

Double Hexagon: A Human-Centred Design
Framework for Innovation

DOUBLE HEXAGON: A HUMAN-CENTRED DESIGN
FRAMEWORK FOR INNOVATION

BY

VAJIHEH “AIDA” MOTAMER¹, B.Sc.

A THESIS

SUBMITTED TO THE DEPARTMENT OF COMPUTING AND SOFTWARE

AND THE SCHOOL OF GRADUATE STUDIES

OF MCMASTER UNIVERSITY

IN PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MASTER OF SCIENCE

© Copyright by Vajiheh “Aida” Motamer², February 2021

All Rights Reserved

Master of Science (2021)
(Computer Science)

McMaster University
Hamilton, Ontario, Canada

TITLE: Double Hexagon: A Human-Centred Design Framework
for Innovation

AUTHOR: Vajiheh “Aida” Motamer³
B.Sc. (Software Engineering)
University of Kashan, Kashan, Iran

SUPERVISOR: Dr. Christopher Anand, Dr. Sandra Moll

NUMBER OF PAGES: xiii, 97

Abbreviations

DH Double Hexagon.

DT Design Thinking.

EBCD Experience-Based Co-Design.

HCD Human-Centred Design.

HCI Human-Computer Interaction.

HMW How-Might-We...?.

IT Information Technology.

NHS National Health Service.

PBP Paper-Based Prototype..

POV Point-Of-View.

UCD User-Centred Design.

UK United Kingdom.

UX User Experience.

UXD User Experience Design.

UXT User Experience Test.

Abstract

Healthcare systems need to adjust services and methods to accommodate the needs, desires, and capabilities of people. Experience-Based Co-Design (EBCD) is the state of the art in participatory service design within the UK National Health Service (NHS), that draws upon design tools and ways of thinking in order to bring healthcare staff and patients together to improve the quality of care. The Co-design process that is integral to the EBCD approach is powerful but also challenging, as it requires active collaboration among multidisciplinary teams, including organizational stakeholders (e.g., investors, managers, advocates, etc.), end-users (e.g., staff, patients, carers, etc.), designers/researchers, and developers. Over the last decade, given the evaluation of the EBCD approach, there has been a gap between theory and practice resulting in limited outcomes in healthcare service improvements. Systematic reviews suggest this low success results from the lack of a systematic elaboration of Co-Design methods, limited tools and insufficient guidance on the ideation process, the tendency to develop a solution without enough divergent thinking, and a poor structure of participation. In order to improve health care services and address the gaps mentioned, we propose a methodology called Double Hexagon, that includes principles of Co-Design, Human-Centred Design, and Design Thinking. This framework is a Human-Centred Design framework that seeks to assist designers and

non-designers in moving from designing “product” categories to designing for “people” by providing a concrete and step-by-step realization for “Designing for People”.

Acknowledgements

I would like to express my gratitude to my supervisors, Dr. Christopher Anand and Dr. Sandra Moll. Their guidance and advice made this work possible, and their encouragement, patience, and generosity with their time were always appreciated. This thesis was much-improved thanks to their reviews. The quality of the Double Hexagon I made for this work benefited greatly from Dr. Anand's reviews. Without Dr. Moll's support and encouragement during the project and the great suggestions of Dr. Anand, I would never have had the idea to pursue this degree.

I would like to thank Dr. Robert Fleisig and Dr. Wenbo He for their thoughtful and useful comments as my Supervisory Committee members. I would also like to thank Lisa Wolfe as an adorable Research Coordinator from whom I learned a lot on the trips to collect data and also her precise notes during the Co-Design workshops.

I would like to thank my colleagues and friends at McMaster University and outside of it, who either directly assisted me with advice about my own work, or indirectly assisted me by providing me with a much-needed break to develop my ideas better.

I am grateful to my family for encouraging me to achieve and for believing in me. Without their support, I would not have had the freedom to follow my desire for further education, and without whom I would not have made it through my Masters's

degree.

Contents

Abbreviations	iii
Abstract	v
Acknowledgements	vii
Contents	xi
List of Figures	xii
1 Introduction	1
1.1 Human-Centred Design	1
1.1.1 Design Thinking and Solving a Correct Problem	2
1.1.2 Experience-Based Co-Design and Co-Design	3
1.2 Challenges and Motivation	3
1.3 Problem and Scope	4
1.4 Contributions	5
1.5 Structure of the Thesis	6
2 Literature Review	7

2.1	Experienced-Based Co-Design	8
2.1.1	The SecondEars Mobile App	21
2.1.1.1	Stakeholders Engagement	22
2.1.1.2	Co-Design Workshops and Activities	22
2.2	Design Thinking in Healthcare	25
2.3	Design Thinking	27
2.3.1	The Design Council’s Double Diamond (2005)	28
2.3.2	The Design Council’s Evolved Double Diamond (2019)	31
2.3.3	Stanford’s d.School Design Thinking Model	33
2.3.3.1	Iteration and Making the Process your Own	38
2.4	User/Human-Centred Design	39
2.4.1	Evolution from UCD to HCD	40
2.4.2	Usability versus User Experience	42
2.4.3	Evaluation of User Experience	43
2.4.4	IDEO.org’s Human-Centred Design Model	44
2.4.4.1	Diverging and Converging approach	45
2.4.4.2	Relationship Between HCD and DT	46
2.5	Related Work	48
2.5.1	The Revamped Double Diamond	48
2.6	Conclusion	52
3	Double Hexagon: A HCD Framework for Innovation	55
3.1	Description	55
3.2	Objectives and Principles	57
3.3	Double Hexagon Architecture	58

3.3.1	Designing for People	59
3.3.2	Point of Departure	59
3.3.3	Integrating Design Thinking into DH	63
3.3.3.1	The First Diamond of DH (Problem Space)	63
3.3.3.2	The Second Diamond of DH (Solution Space)	68
3.3.4	Integrating User Experience Test and Iteration in DH	74
3.3.4.1	UX Validation & Prototype Refinement	75
3.3.4.2	Iterations in DH	77
3.3.5	Integrating the Co-Design Principles into DH	78
3.3.5.1	Incorporation of Stakeholder Engagement in DH	78
3.3.5.2	Multidisciplinary Teams in DH	79
3.4	Conclusion	81
4	Discussion	83
4.1	Strengths of the Double Hexagon	83
4.2	Double Hexagon Limitations	85
4.2.1	Comparing with Previous Work	85
4.2.2	Organizational Culture Barriers	86
4.2.3	Implementation Barriers: Accessibility, Time, Funding	87
4.3	Conclusion	87
5	Conclusion and Future Work	88
	Bibliography	90

List of Figures

2.1	Experience-Based Co-design: a six-stage design process.	11
2.2	The Components of Good Design.	12
2.3	Weaknesses of the EBCD approach.	15
2.4	The Co-Design process for the SecondEars consultation audio-recording app.	22
2.5	British Design Council’s Double Diamond (2005).	29
2.6	Design Council’s evolved Double Diamond : The Framework For Innovation (2019).	31
2.7	Standford’s d.school Design Thinking process (2015).	34
2.8	Human-Centred Design process defined by IDEO.org (2015).	44
2.9	The intersection where Design Thinking lives.	47
2.10	“Revamped Double Diamond”, Point of Departure , A to B.	49
2.11	“Revamped Double Diamond”, Four phases of Double Diamond.	50
2.12	“Revamped Double Diamond”, Designing the right thing/Designing things right;	51
3.1	“Double Hexagon”, Symptom to Solution.	60
3.2	“Double Hexagon”, “Finding the Right Problem”/“Finding the Right Solution”.	61

3.3	“Double Hexagon”, Four “D” phases of the Double Diamond.	62
3.4	“Double Hexagon”, Divergent and Convergent Thinking.	62
3.5	“Double Hexagon”, “User-Centred Empathy” to the 1 st Diamond. . .	64
3.6	“Double Hexagon”, “Data Unpacked” in the 1 st Diamond.	65
3.7	“Double Hexagon”, “Synthesis” in the 1 st Diamond.	66
3.8	“Double Hexagon”, “POV Statement” in the 1 st Diamond.	67
3.9	“Double Hexagon”, “HMW” in the 1 st Diamond.	68
3.10	“Double Hexagon”, “Ideate” in the 2 nd Diamond.	69
3.11	“Double Hexagon”, “Evaluate” in the 2 nd Diamond.	70
3.12	“Double Hexagon”, “PBP” in the 2 nd Diamond.	71
3.13	“Double Hexagon”, “Wire-frames Developed” in the 2 nd Diamond. . .	72
3.14	“Double Hexagon”, “UXT (Verification)” to the 2 nd Diamond.	73
3.15	“Double Hexagon”, “Prototype Developed” to the 2 nd Diamond	74
3.16	“Double Hexagon”, “UXT (Validation)” in the 2 nd Hexagon	76
3.17	“Double Hexagon”, “Prototype Refined” in the 2 nd Hexagon	77
3.18	“Double Hexagon”, “Iterations” in DH	78
3.19	“Double Hexagon”, “Stakeholder Engagement” in the 1 st Hexagon . .	79
3.20	“Completed Double Hexagon”, Multidisciplinary Teams in DH	80

Chapter 1

Introduction

1.1 Human-Centred Design

Design is expected to respond to people's needs and expectations. Every product designed for humans has a user, and each time a product is used, it delivers an experience called User Experience (UX). The term product refers to the result of the design and development process, which is intended to respond to a specific need [1]. The User Experience (UX) is the sum of the emotions, perceptions, and physical and psychological reactions, which a person experiences before, during, and after interacting with a product [1]. Traditional design and engineering tend to emphasize non-emotional aspects of what users experience, including reliability, cost, and performance, so-called Usability [2]. Usability is only one of the components of the User Experience; a product may be usable without necessarily providing a positive and lasting user experience [1]. Today's designers require a pragmatic approach and way of thinking to solve problems in the context of people's lives. Design, unlike other conceptual disciplines, is able to act in accordance with Human-Centred ethics

[1]. Human-Centred Design (HCD) is “the process of ensuring that people’s needs, desires, and capabilities are met, which the resulting product is understandable and usable, and that the experience of use is positive and enjoyable” [2, p. 219]. In other words, an efficient design process strives to fulfill a broad variety of constraints and concerns, including form and shape, cost and efficiency, reliability and efficiency, understandability and usability, pleasing in appearance, and satisfaction with actual use. HCD is a set of procedures and techniques to address these requirements, but with a focus on two components: solving the right problem, and doing so in a way that meets human *needs, desires, and capabilities* [2]. A fundamental question in the design process is, why are designers making the products? It is important to note that good designers aim to make products for people to use. Human-Centred Design approaches and methods contribute to “**Designing for People**”.

1.1.1 Design Thinking and Solving a Correct Problem

Engineers are trained to solve problems. “How do you know you solved the **correct** problem?”, as Norman [2, p. 217] asks. Good designers, instead, are trained to discover the real problems. A perfect approach to the wrong problem can be worse than no solution at all: solve the correct problem [2]. In the real world, problems are not delivered in clean and tidy packets. The correct problem must be identified [2]. This is where the necessity of *Design Thinking* is perceived [2]. Design thinking considers both problem space and solution space as something that needs to be explored [3]. The two design components mentioned earlier 1.1—finding the right problem and addressing human needs, desires, and capabilities lead to two phases of the design process. The first stage is to find the right problem, the second is to find the right

solution, which led the British Design Council to the “Double Diamond” model in (2005). This is the starting point for our approach.

1.1.2 Experience-Based Co-Design and Co-Design

The transition from Human-Centred Design to Co-Design has an effect on the role played by peoples during the design process [1]. Co-Design requires a creative process and active collaboration between designers and users who are “experts of their own experience” and play an important role in the development of knowledge and in the generation of ideas, rather than just in collection of data and validation of results. “The term Co-Design is used to indicate a creative endeavour that is shared between the designer and the end user, who work together as equals during the process of generating and conceiving ideas and the subsequent design phases [4]” [1, p. 132].

Experience-Based Co-Design (EBCD) was developed by (Bate and Robert) [5] and has subsequently been used within the National Health Service (NHS) of the United Kingdom as an approach to the design of healthcare services and can be considered as the “state of the art” for Co-Design of services within the NHS (“The UK’s NHS is the biggest provider of healthcare services in the world” [6]).

1.2 Challenges and Motivation

Over the past decade, applying service design theory and practice in improving public services is an emerging and rapidly growing field [7]. EBCD is a participatory approach to improving healthcare services, which borrows from Co-Design and User Experience Design to bring about quality improvements in healthcare organizations

[7]. Given an international survey of completed, ongoing, and planned EBCD implementations in healthcare services, exploring the features and adaptations of EBCD in the period between 2005 and 2013 [8], found that although the Co-Design process as an integral part of EBCD is powerful, is somewhat challenging [6, 7, 8, 9]. In view of the researches, the adoption and implementation of Co-Design, particularly in public services, need critical approaches to both organizational processes and design practice, additional guidance, and further techniques and tools, in order to help envision and explore potential possibilities for improving complex services such as healthcare services [7, 9, 10, 11]. Given the studies, although EBCD's strengths have been observed in building trust and empathy using a focus on lived experience through stories and emotional mapping [6], has resulted in limited service improvements during the EBCD projects which may be due to the lack the systematic elaboration of co-design methods, limited tools and less guidance on the ideation process, the tendency to develop a solution without adequate divergent thinking, and inadequate structuring of participation [1, 6, 9, 10, 11]. In this regard, we will detail in Chapter 2 the gaps found in the studies and methods applied to the field of EBCD and DT methods used in the current approaches to HCD, which prompted us to propose a model to bridge them.

1.3 Problem and Scope

As mentioned earlier, in evaluating the EBCD approach, a limited outcome in service improvements in the healthcare context has been observed, which other authors have suggested this may be due to the lack of a systematic elaboration of co-design methods, limited tools and less guidance on the ideation process, the tendency to

create a solution without adequate divergent thinking, and inadequate structuring of participation [1, 6, 9, 10, 11].

In order to address this problem and in view of the gaps and suggestions for future work flagged in the EBCD literature and the importance of Design Thinking in health care interventions, we have identified the need for a methodology that includes principles of Co-Design, Human-Centred Design, and Design Thinking. To this end, we propose an iterative hybrid Human-Centred framework called Double Hexagon (DH) that can be used by both designers and non-designers. Double Hexagon has been set out based on the principle of “Designing for People” that aims at solving a design problem to elicit a positive and satisfying User Experience (UX). This structure seeks to provide some ideation techniques and facilitators and encourages divergent thinking, which explores a problem or a bunch of ideas more broadly or deeply, and then convergent thinking, from which emerges a single problem statement or solution. In other words, it emphasizes divergent thinking and convergent thinking in both problem and solution spaces. Furthermore, given the literature on HCD, User Experience evaluation is an essential part of HCD [1], and should be considered an important phase in the design of each product. To address this, Double Hexagon includes the evaluation of User Experience from both the viewpoint of *Verification* and *Validation* as separate stages, to draw the attention of designers to the value of this step in the design process as valuable as other phases.

1.4 Contributions

The main contributions to the area of Human-Centred Design include:

- (i) A framework that makes explicit both what and how activities should be performed, plus who should take part during the design process.
- (ii) Contributing to address the gaps in the Experience-Based Co-Design and in general Co-Design approach which fulfill lack of a systematic of Co-design methods.
- (iii) Contributing to how “Designing for People” instead of designing a “product” to elicit the experience that is positive and lasting, in which meets people’s *needs, desires, and capabilities*.
- (iv) Contributing to evaluate the User Experience from both perspectives of Verification and Validation.

1.5 Structure of the Thesis

The remainder of the thesis is organized as follows:

Chapter 2 reviews the relevant literature on Experience-Based Co-Design, Design Thinking, and Human-Centred Design approaches, highlighting identified gaps. Chapter 3 proposes the Double Hexagon framework and explains how it was built on top of the Double Diamond by adding EBCD, Co-Design, and Human-Centred Design layers. Chapter 4 discusses two strengths the DH contributes to the field of design practice as well as weaknesses of the Double Hexagon. Furthermore, it compares the DH to previous works and discusses the barriers which could emerge during its execution similar to those observed in case studies for related Human-Centred Design methods. Finally, Chapter 5 ties the thesis together and suggests directions for future work.

Chapter 2

Literature Review

A bird's eye view of the gaps in the Experienced-Based Co-Design was provided in the previous chapter. In this chapter, we will overview some of the studies available in the design of healthcare services, as well as some methods and concepts of Human-Centred Design to develop meaningful interventions that can be evaluated for effectiveness in designing or redesigning healthcare services. In Section 2.1 we will consider theoretical research done related to the design approaches to healthcare improvement services, including Experienced-Based Co-Design in healthcare. This will guide us on what has been achieved before, and the gaps and challenges that other researchers have taken into account in their analyses in using this approach in healthcare services design. Furthermore, we included one case study in this section based on the EBCD approach to show how it works in the real world. In Section 2.2, we will review one systematic review on Design Thinking in healthcare to see how Design Thinking has been used in health care and whether it is effective.

In Section 2.3, among the various Design Thinking process models, we will present two of the best-known Design Thinking models. The weaknesses in each

model will be highlighted in this section. Some User/Human-Centred Design principles and concepts will be discussed in Section 2.4 and one well-known model of HCD developed by IDEO.org will be presented at the end of the section. In Section 2.5, we will introduce a combined model that is relevant to our work, which tries to bridge the gaps found in the current models in the scientific literature.

2.1 Experienced-Based Co-Design

To date, healthcare service improvement efforts have not necessarily been concentrated on the **patient’s experience**, beyond asking what was pleasant and what was not. Questions were not asked in order to find out what the experience was or should be like and then the knowledge systematically used to Co-Design interventions for patients [12]. Despite the longevity of the “patient involvement” concept, in most countries, healthcare systems still do not place patients first, unfortunately, what it gains in longevity, it seems to lack in vitality and urgency. This study highlighted there is a gap between ideology and practice [12].

In this regard, Bate and Robert in 2006, proposed Experience-Based Co-Design (EBCD), as a particular form of Co-Design that emphasizes changing or improving the user experience with a product or service rather than the product or service itself [5, 12]. They defined experience as “how well people understand it (in this case: the healthcare services), how they feel about it when they are using it, how well it serves its purpose and how well it fits into the context in which they are using it” [12, p. 308]. EBCD formally is defined as “a user-focused Co-Design process to make user experience accessible to the designers, to allow them to conceive of designing experiences rather than designing products or services.” [12, p. 308]. As briefly

outlined in the previous chapter, Co-Design is a design approach aimed at active collaboration among multidisciplinary teams, including end-users, customers, and other relevant organizational stakeholders (e.g., investors, managers, advocates, etc.) end-users (e.g., staff, patients, carers, etc.), designers/researchers, and developers during the design process.

A core concept of Co-Design is that users are “experts of their own experience”. Research and generation of ideas in the design are not done on behalf of the user but in partnership with the user. The term Co-Design “is used to indicate a creative endeavor that is shared between the designer and the end-user, who work together as equals during the process of generating and conceiving ideas and the subsequent design phases. This is a new approach that sees the user becoming a **co-designer** and the designer becoming a **facilitator** and a **mediator** in the co-design process to help users with design by providing tools and techniques [4]” [1, p. 132].

EBCD approach was first piloted in a head and neck cancer service at Luton & Dunstable Hospital [13]. Subsequently, a free-to-access, online case study toolkit [14] was developed in August 2011 through a partnership between quality improvement practitioners and academics. The toolkit was then disseminated via the King’s Fund charity to make the concepts and practices of EBCD widely accessible to those leading EBCD projects and anyone with an interest in healthcare quality improvement [8, 14]

As detailed in Figure 2.1, the EBCD process, which typically lasts between 9 to 12 months, is divided into six phases of the action research process that together form the EBCD approach to enhancing the patient experience. Phase 1 involves setting up the project, including governance and project management arrangements. Phase 2 involves gathering staff (from the receptionist to the lead clinician) and

gathering experiences through observational fieldwork and in-depth interviews, and then thematically transcribing and interpreting the interview. In this stage, Robert [15] pointed out that during multiple implementations of the EBCD approach, the data obtained from 12 to 15 interviews provide adequate perspectives to represent staff experiences. Phase 3 involves gathering patient and carer experiences through observation and 12-15 filmed narrative-based interviews to identify the significant touch-points (experienced critical moments in connection with the service). This phase typically runs in parallel with phase 2. Phase 4 involves bringing staff, patients, and caregivers together at the first co-design event to share their experience of service and identify priorities for improvement, followed by an edited 20-30 minute “trigger” video of patient narratives. Phase 5 involves continued co-design work in small groups formed around these priorities to design and implement improvements to services, including prioritizing the touch-points by the project participants. This phase typically includes 4 to 6 groups and takes over three months. In the final Phase 6, the separate co-design groups come back together for celebration and review & renewal [5, 7, 13, 15].

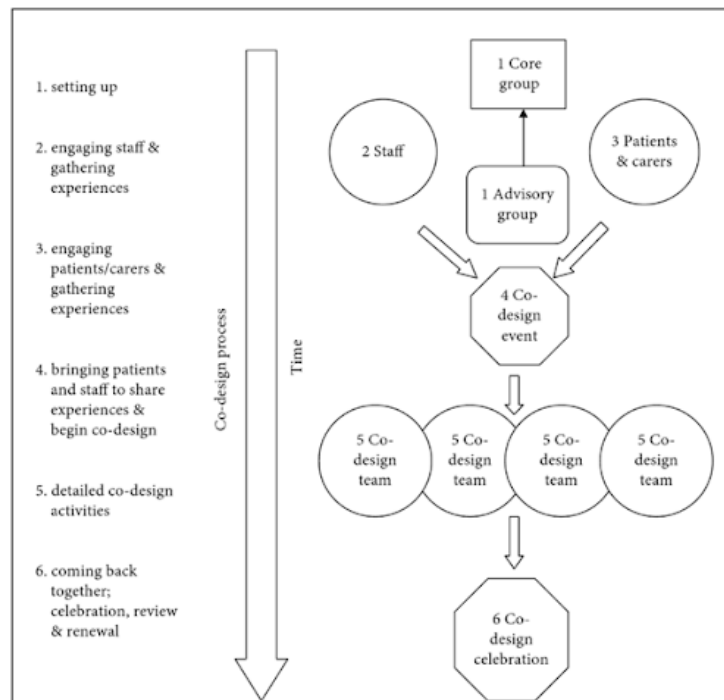


Figure 2.1: Experience-Based Co-design: a six-stage design process.

Image Source:[15, p. 143]

Identifying touch-points is a central concept to EBCD, which makes it possible to begin designing experiences rather than processes. As Robert [15, p. 144] defines, ‘touch-points’ are “the crucial moments, good and bad, that shape a patient’s overall experience”. Touch-points are very simple points of contact with the service or product, but also deeply personal points, in which the patient/end-user remembers being touched emotionally or cognitively (deep and permanent memories) in some way. Stories and storytelling are the basis of experience design, in which the touch-points are the “big moments” that patients/end-users keep coming back to in the telling and retelling of their stories of interaction with the service or product [12, 13]. This co-design approach was explicitly intended to draw on the discipline of design sciences and the design professions, such as architecture, and computer, product, and

graphic design to bridge the above-mentioned gaps in the design of healthcare services [12]. These authors in a follow-up study in 2007 [13] stated EBCD is about co-designing healthcare services and is modeled on the burgeoning field of EBCD in the design sciences. The aim of such a process is not so much to improve the performance, or effectiveness of the product or service itself, rather more accurately, the user’s experience with that product or service [13]. Rather than seeing the user as a passive recipient of a product or service, in EBCD, the user acts as a co-designer of the product or service and becomes an integral part of the improvement and innovation process [12]. The focus shifts from change to improvement, from process to outcomes, resulting in an intervention that will ultimately lead to a “good” design and subsequently a “good” experience for the users [12, 13]. In this study, “good design” includes three components by “Berkun(2004)(adapted by Bate)” [12, p. 308] as shown in Figure 2.2.

Performance	+	Engineering	+	The Aesthetics of Experience
How well it does the job/ is fit for the purpose		How safe, well engineered, and reliable it is		How the whole interaction with the product/service “feels”/is experienced
(Functionality)		(Safety)		(Usability)

Figure 2.2: The Components of Good Design.

Image Source: (Barkun adapted by Bate)[12, p. 308]

All three issues (performance, engineering, and aesthetics/experience) must be achieved simultaneously since all three elements are closely intertwined and can never

be treated as isolated elements [13]. Although these three components are supposed to be considered together, healthcare has always been associated with the first two aspects of design [12], in which performance says what a product/service is supposed to do; and engineering checks the safety (e.g., no harm, no error, consistency, durability, reliability, etc.) [13]. They claimed the third item, **aesthetics**, which is related to designing human experiences that make the user feel good, but has never been engaged to the same extent as the two other criteria by designers [12, 13].

For example, a service or product might be perfect (fast, reliable, no bottlenecks) but result in a terrible experience, or, vice versa, despite the poor quality in the process and pathway, resulting in a rational and good experience [12]. There is a point between a great process and a terrible experience, in which balance needs to be restored to take into account the third aspect (aesthetic) in designing a service/product [12]. Moreover, despite many differences between healthcare design and product design and engineering, what brings this extremely diverse community of professionals together is the common aim of making a product or service “better” for the user, and achieving this by focusing on the knowledge and experience that is held only by the patient/end-user, which requires making the user a co-designer [12]. This knowledge is articulated in what a person thinks, feels, and says about the experience of a service, process, or product [12]. The biggest challenge in interpreting experiences is understanding how the interface between the user and the product is formed. Exploring and understanding people’s experiences is a skill that needs to be learned and practiced. In reality, however, experience research is often little more than a conversation that someone might have had; stories do not work for themselves without any analytical frameworks. Healthcare designers should be rely on observing

the real experience rather than a questionnaire survey (surveys provide attitudes, but they do not provide experiences) [12]. In this regard, Robert elsewhere [15] explained the four overlapping strands of thought that have contributed to the development of the EBCD approach, namely:

- participatory action research
- user-centred design
- learning theory
- narrative-based approaches to change

It provides two specific contributions from User-Centred Design (UCD) to quality improvement thinking in the healthcare area: 1) a new lens to examine approaches to improving patient experience in healthcare, 2) methods, tools, and techniques (such as modeling, prototyping, storytelling, story-boarding, etc.), that have been little used to enhance health care work until recently [8].

As far as the strengths and weaknesses of the EBCD approach are concerned, and as mentioned in the previous chapter, Section 1.2, one 'mapping' analysis [8] was carried out in 2014 to map current and future EBCD approach experiences and explore the features and adaptations of EBCD in the period between 2005 and 2013. This study [8] included an international online survey of researchers and practitioners involved in completed, ongoing, and planned EBCD projects in healthcare services, as well as a series of 18 follow-up telephone interviews and 57 respondents. This analysis [8] revealed that after the pilot project in 2005-6, at least 59 EBCD projects were completed in six countries around the world (the UK, Australia, New Zealand, Canada, Sweden, and the Netherlands) during the period 2005-2013 and at least

27 other projects were in the planning stage during this period. The projects were carried out in a variety of clinical areas including cancer, mental health, drug and alcohol services, emergency services, diabetes, orthopedics, intensive care, palliative care, genetics, neonatal and pediatric care, hematology, and surgical units. It seems the number of projects is increasing year on year [7, 8]. In the mapping study, survey respondents were questioned about the weaknesses of the EBCD process for the project. Figure 2.3 shows the data of the survey on the weaknesses of this process [7, 8].

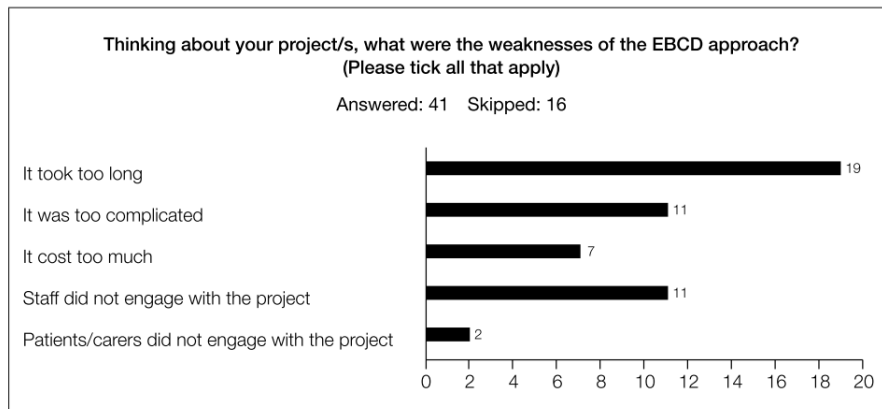


Figure 2.3: Weaknesses of the EBCD approach.

Image Source: [7, p. 236]

This survey [8] highlighted the fundamental importance of Co-Design in the EBCD approach; putting users at the very centre of EBCD as well as the wider impacts of the EBCD approach on staff well-being and behaviors. Based on what the participants expressed in the survey [8], while there are some examples of successful integration of Co-Design into routine organizational processes and a lot can be learned from published reviews of effective Co-Design work, there is still a crucial need for

illustrative and accessible techniques, which will lead to the further clarification of the “how” and “why” of Co-Design process in EBCD [8].

As noted in Figure 2.3, almost 50 percent of respondents in the survey noted that the process “took too long”. Acknowledgement of the time factor is the main criticism of the EBCD process that has, in turn, led to the many adaptations to this approach in practice. Adaptations to the Co-Design process included [8, p. 26]:

- Shortened the process of Co-Design (e.g., only one collaborative co-design workshop).
- Co-design meetings without follow-up.
- Varied formats of co-design meetings, such as the combination of “experience sharing” and the “identification of ideas/solutions” in the workshops; no emotional mapping.
- Attempting exclusively to understand patient experience, not both patient and staff experience.
- Discussed the experiences and identified the ideas with the patients present, but only staff were then asked to develop and evaluate the “solution”

Since some respondents who led EBCD projects, in their survey[8] responses asked for more examples to be provided of Co-Design meetings, appropriate techniques and tools, more information about how to make co-design activities work, the ‘fundamental’ aspects of co-design and where ‘shortcuts’ could be created, authors in the survey believe that project leaders are still struggling with the theory of Co-Design itself [8]. Even where Co-Design projects have been successfully implemented, the Co-Design phases of the EBCD have proven to be, although effective, still complicated to execute in practice [7, 8, 16, 17, 18]

In this regard, some information gathered from the survey [8] related to poor or changed execution of Co-Design phase as follows:

- Only staff members worked on improvements after the joint event (3 projects).
- Staff worked on improvements alongside patients via email communication rather than through formal meetings (1 project).
- Two more interviewees reported having only conducted patient feedback sessions, with staff working on subsequent improvements/developments.
- Attempting exclusively to understand patient experience, not both patient and staff experience.
- One interviewee described that there was no aspect of Co-Design in their project at all.

Below are part of two interviews about Co-Design process from this survey [7, 8]:

(1) “We got together and we discussed the narratives and we tried to identify, in the collective discussion, where or how things could be improved, but when it then came down to what they were actually going to do, those decisions were taken by the frontline managers, the nursing managers, and their line managers. So there was certainly no co-design at that point ... I think you can then identify how the hierarchies worked within the organization, co-designed up to a point, and then it reverted back to a much more hierarchical way of organizing things ... a workshop with a draft action plan which was then taken away and worked on behind closed doors. (Interview #02)” [8, p. 29]

(2) *“So there’s just still that wall to be knocked over yet as far as lived experience being something that’s a valuable tool in informing services of what they’re doing, and how to do it better... (Interview #07)”* [8, p. 32]

The above-mentioned findings demonstrate that there may be some shortcomings in the execution of the co-design phase during the EBCD process. As Bowen discussed [6, p. 241-242] two key weaknesses related to the co-design aspect of EBCD during their case study: (1) The “modest service improvements”, despite the EBCD’s strengths in building trust and interaction focusing on lived experience through stories and emotional mapping. (2) “The perception of designing as being something that was done by others”. In other words, *“most participants perceived themselves as giving input to a design process but did not see themselves as ‘doing’ the designing (despite our best efforts to encourage their active involvement), which was disappointing to us as participatory designers as we wanted them to feel that they were co-creators.”* [6, p. 242].

This study [6], argued that the lack of (participatory) **ideation tools** provided in EBCD [10] and specific **structuring of participation** could be connected to these weaknesses [6]. In another case study [19] that led a Co-Design project with young people with type 1 diabetes to design innovative health services, authors recommended that (1) designers should consider young people as equal design partners rather than subjects of research, sustaining the creative excitement and integrating young people’s experiences into further design activities to strengthen collaboration in design; (2) it is crucial for young people to feel that they have their own ideas, which are valued [19]. Given the above-mentioned results and further case studies, Bowen [6] flagged the development of a participatory, human-centred health service design approach as

a future work.

Bowen, in another research [9], claimed that although EBCD offers efficient methods for reflecting the participants' experience in healthcare services and identifying areas for improvement, it provides **less guidance** on how to proceed from stories to the design of improved services, i.e. ideation [9, 10]. This study criticized the Guide and Tools booklet as an EBCD guidance, which "consists of 24 and 22 pages on the *capture* and *understand* phases, with only 12 and 8 on the *improve* and *measure*" [9, p. 3]. The key improvement tools offered by this guide, are a simple form that maps the defined problem to the proposed action, and cards to document such actions; however, despite suggested online resources, **it lacks special tools to encourage divergent thinking that could reveal different issues and identify radical solutions.** [9, 20].

In the EBCD approach, the generation of ideas in general discussion meetings is well-tailored to identifying and implementing changes that are easy to accomplish, which often in the form of "fixing" what is "broken" rather than seeking broadly radical solutions [9, p. 3]. On the other hand, the above-mentioned toolkit provided **little** assistance for the complex problems, in which the means for improvement were not immediately obvious. Bowen [9] given the challenges encountered in improving the outpatients' service [6], mentioned earlier, concluded that these challenges are common to the participatory and innovation of services in large institutions. **Co-design activities should resist converging to solutions too early, instead, providing space for the participants in which they can step back and seek common factors and more radical solutions** [9, p. 4].

Bowen [9] proposed that future versions of EBCD should incorporate more techniques and tools to help in envisaging and exploring radical solutions particularly in tackling the complex problems encountering in service design [9, p. 4].

Furthermore, Tosi [1] states, “To date, as Rizzo writes [4], systematic **elaboration of the Co-design methods has not yet been developed**, but other co-design experiments can be studied instead, that is, design experiments aimed mainly at understanding useful tools that are necessary for co-design and for supporting creative collaborations and generating design and innovation processes” [1, p. 136].

Although EBCD’s strengths have been observed in building trust and empathy using a focus on lived experience through stories and emotional mapping [6], the impact on service improvements is reportedly more limited, which may be due to the lack the systematic elaboration of co-design methods, limited ideation tools ,and less guidance, the tendency to develop a solution without adequate divergent thinking, and inadequate structuring of participation [1, 6, 9, 10, 11].

In addition to the above-mentioned gaps, identified in the EBCD literature, from our viewpoint, there is an additional pitfall in the EBCD literature that may have resulted in a limited outcome of this approach as an effective technique in healthcare services, that is, the “problem” may have not been identified correctly leading immediately to concentrate on exploring a solution to the problem that is not the root problem in reality. Design science including the Design Thinking approach focuses on both identifying the right problem and discovering the right solution. Therefore, in Section 2.2, we will review the Design Thinking literature in Healthcare and in Section 2.3, DT models in the Human-Centred Design context. We will finish the EBCD and Co-Design literature with one case study, the SecondEars Mobile Health

app, described in the below section 2.1.1.

2.1.1 The SecondEars Mobile App

SecondEars is a co-designed mobile health application that used Experience-Based Co-Design (EBCD) to develop a consultation audio-recording mobile app for cancer patients in 2016 [21]. App prototype development started with stakeholder engagement, accompanied by a series of six co-design workshops, followed by user acceptance testing. Stakeholder engagement involved legal advice, information technology (IT), clinical and allied health leaders, digital strategy, and medical records. Participants in co-design workshops consisted of patients, research team members, IT staff, app designers, physicians, and medical records staff.

The objectives of this co-design research were identified as follows:

- (i) Identify and engage the stakeholders integral to the implementation of mobile health technology within a hospital.
- (ii) Facilitate co-design workshops to identify the necessary features of the app.
- (iii) Develop a wireframe of the app.
- (iv) Conduct user acceptance testing of the app.
- (v) Complete a prototype of the app.

They addressed these Objectives via the co-design process shown in Figure 2.4.

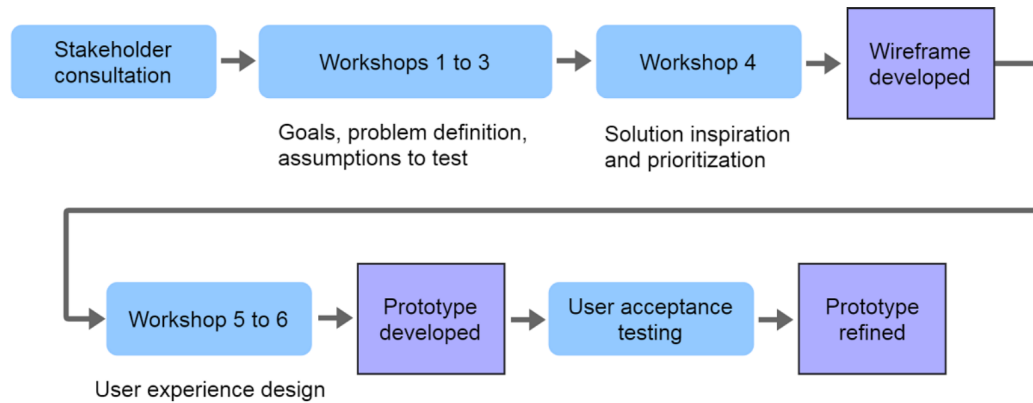


Figure 2.4: The Co-Design process for the SecondEars consultation audio-recording app.

Image Source: [21, p. 3]

2.1.1.1 Stakeholders Engagement

Initial consultations with key stakeholders started in 2016 and continued throughout the development process. This early involvement identified the legal and technical requirements of the app prior to the start of the co-design process. They identified 6 requirements for the app, including being patient-driven, secure, clear according to the legal responsibilities, connected to the medical record of the patient, and that minimum upfront and ongoing resources should be needed. Throughout the development process, stakeholders were kept updated and some participated in workshops.

2.1.1.2 Co-Design Workshops and Activities

Around a dozen individuals attended the workshops. A list of required features and recommendations for user interface design was created by the workshop attendees. These were used by the app developers and designers to create a prototype of the SecondEars app on iOS, which was then refined by User Acceptance Testing. Some of the techniques used to extract experience from the participants during workshops

included asking open-ended and straightforward questions such as "Why" frequently. Moreover, they found it necessary to rephrase assumptions or problems as questions, to be able to capture the objectives of the project correctly and to identify the right problem that the product was attempting to solve.

Stage 1: Goals, Problem Definition, and Assumptions to Test (Workshops 1-3)

During this stage, after the participants were briefed on the rationale of the app and the proposed primary functions of the app, and the specifications and constraints found by the stakeholders, the following questions were asked:

- What do they want the app to do? Participants brainstormed a list of the essential features in the app, added and refined the list iteratively during workshops 1 to 3.
- How do they imagine the failure of the app? Participants identified possible reasons for the potential failure of the application and then reframed them as knowledge-seeking questions.
- Who is going to engage in using the app? The Journey Mapping technique was used and the participants figured out the pattern of application usage in the broader context of the patient's journey through the Melbourne Cancer Centre.

Stage 2: Solution Inspiration and Prioritization (Workshop 4)

- Compiling a list of well-designed current applications.
- Prioritizing the desirable features identified during prior workshops using the MoSCoW approach, which stands for: must-haves (Mo), should-haves (S), could-haves (Co), and won't-haves (W).
- Designers and developers using the wire-framing techniques try to structure the combination of features and functions of the app and connect interfaces to the logical

user flows.

Stage 3: User Experience Design (Workshops 5 and 6)

- Presenting paper-based prototypes (PBPs), paper-based design form, using a series of cut-to-size interfaces, gathering feedback on interfaces that helped build wire-frames in the next workshop (workshop 5).
- Building and presenting wire-frames (mid-fidelity and high-fidelity prototypes) on the iPhone.
- Conducting one-on-one user experience feedback sessions to evaluate wire-frames.

Stage 4: User Interface Design

User Interface Design was the final stage of the design process to create a visual identity for the product, in which a mixture of the logo, colour, typography, and iconography was generated and these brand elements were then applied to the app’s interfaces during the design process.

Stage 5: Prototype Development and User Acceptance Testing

The finalized visual designs were used by the Development team, including designers and developers, to build an app prototype. Immediate feedback was applied from the research team and the refined prototype was released to the co-design team for user acceptance testing so that any bugs could be identified. Before the final design of the app (high-fidelity prototype solution) was made available on iOS, all faults were then fixed.

Iterative Refinement

At each stage of the design process, the requirements and refinements according to the subsequent feedback collected were integrated into the final design of the application.

In summary, this work [21] resulted in the successful co-design of the SecondEars consultation audio-recording app for cancer patients and the development of a *prototype solution* on iOS. They claimed that the balance between patient control and clinical security was achieved via stakeholder engagement, co-design workshops, and user acceptance testing to assure that SecondEars was designed to meet the needs of all users. They emphasized that during the test process, patient and clinician feedback would inform any more design changes that need to be made before the app is developed [21]. As far as the drawbacks in this work [21] are concerned, they stated that although behavior change theory has been used to design many health care interventions, there have been inconsistent outcomes, and in this context, there was continued controversy about the use of that theory, and therefore future researchers should consider a systematic structure for intervention design. Thus, from our viewpoint, this study lacks a systematic structure for the Co-Design process that is consistent with the gaps of the Co-Design approach outlined in Tosi [1, p. 136]. In Chapter 3, we will propose an integrated framework, focusing on Human-Centred Design methodologies including both Design Thinking and Co-Design principles, as well as some ideas from this study such as User Experience Design and Testing.

2.2 Design Thinking in Healthcare

A recent systematic review [22] of “Design Thinking in Health Care” conducted a research in 2018 aimed at evaluating “how Design Thinking has been used in health care and whether it is effective” [22, p. 1]. Health care systems require constant innovation to meet the needs of patients and providers [22, 23, 24]. However, when new interventions or system processes are designed, the stakeholders are not always considered, usually resulting in unused products because they do not fulfill the human context and needs [22, 25, 26].

This study [22] by highlighting the reality of decades-long gaps between intervention

development and implementation claimed that Design Thinking offers a method to bridge this gap by helping researchers to incorporate user needs and their feedback in the design and development process [22]. They defined Design Thinking, as “an approach that prioritizes developing empathy for users, working in collaborative multidisciplinary teams, and using “action-oriented rapid prototyping” of solutions [24, 27]” [22, p. 1]. Design Thinking is an iterative process, in which innovation is arising only after several rounds of ideation, prototyping, and testing, which distinguishes it from the traditional linear and top-down approaches to health intervention design, which have been used to solve complex problems in healthcare with high levels of risk [22, 23, 24, 26].

This analysis [22] included 24 interventions through 31 March 2017, offered an overview of the breadth of applicability of Design Thinking in health care, and demonstrated that it is feasible and applicable to various health care areas including chronic obstructive pulmonary disease, diabetes, caregiver stress, and post-traumatic stress disorder [22]. The outcomes of interventions included in this analysis [22], are as follows: twelve were successful, eleven were mixed successes and one was ineffective [22]; in addition, all four studies comparing Design Thinking interventions with traditional interventions demonstrated greater satisfaction, usability, and efficacy [22]. Most importantly, they observed [22] that the methods and techniques of Design Thinking applied during the studies often varied from each other: only 6 studies performed contextual evaluations of users during the needs evaluation process, no studies recorded a brainstorming stage, 10 studies did not use low-fidelity prototypes, and some reported a limited number of iterations (e.g., one mixed-success study had four intervention iterations, but only two iterations were evaluated with the target users) [22].

Overall, they concluded that “Design Thinking is a promising approach to intervention creation, implementation, and dissemination that can increase the acceptability and effectiveness of health care interventions by actively involving patients and providers in the design process and rapidly iterating prototypes of innovation to maximize success.” [22,

p. 6].

In summary, according to this systematic review [22], Design Thinking is used in various contexts in health care, but its implementation differs in practice. In this sense, this research [22] shows that Design Thinking can help not only innovative processes but also the implementation and acceleration of innovation processes, which can lead to usable, acceptable, and effective interventions. However, there is inconsistent use of the methods and significant limitations inherent in the studies, which restrict their ability to bring conclusions regarding this approach [22]. Therefore, further research is needed to identify the most effective elements of Design Thinking for health services to build a structured methodology with practical techniques and tools to improve health care services [22].

2.3 Design Thinking

When we talk about Design Thinking (DT), we do not use this term in the context of how designers (may) think, rather how anyone “should” think while tackling design issues [3, 28]. Design Thinking is considered “a Human-Centred methodology which is a process and also a mindset that “integrates Design, social sciences, engineering, and business skills. It connects the focus on the end-user and their needs with multidisciplinary collaboration and iterative improvement to provide innovation in a service or product [28].” [1, p. 148]. Design thinking is often an interplay between *diverging* exploration of problem and solution spaces and *converging* via synthesizing and selecting [3, 28]. The knowledge of design thinking helps to obtain a multi-disciplinary, thorough approach to tackle creatively the ambiguity inherent in complex problems. Design Thinking can be based on three fundamental characteristics as follows [3, 28, p. 5-6] :

- (i) *Exploring the problem space*: acquiring the intuitive and comprehensive shared understanding of the problem before the requirement planning starts mainly via learning

about the end-user and their social context from various perspectives.

- (ii) *Exploring the solution space*: promoting a creative process of ideation and conceptualization by exploring a variety of alternative ideas at the rapid prototyping level to convert them into tangible representatives and establish the most feasible solution path.
- (iii) *Iterative alignment of both spaces*: enabling a highly iterative design process in both spaces of problem and solution through the early and continuous integration of end-user feedback based on understandable prototypes.

Among the many Design Thinking process models that have been defined, we will review the two best known: the “*evolved Double Diamond: The framework for innovation*” model developed by the British Design Council in 2019, and the Design Thinking model developed by Stanford’s d.school in 2015, which will be presented and discussed in the next sections.

2.3.1 The Design Council’s Double Diamond (2005)

Double Diamond is the name of the design process model popularised by the British Design Council in 2005 [29, 30], adapted from the divergence-convergence model proposed by the Hungarian-American linguist Béla H. Bánáthy in 1996 [31]. In this model, the design process has four phases: Discover, Define, Develop, Deliver [29, 30]. This model is a design methodology and a simple, detailed, and visual illustration of the design process that has become world-renowned with thousands of references on the web [29, 30]. The design process looked like an “unstructured, chaotic mess” before the Double Diamond [2, 29, 32]. The Design Council discovered this structure while analyzing the way designers worked [2, 29, 32]. Figure 2.5 demonstrates the original Design Council’s Double Diamond, which provides both designers and non-designers with a simple design process [33]. Each diamond

represents divergent thinking, which explores a problem or a bunch of ideas more broadly or deeply, and then convergent thinking, from which emerges a single problem statement or solution [33].

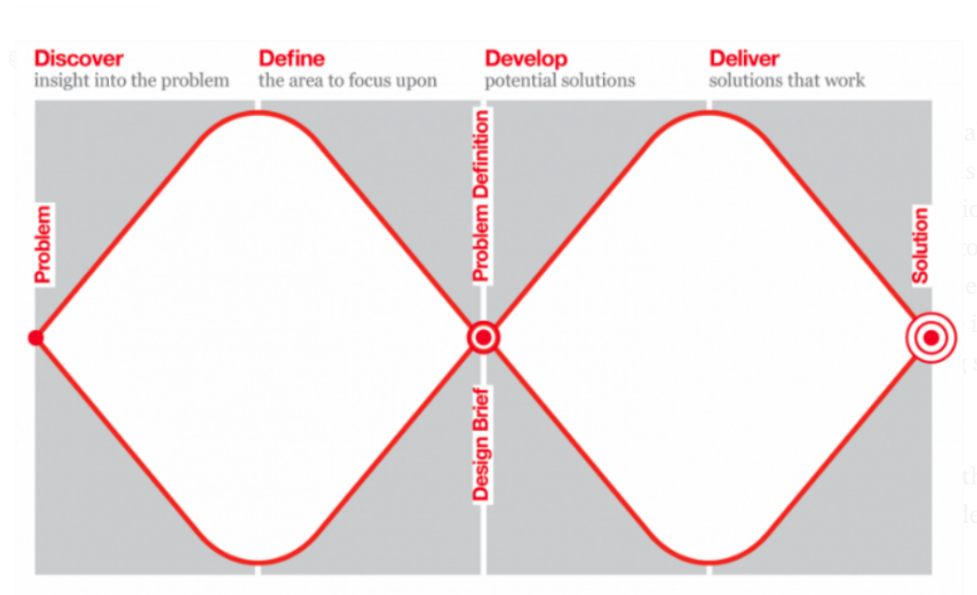


Figure 2.5: British Design Council’s Double Diamond (2005).

Image Source: [29, 32]

The first diamond helps people discover the right problem, rather than just guess it. This entails empathy and listening to the people affected by the issues [29, 33, 34]. The second diamond allows people to propose and prototype various solutions for the problems that were identified in the first diamond [29, 33, 34]. As shown in Figure 2.5, Double Diamond consists of four separate phases: Discover, Define, Develop, and Deliver. The model is often called the 4-D model because the name of each step begins with a “D”. These phases are defined as follows [29, 33, 34] :

- **Discover:** The first quarter of the Double Diamond is a deep dive into the problem that is being addressed [34]. This stage represents the initial divergent part of the

project, in which the designer aims at exploring new possibilities, new knowledge, new trends, and new perspectives [34]. Unlike some of the other design models, the Discover stage is emphasized as one of the most important that can make the best use of the knowledge and skills of the designer [29]. This early-stage has been referred to as the fuzzy front end (FFE) and is important for identifying the nature of the design problem that is being tackled by design [29, 35]. At this stage of the new product/service development process, there is a level of ambiguity, and the process is mostly unstructured [29].

- **Define:** The second quarter which completes the first Diamond is a type of filtering of the Discovery phase, in which the first insights are checked, synthesized, some picked and some rejected, leading the designers to define the challenge in a different way [34]. This phase often includes the initial development of project ideas, in which the designer must engage with the broader knowledge of the identified opportunity and discover a problem definition [34].
- **Develop:** The third quarter of the Double Diamond reflects the development phase, in which designers find themselves in a divergent period again, and multi-disciplinary teams use DT techniques such as brainstorming, sketches, story-boarding, and prototypes to develop, iterate and test the designed solutions [34].
- **Deliver:** In the last phase of the convergence Delivery phase, the final design is carried out through final testing, developed, and launched. This phase requires small-scale testing of multiple solutions, dismissing those that will not work, and refining the ones that will [34].

2.3.2 The Design Council’s Evolved Double Diamond (2019)

The original Double Diamond model of the design process has been the most used model for structuring design projects for the past 15 years [32]. In recent years, the design world has been undergoing several significant changes, and we may ask if the Double Diamond is sufficient for today’s design world [32]. Recently, the originators of the Double Diamond model released a new framework named the “evolved Double Diamond: the Framework For Innovation” [33].

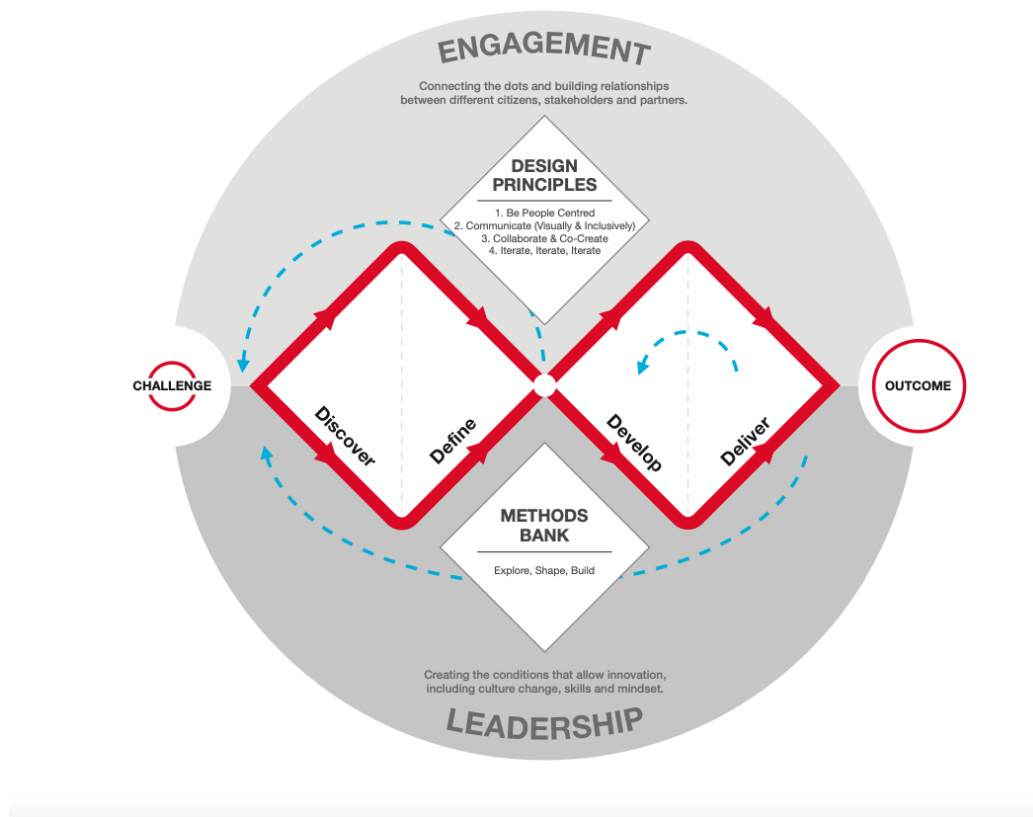


Figure 2.6: Design Council’s evolved Double Diamond : The Framework For Innovation (2019).

Image Source: [29, 32]

As seen in Figure 2.6, at the core of this framework [33] is the Double Diamond

model (2005) outlined in Section 2.3.1. The evolved Double Diamond [33], in addition to demonstrating the design process, encompasses the key principles and design methods that designers and non-designers need to follow to accomplish fundamental and long-lasting positive change [32, 33]. The process of this new framework is the same as the original one that consists of 4 phases of Discovery, Define, Develop, Deliver described earlier (see Section 2.3.1). In this framework [33], the design is clearly not a linear process, as indicated by the arrows in Figure 2.6. It can take the development process back to the beginning whenever we learn something new about the underlying problems [33]. It can be part of discovery to make and test very early phase ideas, and no idea is ever “finished” in the ever-changing and digital world [33]. In this model, designers are continuously seeking feedback about how the product/service works, which allows them to iteratively refine the product/service [33].

The innovation framework comprises four fundamental principles that should be followed by problem-solvers to achieve radical and innovative solution [33]:

1. **Be People-Centred:** Begin by understanding the individuals who use a service, their desires, abilities, and expectations [33].
2. **Communicate (Virtually and Inclusively):** Enable individuals to develop a common understanding of the problem and solutions [33].
3. **Collaboration and Co-Create:** Work together and be inspired by what others do.
4. **Iterate, Iterate, Iterate:** Identify early mistakes via rapid iteration [33].

Engagement and **Leadership** are other parts that can be seen in this framework (see Figure 2.6). The Design Council [33] believed that the culture of an organization and how it interacts with various stakeholders is as critical as the process and principles organizations that designers adopt because the challenges we face today require more than

one idea; hence the collaboration with other organizations and all stakeholders involved is needed to achieve creative solutions for these type of problems [33]. On the other hand, in all discussions about co-design, there might be the misconception that we no longer need leadership, that we can put all the burden on the process and end-user [32]. In this new model [33], the Design Council emphasizes both leadership and engagement in which given the fact that nothing flies without engagement, strong leadership makes it possible to be collaborative and agile in projects, showing progress over time [32]. Another relevant change in the new model, under “Design Principles”, draw designers attention to some of the key design science concepts that play a crucial role in today’s design environment, such as User-Centred Design and Co-Design via the first and third design principles (“Be People-Centred” and “Collaboration and Co-Create”).

One of the key criticisms of the Original Double Diamond (2005) (see Section 2.3.1) was that it is simply a linear model that designers seem to go from A to B because no iteration was seen in this model [32]. Since the design is not a linear process, and reflection and iteration are at the core of the design and innovation system, the inclusion of some blue circles to highlight the iterative nature of the design process for designers seems to be a pleasant change from the Design Council, which has resulted in “evolved Double Diamond” model shown in Figure 2.6 [32, 33].

2.3.3 Stanford’s d.School Design Thinking Model

In 2015, another paradigm of Design Thinking [36], built in a university setting, is that of the d.school at Stanford University and IDEO¹. It is a research program aimed at understanding the approach of designers and converting it into a scientific process. In this model, also based on the experience of IDEO, the Design Thinking process is visualised in five steps (Empathise, Define, Ideate, Prototype, Test) as shown in Figure 2.7, which are

¹For further information, see: www.ideo.com

all interconnected.

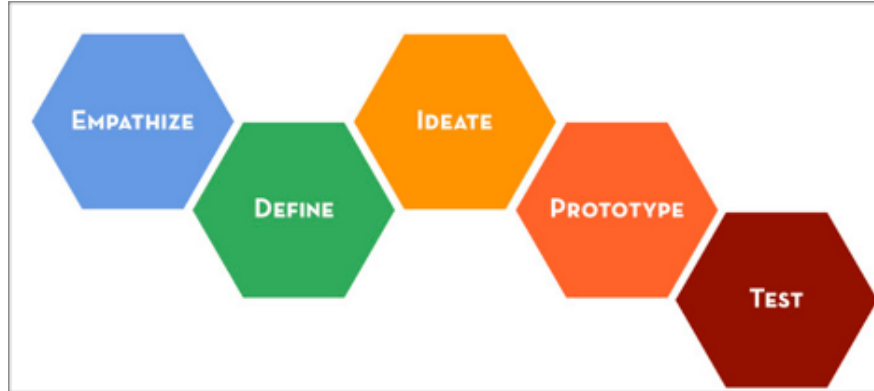


Figure 2.7: Stanford’s d.school Design Thinking process (2015).

Image Source: [36]

These five phases are detailed as follows [1, 36, 37, 38]:

(i) **Empathize**

Empathy is at the heart of a human-centred design process. In the context of the design challenge, it is the step in which the designers understand the physical and emotional needs of people. This stage will be conducted through :

- **Observe:** In addition to interviews, in the relevant contexts, observations should be made as much as possible to establish a connection between what someone says and what they do.
- **Engage:** Often this approach is called ”interviewing” but it really should sound more like a conversation. Trying to elicit people’s experiences when doing interviews, and often asking “Why?” to get a deeper understanding.
- **Watch and Listen:** Designers should indeed combine observation and interaction. Ask others to explain and show how and why a task is completed. When people perform a task or interact with an object, designers should ask them to openly express what’s going through their minds.

It should be noted that to conclude this stage, designers should conduct **Unpacking**, the transition from *Empathize* to the *Definition*, in which they need to process all the things they have learned and seen, get all the details out of their heads, share with other colleagues in a visual form to capture user experiences and information. This is the start of the synthesis process, leading to the “Define” phase.

(ii) **Define**

In this step, design thinkers should define a challenge based on what they have learned about their user and the context to craft a meaningful and actionable problem statement called Point-Of-View (POV), which is the explicit expression of the problem that they are striving to address. The combination of three elements of **USERS** and **NEEDS** and **INSIGHTS** forms a POV in which:

- **USERS**: Type of person who designers are designing for.
- **NEEDS**: Synthesizing and selecting a limited set of NEEDS that you think are essential to fulfill (it may be just ONE major need to address).
- **INSIGHTS**: Working to articulate INSIGHTS has been built through the synthesis of information gained through work on empathy and analysis.

In other words, the POV can be defined as follows:

[**User...**] needs to [**user’s needs ...**] because [**insights...**]

In short, The outcome of this step is a well-scoped and -articulated point-of-view that will lead designers into the ideation in a very natural way. Besides, a good transition step is to build a list of “How-Might-We . . .?” (HMW) brainstorming themes that flow from the problem statement. The HMW questions are the perfect way to open up brainstorming and other ideation sessions, in which designers explore solutions that can help them tackle the design problem. The “How Might We” question purposely

maintains a level of ambiguity, and opens up the exploration space to a range of possibilities.

(iii) **Ideate**

In this stage, designers are concentrating on the generation of ideas. They ideate to move from identifying problems to finding solutions for the users. Especially early in the design process, the ideation is about striving for the broadest possible variety of ideas without filtering, rather than finding a single, best solution. There are many ideation techniques such as brainstorming, brain dumping, sketching, etc. Transition out of this step involves **Evaluation** of the ideas via techniques such as voting, in which innovation potential will be preserved by carrying two or three ideas forward.

(iv) **Prototype**

“Draw it: Promote deeper and different kinds of conversations by picking up a pen and paper and drawing”, (IDEO.org)¹

The Prototype phase is the iterative generation of artifacts designed to answer questions about user needs, that lead the designer closer to the final solution. In these early stages, designers should build paper-based prototypes or any low-fidelity prototypes that are fast and cheap to produce but can provide valuable feedback from users and colleagues. These prototypes can be anything a user can interact with such as a wall of post-it notes or story-boarding, etc. The prototypes become more refined in the later phases, and after several iterations and sufficient feedback from end-users are converted into mid-fidelity prototypes or wire-frames, so-called mid-fidelity prototypes, which reflect more accurate representations of the layout and what interface elements should exist on the main pages. Again after several iterations, the mid-fidelity prototypes convert to the high-fidelity prototypes that demonstrate full functionality including

¹www.designkit.org/methods/draw-it.

actual featured images and relevant written content. In summary, in prototyping, designers should consider the principles below:

- Start building: Even if designers are unsure of what to do, they should start building using low-fidelity tools like post-its, tape, etc.
- Don't spend too long on one prototype.
- Identify a variable: Defining a variable allows designers to break down a big problem into smaller, testable chunks. In other words, they should identify what they need to test with each prototype. A prototype should answer a specific question when tested.
- Build with the user in mind: "What do you want to test with the user? What kind of behavior are you expecting?". Answering these questions while building prototypes can help designers to develop useful prototypes and obtain valuable feedback during the testing process.

In general, at this point, what designers are trying to test, and how they are going to test that element, is extremely important to take into account before building a prototype.

(v) **Test**

The test stage aims at obtaining feedback to refine prototypes and solutions and to learn more about the user. It provides designers a more chance to gain empathy for target groups, however, unlike the initial empathy mode, designers have now likely done more framing of the problem and built prototypes to test, which contribute to an evaluation of the effectiveness of ideas through feedback from the participants. It should be noted that it is important to observe how users test prototypes and listen to them to collect valuable feedback. By observing this interaction, designers can

gather relevant information, review prototypes by improving some usability issues, or generate additional insights that entail the replication of some previous phases. Some of the principles for the test phase identified by d.school that can be helpful to designers are as follows:

- **Show and don’t tell:** Designers should put the prototype in the hands of the end-user and should not explain it at all to allow the tester to interpret the prototype. It should be observed how they use or misuse the prototype, how they deal and communicate with it, then it should be listened to what they say about it and to the questions they have.
- **Create Experiences:** Designers should build prototypes in such a way that users believe that they are responding to an experience rather than an explanation they are testing.
- **Ask users to compare:** Providing several prototypes allows users a basis for comparison, and comparisons also uncover latent needs.

2.3.3.1 Iteration and Making the Process your Own

Iteration is fundamental to good design [36, 37]. Iteration must happen both by iterating through the process multiple times, and also by iterating within a step—for example by creating multiple prototypes or trying variations of brainstorming topics with multiple groups [36]. Generally, as you take multiple iterations through the design process, the scope narrows, and designers move from working on the broad concept to the nuanced details, but the process still supports this development [36]. As d.school’s guidance [36] states, for simplicity, the process is articulated here as a linear progression [36], however, the process presented here is one suggestion of a framework and ultimately designers should make the process their own and adapt it to their style and work [36].

In short, from our view, in comparison with the evolved Double Diamond (Figure 2.6), the d.school DT as in Figure 2.7 shown, is expressed as a linear process, although the steps are more comprehensive than in the Double Diamond. However, the d.school argues that the reason for retaining its simplicity is that design problems can be addressed by using design modes in various orders, as designers can eventually make the framework their own and adapt it to their styles and work [36]. Most significantly, d.school intends designers to continue to incorporate innovation into their own design mindset, in which it contributes to an evolution in the way they work, regardless of the methodology and techniques that they use [36]. Although the DT approach emphasizes iteration, and it is considered as a fundamental of a good design [36, 37], the d.school’s DT procedure (Figure 2.6) does demonstrate iteration **explicitly** in the model neither of the whole process nor within each step, which may result in ignoring it by non-designers or even designers.

2.4 User/Human-Centred Design

The idea of integrating Design Thinking into HCD intervention approaches has recently evolved, which is how both “Design Thinking” and “Human-Centred Design” can be viewed as complementary techniques that can be used together to achieve lasting results [1]. Therefore, in this context, we see the progressive approach today and, also, the overlap between Human-Centred Design methods and Design Thinking [1]. In the next sections, we will describe UCD and HCD concepts and detail the evolution from UCD to HCD, as well as the differences between Usability and User Experience, which are the most relevant and used concepts in this document. In addition, we will present the known model of Human-Centred Design developed by IDEO.org¹ at the end of the section.

¹www.ideo.org/tools

2.4.1 Evolution from UCD to HCD

User-Centred Design (UCD) is a design approach that originated in the 1970s and 80s in the IT field and was later adopted and applied in the design field [1]. The aim of this approach has always been to concentrate on the product/service development process in a way that ensures a high degree of usability [1]. Rubin [39] defines UCD as: "UCD represents not only the techniques, processes, methods, and procedures for designing usable products and systems but just as importantly, the philosophy that places the user at the centre of the process" [39, p. 10]. The evolution of the UCD approach has been driven by the increase in complexity and technological innovation of daily-use products, which dramatically changed the nature of the interaction between the end-user and the product/system/service [1]. In 1990, Human-Centred Design was defined by ISO as: "An iterative process that consists of studies with users and the specific design and evaluation solutions, which ultimately aim to design products and services based on the needs of the final users." [1, p. 48]. Over twenty years, we have moved from mostly tangible experiences to a growing number of intangible ones [1]. In many cases, physical interactions, which alternate or correspond to virtual interactions, are composed of the interaction between the user and the product [1]. In turn, there has also been a growing need for a design solution that can adapt to increasingly more dynamic and intangible experiences, and the design field has thus been forced to adapt its scope and broaden its boundaries [1]. Rizzo [4, p. 11] emphasized that Design today, "is required to act as a pragmatic approach and way of thinking (design thinking), for the design of real, daily-use contexts in people's lives, that is, because the design can act per Human-Centred ethics, unlike other conceptual disciplines." The UCD approaches of the 1970s, 80s, and 90s developed within the Human-Computer Interaction (HCI) field and intended to improve the usability of interactive system interfaces [1]. The evolution of the approach within the Design area mainly related to ways of involving the end users in the design process [1]. In this context, users play an increasingly active role,

who are no longer regarded as only sources of knowledge but as holders of experience and should be involved during each phase of the design process actively and iteratively [1]. Due to the dissemination of interactive systems in our daily lives, the need to evaluate and design parameters and aspects relevant to the User Experience has also arisen in the human-centred design process, particularly in recent years. In this context, the Jordan [40] and Norman [41] studies have made a significant contribution, who highlighted how the emotional elements of user experience are critical aspects of the design process [1, 40, 41].

The definition of the “Usability” itself has undergone lots of changes, of which Queensbury [42] provides one of the most interesting explanations; it identifies the following factors as fundamental goals of “Usability”: *efficiency, effectiveness, tolerance of errors, ease of learning, and engagement* [1, p. 48]. In this regard, engagement focuses on the importance of emotional intervention in the functioning and interactions between elements of a system or product/service. The evolution of the definition of the “Usability” and also the transition from “User-Centred Design” to “Human-Centred Design” was caused by the established theory that positive or negative emotion can dramatically change the **User Experience**, regardless of other indicators relating to the Usability of product [1].

Norman [43, 43] himself addressed this topic and changed his perspective on the subject of “Usability”. Although in his book [43]—“The Design of Everyday Things,”—he considers usability as a key factor of quality in the Design of daily-use products, in his subsequent book [41]—Emotional Design—his thought process evolves [43, 43]. In this respect, Norman [41] argues that, even though an item is difficult to use, it will still be used and desired over products that might be more reliable from an operational or ease-of-use point of view; as long as it is capable of achieving positive emotions and experiences which last [41]. This does not mean that usability and quality of interaction are no longer to be one of the key goals of the design process, but rather that there is a critical need to broaden and consider emotional and relational dimensions during design activities [1]. In summary, the

original purpose of UCD was to evaluate **Usability**, which has evolved over time into design practices that take account of the whole **User Experience (UX)** from the outset and in which the user plays a strategic role at all phases of the design process, which is considered as a turning point in the evolution from UCD to HCD [1].

According to this knowledge, we can now provide a comprehensive definition of HCD in [1, p. 5]: HCD represents not only an intervention philosophy, which places the user at the centre of the design process, but, also a methodological approach that offers methods, techniques, processes, and tools for the study, evaluation, and interpretation of the people’s needs and expectations—both expressed and unexpressed—and their translation into the design process, and finally evaluate and verify a high level of Usability and ease of understanding, which result in a positive and satisfying User Experience [1, 39].

2.4.2 Usability versus User Experience

In this section, we will explain the difference between Usability and User Experience that led UCD to HCD. Three elements of the “Usability” defined by the ISO standard¹ are as follows [1, p. 91-92]:

- **Effectiveness:** the accuracy and completeness with which users achieve certain objectives [1].
- **Efficiency:** the resources spent in relation to the accuracy and completeness with which users achieve their objectives [1].
- **Satisfaction:** the freedom from discomfort and the adoption of positive attitudes towards the use of the product [1].

¹ISO 9241-210:2010, Ergonomics of human-system interaction—Part 210: Human-Centred Design for interactive systems.

Usability is the degree of effectiveness, efficiency, and satisfaction of a person’s interaction with a system, which is only one of the components of the **User Experience**, in which the product can be used without necessarily ensuring a positive user experience.

User Experience (UX) is defined [1, p. 54], “the totality of the effects or perceived effects by a person as a result of their interaction with, and the usage context of, a system, device or product, including the influence of usability, utility, and the emotional impact during the interaction and, finally, memory after the interaction. “Interact with” is a broad concept that includes seeing, touching, and thinking about the system or the product, including our admiration of the product and the effect of its presentation before any physical interaction.” [1, p. 54].

In short, when we use the term “Usability” it refers to the pragmatic, non-emotional dimensions of what the user experiences, such as objective performance measures, subjective measures of opinion, and qualitative usability data [1]. In comparison, when we use the wider term “User Experience”, it is generally referring to what the user feels, including all the effects of usability, utility, and emotional influence [1].

2.4.3 Evaluation of User Experience

An integral part of the HCD approach is the evaluation process [1]. Thanks to the use of prototypes, physical and/or virtual, with reference to the initial design requirements, designers can assess the usability and user experience standards of the solutions that have been developed [1].

- **Verification:** “checking that the product is consistent with what is expected in the requirements documentation” [1, p. 116].
- **Validation:** “checking that the product effectively satisfies the needs for which it has been conceived” [1, p. 116].

The Validation process is rather complicated since it focuses on the actual quality of the product: it includes ensuring that the prototype is capable of meeting the needs, both expressed and unexpressed, of users and the client [1]. In this type of evaluation, the engagement of users is very crucial [1].

2.4.4 IDEO.org’s Human-Centred Design Model

In April 2015, IDEO.org¹ released the Field Guide to Human-Centred Design [38], a new development of the HCD toolkit² [38]. This kit [38] outlines the process and the mindset of design addressing the social sector and provides 57 methods of design to understand the target users, to provide more productive brainstorming, to prototype ideas, and ultimately to end up with more innovative solutions [38]. It also provides a comprehensive list of worksheets and project cases demonstrating Human-Centred Design in action [38]. The model introduced in this design kit [38], has shown in Figure 2.8, including 3 steps: *Inspiration*, *Ideation*, *Implementation*, so-called *3 I Model* [1, 38, 44]. IDEO defines each step in this model as follows:

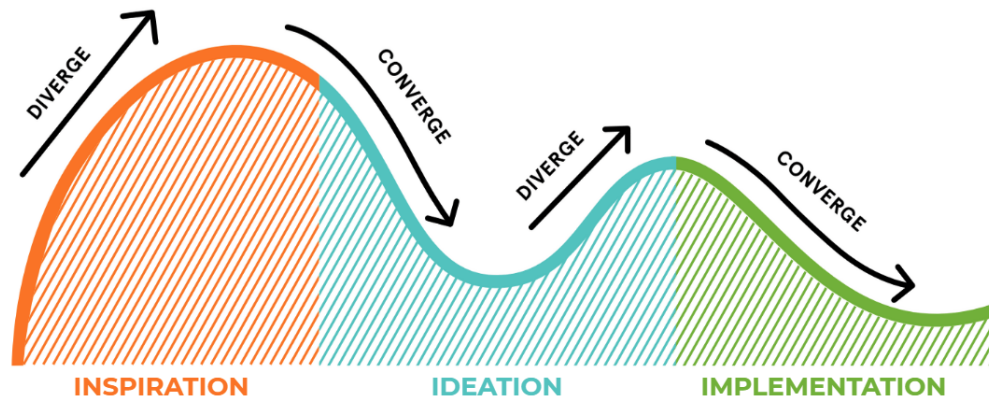


Figure 2.8: Human-Centred Design process defined by IDEO.org (2015).

Image Source: [38, p. 13]

¹www.ideo.org/tools

²Design Kit: www.designkit.org/resources/1

- **Inspiration:** “In this phase, designers will learn how to better understand people, observe their lives, hear their hopes and desires, and get smart on the challenge” [38, p. 11].
- **Ideation:** “In this phase, designers will make sense of everything that they have heard, generate tons of ideas, identify opportunities for design, and test and refine the solutions” [38, p. 11].
- **Implementation:** “In this phase, designers bring their solution to life. They try to figure out how to get their idea to market and how to maximize its impact in the world” [38, p. 11].

2.4.4.1 Diverging and Converging approach

“Trust the Process Even if It Feels Uncomfortable” (IDEO.org)

IDEO believes that Human-Centred Design is a unique approach to problem-solving, one that can occasionally feel more like madness than method—however, designers rarely come up with new and innovative solutions if they already know where they are going [38]. As illustrated in Figure 2.8, there is a **diverging** and **converging** approach in this model, in which designers can learn from people directly in the Inspiration phase and open up to a wide variety of innovative possibilities during the Ideation phase, and then converge to what is most *desirable*, *feasible*, and *viable* for the target users [38]. In other words, designers will often find themselves changing gears during the process, and while they work through these three phases, will rapidly shift from concrete observations to highly abstract thought, and then back down into the nuts and bolts of their prototype [38]. They should diverge and converge a few times, and with each new cycle, will come closer and closer to the solution. [38].

2.4.4.2 Relationship Between HCD and DT

IDEO [38] argues the Human-Centred Design is ideally positioned to generate solutions that are desirable, feasible, and viable as seen in Figure (2.9), in which designers can quickly discover what is most desirable by beginning with people, their expectations, fears, and needs [38]. When designers identify a variety of solutions that could appeal to target users, they then start to concentrate on what is technically feasible and how to make the solution financially viable [38].

IDEO believes that the Design thinking lives in the intersection of three criteria of desirability, feasibility and viability as shown in Figure (2.9), in which puts together what is “desirable” from a human point of view with what is technically “feasible” and economically “viable” [45]. Furthermore, some researchers believe that innovation occurs at the intersection of these three key factors, so they changed the original model and have named the intersection zone “radical innovation” [1, p. 153].

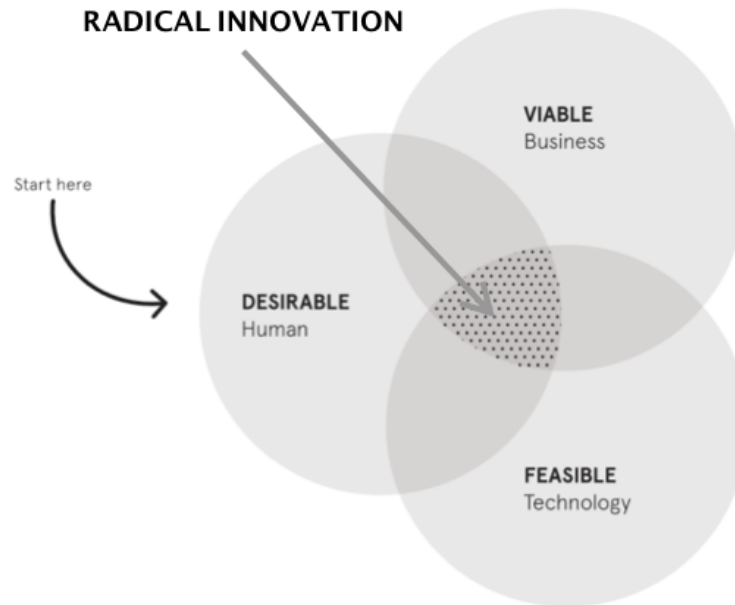


Figure 2.9: The intersection where Design Thinking lives.

Edited from Source: [38]

In sum, the model is clearly focused on IDEO’s experience in the area of business innovation, and it has been applied to case studies in the social sector, but it can be used in any field [38, 44]. IDEO.org and IDEO¹ have used Human-Centred Design process (Figure 2.8) to solve a wide variety of design problems, and while their projects ranged from social organizations to communication campaigns to medical devices, they have used this unique approach to innovative problem-solving every time [38, 44].

Although the toolkit [38] is comprehensive, it is also complicated, which may lead designers to fail to follow the essential activities of the toolkit during their project, because the projects are often behind the budget and the schedule, as Norman introduced DON NORMAN’S LAW OF PRODUCT DEVELOPMENT that is: “*The day a product development process starts, it is behind schedule and above budget*” [2, p. 237].

¹www.ideo.com

Furthermore, although the HCD approach emphasizes iterative build and test, in the visual model (Figure 2.8), they have combined *Evaluation* with the *Implementation* phase. The Evaluation phase including the Verification and Validation phases that are an essential part of the HCD approach [1], leads designers to ensure the **User Experience evaluation** [1]. Therefore, in our opinion, and given the synergy between the intervention methods of both User/Human-Centred Design and Design Thinking, this gap should be addressed.

2.5 Related Work

In this section, we will overview a combined model, the Revamped Double Diamond by Nessler [46], that we found relevant to our work, which may address the aforementioned gaps in the current models.

2.5.1 The Revamped Double Diamond

The Revamped Double Diamond [46] is a design process framework based on the Design Council’s (2005) Double Diamond (see Section 2.3.1, Figure 2.5) developed in [46]¹. Advertised as “How to apply a design thinking, HCD, UX or any creative process from scratch”, his model is the result of his work on a viable way to make sense of the design process and an effort to make it more tangible for “real world” use. He tried to develop a model based on 3 models, including the British Design Council’s original Double Diamond (2005) (Figure 2.5), IDEO’s Human Centred Design ideology (Figure 2.8), and Stanford d.school’s Design Thinking process (Figure 2.7).

He used this idea as a Point of Departure in his model, in which the question is how to get from point A, “Don’t know” or “Could be”, to point B, “Do know” or “Should be”

¹The framework as .pdf slides & .jpgs is downloadable from [46]

in almost every creative or design project (Figure 2.12). As seen in Figure 2.12, the process seems to be finite and linear. In this regard, he pointed out that, this should be the never-ending and iterative process in practice, as innovation is a habit of constantly doing things in different ways, to make a positive change to our lives.



Figure 2.10: “Revamped Double Diamond”, Point of Departure , A to B.

Image Source: [46]

In order to provide more clarification, four main phases suggested by the Double Diamond of the Design Council (Section 2.3.1) have been added to this model, as shown in Figure 2.12, and defined as follows [46]:

1. Discover/Research: “insight into the problem” (Diverging) [46].
2. Define/Synthesis: “the area to focus upon” (Converging) [46].
3. Develop/ Ideation: “potential solutions” (Diverging) [46].
4. Deliver /Implementation: “solutions that work” (Converging) [46].

As far as Human-Centred Design (Figure 2.8) is concerned, he argued that the “Inspiration” phase of the HCD model Figure 2.8 has been divided into two stages, phase 1 “Discovery/Research” and phase 2 “Define/Synthesis”, led to a three-phase process comparable to IDEO.org’s HCD approach (Figure 2.8)—Inspiration, Ideation, Implementation—described in Section 2.4.4.

At the same time, the process of IDEO.org’s HCD (Figure 2.8), comprises two diverging and two converging thinking phases (Section 2.4.4). This work[46] believed that these two types of thinking are essential to being innovative during the design process, described below:

1. “Divergent Thinking: Generating lots of options” [46].
2. “Convergent Thinking: Evaluating options, making decisions” [46].

In the original Double Diamond process (Figure 2.5), each of the four phases is either diverging or converging, in which the aim is during a diverging process to try to open up the thinking as much as possible without restricting oneself, while a converging phase focuses on narrowing the ideas and solutions (see Section 2.3.1).

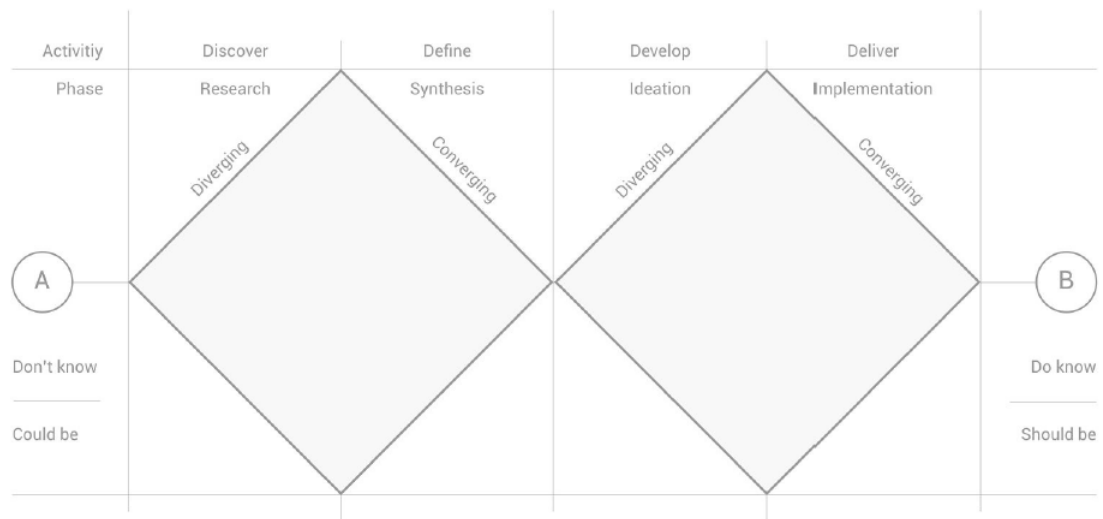


Figure 2.11: “Revamped Double Diamond”, Four phases of Double Diamond.

Image Source: [46]

To simplify and add clarification, he added another layer at the top, combining the four phases of the process into two main and fundamental phases as follows:

- **Stage 1 – Designing the right thing**

The central idea is that designers need to look for the right problem to solve, or the right question to ask before they try to do so. That is all about WHAT it is done.

- **Stage 2 – Designing things right**

The core idea is that when a right question to answer or a right problem to solve has been evaluated, it is to be assured that it is done in the right way. This is all about HOW it is done.

It should be noted that these two stages were considered as two goals of the proposed model.

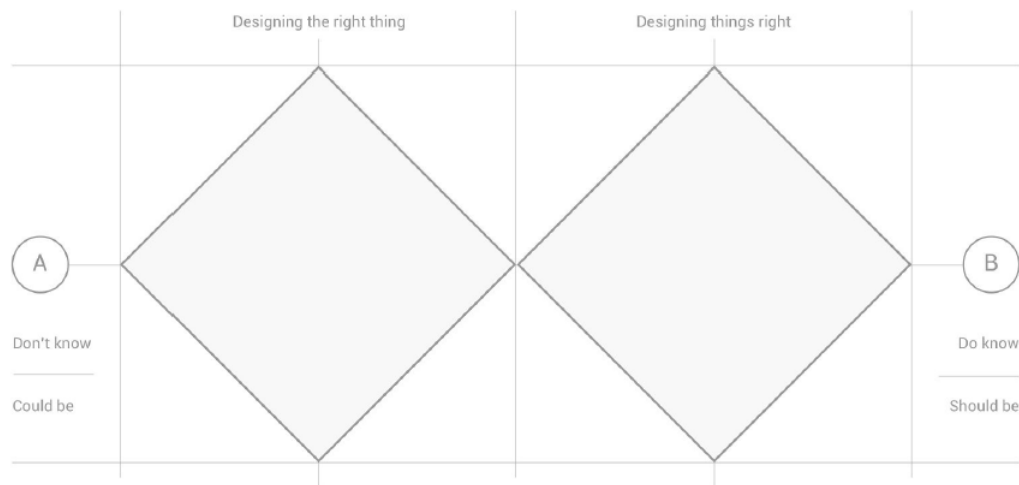


Figure 2.12: “Revamped Double Diamond”, Designing the right thing/Designing things right;

Image Source: [46]

The final version of Revamped Double Diamond came up with the addition of many activities into two Diamonds using tools, processes, and techniques from different sources [46], which we found irrelevant to our work. In other words, we aim to put forward the key ideas in this model which is used in our proposed framework in Chapter 3.

In our view, this study focused only on “Design Thinking” phases through the Double Diamond model. Although it was claimed that the HCD approach and the UX design were incorporated into the model, from our view, integrating the HCD approach into the model only by combining two phases (Discovery/Research) and (Define/Synthesis) as the “inspiration” step, is not enough to claim that the HCD approach and UX Design applied to Design Thinking approach, or “Revamped Double Diamond” model.

As we discussed in detail in Section 2.4.2 and Section 2.4.3, the evaluation phase is an essential part of the HCD approach in particular when we are trying to combine User Experience in a design model [1]. Based on the principles of the HCD approach [1], designers using the developed prototypes should evaluate the safety, usability, and user experience standards of the solutions that have been developed, with reference to the initial design requirements [1]. As mentioned earlier, evaluation requires two significant phases of **Verification** and **Validation** (see Section 2.4.3). The validation phase, in which designers observe the user experience in interacting with the product, is more complicated. We, therefore, consider that User Experience evaluation has been neglected in this model [46], i.e., we dismiss that the HCD and UXD have been applied in the Revamped Double Diamond.

2.6 Conclusion

In this chapter, we have given an overview of the current status of Design approaches and frameworks, specifically in regards to their use in healthcare service improvements. Given the studies, although EBCD’s strengths have been observed in building trust and empathy using a focus on lived experience through stories and emotional mapping [6], has resulted in limited service improvements during the EBCD projects which may be due to the lack the systematic elaboration of co-design methods, limited tools and less guidance on the ideation process, the tendency to develop a solution without adequate divergent

thinking, and inadequate structuring of participation [1, 6, 9, 10, 11].

In addition to these gaps identified in the EBCD literature, from our viewpoint, there is an additional gap in the EBCD literature that may have resulted in a limited outcome of this approach as an effective technique in healthcare services, that is, the “problem” may have not been identified correctly leading immediately to concentrate on exploring a solution to the problem that is not the root problem in reality. In other words, in addition to the lack of ideation tools in the EBCD approach, there is also a lack of techniques in problem identification—or to be more precise, in EBCD, there is a lack of techniques in identifying touch-points. These gaps led us to discuss the importance of the Design Thinking approach, especially in the improvement of healthcare services with a high level of risk.

We discussed two known Design Thinking frameworks, the evolved Double Diamond (Figure 2.6) and Stanford DT model (Figure 2.6). While the d.school’s DT (Figure 2.7) model comes with a more comprehensive list of activities, the model is seen as a linear process, without explicitly displaying the iteration on the model. It should be noted our point is on the lack of the illustration of the iteration on the model, otherwise, as we mentioned earlier there is an emphasis on the iteration both in the HCD kit and the guideline to DT [36, 38].

On the other hand, although User Experience evaluation is an integral part of good design in the HCD approach [1], from our view, evaluation of User Experience is taken into account neither in the DT models nor in the HCD models. Furthermore, in our opinion, there is a major gap in the Human-Centred Design models in the literature, in which despite the emphasis on multidisciplinary collaboration [1, 2, 38], none of the design models explicitly specify who should participate in each activity, which may lead to users behaving passively.

In conclusion, a design framework based on the principles of HCD and Co-design is needed to overcome the aforementioned gaps and to assist both designers and non-designers

in EBCD or any Co-Design project in designing a product/service, that goes beyond usability and instead provides a satisfying User Experience.

Chapter 3

Double Hexagon: A HCD Framework for Innovation

In this chapter, we will propose the Double Hexagon as a new framework for innovation that fills a gap in existing co-design methods that were noted in Chapter 2. Section 3.1 provides an overview of the objectives of the framework and the rationale for the use of an integrated Human-Centred Design framework, combining Design Thinking and Co-Design approaches, which can be used alongside Experience-Based Co-Design to improve healthcare services. Section 3.2 presents a review of the Double Hexagon, main objectives, specifications, and principles of this model. In Section 3.3, we will detail the architecture of the Double Hexagon, the breakdown of each stage, which provides a step-by-step guide on how to develop it. The outcome of the framework will be included in this section.

3.1 Description

The Double Hexagon (DH) is an iterative hybrid Human-Centred framework that primarily aims at solving a design problem to achieve a positive and satisfying User Experience,

especially in health care intervention. Given the current gaps in the models reviewed in the previous chapter, our framework using design science theories aims to cover “What, How, Who” as much as possible during the design process for both designers and non-designers. “**What**” refers to “*What activities should be done*”, “**How**” refers to “*How the activities should be done*”, “**Who**” refers to “*Who should be involved in each activity*”. In order to address the “What” and “How” parts of DH, we will take advantage of Design Thinking’s models (evolved Double Diamond 2.6 and d.school’s Design Thinking 2.7) and some key principles of Human-Centred Design described in Section 2.4.4.

For the “Who” part of the DH, we will draw from the Experience-based Co-Design concepts detailed in Section 2.1. Furthermore, as outlined in Section 2.4.3, user experience evaluation is an essential part of HCD approach and should be considered as an important phase in the design of each product; thus, the focus of the Double Hexagon is the evaluation of User Experience from both the viewpoint of Verification and Validation as separate stages, to draw the attention of designers to the value of this step as at least as valuable as other phases.

This framework demonstrates how multidisciplinary collaboration could occur between researchers, users, designers, and developers and the active engagement of all participants in the whole of the process. At the core of the DH is the Design Council’s Design Thinking methodology—the Evolved Double Diamond shown in Figure 2.6 (see Section 2.3.2). We will develop an integrated framework by analyzing various elements of the most relevant existing models as a springboard, including the Evolved Double Diamond model (see Section 2.3.2), Stanford’s Design Thinking Model (see Section 2.3.3), and key principles in Human-Centred Design and Co-Design with an emphasis on User Experience evaluation (see Sections 2.4.3 & 2.4.4).

The DH framework can be seen as a Human-Centred Design framework that aims at how we move from designing “product” categories to designing for “people”.

Based on this idea—that “Design Thinking” and “Human-Centred Design” can be considered as complementary approaches and can be used together to achieve lasting results—we will borrow the idea from Nessler’s work [46](see Section 2.5.1) and elaborate a new framework. For the Co-Design and User Experience part of our work, we will borrow some ideas from the SecondEar mobile health app developed based on the EBCD approach (see Section 2.1.1).

In this model, we will incorporate the Co-Design principles aiming at the active collaboration of the participants. we will demonstrate in each phase, the level of involvement of multidisciplinary teams including end-users, customers, and other relevant organizational stakeholders (e.g., investors, managers, advocates, etc.) end-users (e.g., staff, patients, carers, etc.), designers/researchers, and developers during the design process. Following these approaches and principles incorporated into the model, two Hexagons will result. A more detailed look at the framework along with an analysis of the visual model will be given in Section 3.3.

3.2 Objectives and Principles

In order to improve healthcare services, and address gaps detailed in the literature, the DH framework incorporates 15 key design principles from Human-Centred approaches and Co-Design concepts. Each of these fundamental principles is linked to design approaches incorporated into the DH as follows:

1. Designing for People (HCD, Co-Design, DT, UXD)
2. Placing the users at the centre of the design (Co-Design & HCD)
3. Finding a Right Solution for a Right Problem (DT)

4. Designing based on an explicit understanding of users, activities, and environments (DT & HCD)
5. Collaborate and Co-Design in both problem space and solution space (DT)
6. Multidisciplinary skills and perspectives on the design team (Co-Design & HCD)
7. Mandated involvement of multidisciplinary teams in all phases of the Co-Design (DH)¹
8. Non-linear process (DT & HCD)
9. Problem identification techniques (DT & HCD)
10. Idea/solution generation techniques (DT & HCD)
11. Iterative improvement (DT)
12. Leading and refining the design by User Experience evaluation; (HCD & UXD)
13. Addressing the entire user experience in design (HCD & UXD)
14. Driving force for innovation (DT)
15. Achieving Positive and Lasting Experience (HCD & UXD)

3.3 Double Hexagon Architecture

In this section, we will discuss the architecture of the DH framework as well as how this framework addresses the above-mentioned principles. The next sections will show the basics of the Double Hexagon, a breakdown of each phase, and will provide a step-by-step guide on how we built it from scratch to mitigate the complexity of the model at first glance.

¹The Double Hexagon framework explicitly aims to model this idea that is discussed by none of the original frameworks or approaches.

3.3.1 Designing for People

Designing for People to elicit a Positive and Lasting UX

We set out our model based on the principle of "Designing for People to achieve a Positive and Lasting User Experience" that has been borrowed from thought the leaders in Human-Centred Design [2, 47]. The debate arises as to the difference between the product and the experience, in which Garret [47] explains that any product designed for humans has a user, whenever the product is used it delivers an experience [47]. Therefore, talking about a user or human-centred design process starts with people. As Norman [2] states, the Human-Centred Design process should start with a good understanding of people, including the needs, desires, and capabilities, which a design process is intended to meet. Accordingly, the core element of Co-Design, Human-Centred Design, and Design Thinking, and User Experience Design, is the need to understand the needs and perspectives of the people who will be using the product or service. In some models, this phase is labeled as "empathize"; where the focus is on initially understanding the user's needs and goals before focusing on the product design (see Sections 2.3 & 2.4).

3.3.2 Point of Departure

Inspired by Nessler's work in Section 2.5.1, we will build and explain the Double Hexagon in stages, starting with the question: "How to get from point A to point B". However, we chose the label "**Symptom**" for point A and "**Solution**" for Point B. The notion of "Symptom" is based on Norman's idea [2]: "One of my rules in design is simple: never solve the problem I am asked to solve. Because, invariably, the problem I am asked to solve is not the real, fundamental, root problem. It is usually a symptom" [2, p. 217]. In other words, designers are never necessarily supposed to address the problem that the customer or project manager identifies. Instead, Norman [2] encourages designers to take

this “problem” only as a suggestion. The problem of the customer is only a “Symptom” of the underlying problem at hand. In other words, the designer is responsible for identifying the root problem from the symptom that the client or project manager requested to solve, and finally, after close observation, starting to solve the root problem, which would also solve the symptom caused. (e.g., Post-Traumatic Stress Disorder that requested to be solved, may result from the touch-points (see Section 2.3) including bad call, difficult boss, long shift, etc., which each may be considered as a root problem).

By choosing this label as a starting point, we emphasize “Solving the Correct Problem” since a creative solution to the wrong problem can be worse than no solution at all [2]. In the real world, problems do not appear in perfect, neat packages. It is all too easy to see only the surface problems, so-called Symptoms, and never dig deeper to address the real issues [2]. Accordingly, we set out a route from Symptom to Solution as the starting point for building the DH as seen in Figure 3.1.



Figure 3.1: “Double Hexagon”, Symptom to Solution.

We will move forward with focus on the equal importance of problem and solution spaces, by splitting the model into two zones, “Finding the Right Problem” and “Finding the Right Solution” as shown in Figure 3.2. It needs to be pointed out, the problem space focuses on “What should be solved?” and the solution space emphasizes “How should it be solved?”

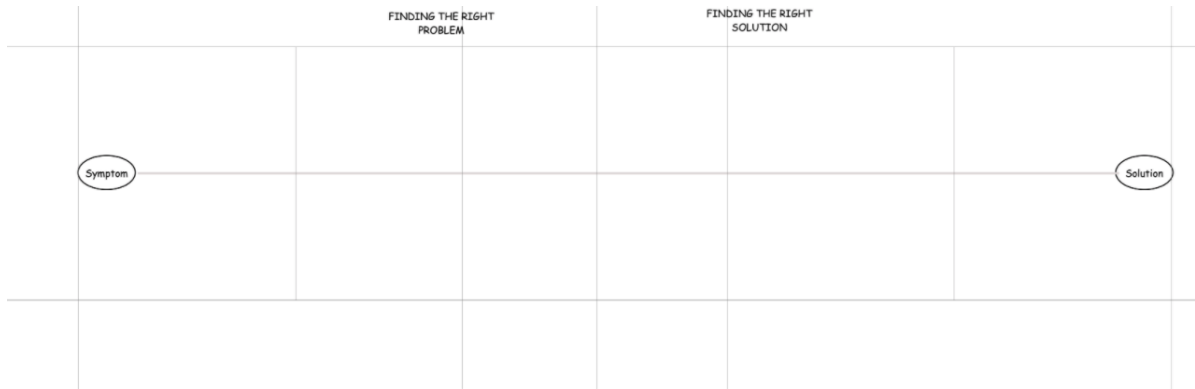


Figure 3.2: “Double Hexagon”, “Finding the Right Problem”/“Finding the Right Solution”.

In the next step, in order to provide more clarity, the Double Hexagon visualizes the journey from “Symptom” to “Solution” in four main phases suggested by the Design Council (see Figure 2.6, Section 2.3.1), as outlined below and shown in Figure 3.3.

- Discover: insight into the problem (diverging)
- Define: the area to focus upon problem (converging)
- Develop: discovering potential solutions (diverging)
- Deliver: choosing and building the solutions that work (converging)

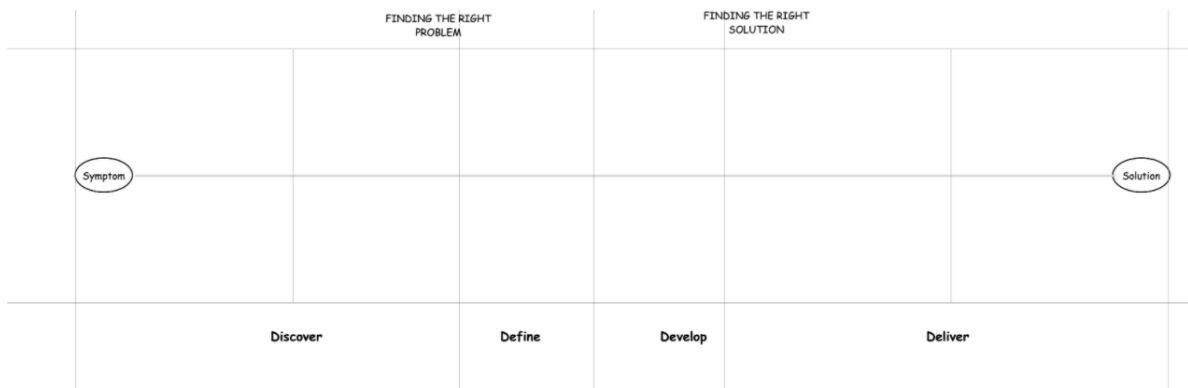


Figure 3.3: “Double Hexagon”, Four “D” phases of the Double Diamond.

We then applied two Diamonds to the model, along with Divergent Thinking and Convergent Thinking. As can be seen in Figure 3.4, each of the four stages, like the Evolved Double Diamond, is either divergent or convergent and has arrows on the Diamonds. The model proposes two iterations: one in problem space, to diverge from “Symptom” and converge to get to a “Problem Statement” at the end of the first Diamond, and one in the solution space, in which will be generated a bunch of possible ideas in the divergence phase and then converge upon a proposed solution.

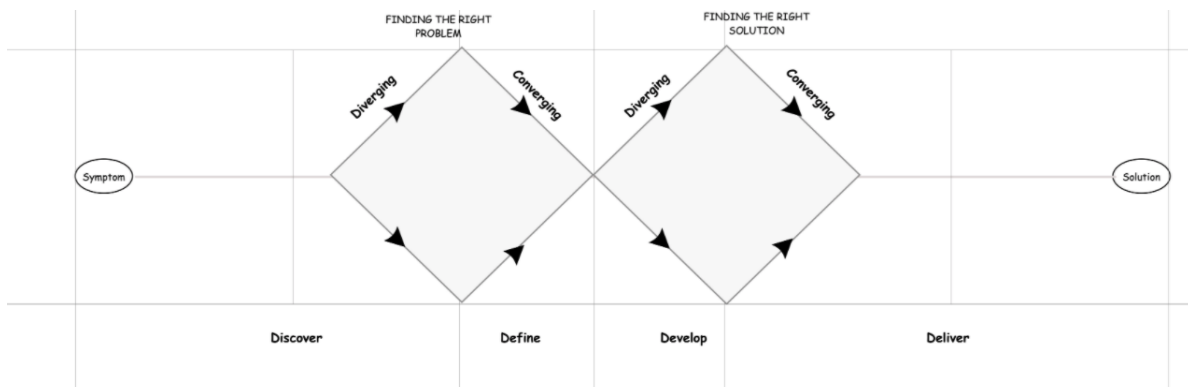


Figure 3.4: “Double Hexagon”, Divergent and Convergent Thinking.

As indicated in Figure 3.4, with the minor changes we came up with the mainframe of

Evolved Double Diamond. In this part, the framework is giving the big picture of a Design process from the Design Thinking perspective. This step addresses the “What” aspect of the Double Hexagon described above.

3.3.3 Integrating Design Thinking into DH

The Double-Diamond combines d.school’s five phases into two abstract phases. However, how should these be actually done? This is where the Human-Centred Design process and IDEO’s HCD toolkit and d.school’s Design Thinking activities come into play. In this section, we will focus on both the “What” and “How” of the Double Hexagon providing designers and non-designers with concrete activities and how they should be carried out.

3.3.3.1 The First Diamond of DH (Problem Space)

The first Diamond of the Double Hexagon focuses on finding the right problem. Five essential phases integrated into the DH which may help to identify the root problem starting from the symptoms see “Symptom” concept in Section 3.3.2, which have been seen or heard, are detailed below.

Phase 1. Added “User-Centred Empathy” to the 1st Diamond—Discover (Divergent Thinking) (Figure 3.5)

- **What**

The efforts to understand people given the problem requested or better to say given the symptoms—(see “Symptom” concept in Section 3.3.2), which include identifying their physical and emotional needs, desires and capabilities, how they think, and what is meaningful to them in the related context, will be done in this phase.

- **How**

Observe, Engage, Watch and Listen (see Section 2.3.3, Empathize part)

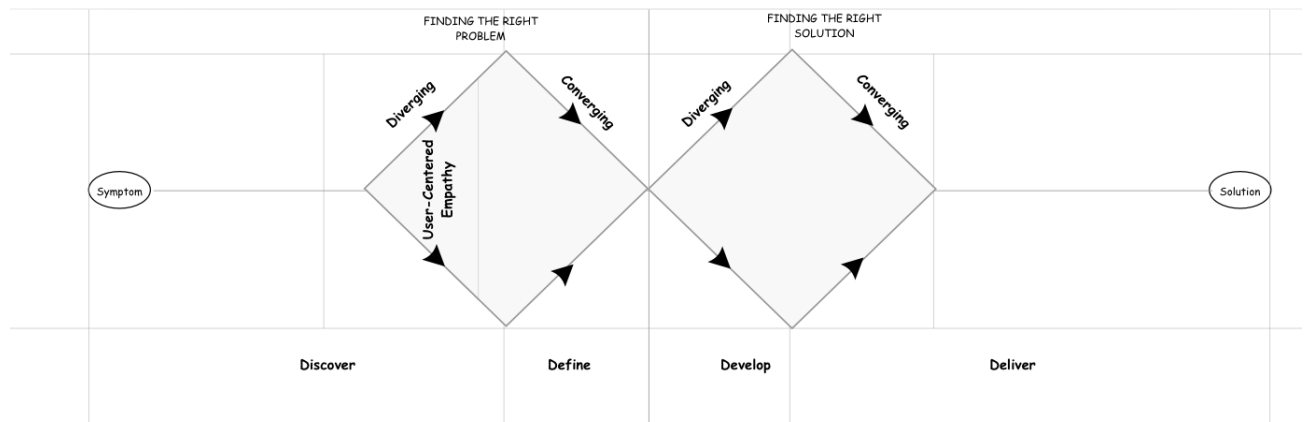


Figure 3.5: “Double Hexagon”, “User-Centred Empathy” to the 1st Diamond.

At this point, the way of thinking must be **divergent** to broaden the scope of the problem and to explore all the fundamental issues that underlie it and are caused by the symptoms heard/seen.

Phase 2. Added “Data Unpacked” to the 1st Diamond—Discover (Divergent Thinking) (Figure 3.6)

- **What**

The transition phase from Empathize to Define. Processing and unpacking all the things that the designer/researcher learned and saw to grasp the big picture and capture all of it (see Section 2.3.3, Empathize part). This is the beginning of the synthesis process leading to the “Define” mode.

- **How**

Getting all the information out of the head and onto a wall—post pictures of the user, post-its with quotes, maps of journeys or experiences.

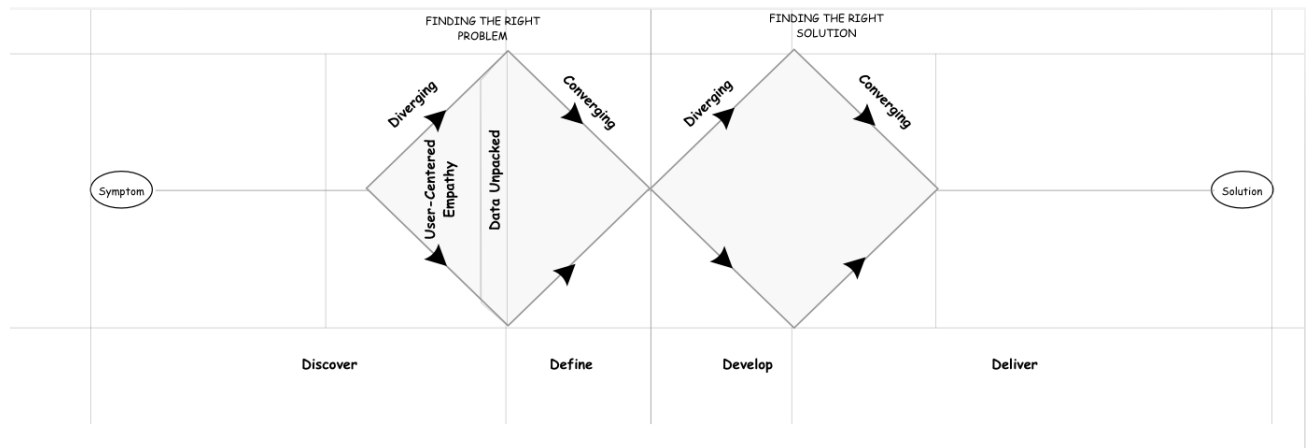


Figure 3.6: “Double Hexagon”, “Data Unpacked” in the 1st Diamond.

Phase 3. Added “Synthesis” to the 1st Diamond—Define (Convergent Thinking) (Figure 3.7)

- **What**

Synthesizing the scattered findings and empathy work into powerful insights. Selecting a limited set of Needs/Challenges considered to be important from the end-user perspective.

- **How**

Empathy Mapping (i.e., what the user or persona: Said, Did, Thought, Felt), Voting/Ranking by users.

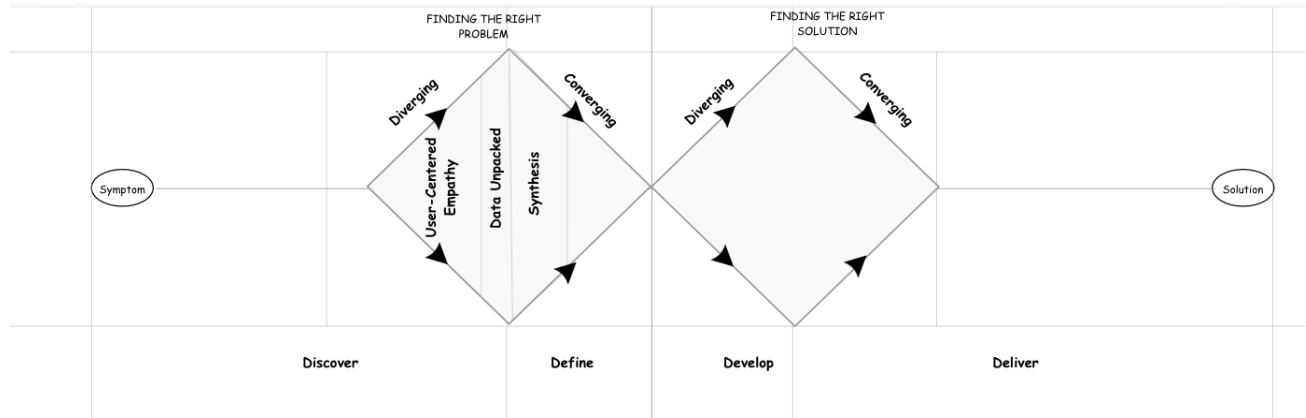


Figure 3.7: “Double Hexagon”, “Synthesis” in the 1st Diamond.

The synthesis will take place in the Define phase, in a way of convergent thinking, to get closer to identifying a meaningful POV statement (see Section 2.3.3, Define part) and a single problem. Although the analysis takes place during the Empathise stage and the synthesis takes place during the Define stage, they do not only happen in the separate phases in practice. In reality, analysis and synthesis often occur concurrently during all steps of the DT process (see Section 2.3.3, Define part).

Phase 4. Added “POV Statement” to the 1st Diamond—Define (Convergent Thinking) (Figure 3.8)

- **What**

Defining a meaningful and actionable problem statement.

- **How**

Combination of three elements of USERS and NEEDS and INSIGHTs that forms POV

(see Section 2.3.3, Define part).

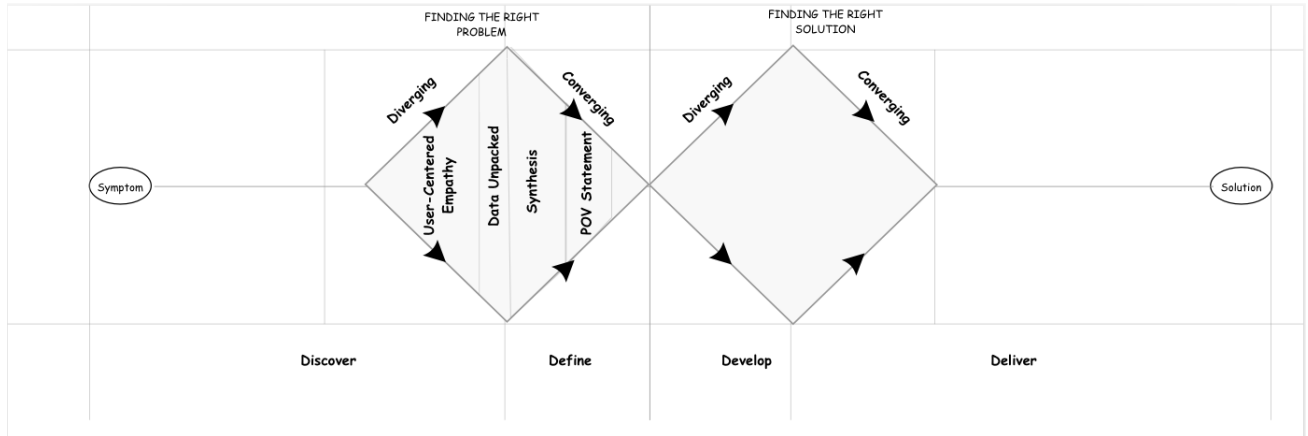


Figure 3.8: “Double Hexagon”, “POV Statement” in the 1st Diamond.

Phase 5. Added “HMW” to the 1st Diamond—Define (Convergent Thinking) (Figure 3.9)

- **What**

Brainstorming the topics that flow from the problem statement and are typically subsets of the problem which might fall out of the POV, focusing on the various aspects of the given problem statement.

- **How**

Creating a list of “How-Might-We” questions (see Section 2.3.3, Define part).

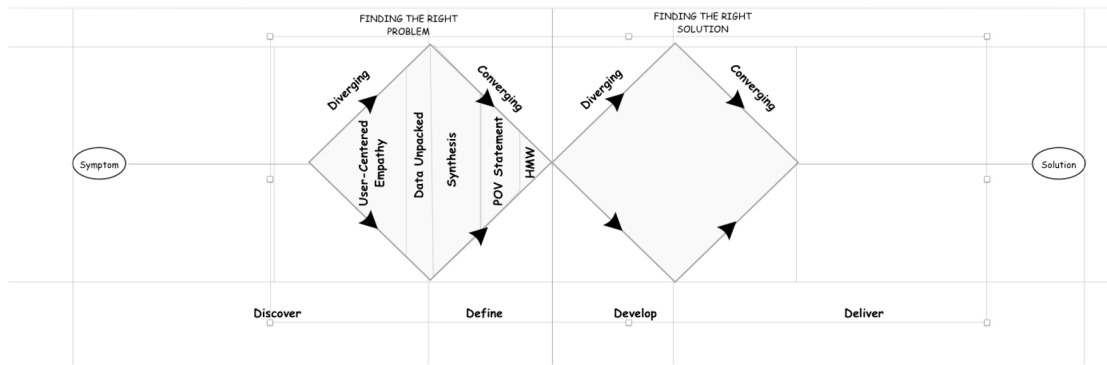


Figure 3.9: “Double Hexagon”, “HMW” in the 1st Diamond.

3.3.3.2 The Second Diamond of DH (Solution Space)

The second Diamond of Double Hexagon focuses on finding the right solution. This section addresses the six essential activities embedded in the DH that can help to find the best solution to the problem identified, which outlined below.

Phase 1. Added “Ideate” to the 2nd Diamond—Develop (Divergent Thinking) (Figure 3.10)

- **What**

Generation of the widest possible range of ideas, rather than a single, best solution.

- **How**

Using techniques such as brainstorming, brain dumping, sketching, etc. (see Section 2.3.3, Ideate part).

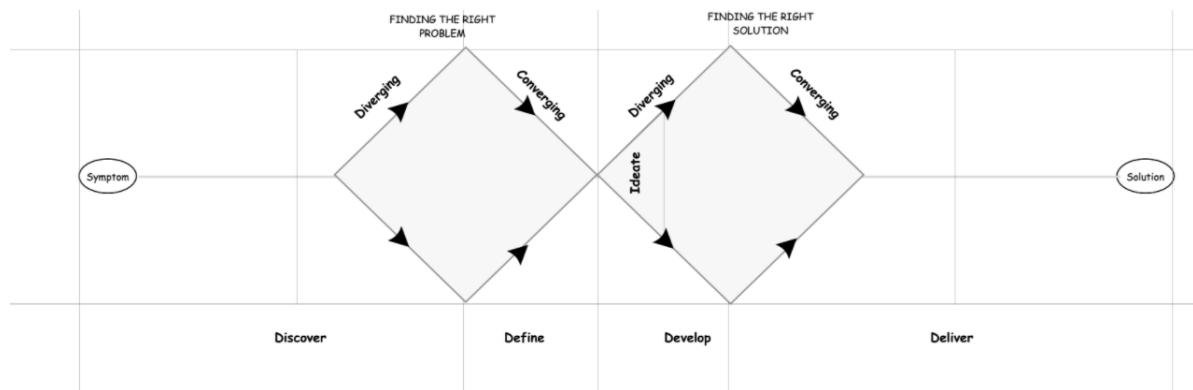


Figure 3.10: “Double Hexagon”, “Ideate” in the 2nd Diamond.

At this point, the way of thinking must be divergent enough to expand the space of possible solutions and to prevent the convergence early to simple “quick fix” solutions mentioned as a gap in EBCD in the Literature Review (see Section 2.1). This phase should provide both the fuel and the source material for building prototypes, this phase is where **innovation** could happen.

Phase 2. Added “Evaluate” to the 2nd Diamond—Develop (Divergent Thinking) (Figure 3.11)

- **What**

Selection or Evaluation of the ideas in terms of feasibility and desirability.

- **How**

Using techniques such as MoSCoW (see Section 2.1.1.2, Stage 2), Voting criteria (e.g., “the most likely to delight”, “the rational choice”, “the most unexpected” as potential criteria). At this point, since innovation potential will be preserved by carrying two or three ideas forward, pull the two or three ideas that get the most votes in the prototyping process.

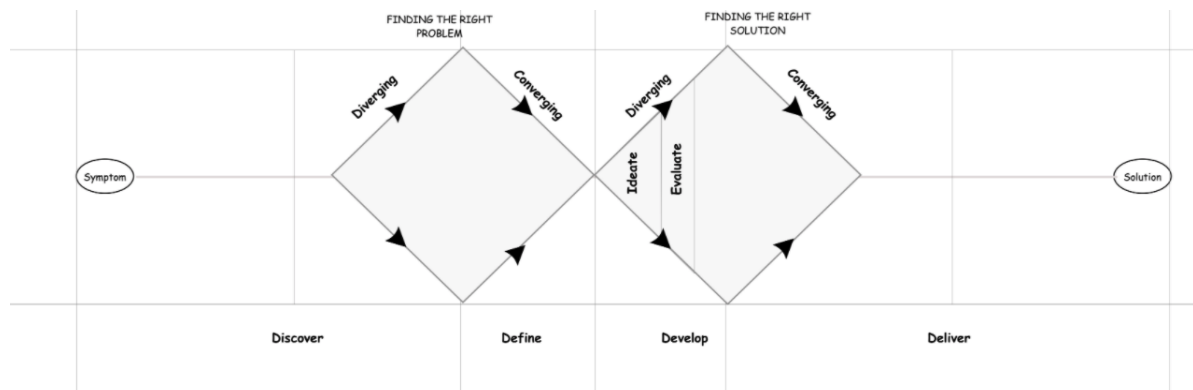


Figure 3.11: “Double Hexagon”, “Evaluate” in the 2nd Diamond.

Phase 3. Added “Paper-Based Prototyping (PBP)” to the 2nd Diamond—Develop (Divergent Thinking) (Figure 3.12)

- **What**

- Making something tangible to test, which conveys the idea generated in the ideation phase.
- Iterative development of the hand drawings and iterative generation of any paper-based presentation of needs, problems, and thoughts to bridge language barriers.
- We are applying the “iterative” term as this stage of the design process should be quick and cheap and productive, to elicit useful feedback from users and colleagues. Then the refinements are made based on the feedback to get closer to the final design. (In the last section, we will add the iterations of the model).

- **How**

Post-it notes, walking through a scenario with a storyboard using pen and paper or any low-fidelity tools

At this point, one of the most important standards that must be considered during the creation of the low-fidelity prototypes is “Don’t spend too long on one prototype” (Section 2.3.3, Prototype part). Hence, this phase should not take long, and still, the method of doing the activity is divergent thinking.

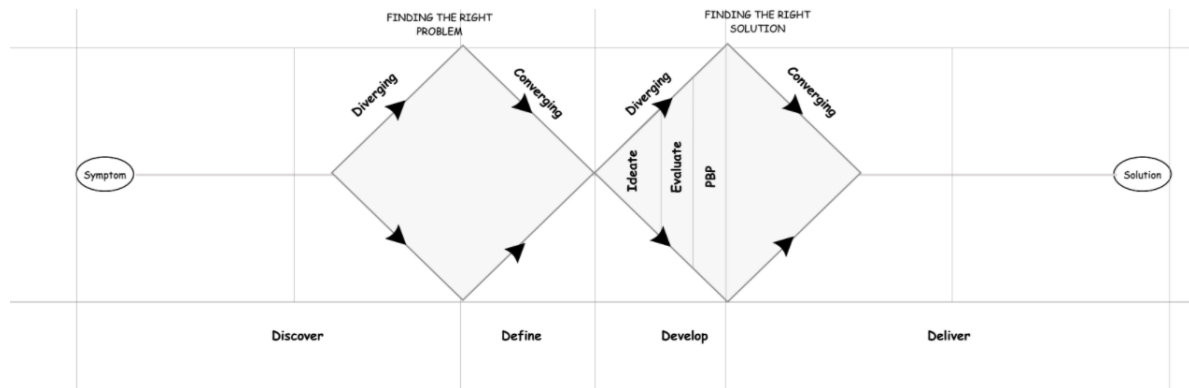


Figure 3.12: “Double Hexagon”, “PBP” in the 2nd Diamond.

Phase 4. Added “Wire-frames Developed” to the 2nd Diamond—Deliver (Convergent Thinking) (Figure 3.13)

- **What**

- More accurate representations of the layout demonstrating what interface elements should exist on the main pages.
- Avoiding distractions such as images or typography.
- Assigning more details to the elements of paper prototypes from the previous phase.

- **How**

- Building the composition of the identified features and functions.
- Prioritizing the content on the user interfaces.

- Connecting the user interfaces into a logical user flow.

The development of the wire-frames is taking place in the Deliver phase, in a way of convergent thinking, to narrow down to the proposed solutions (see Section 2.1.1.2, Stage 3).

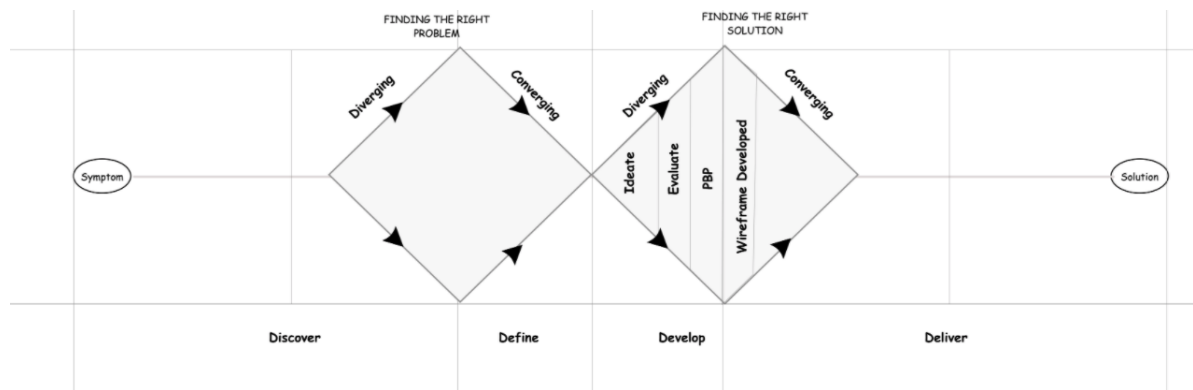


Figure 3.13: “Double Hexagon”, “Wire-frames Developed” in the 2nd Diamond.

Phase 5. Added “User Experience Test (Verification)” to the 2nd Diamond—Deliver (Convergent Thinking) (Figure 3.14)

- **What**

- Evaluation of User Experience Verification
- Getting feedback from the wire-frames (i.e., mid-fidelity prototypes) presented on a device (e.g., mobile, tablet, etc.) to check the proposed solution for consistency with the requirements document (User Experience Verification) (see Section 2.4.3; Section 2.1.1.2, Stage 3)

- **How**

- Conducting one-on-one user experience feedback sessions (virtual or physical) with each of the attendees to gauge each attendees’ thought process and responses to using this wire-frame design.
- Asking attendees to complete the main functionalities of the design without any help or walk-through. (see Section 2.1.1.2, Stage 3).

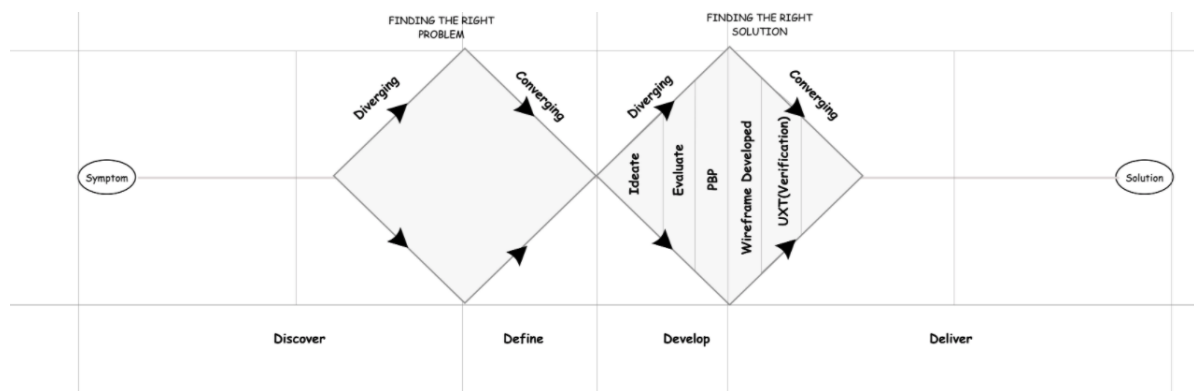


Figure 3.14: “Double Hexagon”, “UXT (Verification)” to the 2nd Diamond.

This stage addresses the Verification phase of UX Evaluation that somewhat is the same as activities during the Test phase of d.school DT process (Section 2.3.3, Test part). However, **it still does not cover the Validation phase of UX design**. The way of conducting this phase is convergent thinking since based on feedback received, the process will be improved and get closer to the best solution in which brings a positive and lasting user experience for the end-user (i.e., Section 2.4.3, Validation part).

Phase 6. Added “High-fidelity Prototype Developed” to the 2nd Diamond—Deliver (Convergent Thinking) (Figure 3.15)

- What

- Development of the high-fidelity prototypes or visual interfaces that demonstrate full functionality including actual featured images and relevant written content (see Section 2.3.3, Prototype part).
- High-fidelity prototypes should be kept for the final stages of the product design cycle.

- **How**

- Using High-Fidelity prototyping tools like Sketch, Invision, etc (see Section 2.3.3, Prototype part).

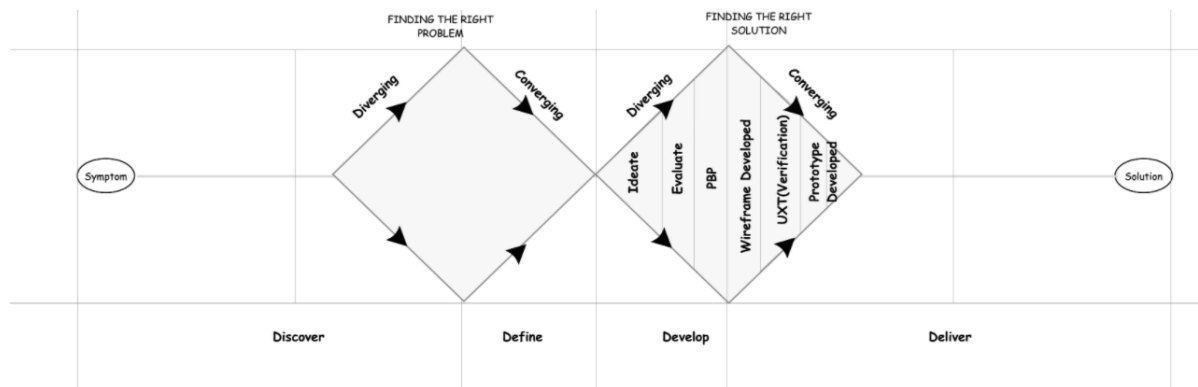


Figure 3.15: “Double Hexagon”, “Prototype Developed” to the 2nd Diamond

3.3.4 Integrating User Experience Test and Iteration in DH

Although prototyping and testing are sometimes completely intertwined, after developing a prototype, it is often the case that preparing and executing a strong testing scenario is a significant additional phase. Hence, in this section, Double Hexagon focuses on another evaluation aspect, which aims to evaluate the actual quality of the prototype solution, the result of the Second Diamond, beyond the verification of consistency with the requirements

document outlined in the UX verification process (see Section 2.4.3). In Section 3.3.4.1, we will detail the User Experience (UX) Validation that will complete the second Hexagon. This stage is what is generally overlooked in the design process. Furthermore, in the Section 3.3.4.2, we will add the essential iterations into the DH.

3.3.4.1 UX Validation & Prototype Refinement

(see Figure 3.16 & Figure 3.17)

- **What**

- Gathering data about the way in which user and product (high-fidelity prototype solution as the output of the second diamond) interactions take place to help designers to identify and analyze the following items:
 - (i) People’s behavior.
 - (ii) People’s needs (both expressed and unexpressed).
 - (iii) Finally, the frequency of errors that people can make while completing the defined tasks relevant to the product’s test.

- **How**

- Putting the high-fidelity prototypes in the users’ hands (It can be conducted physically or virtually).
- Observing the test and analyzing the behavior of users to determine the essential factors:
 - (i) “What” caused the user to make the error.
 - (ii) “When” the error occurred.
 - (iii) The nature of the obstacles they experienced.

- In addition to the user’s involvement, the test should be carried out by at least two individuals as follows:
 - (i) A facilitator who supervises the test and directs it.
 - (ii) One or more observers attending the testing sessions and taking notes of the relevant data.
 - (iii) A standard plan that can be followed by the observers is to check first-hand the tasks that will be assigned to the users at some time before the test itself.
- The feedback of the people guides the next iteration of how the prototype should be refined.
- Refinement of prototype based on the collected data (Figure 3.17).
 - (i) Once it is determined how the prototype should be changed to reflect the users’ feedback, another cycle of building the prototype should be executed.
 - (ii) Building the next iteration of the prototype.

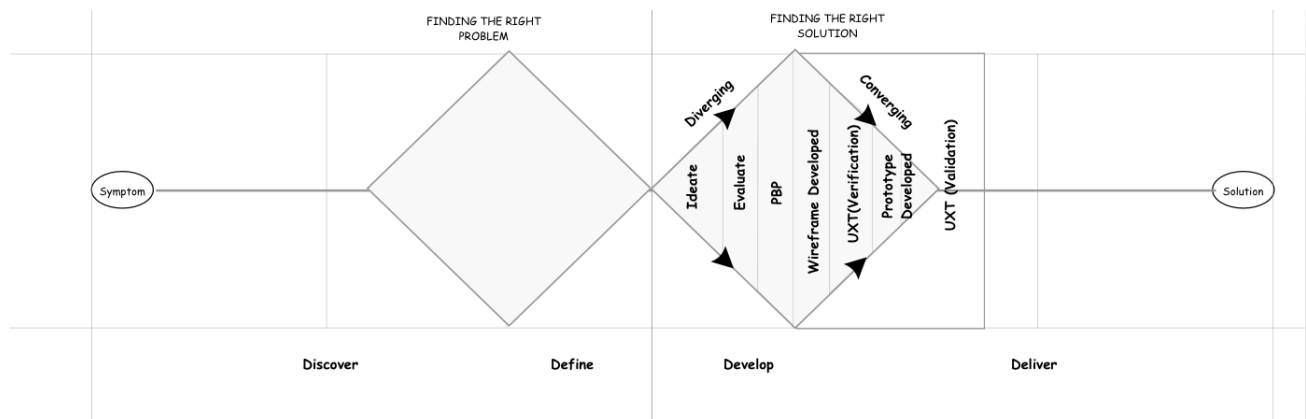


Figure 3.16: “Double Hexagon”, “UXT (Validation)” in the 2nd Hexagon

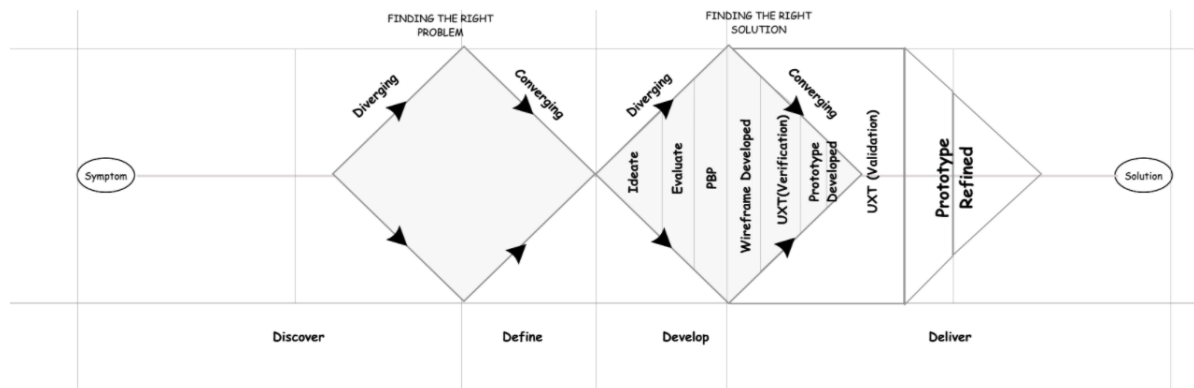


Figure 3.17: “Double Hexagon”, “Prototype Refined” in the 2nd Hexagon

In this section, we have attempted to bridge the gap that lacks the UX evaluation in the current models, specifically the validation aspect.

3.3.4.2 Iterations in DH

As described in the previous chapter, iteration is the nature of each design process (see Section 2.3.3.1). Integrating the feedback into the design and then coming up with another prototype is the best way to refine the idea until it is something that is bound to be adopted and embraced [36, 38]. Since the integration of feedback and iteration is very directly tied to prototyping, refining the prototypes should be conducted a few times to work out the kinks and get to the right solution [36, 38]. Thus, according to these HCD standards, before completing the first Hexagon, we have applied some iterations to the Double Hexagon shown in Figure 3.18. The blue circles are based on the evolved Double Diamond model described in the Section 2.3.2 (see Figure 2.6).

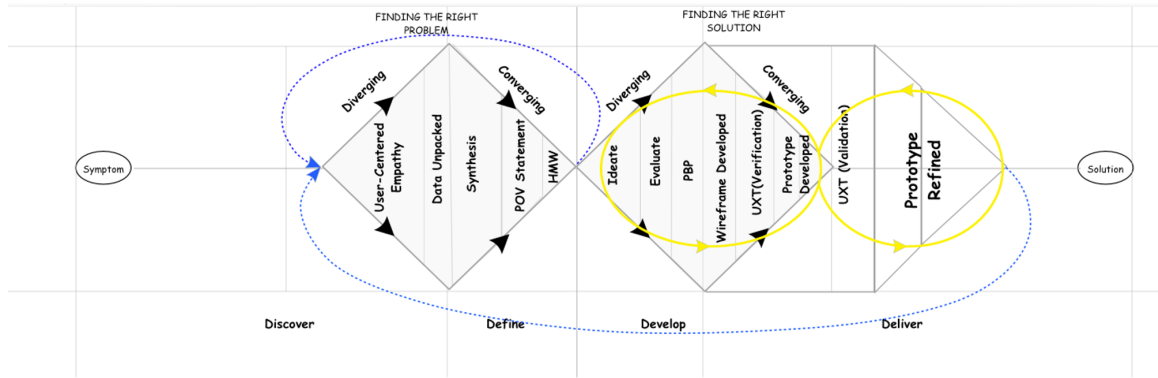


Figure 3.18: “Double Hexagon”, “Iterations” in DH

3.3.5 Integrating the Co-Design Principles into DH

In the prior sections, we addressed the “What” and “How” design aspects mentioned in Section 3.1. As we described earlier, the Double Hexagon also aims to address another design aspect which is “Who should get involved in each activity”. Therefore, in this section, we will get the benefit of Co-Design principles to address the gap related to articulating the key role of the end-user. The additional stages relevant to this aspect will be detailed below.

3.3.5.1 Incorporation of Stakeholder Engagement in DH

In the previous chapter, in the EBCD literature in Section 2.1, we detailed the process of Co-Design and the importance of the involvement of multidisciplinary teams in all phases of the design process. To illustrate the process, we outlined a Co-Design case study developed based on Co-Design principles (see Section 2.1.1). In our proposed DH model, we borrowed some ideas from the Co-Design process of this case study shown in Figure 2.4 in Section 2.1.1. As seen in Figure 3.19, we added “Stakeholder Engagement” to the First Hexagon which includes initial consultations and early engagement with the key stakeholders regarding legal and technical requirements prior to the start of the Co-Design process

(see Section 2.1.1).

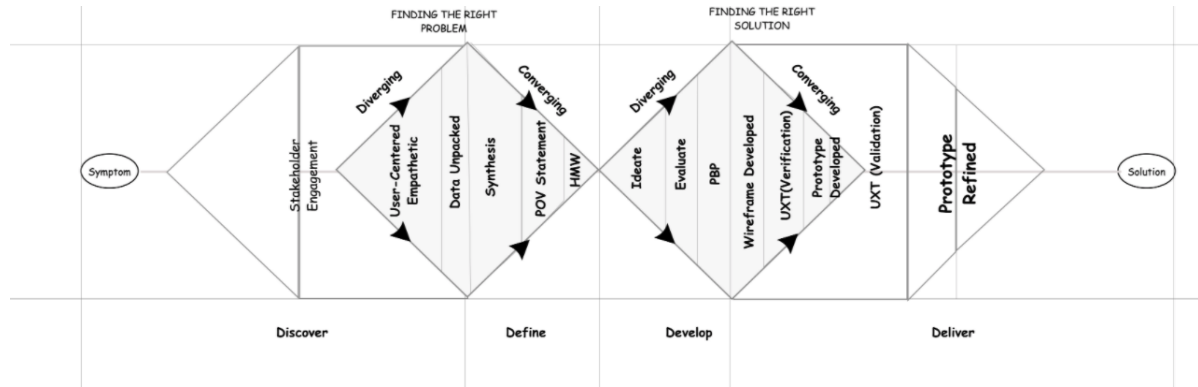


Figure 3.19: “Double Hexagon”, “Stakeholder Engagement” in the 1st Hexagon

3.3.5.2 Multidisciplinary Teams in DH

The final product of our work, in which demonstrates a multidisciplinary collaboration between teams through a mixture of colours, can be seen in Figure 3.20. The multidisciplinary teams used in the DH include end-users, customers, and relevant organizational stakeholders (e.g., investors, managers, advocates, etc.), end-users (e.g., staff, patients, carers, etc.), designers/researchers, and developers. Each role is shown with a solid colour, as the colour guideline indicates, and the colours are blended, where the roles should collaborate on an activity.

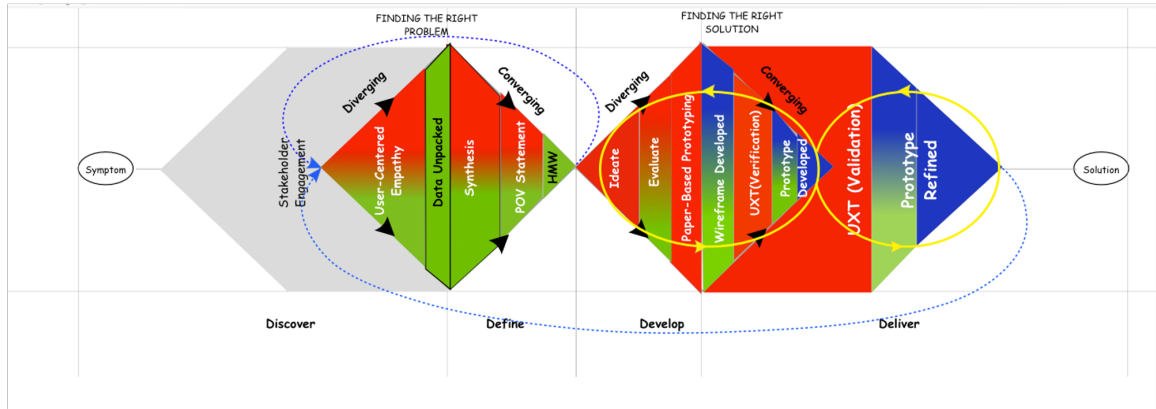


Figure 3.20: “Completed Double Hexagon”, Multidisciplinary Teams in DH

Activities Common between the End-User and Designer

In our proposed DH model, there are times when the end-user and designer should be actively collaborating together. These activities include *User-Centred Empathy*, *Synthesis*, *POV Statement*, *Evaluation* shown in Figure 3.20. During these activities, the role of end-user becomes a Co-Designer, who is involved as an equal partner with the designer in the activities like selecting/ranking of the challenges, generation of the ideas, evaluating/ranking the ideas, and decision-making. These are all key tasks of the above-mentioned activities. The role of the designer becomes a facilitator or mediator who provides the relevant tools and techniques for the end-users to help the end-users draw from relevant experiences to inform the design process.

Activities where the End-User plays the main role

Ideate, *Paper-Based Prototype(PBP)*, and *User Experience Test (Verification and Validation)* are the activities in which End Users play a significant role in the Double Hexagon. The explanation that we considered the end-user only for these activities is that because the Ideate and PBP phases are where they can express their thoughts and experiences

and where innovation might occur. The end-users can bring creativity to the visualization of their experiences as long as they interact with other participants to generate the ideas, without being influenced by the designers' opinions. In the case of the User Experience Test (Verification and Validation), we follow the standards of the HCD testing phase detailed earlier. In this case, Designers should put the prototype in the hands of the end-user and should not explain it at all to allow the tester to interpret the prototype and give the most meaningful and natural, and honest feedback.

Activities where the Designer plays the main role

We considered only the Designer to engage in the *Data Unpacked* and *HMW* activities since these are transition steps to the main phases, so the designer can play an effective role in evaluating the data collected and returning to the end-user to start a new phase based on the data interpreted.

Activities Common between the Designer and Developer

These activities include the *development of wire-frames and high-fidelity prototypes* as they are more technical than other activities, so here is where developers should come into the process, and designers should help them as holders of users' ideas.

3.4 Conclusion

In this chapter, we presented the Double Hexagon that is an iterative hybrid Human-Centred framework aiming at solving a design problem to achieve a positive User Experience. We outlined the main objectives, specifications, and principles of this model, and provided a step-by-step guide on how to develop this framework. In the DH model, we tried to bridge the gaps mentioned in the previous chapter focusing on providing a systematic Human-Centred and Co-Design framework with the inclusion of essential Design Thinking activities

and User Experience evaluation during a design process. In the DH, we demonstrated the active collaboration of users and the involvement of multidisciplinary teams with blending the colours in the design process, because from case reports, and our own experience, we concluded that this is easy to be overlooked. In this point, even if all other steps are followed, a passive collaboration of each category of the roles especially end-users may result in a good product from the Designer/Developer team’s view, but it would not necessarily deliver a positive and lasting User Experience.

Chapter 4

Discussion

Every product designed for humans has a user, and each time a product is used, it delivers an experience [1, 2]. A product can be usable, without necessarily ensuring a positive and lasting user experience [1, 2]. The need to understand people and design for people is at the core of User Experience, Human-Centred design, Co-Design, and Design Thinking [1, 2], but as reported in the literature, there are gaps between theory and practice. We designed the Double Hexagon framework to fill these gaps, and move from designing “product” categories to designing for “people”. In this chapter, we will discuss the expected facilitators and barriers to applying the Double Hexagon framework in the real-world applications based on reported results for similar works in the literature. In Section 4.1, we will discuss the strengths of this method and in Section 4.2, we will compare the DH to previous work and will also discuss the barriers which could emerge during its execution.

4.1 Strengths of the Double Hexagon

The DH makes explicit both **what** and **how** activities should be performed, plus who should take part. This is its main strength and addresses a repeated criticism of design

practice: the omission of end-user engagement and their lack of agency, especially in later stages of development. By using colour coding for different actors in the design process, and colour blending for shared responsibilities, even newcomers to the field will immediately be aware of the need to plan for **active collaboration of end-users** throughout the design process, which is the critical principle of Co-Design. Designers and Developers familiar with traditional methods based on mono-collaboration and focusing on product delivery have tended to overlook this collaboration and have relegated user perspectives to the edges of the process. In this way that they analyze and interpret the needs of end-users before the actual development process starts, and then, at the end of the process, gather feedback from end-users to assess and test the almost finished product. As discussed in Chapter 2, Section 2.4.4, even in the HCD process, although end-users play an active role in the “Inspiration” and “Implementation” phases, their involvement in the generation of ideas during the “Ideation” phase is not mandated. During these two steps, users are engaged using questionnaires, interviews, direct observations (Inspiration), and trial use of various prototypes of the product (Implementation). Failure to actively collaborate with the end-users can be due to a variety of reasons, such as budget/scheduling constraints or even to the mindset of designers/leaders, which will be discussed in later sections.

Furthermore, the DH highlights the importance of both engagement and leadership principles in the design process. As seen in Figure 3.20, at the core of the DH is the Evolved Double Diamond (see Section 3.1). As detailed in Section 2.3.2, the Design Council added “Engagement” and “Leadership” at the top and bottom of this framework (see Figure 2.6) to emphasize the fact that the culture of an organization and how it interacts with various stakeholders is as critical as the process and principles that designers adopt, because the challenges we face today need more than one idea. Nevertheless, in our view, these concepts are abstractions in the Evolved DD; where the DH makes them explicit in the model.

Another strength of the DH is the explicit integration of “User Experience Evaluation”

into Design Thinking and Co-Design practice. We agree that Design Thinking models, such as the 5-steps DT model of Stanford’s d.School (Section 2.3.3) already includes a “Test” phase, in which designers observe how users test prototypes, gather valuable feedback and then refine the prototypes based on feedback collected. By observing this interaction, designers can gather the relevant information and review/refine the prototypes by improving some usability issues, or generate additional insights that entail the repeat of some previous phases. Nevertheless, from our perspective, this step addresses only the “Verification” facet of the User Experience Test, in which it verifies whether the product is compliant with what is expected in the documentation of the requirements (see Section 2.4.3. In this level of test, the end-users will usually be provided with the PBP or the wire-frames for testing (see Section 3.3.3.2—part 3,4). Given scheduling and budget constraints, after verifying whether the final prototype meets all the requirements of end-users, designers/developers often overlook the building and evaluation of high-fidelity prototypes and, as a result, start developing the product. In other words, the Validation phase needs the high-fidelity prototypes of a product to be piloted in an environment with end-users before significant investment in the implementation [21].

4.2 Double Hexagon Limitations

4.2.1 Comparing with Previous Work

Just as we were inspired by Nessler’s Revamped Double Diamond [46] (see Section 2.5.1), criticisms and feedback of his work are likely to be made about the DH for similar reasons. In this regard, one of the most frequent criticisms was that the Revamped Double Diamond made a simple idea complicated [46]. Similar concerns could be raised about the level of details in this model, but we have attempted to address this by using the layers to explain it in digestible chunks. With the original Double Diamond, the Design Council attempted to

add structure to the chaotic design world, at that time. It has certainly made a significant contribution to the spread of design in the world, but we feel that the DH better addresses today's design challenges, just as the Evolved Double Diamond did in 2019.

4.2.2 Organizational Culture Barriers

Case studies of projects following Co-Design and Design Thinking principles [3, 48, 49], indicate that organizations must switch from command and control structures to agile teams. Effectively applying HCD and DT strategies further require updates to work models and functional roles. In order to execute the HCD frameworks successfully, it is highly essential prior to commence the design process to set up multidisciplinary teams of designers, developers, project managers, and end-users working together to be able to drive a vision of the design and the development process. Fragmented teams can easily get out of sync and fail to achieve valuable feedback in these conditions [49]. Applying design thinking in an organization conflicts with common management techniques that depend heavily on predefined workflows and structured quality gateways, anticipating and selecting solutions in a definitive manner but limiting innovation [3]. Corporate culture can also be a barrier to DT [48], with DT's focus on experimentation and iterations, having fun, and multidisciplinary collaboration rather than hierarchical, risk-averse, mono-disciplinary collaboration which predominate in large organizations [3, 48]. Another barrier for large companies constrained by the traditional business structures, the transition to new mindsets, and the establishment of new routines are complicated and challenging. Adopting the Double Hexagon framework does not resolve these barriers, but does provide a structured guide for how to implement these ideas. Cultural evolution does not occur by accident, where major companies such as IBM, Apple, Capital One, etc., have invested heavily in their design cultures, and been rewarded.

4.2.3 Implementation Barriers: Accessibility, Time, Funding

A recent case study identified recruitment, time, and funding as barriers to applying Co-Design in the Implementation stage of IDEO’s process [50]. “Recruitment” means finding and integrating end-users into co-design activities. This is a particular concern in health care. Since one of our contributions is asking “Who should be involved?” in every stage in the design process, this will also be a barrier to applying the DH. Therefore, appropriate recruitment strategies must be developed before beginning the execution of the DH. Norman in his book [2]—“The Design of Everyday Things”—also notes that the schedule and budget are always the two most serious constraints of the Design Thinking and HCD projects [2]. To counter this, we call for separate verification and validation stages, so that budgets and schedules will be made to accommodate them.

4.3 Conclusion

The Double Hexagon offers a single Human-Centred Design framework, which makes explicit “What/How activities should be done” and “Who should be involved in each activity”. Furthermore, it promotes “User Experience Evaluation” rather than “Product Evaluation”. Although the ideal may not be always reached in reality, by making the “who” and the need for “user experience” evaluation led by users explicit in the diagram, even high-level managers can anticipate and plan for them before beginning the process, making it less likely that they will be squeezed out due to budget and schedule constraints, or lack of buy-in from the development team.

Chapter 5

Conclusion and Future Work

In our literature review, we provided an outlook of previous research on Experience-Based Co-Design, Design Thinking, and Human-Centred Design approaches. In this review, we highlighted the gaps identified in the literature on Experience-Based Co-Design and in the current Human-Centred Design and Design Thinking methods. We proposed a Human-Centred iterative hybrid framework called Double Hexagon to bridge the gaps with a method we think is particularly suited to healthcare interventions. The ultimate objective is “designing for people” to facilitate eliciting a positive and lasting user experience, rather than delivering only a good product that although is pleasant from the product owner’s view, would not necessarily deliver a pleasant user experience. To mitigate the complexity of the DH at first glance, we presented a step-by-step guide on how we built it. We discussed two strengths the DH contributes to the field of design practice, making explicit: 1) the active collaboration of end-users and, 2) Evaluation of the User Experience by testing of the prototype solution included both the *Verification* and *Validation* assessments, prior to the considerable investment being made in the implementation phase. Furthermore, we compared the DH to previous works and discussed the barriers which could emerge during its execution by referring to case studies for related Human-Centred Design methods.

In order to go further with this work in the future, it would be interesting to develop and discuss the following points:

- To test and validate the DH, a series of case studies should be carried out, applying the framework to projects that seek to improve healthcare services. The study must investigate whether the DH provides a positive and lasting User Experience in solving a real-world design problem, and identify which phases facilitate the process and which steps are challenging and seem unnecessarily time-consuming.
- Ongoing refinement of the model will be needed to address the challenges faced during the DH execution. Strategies and techniques can then be put in place to make DH more efficient, tangible, and pragmatic in solving a real-world design problem.
- Further study of key elements of the framework could be a direction for future research. Iterative prototyping, for example, plays an essential role in gathering valuable feedback, therefore it would be interesting to study and analyze the tools and techniques available for each form of the prototype (e.g., we can use Balsamiq, Axure RP, or Sketch to develop paper-based prototypes, wire-frames, high-fidelity prototypes). A systematic comparison of the advantages and drawbacks of each tool could lead to recommendations regarding the tasks for which each tool is best suited.

Overall, the goal of this thesis was to explicate key principles of Human-Centred Design and Co-design across several prominent design approaches, as well as advance dialogue in the field regarding the ways in which the strengths of different approaches could be brought together to create a comprehensive, inclusive approach to Human-Centred design that aims at “designing for people” addressing not only delivering a high-quality product but also building a positive and lasting a user experience.

“It is not enough that we build products that function, that are understandable and

usable, we also need to build products that bring joy and excitement, pleasure and fun, and, yes, beauty to people's lives. Beauty and brains, pleasure and usability - they should go hand in hand."

Donald Norman

Bibliography

- [1] F. Tosi, *Design for Ergonomics*, ser. Springer Series in Design and Innovation. Springer International Publishing, 2020, vol. 2.
- [2] D. A. Norman, *The Design of Everyday Things: Revised and Expanded Edition*. Basic Books, A Member of the Perseus Books Group, 2013, vol. 15, no. 2, ch. 6, pp. 217–257.
- [3] T. Lindberg, C. Meinel, and R. Wagner, “Design Thinking: A Fruitful Concept for IT Development?” in *Design Thinking*, C. Meinel, L. Leifer, and H. Plattner, Eds. Springer Berlin Heidelberg, 2011, vol. 15, no. 2, pp. 3–18.
- [4] F. Rizzo, *Strategie di co-design. Teorie, metodi e strumenti per progettare con gli utenti*. Franco Angeli, 2009.
- [5] P. Bate and G. Robert, *Bringing User Experience to Healthcare Improvement: the Concepts, Methods and Practices of Experience-based Design*. Radcliffe Publishing Ltd, 2007, vol. 21, no. 1.
- [6] S. Bowen, K. McSeveny, E. Lockley, D. Wolstenholme, M. Cobb, and A. Dearden, “How was it for you? Experiences of participatory design in the UK health service,” *CoDesign*, vol. 9, no. 4, pp. 230–246, 2013.
- [7] S. Donetto, P. Pierri, V. Tsianakas, and G. Robert, “Experiencebased co-design and

- healthcare improvement: Realizing participatory design in the public sector," *Design Journal*, vol. 18, no. 2, pp. 227–248, 2015.
- [8] S. Donetto, V. Tsianakas, and G. Robert. (2014) Using Experience-based Co-design (EBCD) to improve the quality of healthcare: mapping where we are now and establishing future directions. <https://www.kcl.ac.uk/nmpc/research/nrru/publications/reports/ebcd-where-are-we-now-report.pdf>. Accessed: Feb. 19, 2021.
- [9] S. Bowen, A. Dearden, P. Wright, D. Wolstenholme, and M. Cobb, "Participatory healthcare service design and innovation," *ACM International Conference Proceeding Series*, pp. 155–158, 2010.
- [10] S. Bowen, A. Dearden, D. Wolstenholme, M. Cobb, and P. Wright, "Different Views: Including Others in Participatory Health Service Innovation," *Proceedings of PINC 2011*, pp. 230–236, 2011.
- [11] M. Larkin, Z. V. Boden, and E. Newton, "On the Brink of Genuinely Collaborative Care: Experience-Based Co-Design in Mental Health," *Qualitative Health Research*, vol. 25, no. 11, pp. 1463–1476, 2015.
- [12] P. Bate and G. Robert, "Experience-based design: from redesigning the system around the patient to co-designing services with the patient," *Quality and Safety in Health Care*, vol. 15, no. 5, pp. 307–310, 10 2006.
- [13] Bate, Paul and Robert, Glenn, "Toward more user-centric OD: Lessons from the field of experience-based design and a case study," *Journal of Applied Behavioral Science*, vol. 43, no. 1, pp. 41–66, 2007.

- [14] (2012) Experience-based co-design toolkit. <http://www.kingsfund.org.uk/projects/point-care/ebcd>. London : The King's Fund. Accessed: Feb. 20, 2021.
- [15] G. Robert, "Participatory action research: using experience-based co-design to improve the quality of healthcare services," in *Understanding and Using Health Experiences*. Oxford University Press, 2013, ch. 14, pp. 138–149.
- [16] H. Boyd, S. McKernon, B. Mullin, and A. Old, "Improving healthcare through the use of co-design," in *The New Zealand Wars*. Bridget Williams Books, 2012, vol. 125, no. 1357, pp. 76–87.
- [17] D. Piper, R. Iedema, J. Gray, R. Verma, L. Holmes, and N. Manning, "Utilizing experience-based co-design to improve the experience of patients accessing emergency departments in New South Wales public hospitals: An evaluation study," *Health Services Management Research*, vol. 25, no. 4, pp. 162–172, 2012.
- [18] R. Iedema, E. Merrick, D. Piper, K. Britton, J. Gray, R. Verma, and N. Manning, "Codesigning as a Discursive Practice in Emergency Health Services: The Architecture of Deliberation," *The Journal of Applied Behavioral Science*, vol. 46, no. 1, pp. 73–91, 2010.
- [19] H. Sustar, A. Dearden, S. Bowen, M. Fisher, and D. Wolstenholme, "Using Popular Culture to Enable Health Service Co-Design with Young People," *Proceedings of EAD 2013 - Crafting the Future*, 2013.
- [20] (2010) Thinking differently. NHS Institute for Innovation and Improvement. Accessed: Feb. 20, 2021. [Online]. Available: <https://improvement.nhs.uk/documents/1485/thinking-differently.pdf>

- [21] R. Lipson-Smith, F. White, A. White, L. Serong, G. Cooper, G. Price-Bell, and A. Hyatt, "Co-Design of a Consultation Audio-Recording Mobile App for People With Cancer: The SecondEars App," *JMIR Formative Research*, vol. 3, no. 1, p. e11111, 2019.
- [22] M. Altman, T. T. Huang, and J. Y. Breland, "Design Thinking in Health Care," *Preventing Chronic Disease*, vol. 15, no. 9, p. 180128, 2018.
- [23] J. S. MacFadyen, "Design thinking," *Holistic Nursing Practice*, vol. 28, no. 1, pp. 3–5, 2014.
- [24] J. P. Roberts, T. R. Fisher, M. J. Trowbridge, and C. Bent, "A design thinking framework for healthcare management and innovation," *Healthcare*, vol. 4, no. 1, pp. 11–14, 2016.
- [25] M. M. Searl, L. Borgi, and Z. Chemali, "It is time to talk about people: a human-centered healthcare system," *Health Research Policy and Systems*, vol. 8, no. 1, p. 35, 2010.
- [26] A. R. Lyon and K. Koerner, "User-Centered Design for Psychosocial Intervention Development and Implementation," *Clinical Psychology: Science and Practice*, vol. 23, no. 2, pp. 180–200, 2016.
- [27] F. Ferreira, E. Song, H. Gomes, E. Garcia, and L. Ferreira, "New mindset in scientific method in the health field: Design Thinking," *Clinics*, vol. 70, no. 12, pp. 770–772, 2015.
- [28] K. B. Kahn, *Design Thinking. Understand – Improve – Apply*, C. Meinel, L. Leifer, and H. Plattner, Eds. Berlin, Heidelberg: Springer, 2011, vol. 61, no. 3.
- [29] (2007) "Eleven lessons: managing design in eleven global companies, Desk research report". British Design Council. London, UK. Accessed: Feb. 25,

2021. [Online]. Available: https://www.designcouncil.org.uk/sites/default/files/asset/document/ElevenLessons_DeskResearchReport_0.pdf
- [30] (2007) “Eleven lessons. A study of the design process”. British Design Council. London, UK. Accessed: Feb. 25, 2021. [Online]. Available: [https://www.designcouncil.org.uk/sites/default/files/asset/document/ElevenLessons_Design_Council%20\(2\).pdf](https://www.designcouncil.org.uk/sites/default/files/asset/document/ElevenLessons_Design_Council%20(2).pdf)
- [31] B. H. Banathy, *Designing Social Systems in a Changing World*, ser. Contemporary Systems Thinking. Boston, MA: Springer US, 1996.
- [32] D. Hambeukers. (2019) “The New Double Diamond Design Process Is Here”. medium.com. Accessed: Feb. 25, 2021. [Online]. Available: <https://medium.com/design-leadership-notebook/the-new-double-diamond-design-process-7c8f12d7945e>
- [33] (2019) “What is the framework for innovation? Design Council’s evolved Double Diamond”. British Design Council. London, UK. Accessed: Feb. 25, 2021. [Online]. Available: <https://www.designcouncil.org.uk/news-opinion/what-framework-innovation-design-councils-evolved-double-diamond>
- [34] K. Tschimmel, “Design Thinking as an effective Toolkit,” *Action for Innovation: Innovating from Experience. Barcelona*, pp. 1–20, 2012.
- [35] D. Rhea, “Bringing clarity to the “Fuzzy Front End”,” in *Design Research, Methods and Perspectives*, L. Brenda, Ed. London: MIT Press, 2003, pp. 145–154.
- [36] (2015) “An Introduction to Design Thinking PROCESS GUIDE”. d.school, The Hasso Plattner Institute of Design at Stanford University. Stanford, California. Accessed: Feb. 26, 2021. [Online]. Available: <https://web.stanford.edu/~mshanks/MichaelShanks/files/509554.pdf>

- [37] B. R. Ingle, “Introduction to Design Thinking,” in *Design Thinking for Entrepreneurs and Small Businesses*. Berkeley, CA: Apress, 2013, ch. 1, pp. 1–15.
- [38] (2015) “The Field Guide to Human-Centered Design”, DESIGN KIT. IDEO.org. Accessed: Feb. 26, 2021. [Online]. Available: <https://www.designkit.org/resources/1>
- [39] J. Rubin, *Handbook of usability testing: how to plan, design and conduct effective tests*. New York: John Wiley & Sons, 1994.
- [40] P. Jordan, *Designing Pleasurable Products, An Introduction to the New Human Factors*. CRC Press, 2000.
- [41] D. A. Norman, *Emotional Design: Why We Love (or Hate) Everyday Things*, 1st ed. Basic Books, 2004.
- [42] W. Quesenbery, “The five dimensions of usability,” in *Content and complexity: information design in technical communication*, M. J. Albers and M. B. Mazur, Eds. Routledge, 2003, ch. 4, pp. 81–102.
- [43] D. A. Norman, *The Design of Everyday Things*. Basic Books. New York., 2003.
- [44] T. Brown and J. Wyatt, “Design Thinking for Social Innovation,” *Development Outreach*, vol. 12, pp. 29–43, 2010.
- [45] T. Brown. “IDEO Design Thinking”. Accessed: Feb. 27, 2021. [Online]. Available: <https://designthinking.ideo.com/>
- [46] D. Nessler. (2016) “How to apply a design thinking, HCD, UX or any creative process from scratch—Revised & New Version”. medium.com. Accessed: Feb. 28, 2021. [Online]. Available: <https://medium.com/@dan.nessler/how-to-solve-problems-applying-a-uxdesign-designthinking-hcd-or-any-design-process-from-scratch-v2-aa16e2dd550b>

-
- [47] J. J. Garrett, *The Elements of User Experience, Second Edition: User-Centered Design for the Web and Beyond*. New Riders, 2010.
- [48] L. Carlgren, M. Elmquist, and I. Rauth, “The Challenges of Using Design Thinking in Industry – Experiences from Five Large Firms,” *Creativity and Innovation Management*, vol. 25, no. 3, pp. 344–362, 2016.
- [49] P. Lucena, A. Braz, A. Chicoria, and L. Tizzei, “IBM design thinking software development framework,” *Communications in Computer and Information Science*, vol. 680, no. December, pp. 98–109, 2017.
- [50] C. T. Sandholdt, J. Cunningham, R. G. Westendorp, and M. Kristiansen, “Towards Inclusive Healthcare Delivery: Potentials and Challenges of Human-Centred Design in Health Innovation Processes to Increase Healthy Aging,” *International Journal of Environmental Research and Public Health*, vol. 17, no. 12, p. 4551, 6 2020.