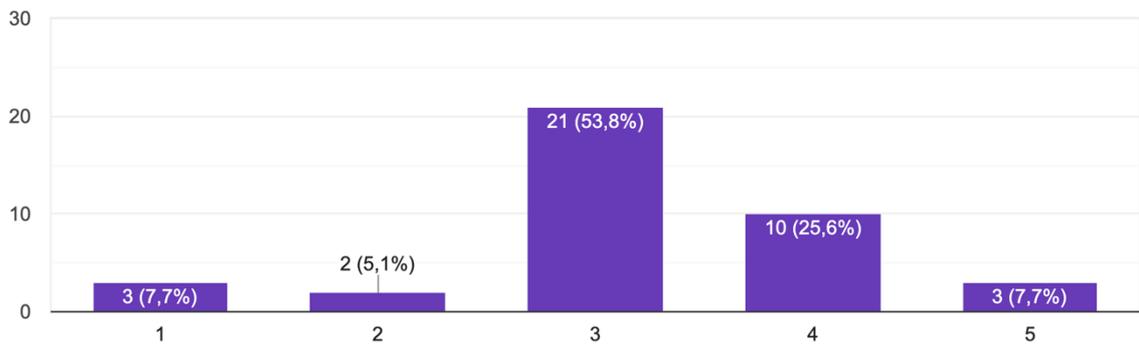
10. I feel uncomfortable in doing design thinking in group

39 risposte



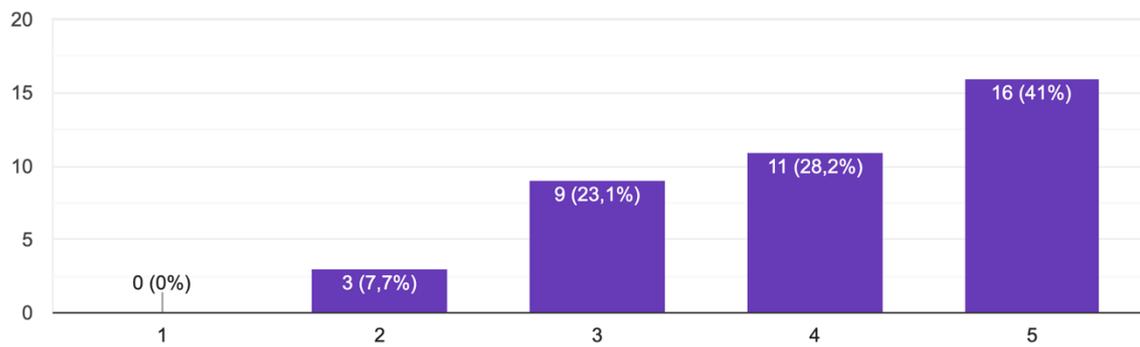
11. Working on a project using design thinking method could inhibit someone

39 risposte



### 12. I get better ideas when I'm working in group

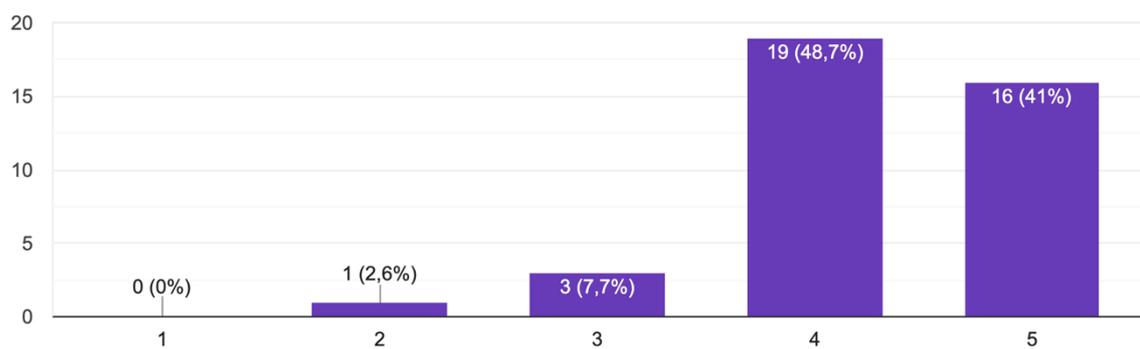
39 risposte



## Section 4

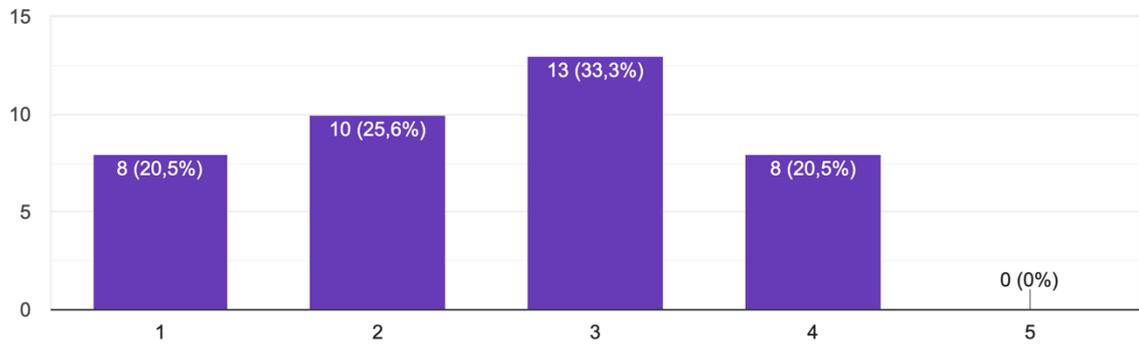
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39 risposte



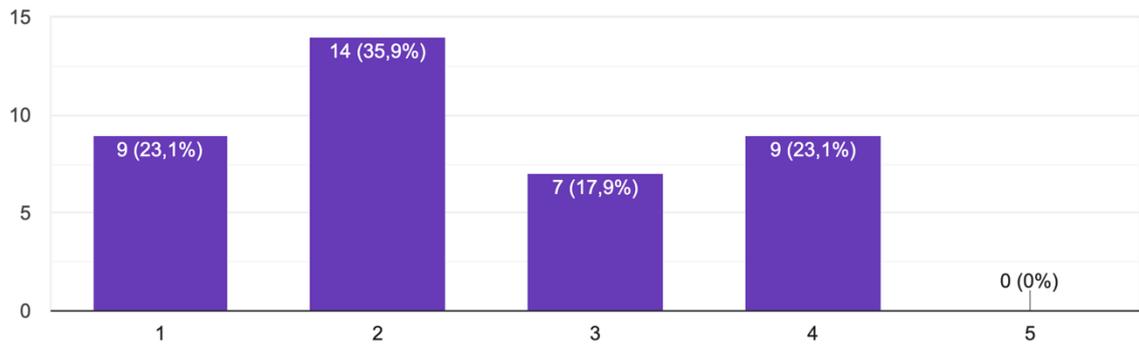
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39 risposte



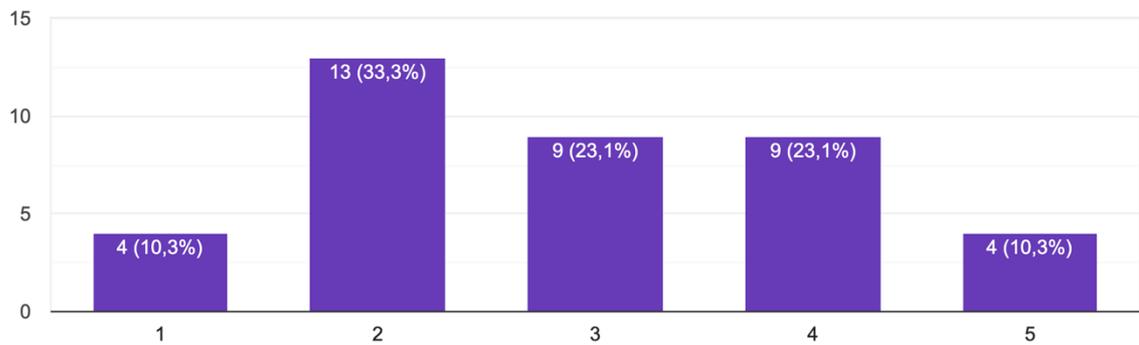
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39 risposte



16. A synchronous remote meeting is enough to discuss and generate great ideas

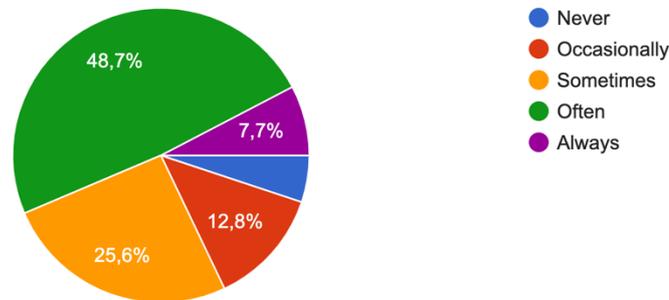
39 risposte



## Section 5

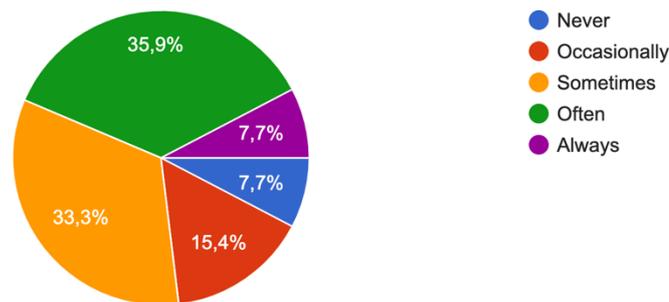
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39 risposte



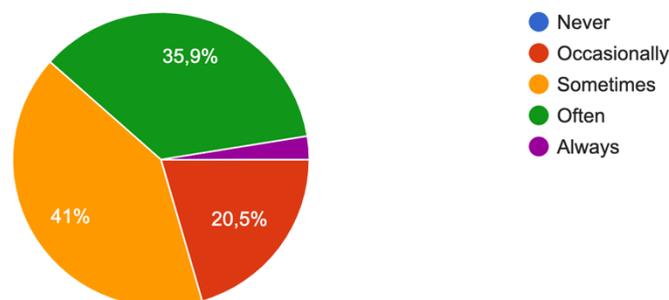
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39 risposte



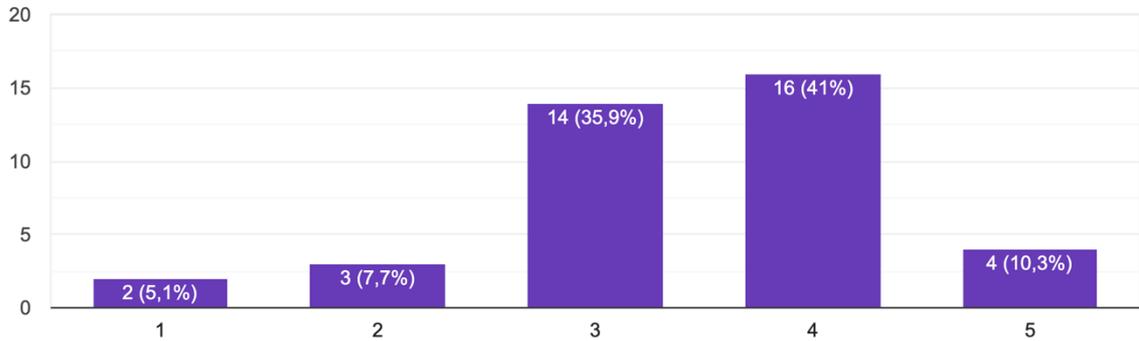
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39 risposte



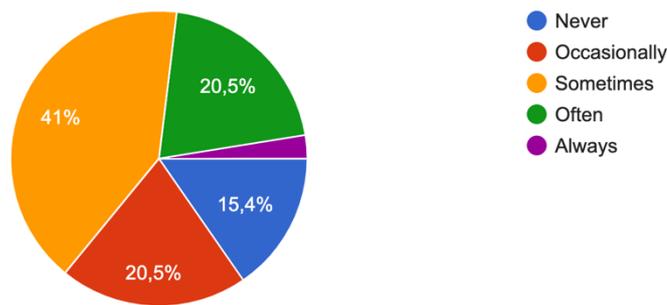
20. In design thinking the solutions don't come in mind suddenly but it is required time and a scientifically approach

39 risposte



21. How often when you are at home the ideas that seemed disruptive in the session become trivial and ridiculous ?

39 risposte



## Section 6

22. The most exciting thing in design thinking is
Coming up with a team vetted solution
Repetitive process
thinking
Multidisciplinary Approach
Creativity
Emathy
Research with real customers to remove our original assumptions and biases
Many people from different backgrounds
Collision of ideas, seeing things from others persoectives
It involves putting yourself in the shoes of the user
The complexity of all involved groups and the challenge to combine all
Ideas can come from anywhere
specifying the goals.

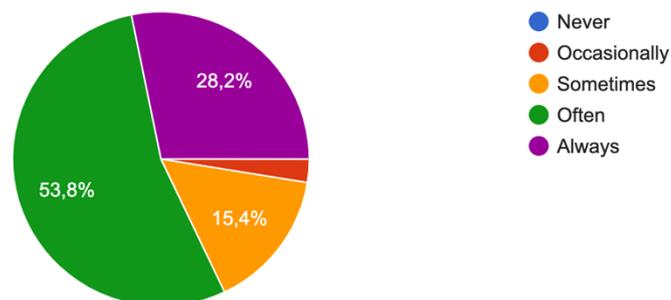
Framing thoughts
Maps building
Explore new solutions
solving user-centered problems
Creativity
Group work
Research
Having to work with many people and make them discover new things
Iterative approach and the evolutionary results that comes with it
exploring the problem space and finding opportunities that are bigger than the initial
The problem reframing
prototyping
Work collaboration and creativity
reframing the problem
Empathising and co creation
Generating new ideas
Solution oriented, bold and innovative.
collaborative thinking
We try to solve Problems affecting diverse groups of people.
Ideas
Collaboration
Involving users in the process (workshops or interviews)
New ideas
Nth excited me. It is a methodology that has pros and cons.
-
I don't think of design thinking in this manner re. having an exciting attribute about it. I like how it is meant to offer a different perspective

<b>23. The most frustrating thing when I participate to design thinking session is</b>
Not having a say.
No teamwork
thinking
Multidisciplinary Approach
People shut down my ideas
the struggle for power
Recruiting the right interviewee sample can be difficult. It takes time and expertise to do properly.
It takes long time
Other people have not prepared
spending a lot of time teaching others or constantly explaining every decision in a rational way
When it is not organized and later gets restricted by the industry again
People rarely consider the needs of people with disabilities
not being accredited for the ideas I have.
Too simplistic at times.
The starting point

If I can't express my point of view
when participants get emotionally attached to their beliefs and ideas, when participants don't accept or acknowledge other participants input, and when participants try to be dominative and take hover activities not allowing other people to participate.
Nothing
People not willing to explore
People who think DT takes place in workshops or sessions.
Bias, all the time. An the dunning krugger effect from c-levels... not taking serious the thing.
Clients that doesn't know how to generate ideas and be open.
When someone won't follow the traceability of the research information and tries to base decisions on personal experiences .
Keeping thoughts together, synthesis
getting everyone to collaborate as a team
Different aproches by participants
not prepared mindset
People not being truly present
Reflecting the result
Reluctant and negative attitude of participants.
bringing everyone to same page
When resources and requirements/needs are not aligned.
People who are contentious
Not being able to let go imagination
Feeling stuck in the process
Old ideas
Systematic evaluation
People thinking in solutions too early
Same as above really, I don't think of design thinking in this manner re. having a frustrating attribute about it. Design by committee can be annoying if this is a relevant answer.

## 24. Design thinking have a valuable impact

39 risposte

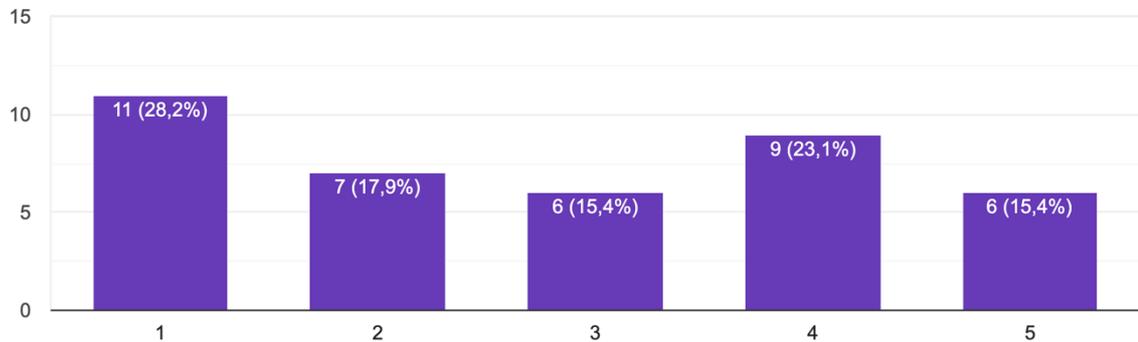


25. A way to measure the design thinking effectiveness is
Group consensus
Self reflection
assume you succeed
Customer Satisfaction / Customer Attraction etc
Outcomes. I used design thinking to create a public mural. The measurement of success is the mural being completed.
4p model
The quality and relevance of the (new) problem statement, and the learnings from the prototypes that were tested
From the result
Context dependent, there is no one way
ROI
Take two groups one used design thinking the other not and test the outcome with real users (e.g. A/B Testing)
whether the ideas either come to fruition or evolve into something that comes to fruition
measuring the final product's impact on users.
Dunno
The two approaches comparison
User's approach
if the problems identified were solved effectively and efficiently, benefiting the user and the business.
Testing the solutions
If people after keep in touch and communicate
Whatever business or user goal was set before the project.
trnaslate your impacto to business metrics
By A/B testing with the idea client had before DT started
The level of understanding and detail that a team develops on a specific challenge
When the mindset changes
the number of solutions we generate
Interviews and customer satisfaction
satisfaction surveys, both costumers, employees, other stakeholders
By measuring the effectiveness of the outcome
Final outcome
customer feedback and satisfaction, employee engagement, kpi
by measuring the final idea or final action step on monthly basis
How will people use the object? and taking feedback back from people.
Impact
User validation test /pilot / prototype / landing page
Prototyping and testing
Does it create a blue ocean?
Don't know
-
I'm not sure, you'd probably have to do an A/B test of something made with a control group not focused on design thinking, and the challenger group mainly focused on design thinking

## Section 7

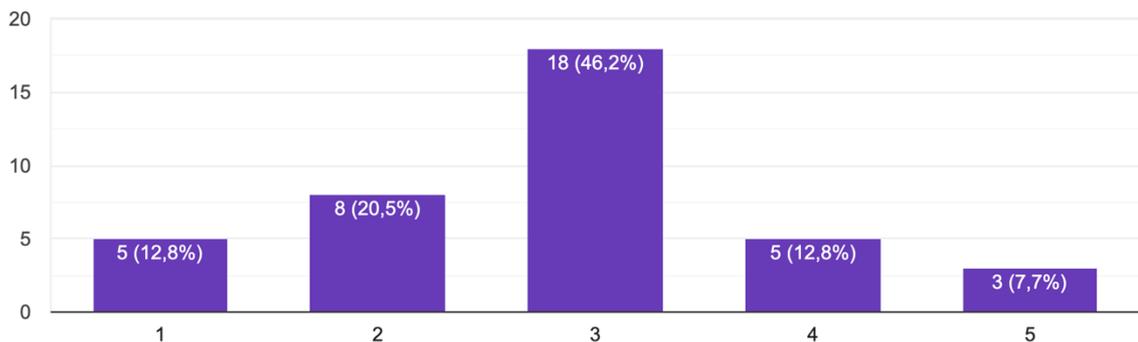
26. Design thinking is based on two phases: problem definition and problem solution

39 risposte



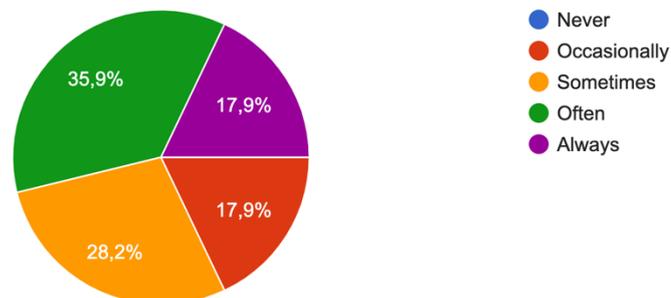
27. The reason of a negative feedback in testing a product is a misunderstanding in the problem analysis

39 risposte



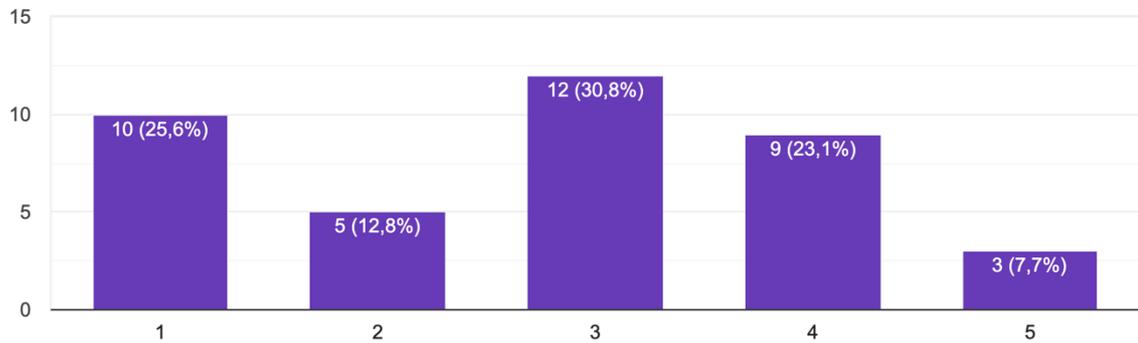
28. When the prototype is not working as expected how often do you do a step back to initial phase of the project (ex. empathizing with the user)?

39 risposte



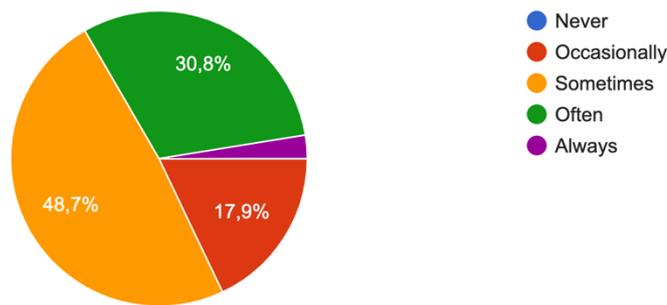
29. All the phases of design thinking aim to build a quick and dirty prototype to test as soon as possible

39 risposte



30. How often when the prototype is not working as expected the reason is that the problem is not well addressed?

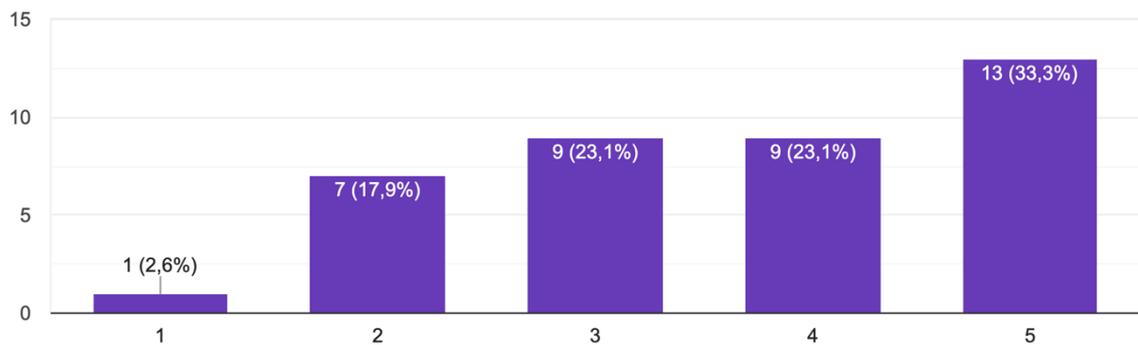
39 risposte



## Section 8

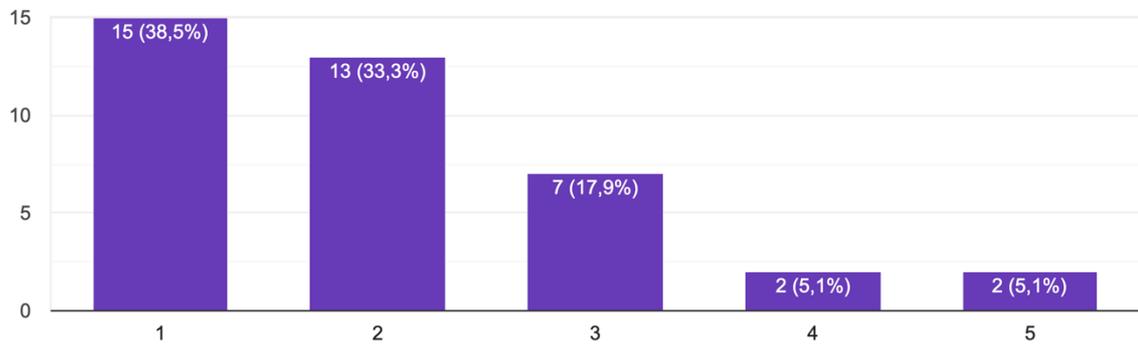
31. There is confusion in defining what design thinking is

39 risposte



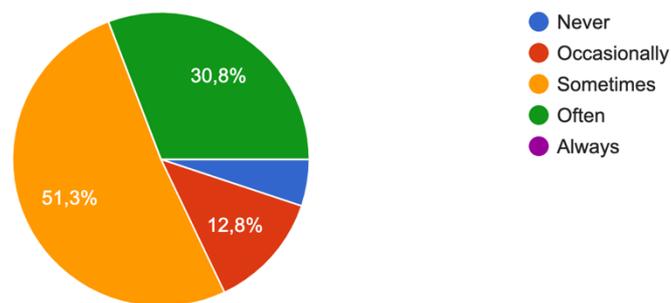
### 32. I feel I don't fully understand what design thinking is

39 risposte



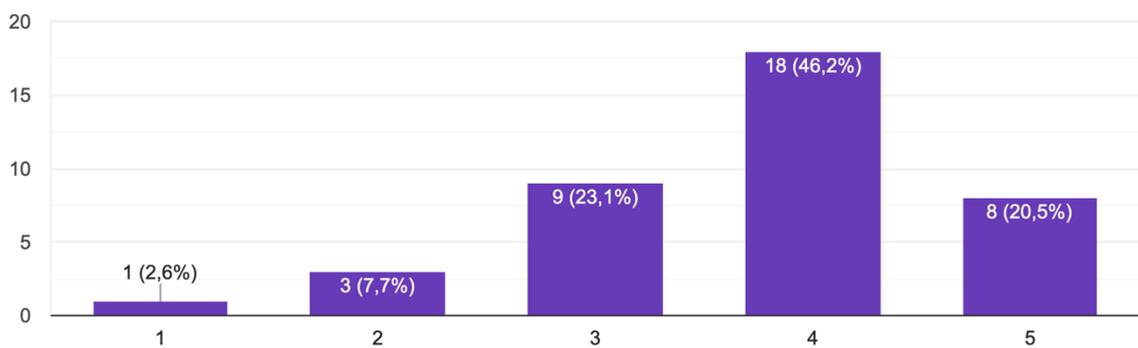
### 33. Design thinking word is used inappropriately

39 risposte



### 34. People talk about design thinking just because it is a trend

39 risposte

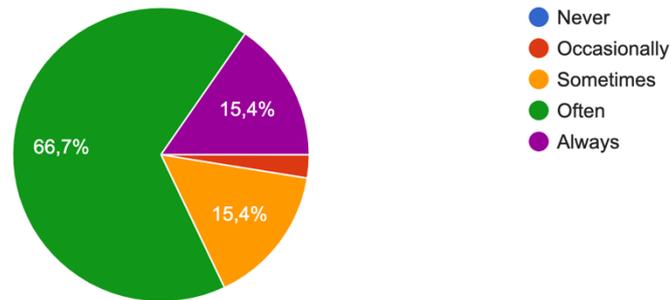


<b>35. For me design thinking is</b>
A systematic approach to bringing a concept to market.
Emphatize to others
waste of time
Design Thinking is an iterative process in which we seek to understand the user, challenge assumptions, and redefine problems in an attempt to identify alternative strategies and solutions that might not be instantly apparent with our initial level of understanding.
Passion
a method
One of many ways to solve a complex problem. Like any other approach, it has its strengths and weaknesses.
creativity
The application of design processes and patterns beyond fields typically though of as design.
is a process for creative problem solving
The basis of my working process
an asynchronous iterative process which tries to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test
doing the right thing, then doing the thing right.
A methodology
The better way to design something
An approach to solve user needs
a process for solving user-centered problems that generates solutions that are desirable by users, technologically feasible, and good for the business.
Problem solving approach
An approach
the application of design mindset and practice to non-traditional areas
A framwork of tools and methodologies, a mindset a design based process to implement a different way of creating and implementing new products into organizattions
Empathy based way to design new and innovative things in a iteratively
Bringing a designer's approach to challenges for teams with non-designers individuals.
Creative problem solving
generating solutions and prototyping
A mindset
the future of organizational innovation
A co-creative problem solving mindset
Finding a solution together
my way of thinking and doing.
finding alternative solutions to a problem in hand
Is the approach to know how will people use the product. and how product should be accessible to all people.(it should make client happy)
Methodologies for problem solving using scientific method
Define problem, free collaborative imagination, developing, testing, adjusting: Don't think you know it all, ask what people want, use your skills to create, check it it was right, adjust to feedback and deliver.
A methodology
Some strange talk accompanying product or service design
The ways designers work with high emphasis on empathy.
making sure to do the right thing before doing it right
prioritising a design mindset, usually focused on the user or human-centred, in order to build a product, tool, or journey that will be of great value to those who use it.

## Section 9

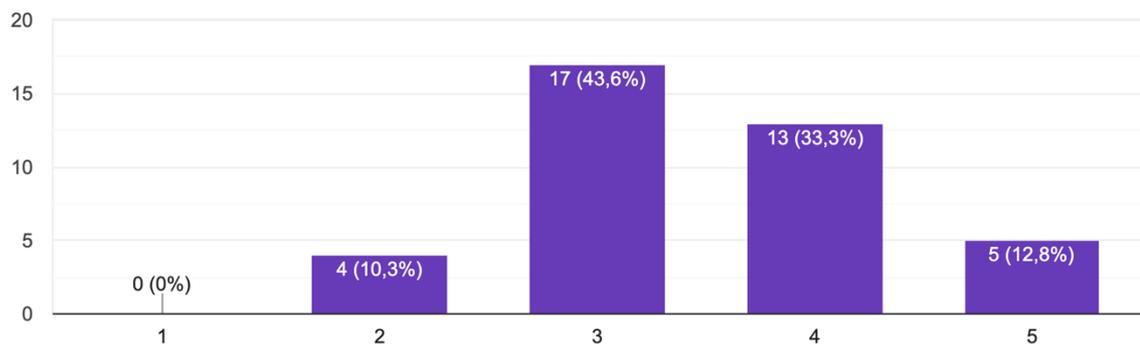
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39 risposte



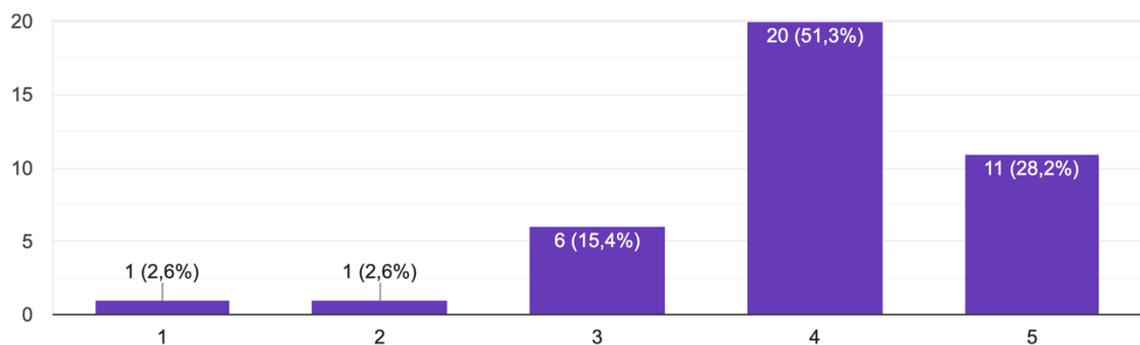
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39 risposte

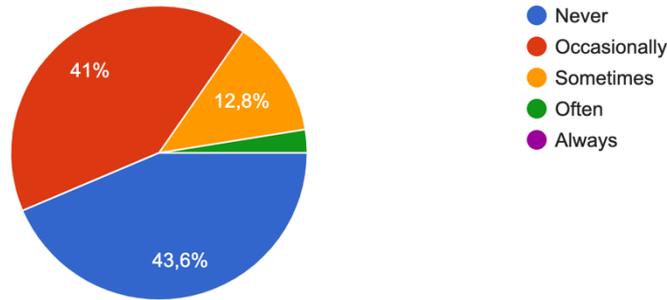


### 38. There are problems that design thinking is more effective in solving than other approach

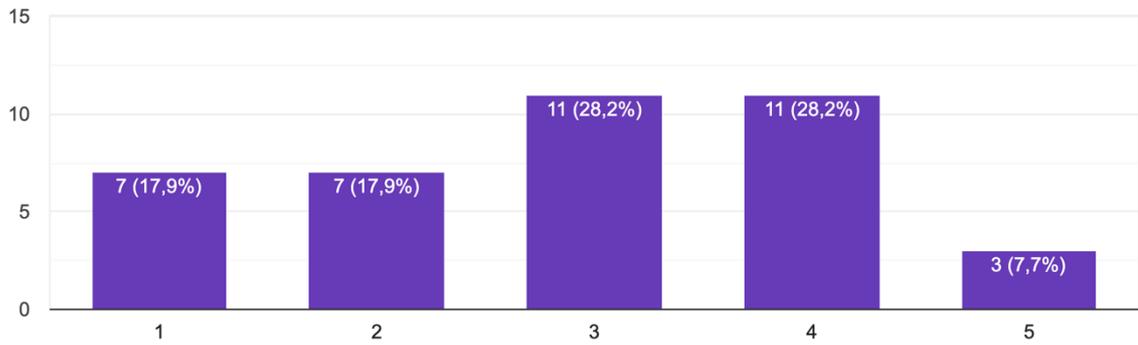
39 risposte



39. I think that design thinking sessions are a waste of time  
39 risposte

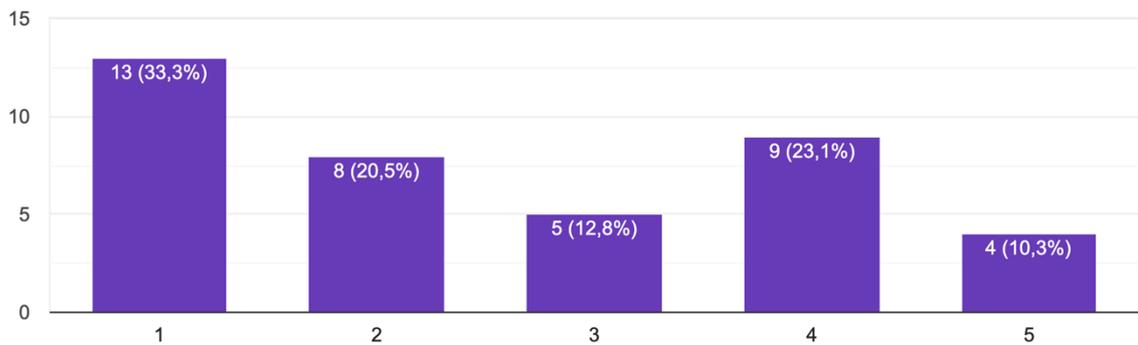


40. Problems related to the social world, the people and the innovation could be faced only with design thinking  
39 risposte

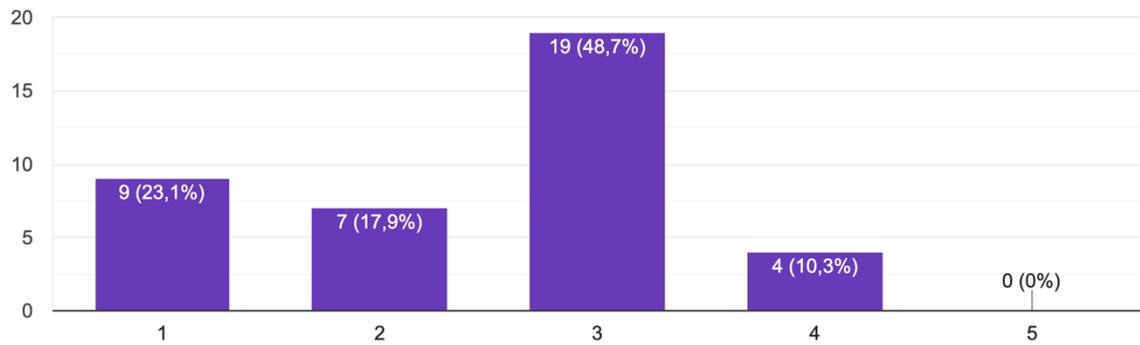


## Section 10

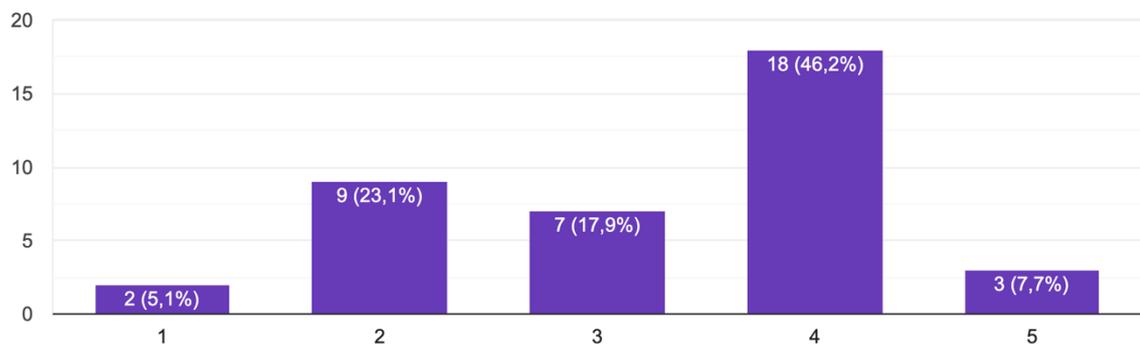
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39 risposte



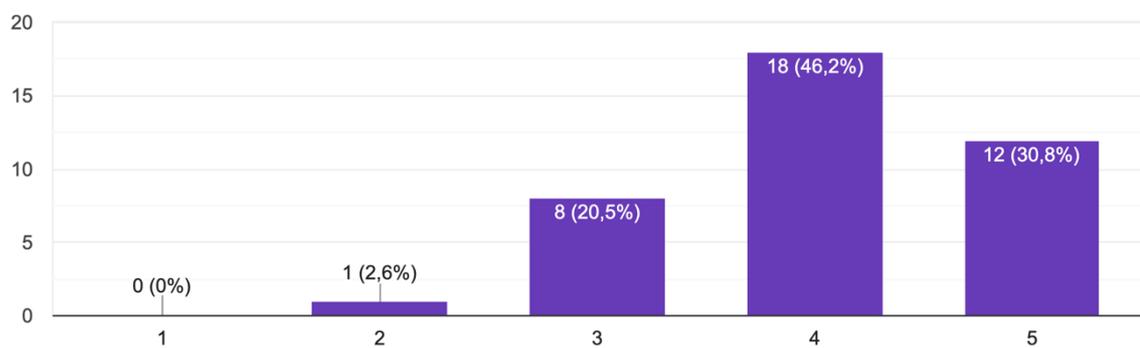
42. During the session all the visions of a problem convert in one interpretation in a natural way  
39 risposte



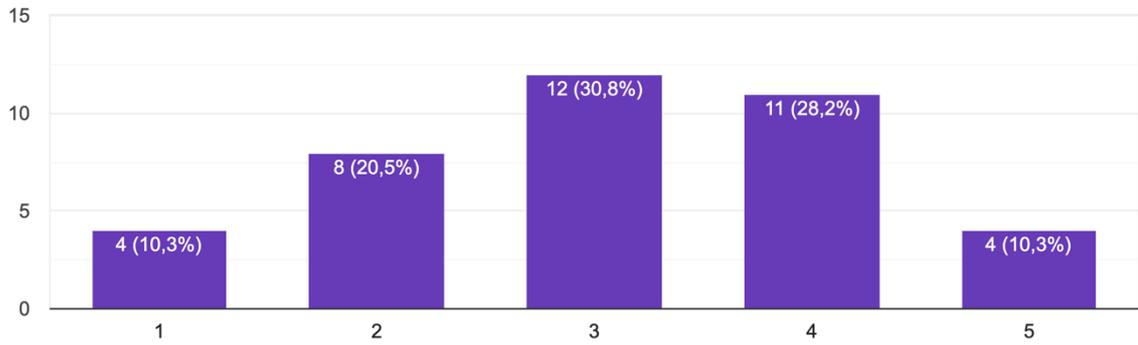
43. Once defined the problem a wide number of solutions come to mind  
39 risposte



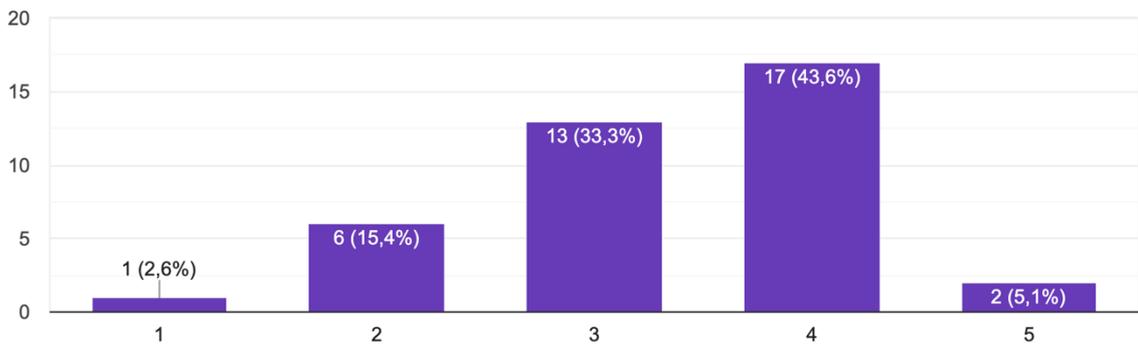
44. In its core design thinking could be defined as a fluid approach to innovation  
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45. The design thinking is something organic and it's useless to define to divide it in stiff steps  
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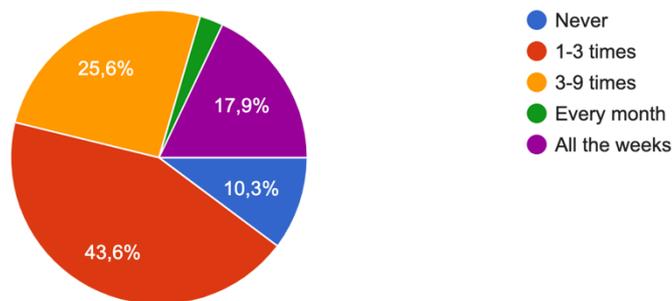


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39 risposte



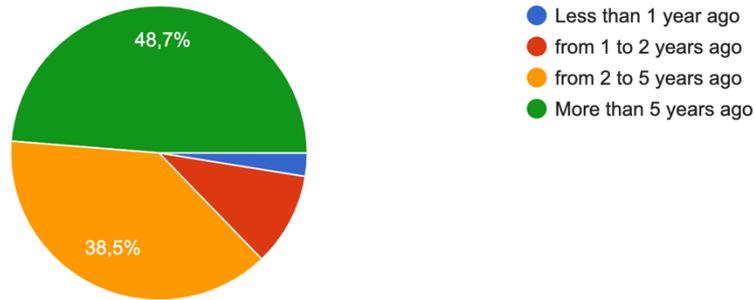
## Section 11

47. How many times did you have attended design thinking sessions in the last 6 months?  
39 risposte



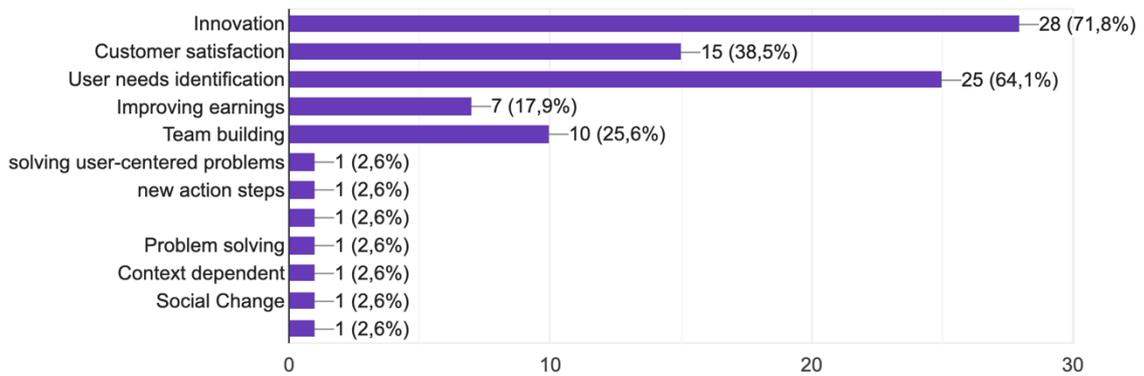
48. When did you hear for the first time about design thinking?

39 risposte



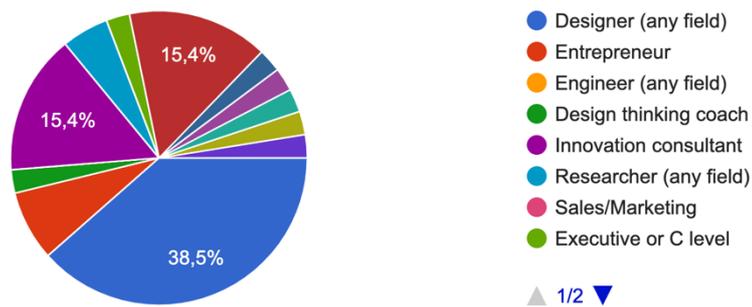
49. For me the main goal of Design Thinking is

39 risposte



50. Please select your profession

39 risposte



51. Age  
39 risposte

### ANNEX 3: Interview protocol

1. What is for you Design thinking?
2. What do you think about the IDEO definition of design thinking?
3. From the survey emerges how Design thinking is bringing struggle in teams, what is your experience in this?
4. From survey it is shown how for participants Design think is mostly understand user rather than creating innovation, what's your opinion about it?
5. Which the differences in project led with analytical mindsets and projects with design thinking mindset?
6. Do you think that Design thinking should be fluid, or a structure is needed in some way?
7. One of the assumptions of the research is the focal importance of the problem statement, after converging-diverging phases, what's your opinion about it?
8. How do you understand that the problem is not the "right problem"?
9. In the survey participants had concerns about doing design thinking remotely, what's your opinion?
10. What is your opinion about the importance of visualization tools and interfaces in design thinking?
11. If you think at your experience, is there a way to measure the effectiveness of design thinking workshops and relative product?
12. There are references about the benefit of DT to the organization culture and team building. Did you have ever been in a situation where it has been asked to do DT workshop to improve team building?

13. From the survey I had the feeling that people who do design thinking is not really into the prototype part but instead they are more interested in the “understanding user” part. What is your opinion about it?