Affidavit

I declare that I have authored this thesis independently, that I have not used other than the declared sources/resources, and that I have explicitly indicated all material which has been quoted either literally or by content from the sources used. The text document uploaded to TUGRAZonline is identical to the present master‘s thesis dissertation.

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Abstract

IDEO, one of the world's leading design firms and the Stanford University Institute of Design developed an innovation method that can be applied to nearly any design challenge. This method is called Design Thinking which is taught in several courses at the Stanford University and over the past decades successfully applied by IDEO.

The Product Innovation Project is a course at the Institute of Industrial Management and Innovation Research at Graz University of Technology where diverse teams work together for one academic year on a project. The task and budget for this project is provided by industrial partners. The goal of the project is do deliver a working prototype, and a business plan.

The challenges in the Product Innovation Project are similar to the challenges that IDEO is facing in their projects. Also the framework that is provided in the Product Innovation Project can be compared to IDEO. Aspects such as the project based working, diverse teams, creativity enhancing environment or rapid prototyping are some examples.

To get proof if Design Thinking should be implemented into the Product Innovation Project the method was introduced to the teams in the academic year 2014/15. The feedback of the students and the comparison to other methods that they used gave answers to the question if Design Thinking can be applied.

Implementing the tools and values of Design Thinking that made IDEO to one of the leading firms in design brings the Product Innovation Project to the next level. By applying these methods the results will increase in quality which is in the favor of the sponsoring industrial partners. The student teams have a higher chance to apply for patents and can gain better experiences during the project. Also the university benefits by having successful teams that deliver innovative products.

Kurzfassung

IDEO, eine der weltweit führenden Designunternehmen, und das Stanford University Institute of Design entwickelten eine Innovationsmethode, die auf fast jede Designaufgabe angewendet werden kann. Diese Methode wurde Design Thinking genannt, die in mehreren Kursen an der Stanford University gelehrt und über die letzten Jahrzehnte von IDEO erfolgreich angewendet wird.

Das Product Innovation Project ist ein Kurs am Institut für Industriebetriebslehre und Innovationsforschung an der Technischen Universität Graz, bei dem vielfältige Teams gemeinsam in einem Studienjahr an einem Projekt arbeiten. Die Aufgabenstellung, sowie das Budget werden von Partnern aus der Industrie zur Verfügung gestellt. Das Ziel dieses Projektes ist, einen funktionierenden Prototypen und ein Unternehmenskonzept zu erarbeiten.

Die Herausforderungen im Product Innovation Project sind ähnlich zu den Herausforderungen denen IDEO in ihren Projekten gegenübersteht. Auch die Rahmenbedingungen des Product Innovation Projects sind vergleichbar zu jenen bei IDEO. Aspekte wie das projektbasierte Arbeiten, vielfältige Teams, Kreativität fördernde Umgebungen oder Rapid Prototyping sind Beispiele dafür.

Um herauszufinden, ob Design Thinking in das Product Innovatino Project implementiert werden kann, wurden die Teams im Studienjahr 2014/15 in die Methodik eingeführt. Das Feedback der Studierenden und der Vergleich zu den Methoden die zuvor verwendet wurden, geben die Antwort darauf ob Design Thinking angewendet werden kann.

Die Umsetzung der Methode und Werte von Design Thinking, die IDEO zu einer der führenden Firmen im Bereich Design geführt haben, bringt das Product Innovation Project auf den nächsten Level. Durch Einführen dieser Arbeitsweisen kann die Qualität der Ergebnisse verbessert werden, was auch im Interesse der Industriepartner ist. Die Studierendenteams haben eine höhere Chance ein Patent anzumelden und können bessere Erfahrungen während des Projektes sammeln. Auch die Universität profitiert von erfolgreichen Teams, die innovative Produkte erarbeiten.

Acknowledgement

I would like to express my gratitude to my professor Univ.-Prof. Dipl.-Ing. Dr. techn. Christian Ramsauer and my supervisor Dipl.-Ing. Hans Peter Schnöll for their useful comments, remarks and engagement throughout the whole master thesis. Furhtermore, I would like to thank the teams of the Product Innovation Project in the academic year 2014/15 for taking part in the workshops and working session to make the application of Design Thinking possible. At last, I would like to thank my family and friends for supporting me during this thesis and throughout my whole studies.

Table of Contents

1 Introduction

1.1 Motivation for this thesis

The Product Innovation Project lets students apply their theoretical knowledge in a project sponsored by external partners. This experience includes working in a diverse team where students can improve their English and social skills. As part of the application process the students state their preferred projects and can also apply for the position of the project manager. Based on these preferences the university forms the teams. During the year the students have to attend monthly lectures where they present their progress. At the end of the course the teams present their results and hand over the prototype to their sponsors.

Experiences show that in the beginning of the project the teams are facing the problem that they don't really know how to start the project and which steps are required to ensure a good result. Usually the teams use a linear innovation process where they first analyze the problem, followed by generating and evaluating ideas and finally build a model out of the most promising concept. Undoubtedly some of the created prototypes contain well-working solutions but since the teams are not obliged to test their prototypes with the intended target customer group the success of it cannot be estimated.

Projects with a similar setting have successfully been realized at a California based company called IDEO. Associates of this company described their ways of working in different books to let other institutions copy their methods. IDEO and the Stanford University Institute of Design established a definition for this method; Design Thinking. It can be assumed that Design Thinking is the main success factor of IDEO. Literature shows that Design Thinking has a lot of similarities with modern innovation processes.

In comparable courses at other universities the idea of Design Thinking is already implemented. To increase the quality of the results this thesis shall give an overview of Design Thinking and how to implement them in the Product Innovation Project. This should go along with the expected future developments of the Product Innovation Project.

1.2 Desired Outcomes

The desired outcomes of this thesis are to give suggestions on how the methods and values of Design Thinking can be implemented into the existing Product Innovation Project and future Product Innovation Project as described by Professor Christian Ramsauer.

Along with these goals the following two questions should be covered:

- How do comparable courses look like at other universities?

- What are the main differences of Design Thinking to other traditional innovation processes and why does Design Thinking fit to the Product Innovation Project?

1.3 Approach

First, specifications of the Product Innovation Project were identified to compare it to similar courses at other universities and to analyze if Design Thinking fits this environment. Traditional innovation processes were examined in comparison to Design Thinking to determine the best fitting approaches for the Product Innovation Project. By applying the methods of Design Thinking to the projects of the Product Innovation Project 2014/15 and teaching the student teams the theoretical background of Design Thinking it shall be investigated if this approach helps the teams to gain better results. With the feedback of these workshops suggestions for the implementation of Design Thinking in the Product Innovation Project are given. The approach is illustrated in Figure 1-1.

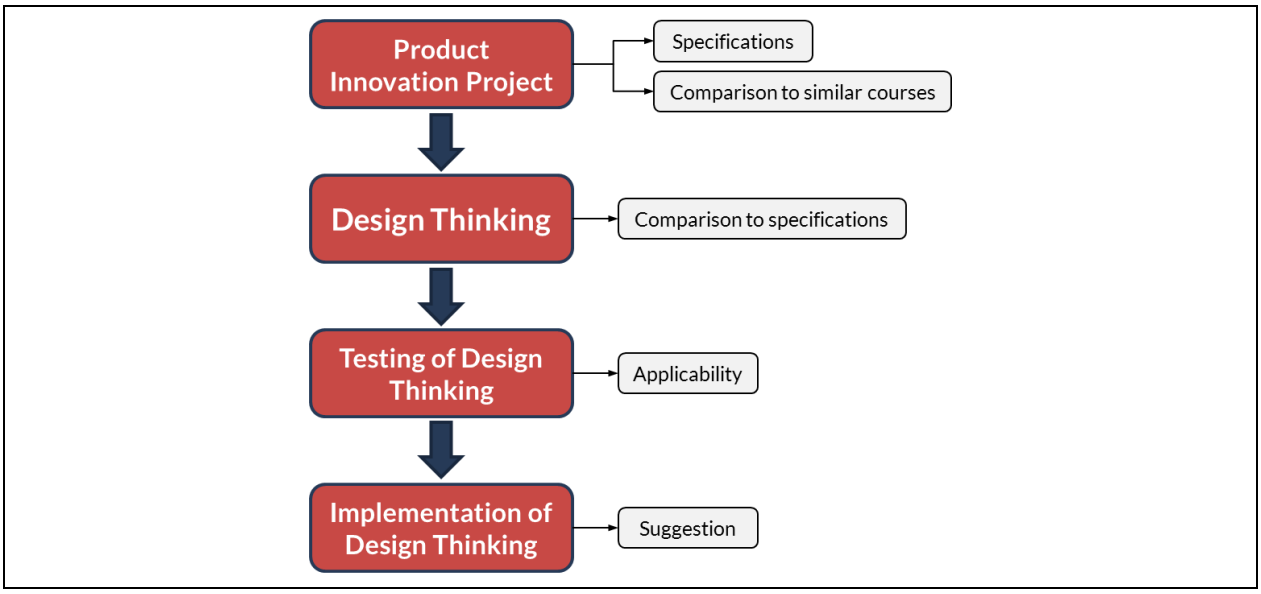


Figure 1-1 – Approach in this thesis[1]

[1] Own illustration

2 Product Innovation Project

This chapter shall give an insight into the course Product Innovation Project in general, the projects of the academic year 2014/15, the future plans and a comparison to similar courses at other universities.

2.1 Overview

The Product Innovation Project is a course lasting for a whole academic year offered by the Institute of Industrial Management and Innovation Research at Graz University of Technology. The topic, a real challenge and the budget of the projects are provided by industrial partners. The goal is to create a product concept, a business plan and build a working prototype.

Figure 2-1 shows the three main entities in the course, the students, the university and the industrial partner. The triangle displays that all of them have a direct relationship to and a communication flow between each other.

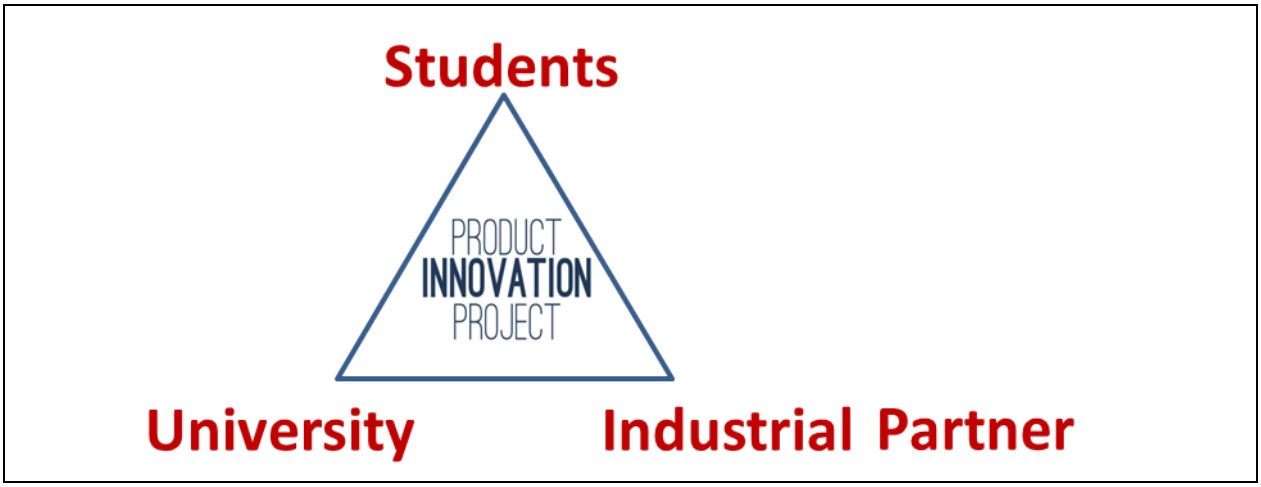


Figure 2-1 – Relationship between the entities[2]

History

The idea of the is based on the course “product development project” at Helsinki University of Technology, now part of Aalto University in Helsinki, Finland. Mario Fallast, a former student at Graz University of Technology took this course in the academic year 2004/05 as a part of his exchange year. He motivated a company during an internship to participate in the product development project and during the next year he supported the collaboration between the company and the university. After seeing the student side and

[2] Cf. Product Innovation Project lecture notes

the sponsor side of the project he got inspired to implement a similar course at Graz University of Technology[3]. In 2006 the Product Innovation Project was introduced.

Figure 2-2 shows the increase of the course over the years. Starting in 2006 with one project and 11 students the participants rose to 22 students in two projects. Due to a lack of resources at the institute and an organizational restructuring the course received less attention and the figures dropped. A new head of the institute emphasized the Product Innovation Project again which lead to a rapid gain in students and project partners over recent years.

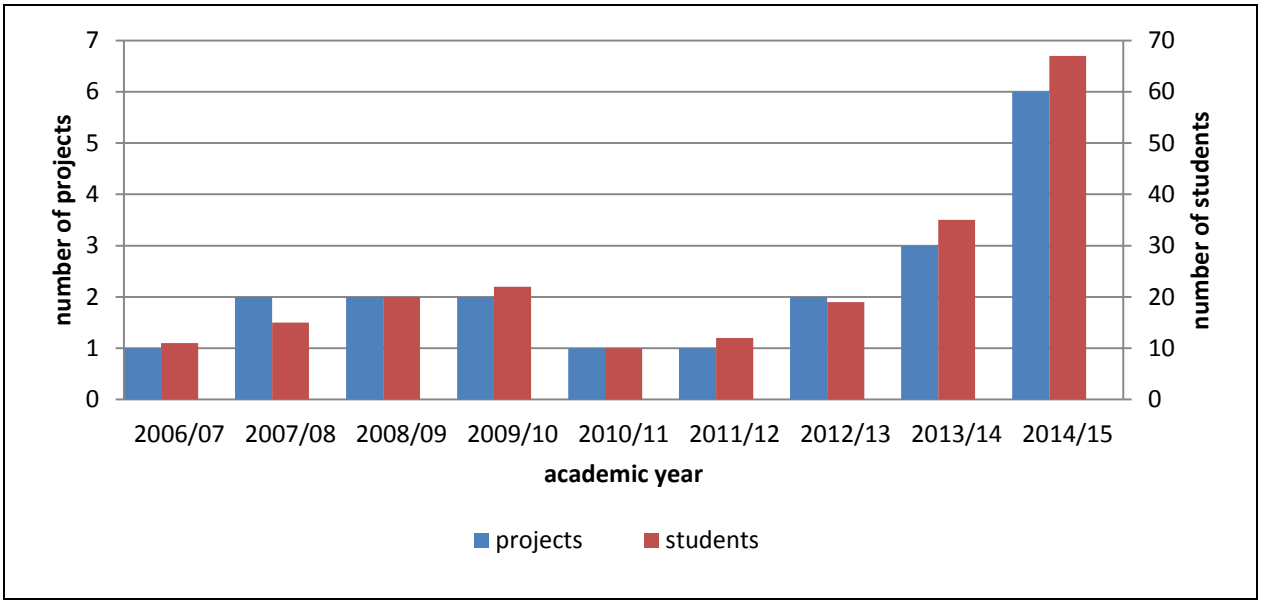


Figure 2-2 – Number of projects and students in the Product Innovation Project[4]

Grouping of the teams

Students from all universities in Graz as well as exchange students from all fields of study take part in the Product Innovation Project in order to have international and interdisciplinary teams which are a vital factor in the course. Students apply for the Product Innovation Project by sending a resume where they have the chance to also apply for the role of the project manager who is the main contact person for the institute and the industrial partner. After conducting interviews with all applicants the institute forms the teams that consist of eight to twelve students with one project manager each. Furthermore, foreign students (remote members) work with the teams at partner universities abroad, i.e. University of Maribor, Slovenia and Pace University, NY, USA. Table 2-1 shows an example of a team constellation of a project in 2014/15.

[3] Cf. Fallast (2007)
[4] Own illustration based on statistics of the Institute of Industrial Management and Innovation Research

Table 2-1 – Team constellation of Team Fronius in 2014/15[5]

FRONIUS "Gentle Energy Turnaround"					
Schiffbänker	Paul	AUT	Mastrodonato	Arianna	ITA
	PSM			Mechanical Engineering	EX
FRO		PM	FRO	GOO	OX2
Sattler	Michael	AUT	Hubrechts	Jacob	BEL
	Architecture			Mechanical Engineering	EX
FRO			FRO	OX2	MAG
Maessen	Alexander	AUT	Halbedl	Thomas	AUT
	PSM			Electrical Engineering	
FRO	OX1	MAG	FRO	GOO	OX1
Wutte	Kathrin	AUT	Hemdrup	Nicolai Olaf	DEN
	Architecture			Industrial Design	
FRO	MAG	OX2	OX2	GOO	FRO
Santiago	Miguel	POR	Michaely	Barak	USA
	Mechanical Engineering	EX/RM		Computer Science	RM
FRO	GOO	OX2			

Key:

(A)	(B)	(C)
	(D)	(E)
(F)	(G)	(H)

(A) last name
(B) first name
(C) country of origin
(D) field of study
(E) additional information for foreign students
  a. EX Exchange student for two semesters
  b. EX/RM Exchange Student for one semester
  c. RM Remote Member
(F) team priority: 1st choice
  a. FRO Team Fronius
  b. GOO Team Google
  c. MAG Team Magna
  d. OX1 Team Oxford 1
  e. OX2 Team Oxford 2
(G) team priority: 2nd choice
(H) team priority: 3rd choice / PM … Project Manager

Project structure

The budget and the task of each project are given by external partners. The tasks are real challenges which those partners face at the moment or will face in the near future. In the past, parts of the prototypes were applied for patents which are now held by the companies but registered on the names of the team members.

[5] Own illustration based on the team constellations in 2014/15

Within nine months, the teams have to create a product concept, a business model and build a working prototype which is presented at the “final gala” (the closing event of the project).

Infrastructure

A working environment for the students, called “Design Lab”, is provided by the Institute of Industrial Management and Innovation Research. This office space can be used for meetings or workshops. This facility is continually developed by the students to have a comfortable working environment. For building the prototype a workshop with basic tools and a so called Fab Lab are available. “*A Fab Lab is a technical prototyping platform for innovation and invention, providing stimulus for local entrepreneurship. […] Currently Fab Labs include* (at least) *a laser cutter that makes 2D and 3D structures, a sign cutter that plots in copper to make antennas and flex circuits, a high-resolution NC milling machine that makes circuit boards and precision parts, a large wood router for building furniture and housing, and a suite of electronic components and programming tools for low-cost, high-speed microcontrollers for on-site rapid circuit prototyping.”*[6]

2.2 Teams 2014/15

In the academic year 2014/15 there were a total of six different projects – four with industrial partners and two with the University of Oxford. There were 67 students from 20 different countries, remote members in three countries and 25 fields of studies involved. An overview of the six teams, their composition and the task description is given in Table 2-2.

[6] N.N. (N/S), available online at www.fabfoundation.org, accessed on 08.01.2015

Table 2-2 - Overview of the teams in 2014/15[7]

Industrial Partner	Members				Short task description
	Total	Remote	Disciplines	Countries of origin	
Fronius	12	1	6	6	Development of a power system which is based on decentralized energy production and use.
Google	12	1	7	7	Further development of Google Glass for hardware and software to optimize application.
Magna	11	2	7	7	Analysis of existing solutions and understanding of users problems with cargo management in the automotive industry.
Oxford (1)	12	0	6	8	Collecting, analyzing and processing of available data, which can be measured through sensors to gain new insights.
Oxford (2)	11	1	6	6	Development of an autonomous, energy-self-sufficient, and silent flying object which takes HD pictures and videos of landscapes for documentation.
Voest	9	0	4	4	Analysis of existing solutions and understanding of user problems of detecting inner failures for continuously casted products.

[7] Own illustration based on statistics at the Institute

2.3 Vision

For the expected future development of the Product Innovation Project Prof. Christian Ramsauer, head of the Institute of Industrial Management and Innovation Research, was interviewed. The goal was, to find out how the framework of and the environment of the project should ideally look like in the future.

Currently the project is evolving and changing from year to year in order to find a good and well-working structure. The long-term goal is to let students present ideas for new products or services, from which the university decides those ideas that will be further developed in a project. With the support of the university the selected students choose a project team and in the best case this team creates a start-up company during or after the project. The budget for the teams comes from the university or industrial sponsors who are aware of the fact that the invested money can be lost if there is no company founded. On the other side if the team decides to go for a start-up company the main share belongs to the students while the university and outside sponsors get a minor share as well.[8]

The next topic of the interview was the process and environment of the Product Innovation Project. Student should be made aware of the process used at IDEO to copy their approaches and apply them to their projects. The suggested approach was to use case studies such as the IDEO case study and discuss them during a workshop with all project members. Also the physical space should be designed according to the values of IDEO such as the building and all the different rooms dedicated to the project.[9]

As a conclusion, the goal of the Product Innovation Project is to give students the chance to bring their own ideas to life and develop a product or service with a team supported by the university. During the project the students shall apply IDEO's method Design Thinking in an environment that also follows IDEO's values.

2.4 Similar courses at other universities

As already mentioned, the Product Innovation Project is based on a similar course at Aalto University in Finland, the product development project. Looking at other universities that teach the methods of Design Thinking, two other courses that have a comparable setting to the Product Innovation Project could be identified. One of them is called ME310 at Stanford University and the other one is split up into two projects, the Basic Track[10]

[8] Interview with Univ.-Prof. Dipl.-Ing. Dr.techn. Christian Ramsauer, 27.03.2015
[9] Ibidem
[10] N.N. (N/S), available online at www.hpi.de, accessed on 02.04.2015

and the Advanced Track[11] at the School of Design Thinking at the Hasso Plattner Institute at the University of Potsdam. The three courses are shortly explained and then summarized to have a comparison and a basis to suggest changes in the Product Innovation Project.

Product development project – Aalto University (Finland)

The largest course in terms of number of project is the product development project where 20 projects are realized in the academic year 2014/15. The course is started with an introduction of what is expected over the upcoming year. During weekly lectures students get information on how to perform in a team and how to proceed in the project. During the second lecture students can apply to the position of a project manager who will then have a short hearing with all students a week later. After the hearing the project managers talk to their fellow students and why they should be in their team. After a discussion, the students decide with which project manager they want to work. A week after forming the teams, they can talk to the companies and hand in a list of their preferred projects and their bottom three projects. During the project the teams have monthly checkpoint meetings where they have to present the progress of their project and then get input from the university staff on how they should proceed. Halfway through the project the teams have to present their task and their progress at an official event at the university. Similar to this is the final gala where the teams present the whole project, the process and the outcome which is followed by an exhibition day where external people can have a look at the prototypes.[12]

ME310 – Stanford University (USA)

In cooperation with other universities and companies around the world (i.e. National Taiwan University or Aalto University and Volvo or SAP) Stanford University offers student projects at the Institute of Mechanical Engineering called ME310. Students apply to this course through an online system. Out of these applicants the university selects an interdisciplinary group that will form the teams after the course has already started. During the academic year, the teams get different assignments called “missions”. A mission can be a design challenge, deliverables such as a prototype, a presentation or checkpoints by the university. To start off the course small teams are formed for design challenges which however are not the final teams for the projects. The project teams are formed by the university where a limited amount of “dyads” can be announced. A team consists of four students with different backgrounds, nationality and gender that will work together on a project for nine months. To check the progress of the teams and to make sure that the goal of a working product is achieved the university demands several

[11] N.N. (N/S), available online at www.hpi.de, accessed on 02.04.2015
[12] Cf. N.N. (N/S), available online at www.pdp.fi, accessed on 08.04.2015

deliverables in the form of user observation results, prototypes or budget plans. Besides these deliverables the teams have two major presentations during the year, where also reports have to be handed in. After every presentation the university staff checks off every team if they have fulfilled the requirements and are on track with their project. Through lectures the students get input on different topics that are ahead of them every week. The end of the project is a final presentation and a "product exposition" followed by a final report.[13]

Basic and Advanced Track – University of Potsdam (Germany)

One of the courses offered at the Hasso Plattner Institut in Potsdam is about the basics of Design Thinking were students apply the methods to a small project within one week. Once per semester the institute offers a lecture called "Basic Track" which is divided into a one-week, a three-week and a six-week project. During the one-week and three-week project the students get familiar to methods and mindsets of Design Thinking while in the six-week project the teams get a task from an industrial partner and have to find innovative solutions. Similar to this is the "Advanced Track" which is a twelve-week project where students with a sophisticated knowledge of Design Thinking can deepen their experience. The projects are run with major industrial partners, public institutions or non-profit organizations.[14]

The Hasso Plattner Institut cooperates with Stanford University in the ME 310. There are no other courses offered which have an identical structure to the Product Innovation Project.

Overview

In the Product Innovation Project, the supervisors of the project teams suggest how the processes in the project could look like. There are no predefined phases that the teams have to follow. Lectures including team presentations and the following company meetings are fixed dates on the schedule throughout the year. The final presentation together with a working prototype and the rehearsal of the presentation complete the list of preset deadlines. The team and their partner institution agree on deliverables during the project.

In the product development project only an introduction phase is defined where students get input on how the process of a project could look like. After the selection of project managers, the teams and the projects there are checkpoint meetings and a few deadlines

[13] N.N. (N/S), available online at www.wikibox.stanford.edu, accessed on 02.04.2015
[14] N.N. (N/S), available online at www.hpi.de, accessed on 03.04.2015

regarding posters, patent application and the final report. The university gives input on the progress of the teams and how they can proceed during the checkpoint meetings.[15]

In contrast to the previous two lectures the ME310 course has a lot of different deadlines and defined phases to ensure the progress of the teams. The deliverables are clearly defined and deadlines are set where they have to be handed in. One deliverable, the "dark horse" prototype needs to be described a little bit in detail. Such a prototype has three requirements. First, the prototype has to be a radical solution which is not an obvious solution to the problem. Second, to be able to distinguish between radical and not radical, a reference solution of an established product should exist. And last, the "dark horse" prototype is already refined and ready to be tested.[16]

In the Advanced Track at the Hasso Plattner Institut, students can express their preferences on which topic they want to work on. The faculty staff then forms the teams to ensure diversity in which there are no fixed roles predetermined by the university. During the twelve weeks the students go through the Design Thinking process step by step and have to give interim presentations. The teams are supervised by a staff member of the institute.[17] Due to the different settings such as different time frame and approach of the students this course is not considered in the illustrated overview in Figure 2-3.

The four student projects are illustrated in Figure 2-3 to have an overview of the different processes and deadlines in each of them.

[15] Cf. N.N. (N/S), available online at www.pdp.fi, accessed on 08.04.2015
[16] Cf. Bushnell et al. (2013), p. 2
[17] Phone call with Ms. Balluneit, 15.04.2015

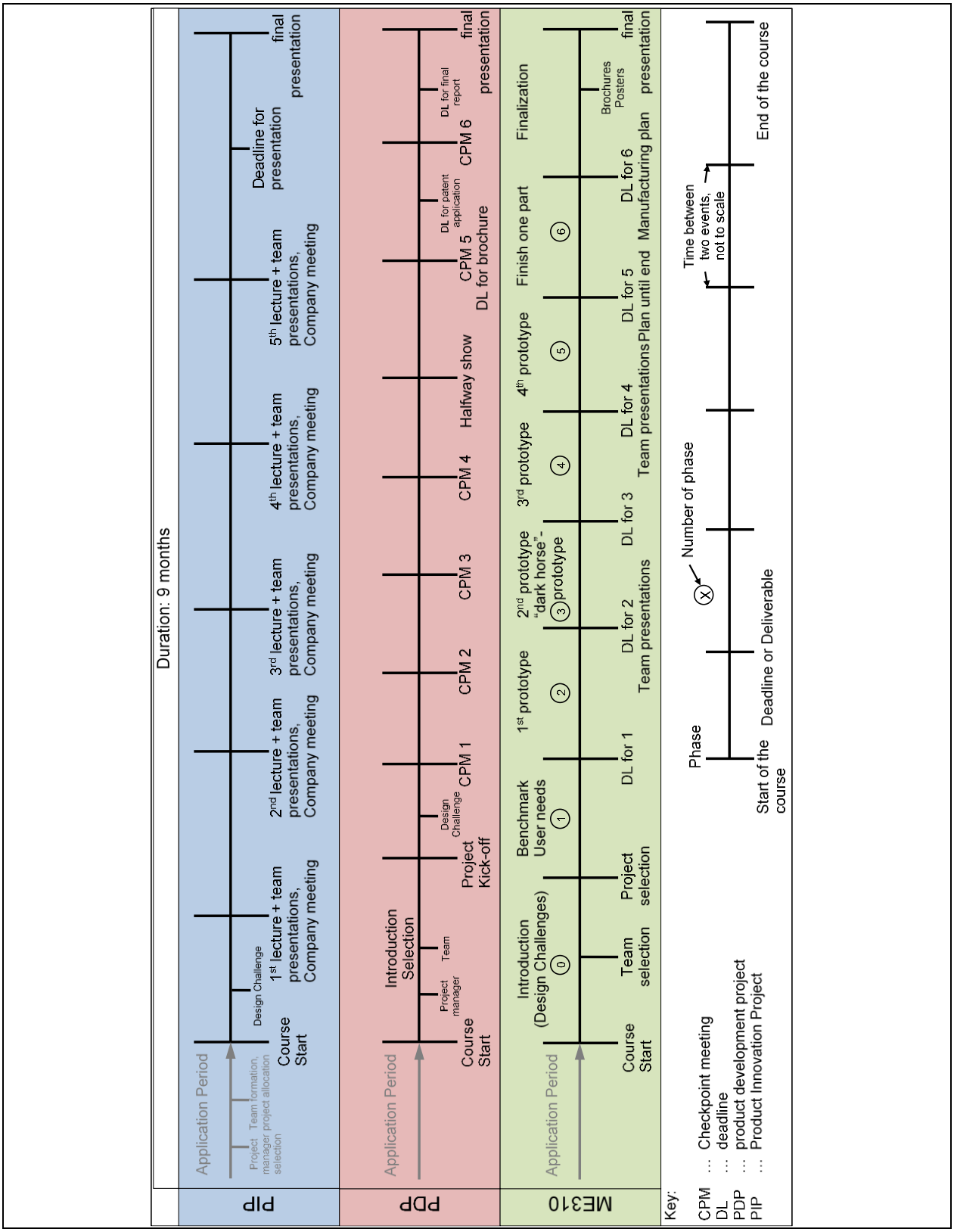


Figure 2-3 – Process overview of the three student projects[18]

[18] Own illustration

2.5 Conclusion

The tasks companies give to the students include different challenges such as finding new innovative solutions for existing problems within their project. A cross-functional team that has a high team quality is more likely to succeed in innovation projects[19]. Another factor to increase the success for creative solutions is the physical environment[20].

In order to identify if created concepts would work the teams are recommended to test quick prototypes with their defined target user group. The university offers rapid prototyping spaces such as the Fab Lab and the workshop in the Design Lab to build such models.

In terms of deadlines, deliverables or predefined phases the student teams have almost complete freedom in the Product Innovation Project. The monthly presentations and the final gala are the only deadlines throughout the year. At ME310 phases, deliverables and deadlines are defined, but the teams have no standards to follow how to get to these milestones. For the Product Innovation Project this approach would provide a clear structure throughout the year where the participating students know what is expected from them at any point in the project.

The following list sums up the specifications of the Product Innovation Project:

- Cross-functional teams
- Creativity enhancing working environment
- User orientation
- Rapid prototyping
- Non-linear approach

[19] Cf. Meusburger/Funke/Wunder (2009), p. 191
[20] Cf. Kelley/Littman (2004), p. 122

3 Design Thinking

This term was broadly discussed in the past and several interpretations and methods emerged from it. Depending on the field of research the definition of Design Thinking varies. One of the applications of the term is a human-centered innovation process elaborated and over the years successfully applied by IDEO, a global design firm founded in 1991[21]. The first Apple mouse or the Palm V are the stand-out innovations by IDEO and prove for the success of the company and its methods. As a result, associates of IDEO published books to let other companies copy their methods. These publications and the material provided by the Stanford University Institute of Design are the basis for the term “Design Thinking” in this thesis.

With the idea to teach Design Thinking at an academic institution, David Kelley, founder of IDEO, founded the Stanford University Institute of Design in 2004[22]. Today the institute improved these methods for educational standards and published workshops for other academic institutions to teach their processes. To give the students of the Product Innovation Project of 2014/15 an overview of Design Thinking, those workshops were conducted with them.

3.1 Origin and history

Different publications related to the human-centered design definition of Design Thinking are summarized and compared in this chapter. But before discussing the term Design Thinking a closer look at where it originates from is be taken.

Johansson-Sköldberg/Woodilla/Çetinkaya researched the literature about Design Thinking by looking up the terms “Design Thinking”, “Design” or “Thinking” in several databases. The outcome was a list of 168 publications where more than 80% of the literature is dated after the year 2000. The number of publications for each year between 1969 and 2010 is shown in Figure 3-1.[23] Starting in 1969 publications increased until a peak in 2009 while in 2010 a decline can be identified.

[21] Cf. Myerson (2004) p. 4
[22] Cf. Roethel (2010), available online at www.sfgate.com, accessed on 17.03.2015
[23] Cf. Johansson-Sköldberg/Woodilla/Çetinkaya (2013), p. 122

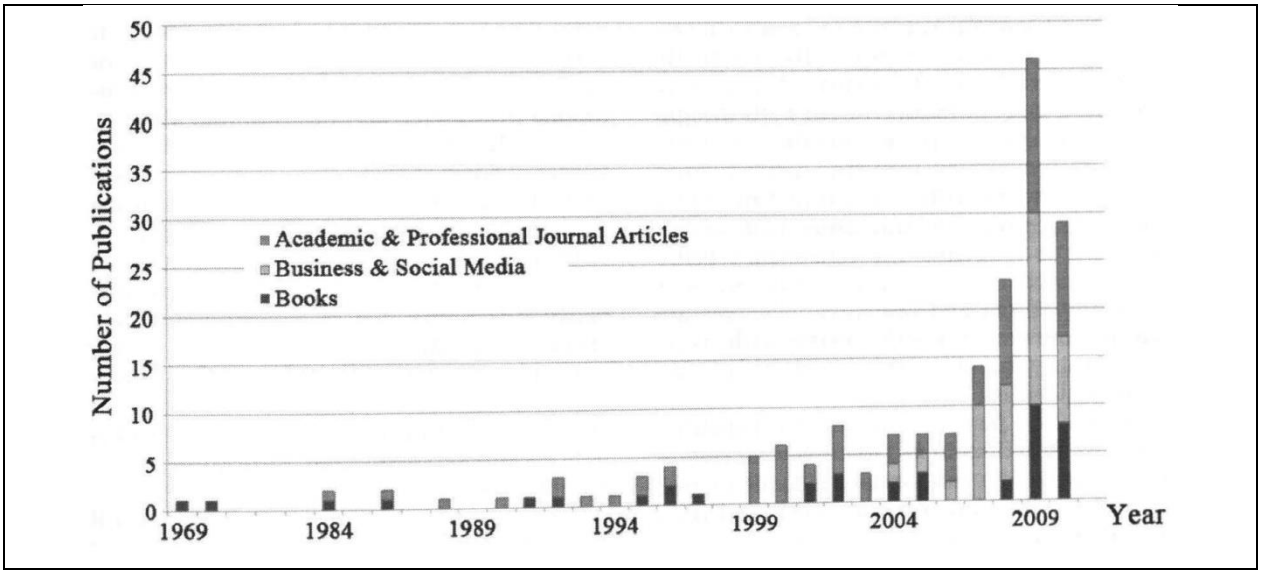


Figure 3-1 – Timeline of Publications by Type[24]

Simon's publication in 1969 was the beginning and fundamental work for Design Thinking.[25] Although Rowe addressed the field of architecture in his book "Design Thinking"[26], the term was then in the minds of design researchers.[27] This led to the increase in publications using design methods in other fields as seen in Figure 3-1. In 1991 Rouse revealed how companies can compete on the market with a human-centered design.[28]

Hassi and Laakso interviewed academics in 2011 to investigate the origins of Design Thinking. Every respondent made statements such as *"The roots of design thinking ultimately are in IDEO and their notion of user centered design.[29]"* Also the d.school of Hasso Plattner Institute of Design at Stanford is heavily linked to IDEO and the definition of Design Thinking.[30]

The approach, putting the end user in the center of product design is the main philosophy of IDEO. Tom Kelley, general manager of IDEO and Jonathan Littman as a first step described the working methods used in IDEO in "The Art of Innovation".[31] In 2009 Tim Brown, CEO and president of IDEO explained IDEO's definition of the term "Design Thinking" in his book "Change by design".[32]

[24] Johansson-Sköldberg/Woodilla/Çetinkaya (2013), p. 123
[25] Cf. Johansson-Sköldberg/Woodilla/Çetinkaya (2013), p. 122; Cf. Buchanan (1992), p. 9
[26] Cf. Rowe (1987), p. 1 ff
[27] Cf. Dorst (2011), p. 521
[28] Cf. Rouse (1991), p. 1 ff
[29] Hassi/Laakso (2011), p. 4
[30] Cf. Hassi/Laakso (2011), p.4
[31] Cf. Kelley/Littman (2004), p. 308
[32] Cf. Brown/Kātz (2009), p. 1 ff

A cooperation between IDEO and the Riverdale Country School summarized Design Thinking as it is practiced by IDEO and put together a toolkit explaining their methods within five phases.[33]

David Kelley, founder of IDEO created the Stanford Institute of Design at Stanford University[34] (hereafter referred to as the d.school) that teaches the method of Design Thinking in their classes. The d.school also provides materials for external people to reproduce these classes and create own courses.

3.2 Design Thinking at IDEO

IDEO associates released several publications about Design Thinking that give an inside look into the company's working methods. Among these are two books that cover relevant aspects of the human-centered product design approach.

In 2001, the first book, The Art of Innovation, about the methods used by IDEO was published for companies to understand and copy their processes[35]. Based on past inventions from IDEO for their customers the phases and important facets of their methods are described. The second book that is discussed is Change by Design by Tim Brown where the term Design Thinking is specified and how it can be applied to companies[36].

3.2.1 The Art of Innovation

Innovation is a topic that concerns more and more companies due to a fast-changing environment. In order to help those companies to create new innovations this book outlines some factors of how to be more innovative based on the experiences IDEO made in the past. The basic method consists of five phases as illustrated in Figure 3-2.[37] In addition to this model other aspects such as the team formation or the working environment are described.

[33] N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015
[34] Cf. Kelley/Kelley (2013)
[35] Cf. Kelley/Littman (2004), p. 1 ff
[36] Cf. Brown/Kātz (2009), p. 1 ff
[37] Cf. Kelley/Littman (2004), p. 3 ff

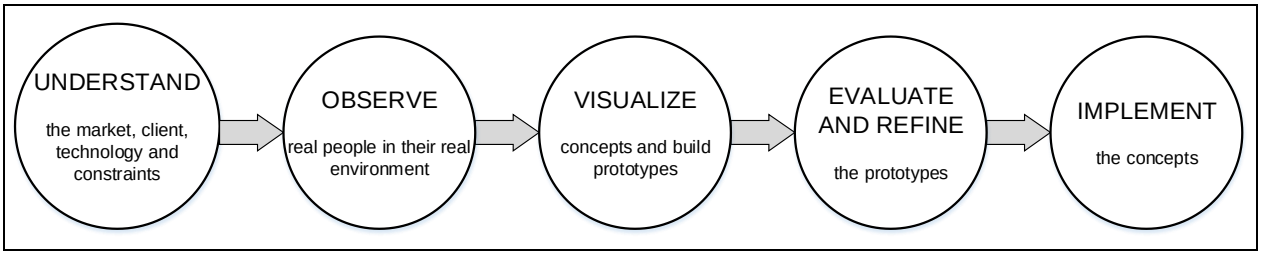


Figure 3-2 – Five steps methodology[38]

Understand and Observe

Understanding the market or the technology can be achieved by browsing the internet for information. IDEO focuses on observing and understanding the clients and the resulting constraints of the products. They believe that it is not enough to just ask the users or focus groups for their opinion and input on a certain product. A critical part for breakthrough ideas is to observe and experience things by oneself. This is called the "human factor" or "human inspiration". By watching the customers use the product, problems and things that bug them can be identified. Parallel to the observations, interviews to understand the motivation and emotions of the customers why and how they are using products in a specific way should be conducted. Adding well-chosen "Why?" questions helps to dig deeper into certain areas and results in better empathy. Another aspect is to interview the right people. IDEO doesn't analyze the result of forms and surveys filled by carefully chosen users and focus groups. They rather look for several interesting people, observe and have a talk with them. Those are called crazy users (people that use the product a lot or have a passion for it) who can provide very important information. People that are breaking the rules and found ways to use a product for which it was not originally intended or adapted the product in order to meet their personal requirements can be an inspiration for new innovations. A third source can be "left-handed" customers (people with different experiences, i.e. children) in order to find simple solutions. The last inspiration source that is described is called cross-pollination which means taking ideas from different areas and uses them in another one.[39]

Visualize, Evaluate and Refine and Implement

The main ideation method, brainstorming, is described as a skill that can be trained to improve the results of it. For a good outcome there have to be definite rules which the brainstorming team should follow. Kelley also suggests having sessions that last around one hour, maximum an hour and a half due to the mental and physical energy required.

[38] Own illustration; Cf. Kelley/Littman (2004), p. 6 f
[39] Cf. Kelley/Littman (2004), p. 25 ff

IDEO defined seven secrets (see Figure 3-3) and six "killers" of brainstorming to follow during their sessions.[40]

Sharpen the focus: Define a well-articulated problem statement that focuses on specific customers.

Playful rules: Don't start to critique or debate ideas.

Number your ideas: Go for a lot of ideas; 100 per hour indicate fluency.

Build and jump: Build on ideas of others and jump to different approaches if necessary.

The space remembers: Write down ideas on a medium that is visible to everybody.

Stretch your mental muscles: Do a warm-up in the beginning if needed.

Get physical: Include sketches, mind maps, diagrams and stick figures as well as 3D models to visualize the ideas.

Figure 3-3 – Seven secrets of brainstorming[41]

Kelley mentions following six points that kill a brainstorming: [42]

1. The boss gets to speak first (i.e. setting an agenda, defining limits)
2. Everybody gets a turn (everyone gets a certain amount of time)
3. Experts only please
4. Do it off-site (link creativity with nice places)
5. No silly stuff
6. Write down everything (focusing on explaining with words rather than drawing)

According to Kelley, brainstorming should be taken as a process that can be improved all the time. It's about learning from previous sessions and developing the future ones to increase the quality of the ideas. [43]

"[…] a picture is worth a thousand words. Only at IDEO, we've found that a good prototype is worth a thousand pictures."[44] It is the main philosophy at IDEO to prototype every single idea. A physical model helps understanding some principles about a product and it can easily be tested if an idea would work or not. Such a mockup should give answers to a specific question and the team can learn from the feedback it got. During

[40] Cf. Kelley/Littman (2004), p. 53 ff
[41] Own illustration; Cf. Kelley/Littman (2004), p. 56 ff
[42] Cf. Kelley/Littman (2004), p. 64 ff
[43] Cf. Kelley/Littman (2004), p. 55 ff
[44] Kelley/Littman (2004), p.112

testing it is also an advantage for the interviewees to interact with a product rather than just having a sketch. It can save a lot of money if the “bad ideas” and “failures” within a project are made in the beginning where prototypes are realized cheaply.[45]

How the concepts are implemented in a company are not further specified.

Teams

A very important factor for a successful project is having a well working team tackling it. At IDEO teams are chosen for one project and the members are only working together on this until it is finished, then they start a new project in a different team. Employees can choose their own projects and project manager in order to ensure that the group is passionate about the work. Kelley shows an example of their team selection for a project during a show called Nightline to outline some characteristics of a well working team[46]. Six different aspects should be considered when forming a team for a project:[47]

1. Everyone in the team needs to be dedicated to achieve the end result without doubting the project itself.
2. A strict deadline should be set, in the case of the shopping cart project it was just one week but these short deadlines are not common.
3. The group has to be irreverent and have no hierarchy in it.
4. Members should come from different disciplines and have respect for each other, no matter from which field they are.
5. The team should work in an open, eclectic space which benefits flexibility, group work and good brainstorming sessions.
6. The team should also feel the need for help from outside because not all answers lie within the group.

Physical environment

IDEO puts a lot of value on their spaces, especially how they are designed. Having an open environment that inspires and reflects the work of their employees is another key factor of their success. There are several aspects that should be considered when designing the space for a project. “Build neighborhoods” in order to tie together individuals, “Think project, think personal” by letting the group express their identity through the created space, “Prototype your space” to find the best arrangement, “Tell stories” to let visitors know what the project is about or “Hierarchy is the enemy of cool space” which suggests that superiors within the company don’t have superior spaces,

[45] Cf. Kelley/Littman (2004), p. 103 ff
[46] N.N. (N/S), available online at www.ideo.com, accessed on 17.03.2015
[47] Cf. Kelley/Littman (2004), p. 67 ff

such as bigger offices. Kelley states that the physical space has a significant influence on groups and how innovative they are.[48]

Copy and adapt

One simple but very efficient source for innovation is to look at technologies of other fields and try to apply them in a similar way to the current project. Kelley suggests some methods of how to increase this technology adoption as illustrated in Figure 3-4.[49]

Subscribe and surf: Browse magazines and surf the internet – the farther afield the better.

Play director: Break the world down into scenes to become an expert at watching people.

Hold an open house: Engage with outsiders to get new input and information on the project.

Inspire advocates: Include people with different viewpoints.

Hire outsiders: Get new talents from other fields.

Change hats: Take the perspective of others in a conscious way.

Cross-train: Borrow drills and processes form other businesses.

Figure 3-4 – Seven facets to increase technology adoption[50]

Barriers

Even after some observations, brainstorms and prototyping are performed there is a chance that an idea or a project fails. The reason is that there are different barriers that need to be identified in every project, i.e. cultural resistance to a new product or the traditional barrier of patents. It is crucial to determine the existing barriers for the project in order to prevent this source of failure in advance.[51]

Other aspects

The human-centered approach involves people experiencing a product. This means that it's not about making the product better with new features rather than letting people enjoy

[48] Cf. Kelley/Littman (2004), p. 121 ff
[49] Cf. Kelley/Littman (2004), p. 149 ff
[50] Own illustration; Cf. Kelley/Littman (2004), p. 159 ff
[51] Cf. Kelley/Littman (2004), p.165 ff

the use of it, i.e. creating a better shopping experience rather than designing a beautiful store. This entails having empathy for the customers.[52]

There are also economic factors that need to be taken into account. Making a decision about innovations implies taking risks within a company. Another rule at IDEO is "Fail often to succeed sooner[53]". Failure is the drawback of taking risks. However, in order to be successful some risks have to be taken and the earlier failures are made the less expensive they are for the company.[54]

After establishing a product on the market and being able to call an idea an innovation there might be the question how to further improve it? Kelley describes some objectives that IDEO follows in this optimization process (see Figure 3-5).[55]

Make a great entrance: First impressions are important – make people feel welcomed and comfortable.

Make metaphors: Come up with metaphors to inspire the new product.

Think briefcase: Design the product to make customers want to bring it home.

Color inspires: Choose a color that goes along with what the product should communicate.

Backstage pass: Let customers know what is going on behind the scenes.

One click is better than two: Make the product faster and simpler to use.

Goof-proof: Let customers be able to correct their own mistakes or even avoid them.

First, do no harm: Take the pain or struggle out of using the product.

Checklist: Define the minimal elements that the product should have.

Great extras: Great accessories can make a difference and even carry a product.

Figure 3-5 – Ten objectives to create great products and services[56]

Kelley lists some innovation practices that IDEO developed over the years (see Figure 3-6). It is also stated that these practices doesn't have to be copied exactly as they are formulated but rather rephrase them in order to be able to apply them.

[52] Cf. Kelley/Littman (2004), p. 195 ff
[53] Kelley/Littman (2004), p.232
[54] Cf. Kelley/Littman (2004), p. 231 ff
[55] Cf. Kelley/Littman (2004), p. 255 ff
[56] Own illustration; Cf. Kelley/Littman (2004), p. 266 ff

Watch customers – and noncustomers – especially enthusiasts

Play with your physical workplace in a way that sends positive "body language" to employees and visitors.

Think "verbs", not "nouns" in your product and service offerings so that you create wonderful experiences for everyone who comes into contact with your company and brand.

Break rules and "fail forward" so that change is part of the culture, and little setbacks are expected.

Stay human, scaling you organizational environment so that there's room for hot groups to emerge and thrive.

Build bridges from one department to another, from your company to your prospective customers, and ultimately from the present to the future.

Figure 3-6 – Facets of innovation practice[57]

3.2.2 Change by Design

The book contains two main parts, the first, deals with the aspects of Design Thinking and the most important factors are explained. The second part suggests how to implement Design Thinking in a company. Brown mainly shares stories where the methods were successfully applied. Since this chapter should discuss the definition of Design Thinking the second part of the book is not considered.

Definition

Design Thinking is defined as the skill to meet user needs with the technical possibilities that designer learned in the past and can be obtained by everyone to tackle a broader range of problems. In addition, it is stated that Design Thinking is not about being a designer but rather thinking as one and can be applied to not only products but services or experiences as well.[58]

In innovation there is no right way how to ensure to get a satisfying end result out of a project. There are only starting points and supportive milestones during the process. Instead of a series of steps this process can be seen as overlapping phases which are inspiration, ideation and implementation (illustrated in Figure 3-7).

[57] Kelley/Littman (2004), p. 296
[58] Cf. Brown/Kātz (2009), p. 3 f

Figure 3-7 – Main phases of Design Thinking by Brown[59]

Success factors

The downside of this iterative approach is the time it takes until a product can be brought to the market. A saying at IDEO *"Fail early to succeed sooner[60]"* emphasis making mistakes in the beginning of a project and having lot of iteration cycles in the early stages in order to save time and money. Other aspects of these overlapping phases are boundaries that have to be defined. On the one hand they should be narrow enough to be able to set clear goals and on the other hand broad enough to leave space for own

[59] Brown (2008), p. 88 f
[60] Brown/Kātz (2009), p. 17

interpretations. These boundaries have three different criteria: viability, desirability and feasibility. A harmonious balance of these three criteria can lead to successful ideas (illustrated in Figure 3-8).[61]

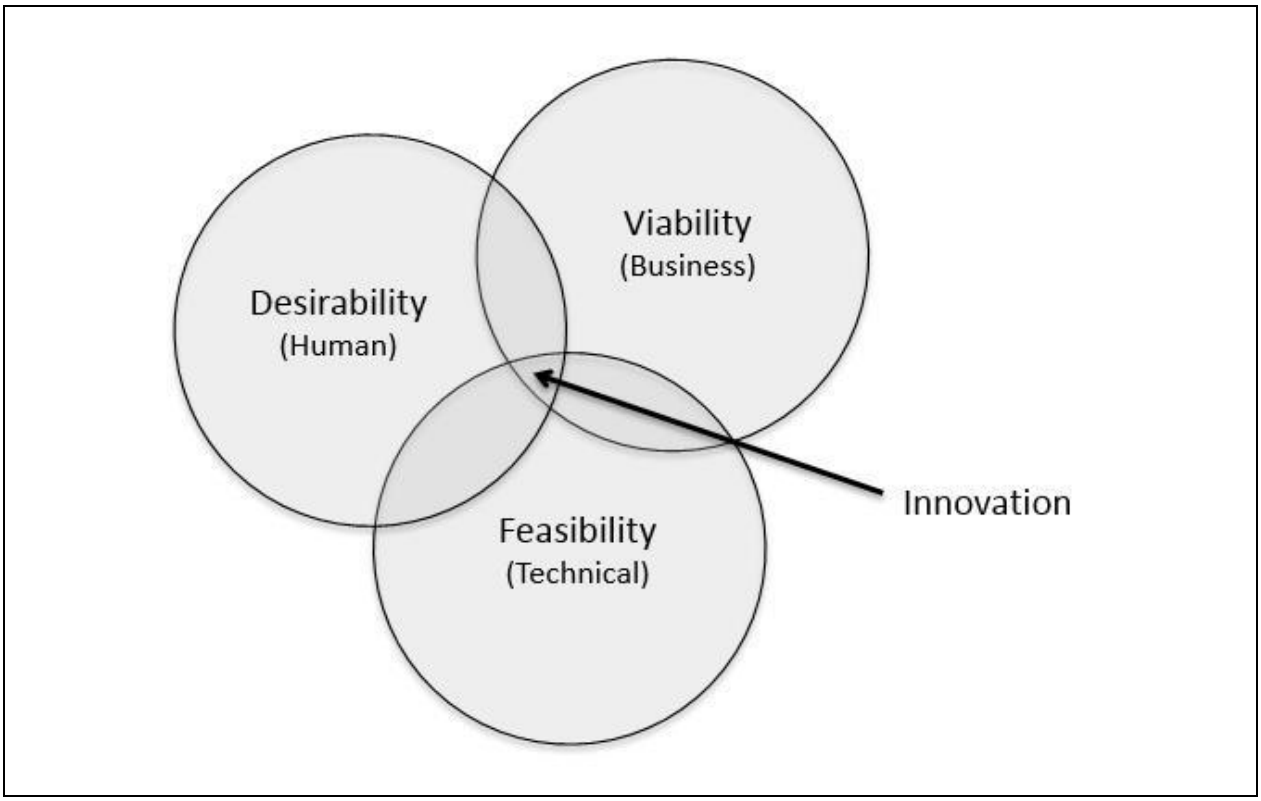


Figure 3-8 – Three criteria for successful ideas[62]

Brown describes other crucial parts in Design Thinking; one of them is an interdisciplinary team. This means that the members of a team should cooperate across their different disciplines. Additionally, such a team needs the right atmosphere to work in order to create innovative solutions. The members should be allowed to take risks, have the permission to fail and be rewarded for success. In general, an environment where people rather ask for forgiveness afterwards than permission before. Another aspect is the physical space in which the team runs the project. Brown suggests having a room designated for the project in which the team feels comfortable in.[63]

Inspiration

In Design Thinking traditional techniques such as surveys in which the participants are solely asked what they want are not important and hardly applied. In order to find new-to-the-world ideas three factors are necessary: insight, observation and empathy. Insights

[61] Cf. Brown/Kātz (2009), p. 16 ff
[62] Lindberg (2013), p. 186
[63] Cf. Brown/Kātz (2009), p. 26 ff

are one of the major sources in Design Thinking and these are not coming from asking customers what they miss in a product. People's behavior, use of a product or their self-built solution can provide insights that can be used to identify their unmet needs. This is achieved by watching people in their natural environment where Brown mentions that it is not an easy task to know whom to observe. However, he suggests turning to "extreme" users who use the product differently and in an "extreme" way. The last element is empathy which is described as the understanding and connecting with the people that are observed (i.e. What do people feel?, What motivates them?, etc.). One possibility described is to experience using a product for the first time because in this situation a closer look on details is taken and everything is scrutinized. In addition, it is important to gain empathy for the whole target group (i.e. understanding a culture) and not just individuals.[64]

Ideation

A solid understanding of the task and gained insights through observations is the basis for creating ideas. The more data is collected the more choices can be created which means to have more possibilities for innovations. This can be seen as the analysis of the problem of a project. On the other hand, not every single solution can be realized and considered a product. Eliminating options is needed by finding stories behind the ideas and deciding which of the concepts it is worth following. This can be seen as a synthesis. Figure 3-9 illustrates the analysis and synthesis phase called the mental matrix, while diverge and converge are the complements to the two phases. At first, ideas and concepts diverge and create choices and at one point by making decisions the concepts will converge. In Design Thinking this process is a balanced switching between the analyzing and the synthesizing phase. One trigger for a stop of diverging can be a deadline within a project where specific concepts have to be shown to the client.[65]

[64] Cf. Brown/Kātz (2009), p. 41 ff
[65] Cf. Brown/Kātz (2009), p. 66 ff

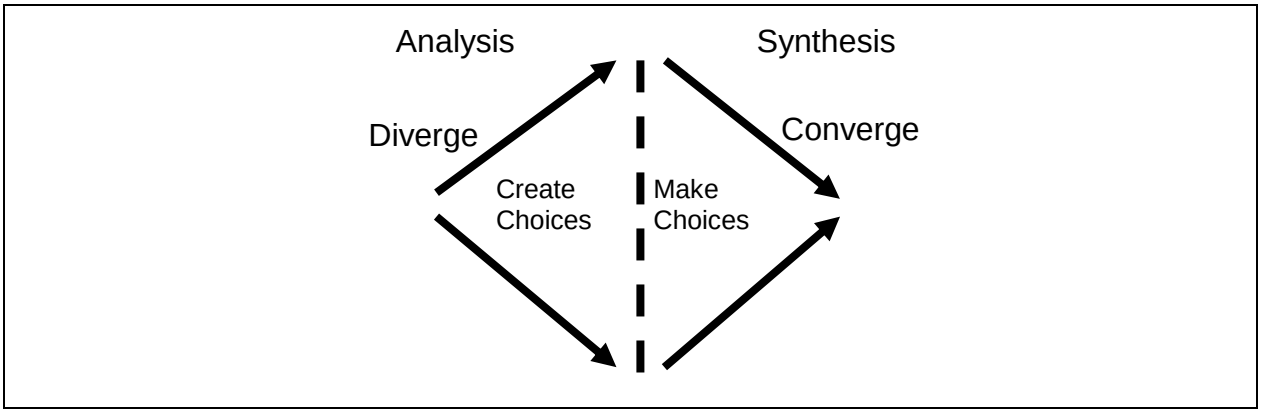


Figure 3-9 – Mental matrix[66]

This mental matrix requires methods in order to support keeping the balance between analysis and synthesis. For methodical experimentation a project team should have the time, space and budget to make mistakes within the project. This risk has to be taken in order to learn from the mistakes and create better solutions. For brainstorming certain rules have to be followed to have a framework within the team can collaborate. Brown mentions that at IDEO the rules are written on the walls such as “defer judgement”, “encourage wild ideas”, “stay focused on topic” and “build on the ideas of others” (these four match the ones in Figure 3-11 in the next chapter where in total seven are listed). Brainstorming is described as a very important idea generation method but not as the single ultimate technique.[67]

Prototyping

Prototyping, described as bringing ideas to life, is a powerful tool in experimentation. This does not mean building a working model of the final idea, but rather it is defined as the eagerness to try to build something whether it is a model, storyboard or even acting out. It might seem that prototyping an idea takes more time than thinking it but the information and insights that can be drawn from a prototyped idea cannot be found by just thinking of it. Taking the time for prototyping early on, a lot of mistakes can be avoided such as getting too detailed in a weak concept. The sooner form is given to a possible solution the earlier it can be evaluated against other solutions and improved upon the learnings. A successful prototype would be one that the team can learn something new and not one that is working perfectly. It is better to have a lot of cheap and quickly executed prototypes in the beginning of a project to eliminate poor ideas early and improve the other solutions. Along the project the number of prototypes will decrease in favor of resolution and level

[66] Own illustration; Cf. Brown/Kātz (2009), p. 67 f
[67] Cf. Brown/Kātz (2009), p. 71 ff

of detail. Brown also suggests that the average time to the first prototype is a measure of an innovative organization.[68]

Design experiences

Along with almost every product comes an experience such as shopping for an item or travelling. Brown argues that functionality is not enough anymore to pursue customers of buying a product. The empathy and understanding of people for designing a product can be used to design experiences for them as well. A successful experience can be achieved by including active customer participation that is authentic and compelling and with a great sense of detail. In the best case such an experience is individually tailored to each customer but it has to be kept in mind that changing people's behavior is almost impossible. However, there is the possibility to build on existing practices to introduce new ones.[69]

The goal that a designed experience should follow is to tell a compelling story. To give ideas a meaning they are put into a story where people can relate to; in Design Thinking this is called "designing with time". By combining actions or events to a sequence that are based upon each other an authentic story can be created. This is not only used to express empathy but also to spread the ideas as an advertising tool.[70]

3.3 Design Thinking for Educators Toolkit

IDEO and the Riverdale Country School created a toolkit including worksheets were five phases of Design Thinking and how to use them are explained. Based on similar processes and methods practiced by IDEO this toolkit describes each step in great detail. The main application of this toolkit is as the title suggests in education and improving the learning environment; however, it is also stated that Design Thinking can be used to take any challenge.[71]

Four key elements are defining Design Thinking. It is a human-centered approach in which the needs and motivations of people are detected. In the example for educators these people include students, teachers, administration staff or parents who are part of the environment. Another aspect is collaboration; a team achieves better results than the lone fighter. Having different views on a topic and building on each other's creativity leads to more innovative ideas. *"Design Thinking is a mindset."*[72] It is the belief to be able to

[68] Cf. Brown/Kātz (2009), p. 88 ff
[69] Cf. Brown/Kātz (2009), p. 110 ff
[70] Cf. Brown/Kātz (2009), p. 132 ff
[71] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 9 ff
[72] N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 11

be creative and have an impact, regardless of the size and difficulty of the problem. The last factor is to be experimental. A failed attempt is considered as a positive event as long as lessons learned can be drawn from it. The whole process evolves into an iteration cycle in order to get to the best possible result.[73]

A design challenge can be divided into five phases, “Discovery”, “Interpretation”, “Ideation”, “Experimentation” and “Evolution” as illustrated in Figure 3-10. This toolkit provides various steps for each phase ranging from taking on a challenge and interpreting it to generating solutions, prototype them and test them to how to proceed with a working concept. When going through this design process a few things regarding the mindset of the people taking on a challenge are emphasized. One major aspect is to step out of the comfort zone to be open for new possibilities and learn from failures. This includes the willingness to experiment and to accept not having the right answer but to find it. The feeling to be a designer and to come up with creative ideas is essential as well as turning problems into opportunities for design.[74]

[73] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 11
[74] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 14 f

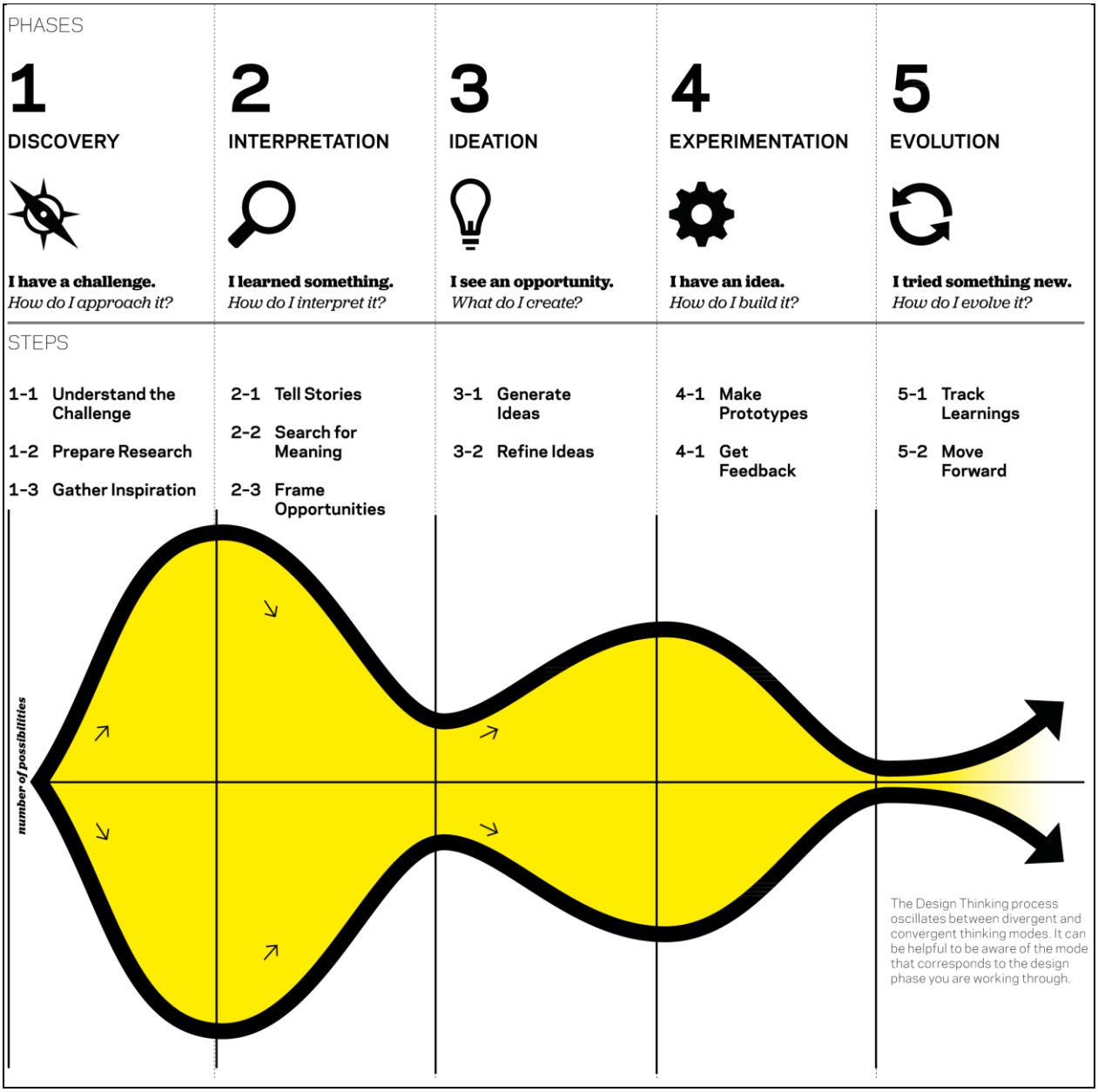


Figure 3-10 – Design Process[75]

Before tackling a certain problem a so called design challenge has to be defined. Such a challenge should be approachable, understandable and actionable. This is not part of the iterative process in Design Thinking; it's the preparation before it.[76]

A design challenge typically originates from problems that occur in everyday life. Each of those problems can be seen as an opportunity for improvement. The first step is to create a list with the problems that can be noticed or other aspects that can be further developed.

[75] N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 15
[76] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 19 ff

By rephrasing the listed problems into a “How might we …?” question the problems are transformed into possibilities. This question is the design challenge that should be taken. Thus it is important to keep it simple in order to be able to handle it, broad enough to discover new areas and narrow enough to be able to manage it. To have clear targets, achievable and measurable goals should be set like in every project that is started. A short brief and a project plan (ranging from one day to several months, depending on the task) help to keep track of the challenge.[77]

The toolkit emphasizes on three components to achieve better results, team, space and material. It is suggested to have a rather small team (two to five individuals) from different fields of expertise to have different views on the problem. Devoting a space for the project helps to be inspired and get to more innovative ideas. This area should change from time to time in order to not get stuck on certain concepts. For ideation and prototyping some materials, i.e. post-its, card boards, cameras, etc. have to be provided to visualize the ideas.[78]

Discovery

Understanding the user (in the case of education, students, parents, teachers, etc.) is the foundation for generating ideas. Discovery is the phase where empathy is gained to get inspired for creating solutions.[79]

A short review should be taken on the defined challenge prior to this step. By adding thoughts, constraints and barriers that are visible and rephrasing them into “How might we …?” questions the task can be reframed, if necessary, until the team taking the challenge feels that it is manageable. The team members might already have some expertise about the topic. This knowledge should be written down and visibly organized for everyone to see and reflect on it. Setting up such themes and sets of information helps identifying where the team should conduct more research and observations. One of the most important parts of the challenge is the team that is tackling the problem. For a better working environment certain roles should be allotted to each team member to know who is responsible for what. After settling the team’s roles the audience that is directly involved in the challenge has to be defined. The broad picture has to be kept in mind; not focusing on the one specific end user but finding everyone who is associated or even just

[77] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 19 ff
[78] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 23
[79] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 25

peripherally relevant with the audience. As a last guiding and defining sub-step, a project plan with a timetable, milestones, goals, etc. should be set up.[80]

In Design Thinking the people, specifically experts, users and peers are the focus of attention; therefore it is necessary to be prepared before observing them. First it has to be defined what kind of people should be met and observed, followed by in which environment and for how long should the meeting take place. To support the fluency of the interview a question guide should be created. Starting with identifying the topics and what needs to be learned some questions can be formulated. Sorting those questions from comfortable and easy to answer, going broader and asking for emotions or feeling to digging deeper in fields that were picked up during the conversation eases having a good discussion with the interviewees. Also early ideas and prototypes should be shared to immediately get input on them. For such observations and interviews it is beneficial to assign roles, such as a person that leads the conversation, one is looking at the behavior or facial expressions and another one takes photos. It is essential to document all the outcomes of the interviews, collect them and place it somewhere in the dedicated area of the project.[81]

Besides receiving input from experts for a first in-depth knowledge about a topic there are several other sources. Learning from individual users, self-documentation (written down experiences from users), groups or peers observing other peers can reveal new valuable insights. Inspiration can also be gathered from analogous settings, such as similar surroundings and environments. For example, visiting an electronic consumer shop in order to find out how customers experience new products in order to apply this to a library. The two facilities are very different but have some common basic ideas which can be copied.[82]

Interpretation

Just collecting data and gaining empathy for the user won't result in a defined challenge. Before starting with brainstorm sessions and generating ideas it is necessary to analyze the acquired knowledge and define a meaningful challenge. When going through the collected material a better understanding for the topic will be gained. To ease the navigation through the interpretation process the toolkit suggests some small steps.[83]

[80] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 26 ff
[81] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 29 ff
[82] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 33 ff
[83] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 39 f

Each of the observations done in the prior phase should be documented and shared within the team. Aside from who and what was observed it should be noted what the most inspiring moments were, what was the person's motivation and what frustrated the person. These stories and the newly gained knowledge should be written down or illustrated for a better overview as it is the basis for creating solutions.[84]

All the collected information will be random facts and opinions on the topic. Thus, by clustering related information and identifying categories, themes can be defined which helps to find meanings in it. Analyzing the themes and finding links between them will lead to a clearer picture of the problem. At this point the first user needs can be discovered. As the whole process, this step as well will lead to better results by iteration and involving inputs from outside. At the end, the team should have a clear understanding of what the learnings from the research mean.[85]

By reflecting on the outcomes of the sense-making, new insights can be found that haven't been obvious in the beginning. The strongest and most surprising information will later be the catalyst for new ideas and possible innovation. For an easier start to ideation the insights should be rephrased as "How might we…?" questions in order to trigger ideas for solutions to this formulated problem.[86]

Ideation

Before starting generating ideas some preparation is needed. Brainstorming sessions should be used to create possible solutions for a specific problem. Thus, defining which problem should be attacked has to be decided before starting the session. A good selection of "How might we…?" questions about the problem helps in ideation. An appropriate space and a certain time should be scheduled for a brainstorming session (IDEO suggest 45 to 60 minutes). One key factor is a diverse group of people because having different fields of expertise means having different views on the topic. This generates various answers to the asked questions.[87]

In order to keep a good flow during the brainstorming sessions and create good solutions it is necessary to follow certain rules (Figure 3-11). The suggested rules are needed for the above mentioned setup of people to ensure a satisfying outcome. During the session one person should lead the group. It's this person's responsibility that the participants

[84] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 41 f
[85] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 43 ff
[86] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 46 f
[87] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 50

stick to the brainstorming rules. The team should also set a goal for how many ideas they want to generate in total which is later also supervised by the facilitating person.[88]

Defer judgement: There are no bad ideas at this point. There will be plenty of time to narrow them down later.

Encourage wild ideas: Even if an idea doesn't seem realistic, it may spark a great idea for someone else.

Build on the ideas of others: Think "and" rather than "but".

Stay focused on topic: To get more out of your session, keep your brainstorm question in sight.

One conversation at a time: All ideas need to be heard, so that they may be built upon.

Be visual: Draw your ideas, as opposed to just writing them down. Stick figures and simple sketches can say more than many words.

Go for quantity: Set an outrageous goal – then surpass it. The best way to find one good idea is to come up with lots of ideas.

Figure 3-11 – Brainstorming rules[89]

Similar ideas and solutions should then be clustered and groups should be formed for a better overview. Each team member receives a limited amount of votes for deciding on which idea they want to develop further or which might be a promising idea. In order to not be influenced by other opinions everyone should write down the votes and after the whole team is finished the results will be revealed.[90]

Until this point the constraints and possibilities shouldn't be taken into account. The chosen concepts have to be checked how they can be realized. The basic principles of these solutions have to be examined and new ideas developed by considering all the limitations of the project. The original concepts will be evolved until they meet all the criteria. The evolution of each idea should be captured to be able to follow the thoughts

[88] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 51 f
[89] N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 51
[90] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 53

later in the project. This is useful when iteration is needed and the team has to go back to this point.[91]

Experimentation

The ideas developed in the last phase are now realized with prototypes. This step is necessary to show and explain the main concepts and get feedback on them. A prototype is something that the user can interact with and get a feeling of how the idea will look like. With the feedback of the users the ideas can be further developed and refined.[92]

A prototype is not inevitably a first working version of a serial product. There are several ways of how to prototype in order to test an idea. Table 3-1 lists seven different possibilities of prototyping and how it could be done in practice. Those methods can also be combined in any variation. [93]

Table 3-1 – Different prototyping methods[94]

Prototyping method	**Description**
Storyboard	Visualization of the idea with images, sketches or text blocks.
Diagram	Mapping the structure or process of the idea.
Story	Telling a story as it would appear in a newspaper or a website.
Advertisement	Creating an advertisement that promotes the idea in the best way possible.
Mock-up	Simulating the idea with digital tools or sketches on paper.
Model	Building a simple 3D model of the idea.
Role-play	Acting the experience of the idea.

[91] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 54 f
[92] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 57
[93] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 58
[94] ibidem

The goal of prototyping is to let the user experience and test the idea in a certain environment. The closer this experience is to the reality, the better feedback can be obtained.[95]

As the idea itself also the prototypes will evolve over time and more details will be added in order to get closer to the real situation. The methods described in Table 3-1 are mainly for the beginning. Towards the end of a project the prototype will most likely be a working model of a serial product.

The second part of experimentation is testing and getting feedback on the created prototypes. This step is similar to the Discovery stage where users are observed and asked for their input. Starting by identifying sources for feedback where it is defined what kind of feedback is needed. This could be a first impression of an idea or specific details on a prototype, i.e. how to design a handle bar. This feedback activity requires planning and a structure in order to receive valuable input. After the testing environment is defined, participants have to be chosen. There should be a mix of people who already know about the project (people who already gave feedback during the project) and people that are new to the ideas. Another aspect that should be considered in the participant selection is that they are familiar with the topic and can give valuable feedback. The next step is to build a question guide that should support the interview. A good feedback conversation is a mix between this question guide and spontaneous reactions to what is said during the interview. It is important to keep the goal in mind which is to find an answer to the question for which the prototype was built. A good facilitation of the interview helps finding this answer. Some tips are provided in the toolkit in order to get constructive feedback. The most important factor is honesty from the people in order to be able to improve the prototype. On the other hand the interviewers have to stay neutral and should not defend the ideas or try to sell an idea. Providing multiple prototypes and encourage people to build on the ideas leads to better results. The collected feedback is now a wild mix of improvement points, aspects that worked, new ideas and questions that raised during the interviews. This information should now be analyzed and similar ideas should be clustered. Based on this analysis decisions can be made on how to proceed with the ideas. At the end the integration of the feedback is needed. This is the latest point where iteration starts.[96]

[95] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 58
[96] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 60 ff

Evolution

After finishing the final prototype the project doesn't stop. In this stage it is necessary to define the next steps. As the toolkit covers the topic of education there are suggestions on how to proceed with social projects. Such steps would be engaging others or building a community. Applying this step to other projects would be similar to marketing and launching the product as well as developing it further.[97]

Additional notes

IDEO states that they are using similar processes and it is pointed out that those step by step procedures are mainly for the world of education. The Riverdale Country School is actively using this approach to improve their classrooms and classes. It is also very important to mention that this toolkit is a guideline and not a rulebook where parts can be altered and applied to any innovation project if they fit the framework.[98]

3.4 d.school

The d.school provides a lot of material on their homepage[99] to let others use their methods of Design Thinking. Two main sources can be found; first the five modes in Design Thinking as seen in Figure 3-12 which is mainly used as a guideline for a workshop called "Design Project Zero". The other approach suggests a six-step approach published on a wiki designed by the d.school called K12 lab[100] as seen in Figure 3-13. Only minor differences can be recognized between the two methods; they shall be discussed at the end of this subchapter.

3.4.1 The five modes of Design Thinking

This approach is the methodology used in the workshop "Design Project Zero" (see chapter 3.6.4) which students go through in an hour and a half. The description of each step is summarized from the handouts for the facilitator (see Appendix A and Appendix B) and a process guide (see Appendix C and Appendix D) that are provided by the d.school. The modes are described as a linear approach (as shown in Figure 3-12); however, the order can vary and the process is iterative.

[97] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 67 ff
[98] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 81
[99] N.N. (N/S), available online at, accessed on 15.01.2015
[100] Ratcliffe (2009), available online at www.dschool.stanford.edu, accessed on 26.01.2015

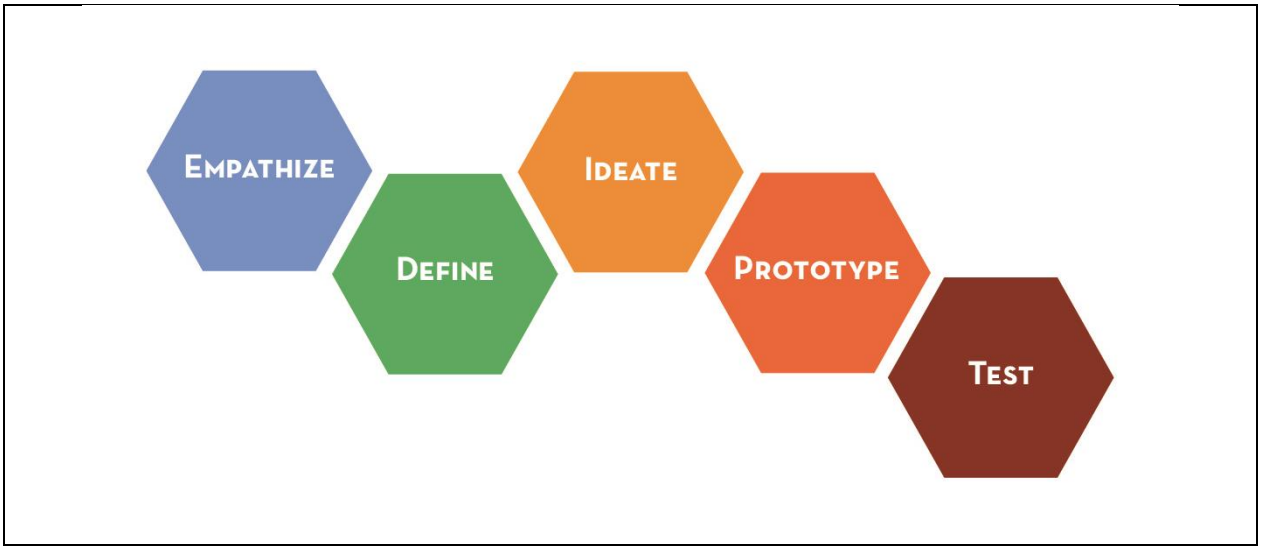


Figure 3-12 – The five modes of Design Thinking[101]

Empathize

According to the Oxford Dictionary empathy is *"the ability to understand and share the feelings of another[102]"*. This is the core of the human-centered approach in Design Thinking. It implies observing and understanding the user, finding out what they are looking for in a product, about their emotional needs and what is important and meaningful to them.[103]

In Design Thinking the problems that are tackled are the ones of a group and not of a single person, which is why empathizing is a crucial factor. Watching people use the product gives a lot of input on what to focus on and which features are necessary or can be improved. Only by studying the behavior of people who are interacting with their environment, leads to valuable insights and innovative solutions. It is also important to realize the hidden needs, those that are not stated by the users or obvious to see while observing. Asking questions to find out the reason why people behave or use a product in a certain way helps to find out latent needs.[104]

One way to include observing and engaging with people is to let them go through the steps of using a product and let them explain what they think and feel. During this process

[101] N.N. (2012) *Steps of Design Thinking,* available online at www.dschool.stanford.edu, accessed on 15.01.2015
[102] N.N. (N/S), available online at www.oxforddictionaries.com, accessed on 26.01.2015
[103] Cf. N.N. (2010) *Mode Guide BOOTCAMP,* available online at www.dschool.stanford.edu, accessed on 26.01.2015, p. 2
[104] ibidem

questions should be asked and at crucial points it is necessary to dig deeper in order to get the right insights.[105]

Usually the next mode after empathizing is the “Define” mode where the problem is described. To make the next step easier it is helpful to collect the information gathered, i.e. pictures of the users, sequence of a process, written down inputs, in general everything that reflects impressions and the user’s needs.[106]

Define

Getting empathy by observing and engaging with the users provides the knowledge to become an “instant-expert” of the subject. The collected information is analyzed and phrased into a substantial problem statement which is called the point-of-view. By synthesizing the data and drawing connections valuable insights and patterns can be found.[107]

The “Define” mode is crucial since it results in a point-of-view which is the person’s or the team’s personal definition of the problem. This interpretation however is the right challenge to address because it is the outcome of understanding the user. Although it might seem counterintuitive, defining a precise problem statement leads to a higher number of more sophisticated ideas. The main advantage of Design Thinking is that the gained empathy for the users has an influence on the results.[108]

In order to formulate a thoroughly defined problem statement three elements have to be taken into account. First, a clear understanding of the user has to be created by looking for patterns and what stood out during the observations. Also asking why users behave in a certain way leads to better understanding. The second element is defining a certain amount of important needs. In Design Thinking needs are defined as something that a user is trying to achieve; described in verbs. The last part is specifying insights that could be drawn throughout the process. Insights are new discoveries about the users’ emotions, feelings and motivations. That also includes anything that was observed and not mentioned by the users’ themselves.[109]

A well described point-of-view contains a narrowly focused problem frame that results in generating a great quantity of high quality solutions to that problem during ideation. This

[105] Cf. N.N. (2010) *Mode Guide BOOTCAMP,* available online at www.dschool.stanford.edu, accessed on 26.01.2015, p. 3
[106] Cf. N.N. (2010) *Mode Guide BOOTCAMP,* available online at www.dschool.stanford.edu, accessed on 26.01.2015, p. 3
[107] Cf. N.N. (2010) *Mode Guide BOOTCAMP,* available online at www.dschool.stanford.edu, accessed on 26.01.2015, p. 4
[108] ibidem
[109] Cf. N.N. (2010) *Mode Guide BOOTCAMP,* available online at www.dschool.stanford.edu, accessed on 26.01.2015, p. 5

is a great indicator if the point-of-view is well-articulated. To ease the transition to the "Ideate" mode the d.school suggests creating a list of "How-Might-We …?" questions to tackle different sub-problems.[110]

Ideate

This mode is about generating a broad range of ideas to the defined problem. This includes going for wild concepts not paying attention to feasibility nor viability. It is the foundation for prototyping and to come up with new, innovative solutions.[111]

Ideation is the transformation of the identified problems into possible solutions. Creating as many ideas as possible is a key in Design Thinking which means that there is no "single, best solution". This is determined later by testing and iteration.[112]

The d.school describes some mindsets to get the most out of the "Ideate" mode. To increase the innovation potential the strengths of each person in a team have to be merged to be able to think beyond the obvious solutions to a problem. Exploring unexpected fields and allowing any variation of ideas to get to more innovative results.

There are many creativity techniques for ideation but there is one point that applies to all of them – separate idea generation and judgment. The guiding principle is building on the ideas of others which will lead to exceptional solutions.[113]

At the end of the "Ideate" mode the evaluation starts which of the ideas should be prototyped by deciding on selection criteria and voting for the different ideas.[114]

Prototype

An essential part of getting to the final solution is to show the user the generated ideas. The best way is not to explain but building the ideas and let the user interact with it. This step evolves into iteration where the prototype is refined in each cycle to meet the users' needs. Such a prototype may start as a wall of pictures or a role-play.[115]

The earlier a first prototype is built the more iteration cycles can be undergone. It is helpful to test some possibilities early and fail with these cheap solutions rather than go for a

[110] Cf. N.N. (2010) *Mode Guide BOOTCAMP,* available online at www.dschool.stanford.edu, accessed on 26.01.2015, p. 5
[111] Cf. N.N. (2010) *Mode Guide BOOTCAMP,* available online at www.dschool.stanford.edu, accessed on 26.01.2015, p. 6
[112] ibidem
[113] Cf. N.N. (2010) *Mode Guide BOOTCAMP,* available online at www.dschool.stanford.edu, accessed on 26.01.2015, p. 7
[114] ibidem
[115] Cf. N.N. (2010) *Mode Guide BOOTCAMP,* available online at www.dschool.stanford.edu, accessed on 26.01.2015, p. 8

fully working prototype.[116] *"If a picture is worth a thousand words, a prototype is worth a thousand pictures[117]."*

Prototypes are built to test ideas and any emotional attachment to a prototype has to be avoided. They are designed to get an answer to specific questions and to get feedback if ideas work or fail.[118]

The most important part of a prototype is to test it which is the last mode in this approach. The feedback of the users to a prototype is a valuable input and a crucial part of Design Thinking.[119]

Test

The valuable feedback of the users and the resulting new learnings and insights about them that are gained while testing a prototype are the driving force to get to the final solution. It is another opportunity to gain empathy for the people and to ask "Why?" as in the "Empathize" mode. The best outcome of a test is when the users are testing the prototypes in their natural environment and can use it as they would when they are alone. It is a chance to improve the created solutions.[120]

During a test it is important to give the users the chance to interact with the prototype by themselves; not everything should be explained in the beginning. A lot more insights to the users' behavior are the result.[121]

Iteration

With the newly gained knowledge about the user the previous work can be refined. Iteration is a significant attribute of Design Thinking and is not only applied to the whole process but also within each mode. This way it can be assured to move from a broad scope to the details of each feature.[122]

[116] Cf. N.N. (2010) *Mode Guide BOOTCAMP,* available online at www.dschool.stanford.edu, accessed on 26.01.2015, p. 8
[117] N.N. (2010) *Mode Guide BOOTCAMP,* available online at www.dschool.stanford.edu, accessed on 26.01.2015, p.8
[118] Cf. N.N. (2010) *Mode Guide BOOTCAMP,* available online at www.dschool.stanford.edu, accessed on 26.01.2015, p. 9
[119] ibidem
[120] Cf. N.N. (2010) *Mode Guide BOOTCAMP,* available online at www.dschool.stanford.edu, accessed on 26.01.2015, p. 10
[121] ibidem
[122] Cf. N.N. (2010) *Mode Guide BOOTCAMP,* available online at www.dschool.stanford.edu, accessed on 26.01.2015, p. 11

3.4.2 Steps in Design Thinking by the K12 lab

Figure 3-13 shows a linear visualization of the steps with suggestions how to jump between the steps with transparent connecting lines.

In this approach the “Empathize” mode is split into the steps “Understand” and “Observe” while “Define” is replaced by “Point of View”. “Understand” is the step where the first knowledge is gained for a project by contacting experts and conducting researches. This information is the background to better understand the users in the “Observe” step. As in “Empathize” the people are carefully monitored in their natural environment and asked why they behave in a certain way. Leaving out the “Observe” step, this approach is more suitable for highly technical projects that do not include people using a physical object.[123]

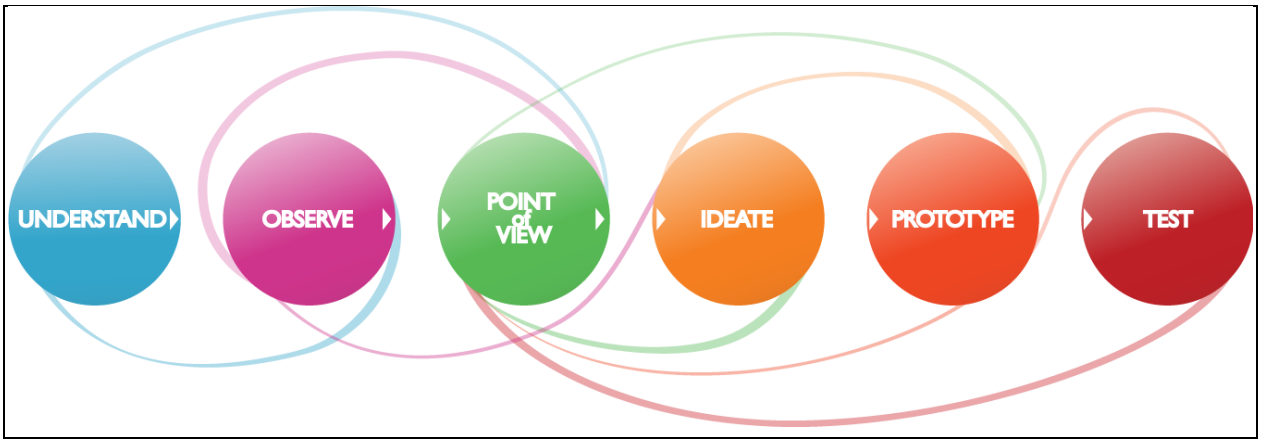


Figure 3-13 – Steps in Design Thinking by the K12 lab[124]

3.4.3 d.school mindsets

Additionally to the main phases of Design Thinking (see Figure 3-12) the d.school teaches mindsets as well that should help increasing the quality of the outcomes of a project. These mindsets or rules (explained and illustrated in Figure 3-14) are designed to encourage empathy, divergent thinking, collaboration and thinking by doing which are the basic elements of Design Thinking.[125]

[123] Cf. Ratcliffe (2009). *Design Thinking Process,* available online at www.dschool.stanford.edu, accessed on 26.01.2015
[124] Ratcliffe (2009). *Design Thinking Process,* available online at www.dschool.stanford.edu, accessed on 26.01.2015
[125] Cf. N.N. (N/S), *Mindsets,* available online at www.dschool.stanford.edu, accessed on 04.02.2015

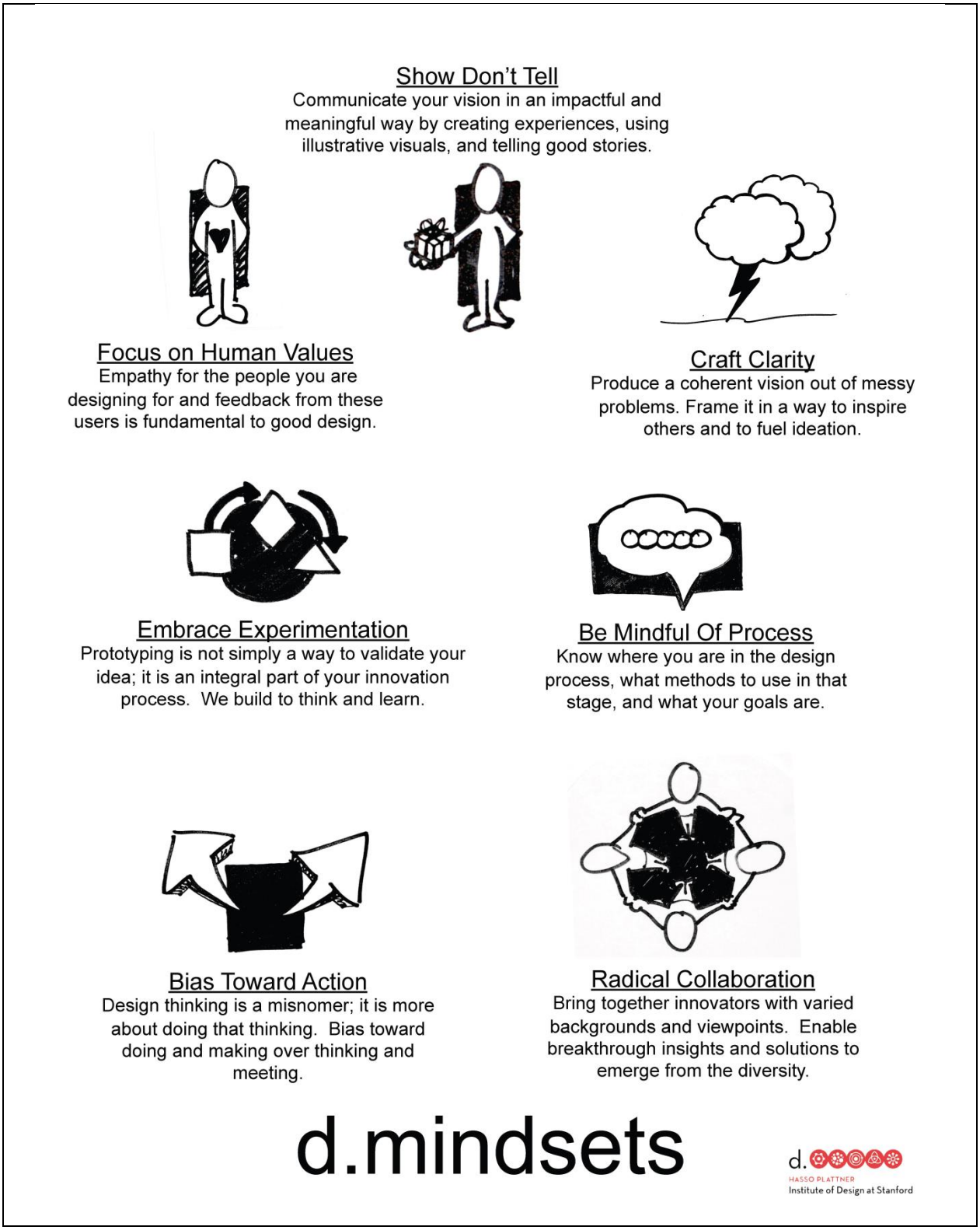


Figure 3-14 – d.school mindsets[126]

[126] N.N. (N/S), *Mindsets,* available online at www.dschool.stanford.edu, accessed on 04.02.2015

3.5 Summary of Design Thinking

This subchapter gives an overview of the most important points of Design Thinking and sums up the different sources.

Process

Four of the suggested processes can be separated into two main categories, industrial (white background in Table 3-2) and academic (blue background in Table 3-2) process. Kelley and Brown cover the industrial process while the d.school and the K12 lab cover the academic process. The main differences between the industrial and academic process are the origin of it, either a company or a university, and that the academic process does not cover the implementation of a product. A crossover between the two is the Design Thinking for educators toolkit ("DT for edu", orange background in Table 3-2) which covers all phases but was developed by both, a company with an educational establishment.

Table 3-2 gives an overview of the Design Thinking sources compared to each other. Five major phases can be identified "understand", "idea generation", "prototyping", "testing" and "implementing". Depending on the sources particular phases are split up or merged. However, the five mentioned phases are taken for further discussion in this thesis.

Table 3-2 – Overview of the process phases in Design Thinking[127]

Source	Phases						
	Understand			Idea Generation	Prototype	Test	Implement
d.school	Empathize		Define	Ideate	Prototype	Test	-
K12 lab	Understand	Observe	Point of View	Ideate	Prototype	Test	-
DT for edu	Discovery		Interpretation	Ideation	Experimentation		Evolution
Kelley	Understand	Observe		Visualize		Evaluate and Refine	Implement
Brown	Inspiration			Ideation			Implementation

[127] Own illustration

"Understand" covers every action taken to gain empathy and to define the problems of the project such as observations of users, expert talks or inspiration from analogous settings as well as analyzing the collected data and looking for patterns. "Idea Generation" is exactly what is defined in every academic process which contains brainstorming sessions and other creativity techniques plus discussing the ideas and deciding with which to proceed. "Prototyping" is the phase where the chosen concepts are visualized as stories, mock-ups, physical models or role plays. These prototypes are then evaluated and refined according to the feedback gotten in the "Testing" phase. The last phase is "Implementing" where a working product is implemented into the business world. This may include design a marketing strategy.

As in all of the sources, the major phases are described as a linear approach. However, the order, sequence or iteration of the process phases is not considered. They differ in any variation depending on the project. Each of the phases can be performed parallel to another and the order changes according to the outcome of a phase. Testing the concepts can be refined by several iteration cycles and the more refinement is done the better the results will be.

Setting

Besides the process itself there are other factors that play a crucial part in Design Thinking. One of those is the setting of a project; more detailed the physical environment and the project team.

The physical space in which a project is carried out has an influence on the project team and on the process of innovation. Kelley suggests having as few rules as possible for designing this space which should not be done by architects but rather by the project team itself. As in the whole process of Design Thinking also the working area should evolve over the course of the project. At IDEO the offices look like a neighborhood with personalized working places which can be easily transformed into meeting areas. For the project itself a dedicated room is reserved where all information is gathered and essential data is made visible to the whole team or even outsiders.[128]

Although Design Thinking is described as a skill for the individual (see chapter 3.2) it is performed in groups[129]. Due to the complexity in different fields a team should include members who have experience in more than one field[130]. Forming this team with the right mix is not easy but the goal is to have a diverse team in terms of expertise and personality[131]. The difference of a well-working group comprising such individuals to a

[128] Cf. Kelley/Littman (2004), p. 121 ff
[129] Cf. Brown/Kātz (2009), p. 28
[130] Cf. Brown (2008), p. 87
[131] Cf. Kelley/Littman (2004), p. 83 f

bad group is that the first mentioned has a clear goal, deadlines and passion[132] as well as a high level of trust among the members[133].

Important factors

There are three factors in Design Thinking that play a significant role in the success of it. These factors are the right mindset of the project team members, a focus on human values as well as following certain rules to have a framework in which the team can work.

The mindsets illustrated in Figure 3-14 are the basis for applying the Design Thinking method. Each team member should understand, accept and agree to these values which give the team a higher chance to be successful.

One of the mindsets is the focus on human values which should be pointed out and described in detail. As the whole process builds on the input and feedback of customers and users this could be defined as the core of the method. In each step of the process the team can or should consider the users and their opinions. This human centered approach allows the project team to come up with solutions and designs that are important to the users which can lead to innovations.

In every project and team certain regulations have to be defined in order to have a clear framework and boundaries in which the members can work. Besides the team-internal rules that are defined and agreed by the team, Design Thinking suggests rules and guidelines for different steps in the process. The most essential ones that are mentioned several times are the rules for brainstorming (cf. Figure 3-11). In combination with the above mentioned mindsets a good framework is provided for a project.

3.6 Workshops and methods

Five main methods, *"The Bootcamp Bootleg"*, *"Mixtapes"*, *"Design Thinking for educators toolkit"* , *"Design Project Zero"* and *"Future of Stuff Challenge"* can be found. The last mentioned method gives input on how to apply Design Thinking to a challenge area which is not part of this thesis and therefore, will be neglected.[134]

"The Bootcamp Bootleg" is a compilation of 39 modes used in Design Thinking collected by the d.school. In *"Mixtapes"* some of those modes are selected and put into a guideline how to address three of the five steps in Design Thinking. *"Design Thinking for educators toolkit"* provides tools that can be used while going through a project and *"Design Project Zero*" is a workshop to understand the basics of Design Thinking.

[132] Cf. Kelley/Littman (2004), p. 69
[133] Cf. Kelley/Littman (2004), p. 85
[134] N.N. (N/S), available online at, accessed on 15.01.2015

3.6.1 The Bootcamp Bootleg

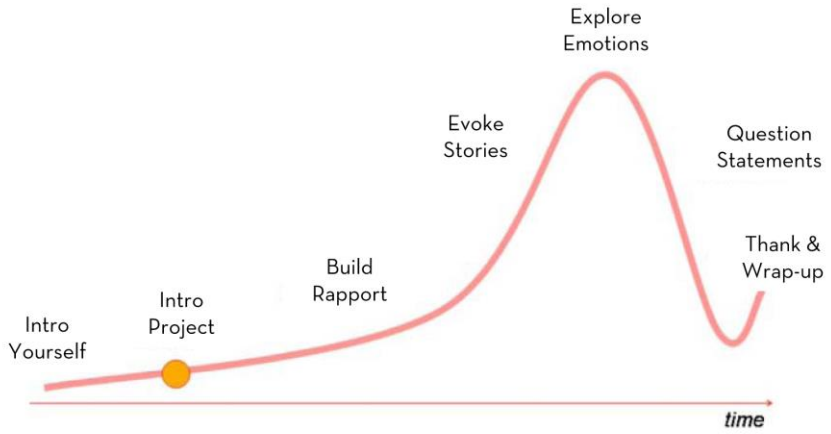
The foundational course about Design Thinking offered at Stanford University is called “design thinking bootcamp” at the d.school which uses the “bootcamp bootleg” to teach students how to put Design Thinking into practice. For each phase illustrated in Figure 3-12 there are several modes of how to embrace a human-centered approach. These modes support the mindsets of Design Thinking shown in Figure 3-14.[135]

The toolkit consist of 39 different modes where it is stated why to use them and how they should be performed. Figure 3-15 shows one example “Interview for Empathy”, why and how to perform it. These methods are suggestions for easier application of the Design Thinking approach.[136]

[135] Cf. Both (2013). *Bootcamp Bootleg,* available online at www.dschool.stanford.edu, accessed on 24.03.2015, p. 6 ff
[136] ibidem

METHOD

INTERVIEW FOR EMPATHY



WHY interview

You want to understand a person's thoughts, emotions, and motivations, so that you can determine how to innovate for him or her. By understanding the choices that person makes and the behaviors that person engages in, you can identify their needs, and design to meet those needs.

HOW to interview

Ask why. Even when you think you know the answer, ask people why they do or say things. The answers will sometimes surprise you. A conversation started from one question should go on as long as it needs to.
Never say "usually" when asking a question. Instead, ask about a specific instance or occurrence, such as "tell me about the last time you ___"
Encourage stories. Whether or not the stories people tell are true, they reveal how they think about the world. Ask questions that get people telling stories.
Look for inconsistencies. Sometimes what people say and what they do are different. These inconsistencies often hide interesting insights.
Pay attention to nonverbal cues. Be aware of body language and emotions.
Don't be afraid of silence. Interviewers often feel the need to ask another question when there is a pause. If you allow for silence, a person can reflect on what they've just said and may reveal something deeper.
Don't suggest answers to your questions. Even if they pause before answering, don't help them by suggesting an answer. This can unintentionally get people to say things that agree with your expectations.
Ask questions neutrally. "What do you think about buying gifts for your spouse?" is a better question than "Don't you think shopping is great?" because the first question doesn't imply that there is a right answer.
Don't ask binary questions. Binary questions can be answered in a word; you want to host a conversation built upon stories.
Make sure you're prepared to capture. Always interview in pairs. If this is not possible, you should use a voice recorder—it is impossible to properly engage a user and take detailed notes at the same time.

:: 10 :: Visual adapted from Michael Barry, Point Forward

Figure 3-15 – Example of one mode in the "bootcamp bootleg"[137]

[137] Both (2013). *Bootcamp Bootleg,* available online at www.dschool.stanford.edu, accessed on 24.03.2015, p. 10

3.6.2 Mixtapes

In order to have a step by step guideline the d.school published so called mixtapes about gaining empathy, ideation and experimenting. These are designed for half a day working sessions to make significant advances in a project. Each mixtape is a collection of the modes from the bootcamp bootleg which should be performed in the suggested order.

Understand mixtape

As a start to a project or reviving a project this first mixtape is designed to gain empathy for the users, understand the needs and insights. This covers the “empathy” and “define” phase of Figure 3-12. Each mixtapes starts with the same step, getting the team together, scheduling half a day and read through the provided material.[138]

The initial step is to reframe the work for the working session in a human-centered way. This means to put the user into the focus of a task and goal for the session. Similar to sports activities it is suggested to do a physical and mental warm-up phase.[139]

The main part of this mixtape is to gain empathy by engaging with real people, capturing everything that is observed and taking notes and pictures to get as much information as possible. The gathered information is then collected and clustered to get a clear overview with which the needs and insights are defined.[140]

Again, the end of a mixtape is identical in all of them, recapping the work and defining the next steps.[141]

Ideate mixtape

Adding to the previous mentioned starting actions the team should find a place that is suitable for ideation and which encourages creativity. Taking the needs and insights defined in the understand mixtape the right “How might we …?” questions have to be phrased to enable innovative solutions.[142]

The brainstorming rules should be introduced for such a session (cf. Figure 3-11) in order to set a right attitude and to have a clear structure. After generating ideas the solutions should be discussed, further developed and in the end the team should decide which of the concepts should be followed.[143]

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[138] Cf. N.N. (2012) *Understand Mixtape,* available online at www.dschool.stanford.edu, accessed on 18.05.2015, p. 1
[139] ibidem
[140] ibidem
[141] ibidem
[142] Cf. N.N. (2012) *Ideate Mixtape,* available online at www.dschool.stanford.edu, accessed on 18.05.2015, p. 1
[143] ibidem

After a short recap and decision on how to proceed, the team can examine the working methods used and also if they can be improved for future sessions.[144]

Experiment mixtape

The last mixtape covers the prototyping and testing phase of Figure 3-12. Besides the scheduling and reading the instructions the team should, similar to the ideate mixtape, find a place where prototyping is possible. There is also preparation needed for this session, such as providing materials for prototyping, digital tools and who will be the test person.[145]

With the concepts generated in the ideate mixtape the team should start building prototypes that can deliver the main idea behind each concept. These prototypes are the basis for the testing with users who should be able to experience the prototype in order to give the most valuable feedback. Closing the session is done by capturing the feedback and discussing the outcomes.[146]

The next steps after this mixtape could be to repeat the experiment mixtape or one of the other two depending on the decision of the team.[147]

3.6.3 Design Thinking for Educators – Toolkit

Alongside with the step by step description of the approach, a workbook to apply the methods is provided. As the toolkit is meant to be a guideline the processes are not copied as they are described but rather taken as an inspiration of how to apply them in different projects.[148]

3.6.4 Design Project Zero

This hour and a half workshop is designed to introduce students to the basic steps of Design Thinking by going through them in a fast-paced linear process. The d.school provides two different topics for this project *"Redesign the gift-giving experience"* and *"The Wallet Project"*. The first topic addresses improving a service while the second topic addresses improving a product. There is also the possibility to pick a new topic but certain guidelines[149] to find the right one should be followed.

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[144] Cf. N.N. (2012) *Ideate Mixtape,* available online at www.dschool.stanford.edu, accessed on 18.05.2015, p. 1
[145] Cf. N.N. (2012) *Experiment Mixtape,* available online at www.dschool.stanford.edu, accessed on 18.05.2015, p.1
[146] ibidem
[147] ibidem
[148] Cf. N.N. (2012) *Design Thinking for Educators Workbook,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 1 ff
[149] N.N. (N/S), available online at www.dschool.stanford.edu, accessed on 20.01.2015

For this workshop the students get into pairs (an even number of participants is required) and go through each step of the handout (see Appendix A and Appendix B) within a given time. Before each step a short introduction of what they are expected to do next is explained by a facilitator. After completing all nine steps of the handout a few reflecting questions are asked by the facilitator to encourage the students to reflect on what they did during the workshop.

To make sure the facilitator is giving the right input during the workshop the d.school provides a guideline with phrases that can be used (see Appendix C) and uploaded a video[150] on their homepage of one whole workshop that was conducted at the Stanford University Institute of Design.

Preparation

A PowerPoint presentation including one slide for each page of the handout to explain the different actions that the students have to perform and one slide showing Figure 3-12 to show the basic steps of Design Thinking supports the workshop.

Tables have to be arranged in an order that two students can easily talk to each other without being disturbed by other pairings. Each participating student received one printed copy of the handout.

During the workshop the students have to build a quick prototype. Therefore, some cardboard, duct tape, pens, etc. should be available.

While the participants are going through the steps some upbeat music should be played which is turned down when instructions are given.

Process

A short introduction to the workshop is necessary to inform the students what they are going to do within the next hour and a half. It is about getting to know the method of Design Thinking and is not related to their projects.

First, the task is explained in detail to avoid misinterpretations of the topic. For example for “The Gift-Giving Experience” the task includes things like realizing a gift has to be bought or was forgotten to be bought, thinking about what to get, as well as buying and wrapping it and not helping the other person finding a better gift. After clarifying the task the five steps of Design Thinking are briefly discussed.

For the whole project the pairings are divided into partner A and partner B in order to simplify the instructions. Prior to each step the students are told what to do in a short explanation and the available time is announced.

[150] N.N. (N/S), available online at www.dschool.stanford.edu, accessed on 16.01.2015

Before ending the session the students have a debriefing to reflect on their outcomes. There are five question stated at the end of the handbooks to get started. Some core values of Design Thinking should be drawn out during the discussion *"human-centered design"*, *"experimentation and prototyping"*, *"a bias towards action"*, *"show don't tell"* and *"power of iteration"*.

3.6.5 Feedback form

After every conducted workshop the students are asked to fill out a feedback form (see Appendix E) in order to analyze if the workshops help them and how the facilitator can improve. The form consists of two main parts, one about the facilitator "Person" and the other one about the workshop itself "Content". The students are asked to state in which project they are in to be able to evaluate the different perspectives of the team members and to see if the problem statement has an influence on the perception of the students.

The first two questions of the form are only about the facilitator and will not be analyzed in this thesis. However, questions three to five are about the content of the conducted workshop and the answers will be used for the analysis.

3.7 Traditional innovation processes

Since Design Thinking is described as a method for innovation[151] a comparison to other traditional innovation processes should be drawn. A lot of different approaches for innovation processes within a company can be found in literature. Two of the most important models due to their application in the industry were developed by Thom[152] and Cooper[153]. These two approaches shall be investigated further. A third model developed by Holt[154] is also taken into consideration because it includes a human centered approach similar to Design Thinking. After reviewing the three concepts they will be compared to Design Thinking focusing on assets that are important in the Product Innovation Project (see chapter 2.5) such as user orientation, cross-functional teams and prototyping.

3.7.1 Innovation process by Thom

Thom analysis the operational innovation management and discusses existing models of innovation. The first model is described as the phases of change processes where it has to be mentioned that the different phases are not followed in a strict order. The phases can be processed at the same time and partly also repeated. Figure 3-16 shows these

[151] Cf. Brown/Kātz (2009)
[152] Thom (1980)
[153] Cooper (2011)
[154] Holt (1988)

phases and the correlations between them. This model is very plain and could be applied to any innovation.[155]

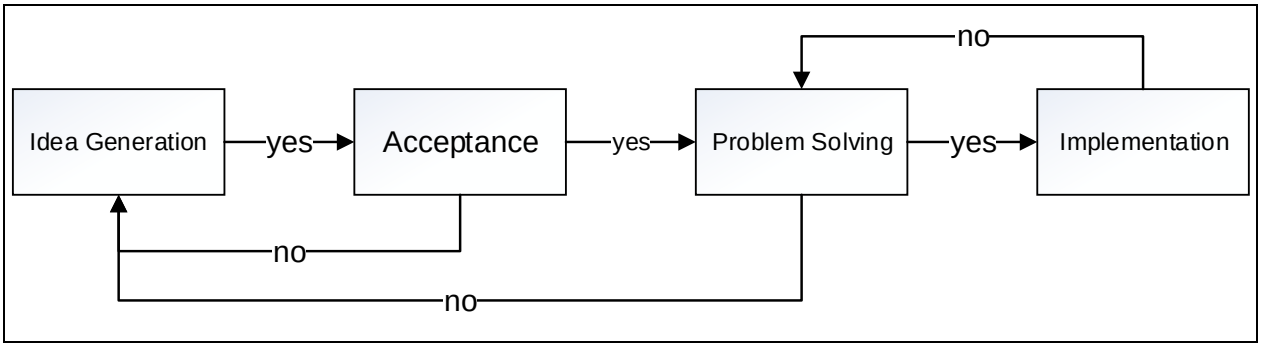


Figure 3-16 – Phases of change processes with iteration cycles[156]

Further differentiation is made between social innovations and product innovations[157]. A model for product innovation that projects the reality adequately was designed by the German Association of Engineers (VDI) which is illustrated in Figure 3-17[158]. The model for social innovation includes the diagnosis of organizational problems, planning of the change process, initiation of organizational changes and monitoring of organizational changes[159].

[155] Cf. Thom (1980), p. 46 ff
[156] Own translation based on Thom (1980), p. 47
[157] Cf. Thom (1980), p. 47
[158] Cf. Thom (1980), p. 48
[159] Cf. Thom (1980), p. 47

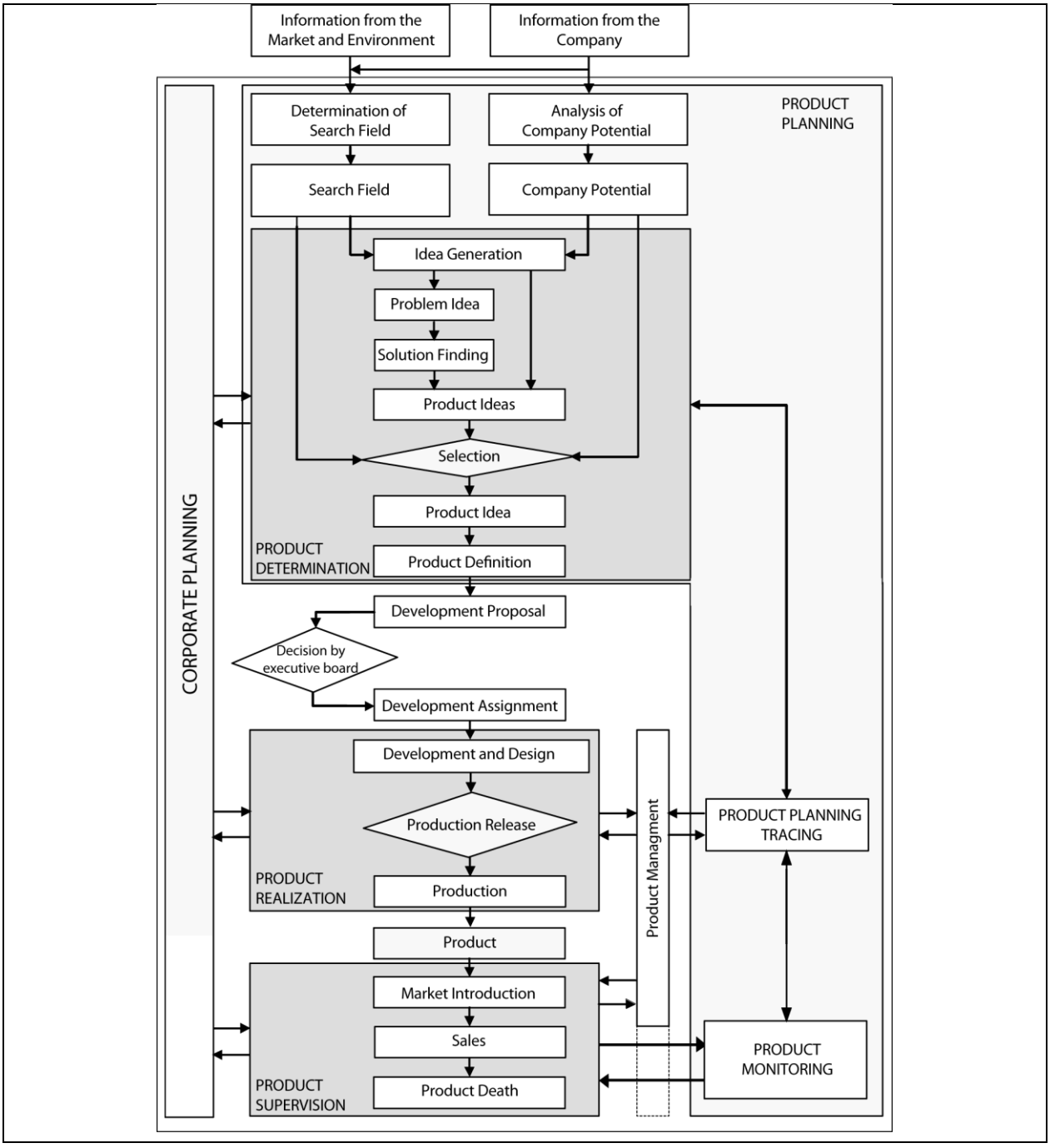


Figure 3-17 – Phase Model of the German Association of Engineers[160]

Based on these previous innovation processes, Thom states that an innovation process consists of minimum two phases, which are idea generation and idea realization[161]. However, the acceptance of a new idea is not considered in such a model, therefore, a decision phase is required due to a high degree of novelty and complexity in innovation

[160] Own translation of VDI guideline 2220
[161] Cf. Thom (1980), p. 51 f

challenges[162]. This results in a three-phase-model that can be further split up into sub-phases (illustrated in Figure 3-18). The basic principle is to generate several ideas which then are reviewed and the most promising are selected. Idea realization deals with realizing the selected concept, introducing it to the market and controlling its success.[163]

Phases of Innovation Processes		
Main Phases		
1. Idea Generation	2. Idea Acceptance	3. Idea Realization
Specification of the Main Phases		
1.1. Determine search field	2.1. Test and rate ideas	3.1. Realizing the new idea
1.2. Find ideas	2.2. Create realization plans	3.2. Sell new idea to addressee
1.3. Suggest idea	2.3. Decide to realize a plan	3.3. Control acceptance

Figure 3-18 – Three-Phase-Model by Thom[164]

3.7.2 Innovation process by Holt

Holt breaks down the innovation process step by step starting from a one-dimensional model (see Figure 3-19). This model shows that the satisfaction of needs comes from a conversion of resources into products. Such resources can be of human, physical and financial nature. The developed products might only be new for a company or even for the whole market.[165]

[162] Cf. Thom (1980), p. 52
[163] Cf. Thom (1980), p. 52 f
[164] Cf. Thom (1980), p. 53; translation Brem (2008), p. 41
[165] Cf. Holt (1988), p. 4

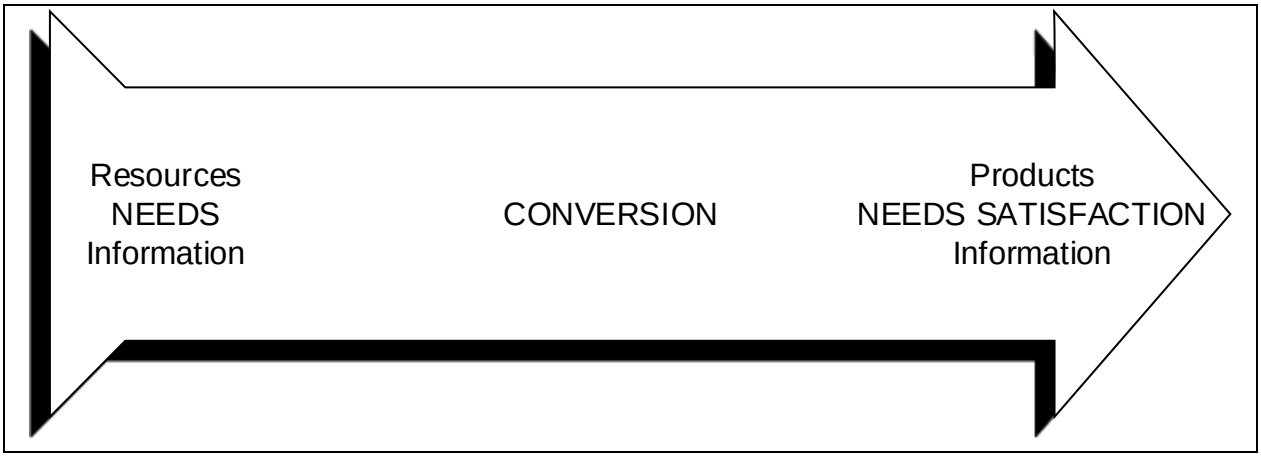


Figure 3-19 – One-dimensional model by Holt[166]

By adding more details, the one-dimensional model results in a three-dimensional model, illustrated in Figure 3-20. “Strategies” and “Policies” are company related standards and can be gained by analyzing the company’s strengths and weaknesses as well as discovering its threats and opportunities. “Transformation” is analogous to the conversion in the one-dimensional model, transforming available resources into marketable products. The “Control Processes” are the guiding activities for the transformation, influenced by the environment and the “Organizational Processes” are dealing with integrating the activities executed in the transformation and control processes.[167]

[166] Holt (1988), p. 4
[167] Cf. Holt (1988), p. 4

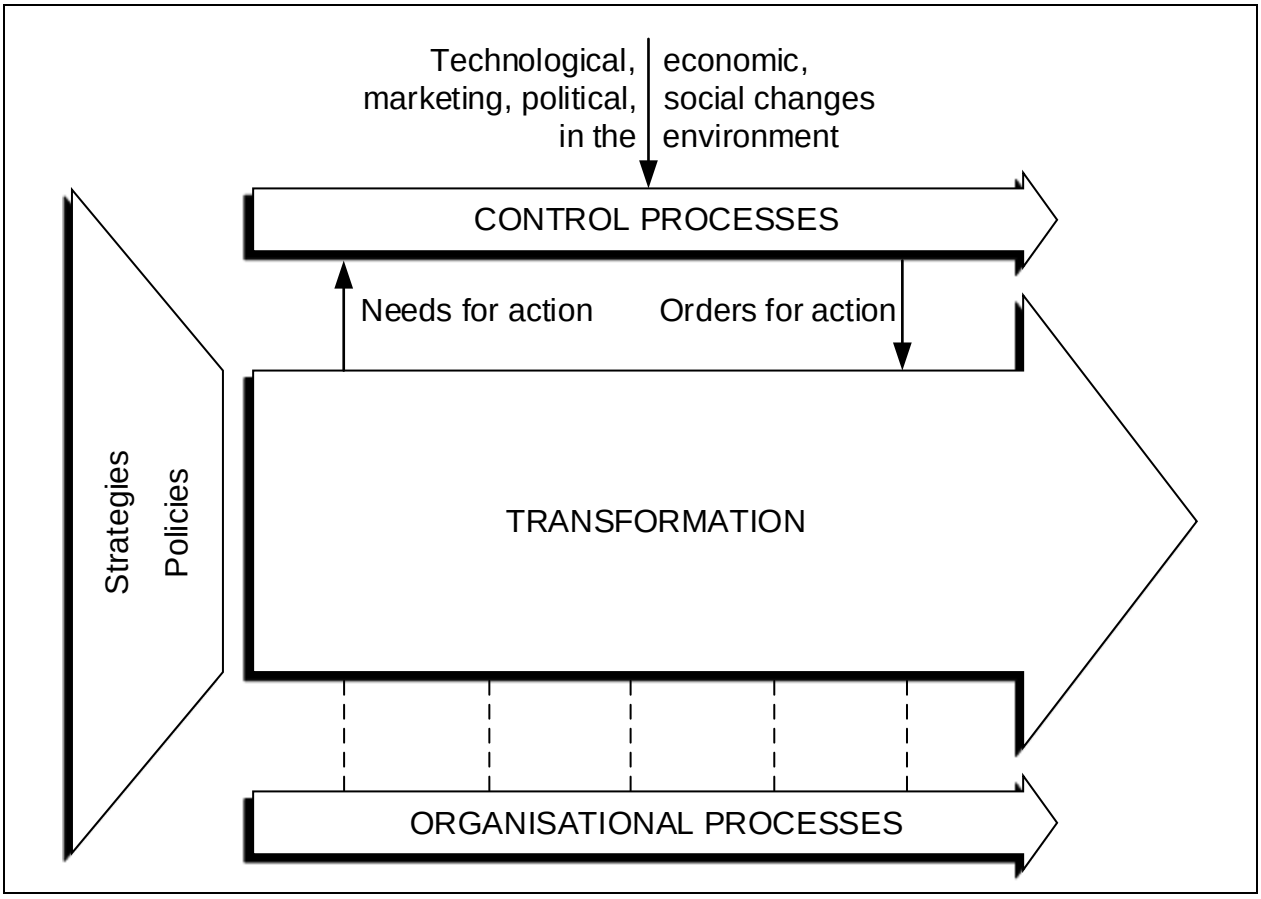


Figure 3-20 – Three-dimensional model by Holt[168]

The transformation process can be further split up into several steps. Figure 3-21 shows Holt's Four-Stage-Model. The first stage "Generation of Ideas" is about finding a technological opportunity to an observed need which results in an idea. After deciding for a specific idea the best technical solution has to be worked out; this could either be an existing one from outside the company or an in-house development. The outcome of this stage is a mock-up or a prototype with detailed specifications. Before bringing the product to the market some preparations need to be done such as planning the manufacturing plant, manufacturing and marketing operations. The last step is to introduce the final product to the market. This includes the actual manufacturing and the marketing strategy. All stages are controlled regarding available time, available money and the outcomes. Trial and error can happen during this process and iteration cycles are highlighted as dotted lines.[169]

[168] Holt (1988), p. 4
[169] Cf. Holt (1988), p. 5 ff

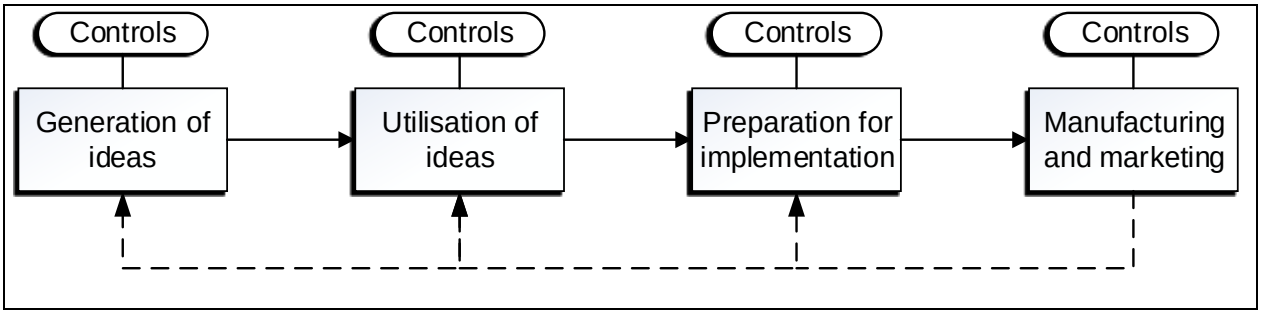


Figure 3-21 – Four-Stage-Model by Holt[170]

The final breakdown is a step-by-step model of an innovation process that can be applied to any innovation challenge. The four stages “Generation of ideas”, “Utilization of ideas”, “Preparation for implementation” and “Manufacturing and Marketing” are expanded into several steps. Two major factors have to be mentioned in this model; the information flow and available tools. Each step of each stage receives information from the prior step, gives and receives information from control processes and provides information for the next step. Tools are used to collect the information from the environment and process it. Holt suggests various new tools that have not been used before. Two of those set of tools shall be mentioned here “Intelligence – need related” and “Quality verification”. Notable tools are “User observation”, “User contacts” and “User Testing” that propose a close working with the actual user of a product.

“User observation is a method for the systematic study of what is unsatisfactory in a user situation by observing, recording and analysing the behavior of those involved (‘observation from outside’).”[171]

Holt further suggests that this might be the best approach to identify user needs. The second tool “User contact” is about letting the users actively contribute:

“User contacts is a method for need assessment based on the systematic collection of relevant information from users regarding a certain task or product and what they find unsatisfactory with it.”[172]

These two tools are very close to what Design Thinking suggests in gaining empathy. The last mentioned tool that shows similarities to Design Thinking is “User testing”:

“User testing is a method for testing a new product’s fitness for use by letting one or several potential buyers make regular use of it, before regular manufacturing and marketing.”[173]

[170] Cf. Holt (1988), p. 6
[171] Holt (1988), p. 126
[172] Holt (1988), p. 127
[173] Holt (1988), p. 217

Holt states that user testing is a final check before introducing the product to the market and major changes should not happen. [174]

3.7.3 Innovation process by Cooper

Cooper developed the Stage-Gate System first in 2001 which nowadays is a registered trademark[175]. The basic principle of product innovation is treated as a process with an idea as an input, processed by a team and a market-ready product as the outcome. This process is split up into several phases (stages), as shown in Figure 3-22.

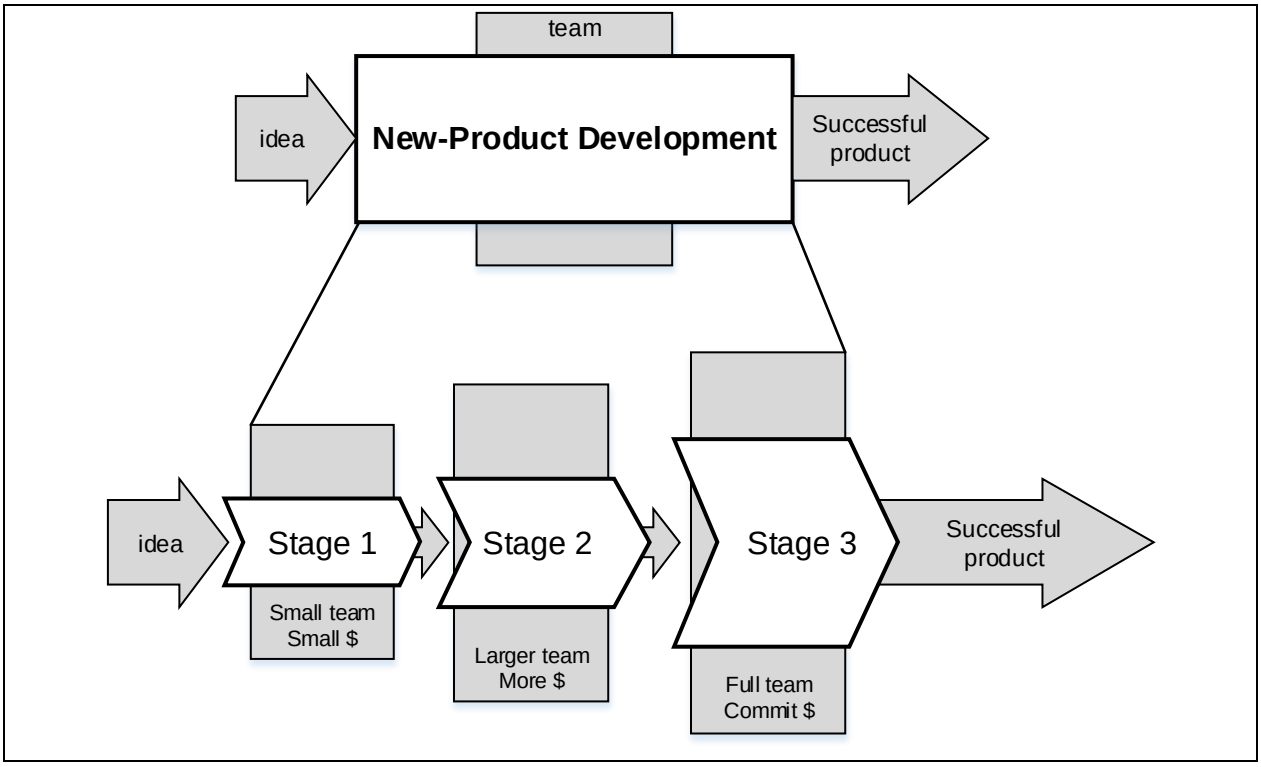


Figure 3-22 – Stage-Gate System basic principle[176]

In each of the stages the team first gathers relevant data which is afterwards analyzed and interpreted in order to generate deliverables. Based on this deliverables a go or kill decision (primarily by the senior management) can be made (see Figure 3-23). This is called the gate which can be seen as the end of a stage or the start for a new stage. It also acts as a quality control checkpoint.[177]

More precisely, a stage is the process of collecting information to get the project to the next gate or decision point. This information can be of technical, operational, market

[174] Cf. Holt (1988), p. 218
[175] N.N. (N/S), available online at www.stage-gate.com, accessed on 27.02.2015
[176] Cf. Cooper (2011), p. 99
[177] ibidem

related nature and therefore the tasks within a stage are cross-functional. There are no parallel processes such as R&D or marketing, these are all included in the different tasks. Cooper also states that the described actions in each stage are not mandatory and are more of a guideline than a rule book.[178]

As already mentioned, gates are decision points where all the gathered data is reviewed and a quality check can be performed. These deliverables are the basis for the decision and are judged by certain criteria such as must-meet or knock-out questions. Each gate has a defined output which can be an action plan and a deadline for the next stage including involved people, money and time needed.[179]

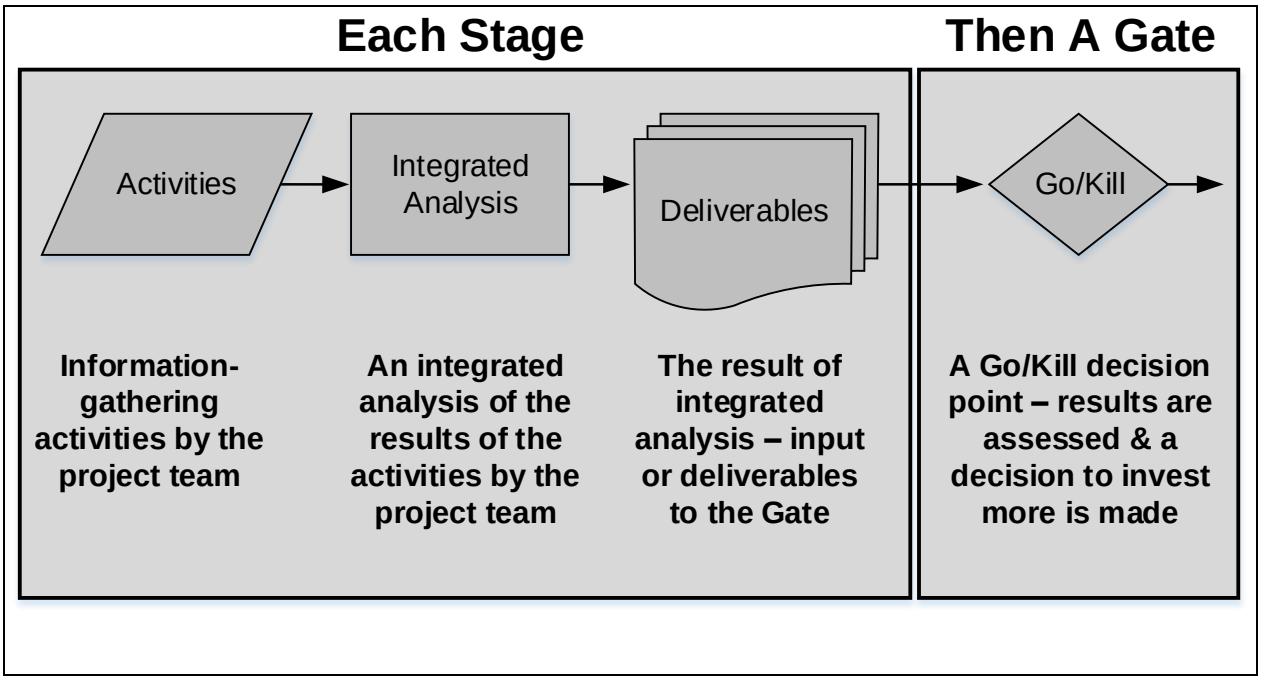


Figure 3-23 – Stage and Gate in detail[180]

The process is triggered by the discovery of an idea or ideation. Cooper and Edgett discussed the sources for the best ideas and created a diagram based on the rating of effectiveness and the percentage of using each method (see Figure 3-24). They identified three different categories Voice-of-Customer, Open Innovation and Other Methods. Rated the most effective are Voice-of-Customer methods which have the same principles as the Design Thinking methods. Two stand-out ideation methods are “Ethnography” and “Customer visit teams”. Ethnography is the study of cultures and people, exploring the behavior from the point of view of the subject of the study. This helps understanding why people act in certain ways and what their habits are. The second method “Customer visit

[178] Cf. Cooper (2011), p. 99 f
[179] Cf. Cooper (2011), p. 100 ff
[180] Cf. Cooper (2011), p. 100

teams" is the best method taking both rated effectiveness and percent extensively using into account. In this approach a cross-functional team conducts interviews with customers. By asking indirect and inferential questions needs, certain functions and benefits can be discovered.[181]

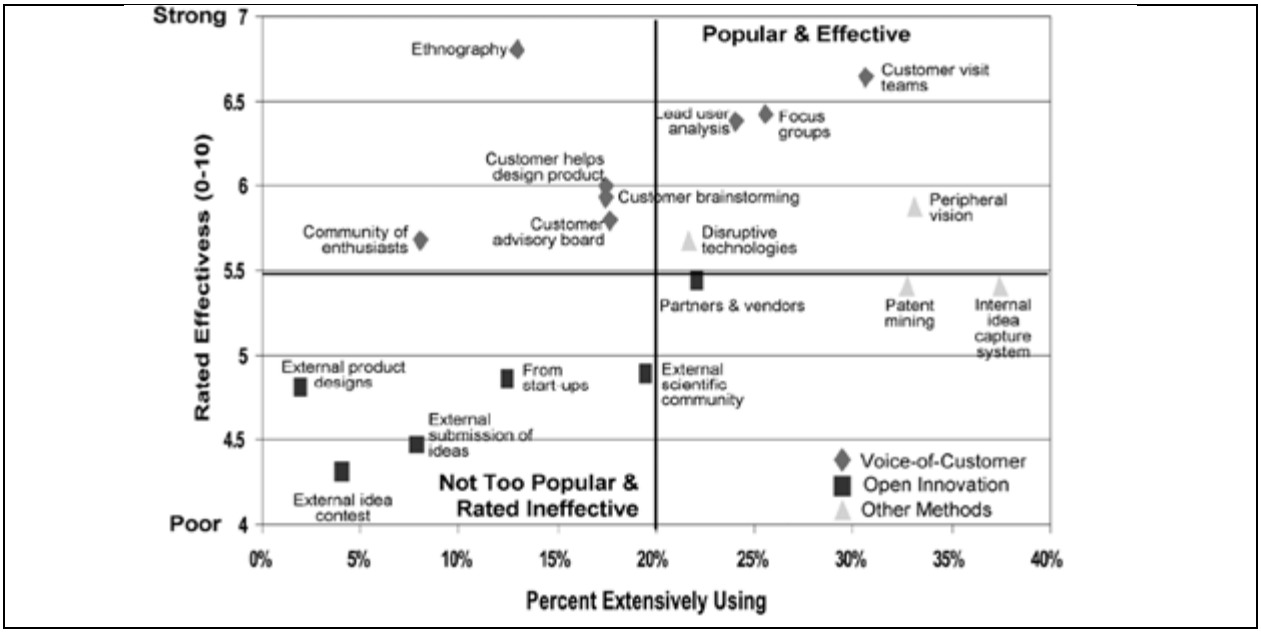


Figure 3-24 – Ideation Study[182]

The first Gate of Cooper's model "Idea Screen" is an early selection of which concept should be followed. Some knock-out or must-have criteria can be defined in order to help choosing the best ones.[183]

"Scoping" as Stage 1 is getting a quick and simple overview of the project. This includes a cheap marketing research, brief research, i.e. Internet research, first contact to key users or library research. Also a preliminary technical assessment is conducted, investigating the possibilities and the feasibility within the company. The goal of this stage is to determine whether the concept can be followed regarding technical and marketing details.[184]

Another screen is performed before taking a project to the next stage. Based on the information gathered in Stage 1 the different options are judged by certain criteria similar to Gate 1. It is important to quickly assess the financial return of the projects because taking the next step includes spending more money.[185]

[181] Cf. Cooper (2011), p. 160 ff
[182] Cooper/Edgett (2008), p. 15
[183] Cf. Cooper (2011), p. 104 f
[184] Cf. Cooper (2011), p. 105 f
[185] Cf. Cooper (2011), p. 106 f

In the following stage “Build Business Case” the product details, requirements and specifications are defined, which attributes the product should have. A market analysis and a market strategy has to be worked out to have a clear statement what wants to be achieved with the product.[186]

Gate 3 “Go to Development” is the last checkpoint where the project can be killed before the investments are too high. Therefore it is substantial to check if the previous stages and gates were performed with high quality. In case of a “Go” the company commits to the product.[187]

In “Development” the product is physically realized, lab or in-house tests and first versions of the product are built. Besides the technical work in this stage marketing and operational work also needs to be done, i.e. market launch plans or production plans. The deliverable of Stage 3 is a tested prototype.[188]

Again the finished tasks of the previous stage have to be checked for quality. A more detailed testing, economic and financial analysis are executed in Gate 4 “Go to Test”. The plan for the next stage is also approved.[189]

The product is tested again in “Testing and Validation” but also the whole project including market strategy, production plan, customer acceptance and the economics of the project is tested. A negative outcome of this stage means that the project has to go back to Stage 3.[190]

Gate 5 “Go to Launch” mainly deals with checking whether the result of Stage 4 is positive or not. If this is the case then the market launch plans are reviewed and approved.[191]

In the last stage “Launch” the production line is installed and marketing is undertaken. Raw material is purchased as well as selling the product starts.[192]

After a successful product launch the whole project is reviewed in “Post-Launch Review”. This assessment of the team’s performance is the end of the project.[193]

For all of the stages and gates some additional things have to be considered. There is no rule book how to perform each action and the order of executing them does not have to be linear. Several activities can be undertaken at the same time or has to iterate back to a previous stage. Project management is a part of the approach but is not the method

[186] Cf. Cooper (2011), p. 107 f
[187] Cf. Cooper (2011), p. 109
[188] Cf. Cooper (2011), p. 109 f
[189] Cf. Cooper (2011), p. 110
[190] Cf. Cooper (2011), p. 110 f
[191] Cf. Cooper (2011), p. 111
[192] ibidem
[193] ibidem

itself, the two methods should be performed at the same time. The whole process with the five stages and gates is illustrated in Figure 3-25.[194]

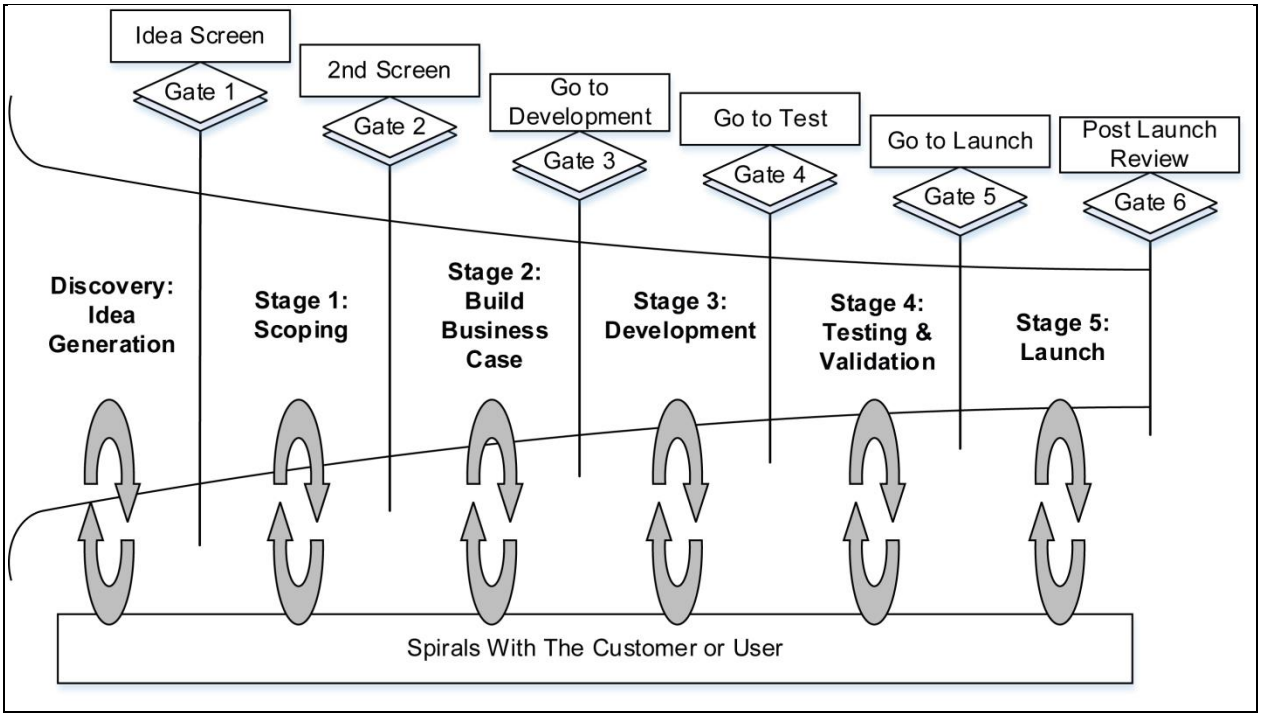


Figure 3-25 – The Stage-Gate process by Cooper[195]

3.7.4 Comparison of traditional innovation processes to Design Thinking

Reviewing the three innovation processes some similarities but also differences can be observed. The following section provides an overview of the models from Thom, Holt, Cooper and Design Thinking. The success criteria in Design Thinking are compared to the other approaches to figure out differences and similarities. Those criteria are user orientation, cross-functional teams, prototyping, working environment, launching a product and sequence of phases and iteration.

User orientation

As in the mindsets of Design Thinking (cf. chapter 3.4.3) stated the focus should be on human values. Gaining empathy for the people by understanding what and why they use products in a certain way is a major part to good design. Whether it is experiences or ideas the users share, testing prototypes or observing people using existing solutions the input is always valuable. In a project users should be involved as soon as possible and as often as possible. Getting feedback on quick prototypes, in order to assess if an idea is worth following or not, will save time and money. Throughout the whole process

[194] Cf. Cooper (2011), p. 103 ff
[195] Cf. Cooper (2011), p. 101 f

it is helpful to get feedback on new ideas and possible solutions. However, this human-centered approach is not discussed in all innovation processes.

Thom suggests having a company idea system or traditional creativity techniques as idea generation methods[196]. Ideas for innovation are only coming from inside the company. There are no details given which specific creativity techniques should be applied, only a list of literature that deals with the topic. The customer or user is only mentioned regarding the success of a new product innovation. Without the acceptance of the customer the new product is not an innovation[197]. It is mentioned that the customer gives proposals for new innovations but is not the focus as Design Thinking suggests.[198]

In contrast Holt includes user contacts as one of the sources in idea generation and in verifying the final design as part of the preparation process[199]. A critical part is to meet the customer's requirements, but they are hard to define before developing a new product. Since most companies experience lots of changes in the user needs it is helpful to have a clear understanding of the user environment and their preferences. The users should also be taken into account during quality verification. Getting feedback through user testing is one possible approach. Similar to Design Thinking, Holt describes identifying user needs by getting in contact and observing them as one option for idea generation and getting feedback on physical prototypes in order to reduce complaints after the introduction.[200]

Cooper revealed that voice-of-customer ideation methods are rated the most effective among different other methods (see Figure 3-24). There are several precise approaches how to get input from potential customers and lead users. The involvement of the customer is not only needed during ideation but also for testing a product. The newly developed product should be accepted and work correctly when customers misuse or abuse it[201].

Putting potential customers in the focus in innovation processes received more attention in recent publications (Holt, 1988 and Cooper improving the Stage-Gate model from 1986 until 2011). Without knowing exactly what the user needs are and if the user will accept the product it is very hard to predict if a new product will succeed on the market or fail. By integrating users in the process of ideation and testing the outcome of the project will be improved.

[196] Cf. Thom (1980), p. 472 ff
[197] Cf. Thom (1980), p. 151
[198] ibidem
[199] Cf. Holt (1988), p. 8 ff
[200] Cf. Holt (1988), p. 25 f
[201] Cf. Cooper (2011), p. 308

Cross-functional teams

One of the main factors in Design Thinking is having the right team. Kelley even describes the team around a project as the heart of the IDEO method[202]. There are several aspects in forming a team as the people's dedication and passion for the project. Other important conditions for a successful team are the trust between them, respect for each other and focus for a set goal. These characteristics are not depending on the expertise of the team members but rather on their personality. Cross-functional teams even increase the quality of the final outcome due to the different views on a problem. At IDEO, team members choose their own project they want to work on (cf. chapter 3.2) which implies that each employee works on one project at a time.

Thom only covers the ability to work in a team which is split up into several "sub-abilities" such as the ability to develop and respect the rules for the teamwork, willingness to compromise, communication skills, ability to bear with conflicts, empathy and the ability to participate.[203]

The role of the team in a project was not considered by Holt.[204]

Similar to Design Thinking is Cooper's description. One reason why a new product fails is if the team working on the project is not cross-functional[205]. Projects are handed through the departments rather than picking employees from each one and form a project team[206]. On the other hand, for an ideal new-product system the team needs to be cross-functional. Such a team has members from various functions and departments with a defined team leader who has formal authority and the people are only working on the one project. Furthermore, it is possible to exchange members according to the work requirements and the whole team is responsible for the success of the project.[207]

Thom and Holt didn't put great importance on cross-functional teams. Cooper and IDEO label those teams as very significant and as a major factor for successful projects. The difference between the two is that Cooper covers only employees from various departments, i.e. marketing, engineering or manufacturing but IDEO includes every single discipline, i.e. mechanical engineering, biology, arts, etc.

Prototyping

In Design Thinking prototyping is a separate phase in the innovation process but should be practiced as often as possible during the other phases as well. Prototyping is used for

[202] Kelley/Littman (2004), p. 69
[203] Cf. Thom (1980), p. 363
[204] Cf. Holt (1988), p. 1 ff
[205] Cf. Cooper (2011), p. 30
[206] ibidem
[207] Cf. Cooper (2011), p. 90f

problem solving since anything can be prototyped (see Table 3-1 – Different prototyping methods) to gain new insights[208]. Even though creating an idea in one's mind takes less time than prototyping, building a model of the idea helps evaluating and refining it and moving towards the best solution[209]. Through focused prototyping of simple and cheap concepts specific problems can be addressed.

In Thom's model prototyping could be part of the idea realization phase but it is not explicitly stated. Another indication is that during this phase the development of costs has a strongly progressive trend[210].

In the descriptions of each step by Holt there is also no suggestion for prototyping. However, several steps, such as design and testing of models, laboratory testing or user testing imply that different models have to be created which would be identical to a prototyping phase.[211]

The development stage in Cooper's model is an equivalent to a prototyping phase. It is described as the most obvious action in this stage. The physical development of the product is accompanied by various tests. Multiple versions of the product are created in this stage following the "build-test-feedback-and-revise" iteration cycle.[212]

Similar to the cross-functional teams only Cooper and Design Thinking take active prototyping into consideration. In both approaches prototyping is used as a tool to constantly improve the product to find the best solution possible.

Working environment

In Design Thinking the space in which the project team works is also a crucial factor in order to be creative. A common office would be a block for creating innovative solutions. The effectiveness of the team members is defined by the physical and psychological space the team works in. At IDEO each project is allocated to a room which is reserved for the duration of the project and where all information and material (i.e. storyboards, prototypes and photos) can be placed in order to have an overview of the project every time the team is working on the project.[213]

Neither Thom, Holt nor Cooper takes the physical space into account as a factor for creativity in the innovation process.

[208] Cf. Kelley/Littman (2004), p. 103
[209] Cf. Brown/Kātz (2009), p. 89
[210] Cf. Thom (1980), p. 215
[211] Cf. Holt (1988), p. 1 ff
[212] Cf. Cooper (2011), p. 298
[213] Cf. Brown/Kātz (2009), p. 32 ff

Launching a product

The last phase of the Design Thinking method described by Tom Kelley is Implementation. However, Kelley focuses only on coming up with a good solution to a problem in his book and gives no input on how to implement it on the market. Brown's defined phase "Implementation" is similar to Kelley's definition; implementing the product is mentioned but not described. The Design Thinking for Educators suggests the Evolve phase where it is described to further develop the working product but no strategy on how to bring it to the market.

The definition of innovation in Thom's model includes the acceptance of the product by the customer[214]. This is reflected in the model as "sell new idea to addressee" and "control acceptance" under Idea Realization. The main topic in the publication is innovation management and not descriptions of how to perform each step in the innovation process. Consequently there is no further information of how to launch a product.

The fourth phase of Holt's model is Implementation which deals with the introduction of a product to the market. Each step from the first introduction and its strategy to elimination analysis is considered in this phase. Prior to this stage the model suggests test marketing steps in order to evaluate if the product will be accepted on the market. If the product succeeds it will be launched by selecting an appropriate strategy. Criteria for the actions are preparation of plans (i.e. advertising material, training of salesmen, etc.), decision on size of the introduction campaign and decision on the form of introduction (test or full scale launch). After launching the product the actual sales figures have to be recorded.[215]

In the Stage-Gate System launching a product is the final stage of the process. The second last gate is the final check if a product should continue to be introduced to the market. After that, a market launch and operations plan has to be developed for the implementation of the product. These plans include defining the target market, a product and pricing strategy. Cooper gives clear descriptions and states questions that need to be answered in order to successfully launch a product.[216]

Sequence of phases and iteration

As already discussed in chapter 3.5 the number and definition of stages varies depending on the source. For this comparison the five identified phases (see Table 3-2) are used. The five phases "understand", "ideate", "prototype", "test" and "implement" have no strict order and can be performed in any sequence. The human-centered approach allows gathering information in every phase and using the outcomes as a start for other phases.

[214] Cf. Thom (1980), p. 24
[215] Cf. Holt (1988), p. 227 ff
[216] Cf. Cooper (2011), p. 316 ff

Depending on the results of a phase it needs to be decided which step follows. A higher number of repetitions lead to more precise problem statements and better results. This leads to a complex sequence and iteration cycles in every project.

Thom examines approaches of various publications and describes the two-phase model including idea generation and idea realization as rudimentary. Another step in between the two phases is needed, a judgement phase irrespectively of small decisions made during the project. Thus, the two-phase model is enhanced by the idea acceptance phase.[217]

Holt breaks down the innovation process starting from the basic transformation of a need into a need satisfaction and created a general model with each step precisely defined which could be applied to any organization. In the process are four main phases, “Generation of ideas”, “Utilization of ideas”, “Preparation for Implementation” and “Manufacturing and Marketing”. Theses phases are connected by a flow of information that also indicates iteration cycles.[218]

The five stages in Cooper’s model a very well described and between the stages the gates are the decision points if the next step can be taken. However, not in every project each stage or gate needs to be passed, also more activities within a stage can be performed at the same time. As Design Thinking this process doesn’t follow a linear sequence. Within one stage, as well as the whole process iteration and loops in the project with customers and suppliers take place.[219]

Overview

Table 3-3 gives an overview of the seven compared aspects between Design Thinking and the innovation process models described in chapter 3.7.

[217] Cf. Thom (1980), p. 51 ff
[218] Cf. Holt (1988), p. 6 f
[219] Cf. Cooper (2011), p. 113

Table 3-3 – Overview of the comparison[220]

Model / Aspects	Design Thinking	Thom (1980)	Holt (1988)	Cooper (2001)
Number of phases	5	3	4	5
User orientation	Main focus	Can give input but is not actively involved	Considered in various steps of the process	Considered in various steps of the process
Cross-functional teams	Crucial factor in generating high quality solutions	Not considered	Not considered	One reason of successful products
Prototyping	Should be performed all the time during a project	Not emphasized – maybe part of idea realization	Not emphasized – different steps indicate the need for prototyping	Performed in Stage 3 - Development
Working Environment	A social and spatial space increases the effectiveness of the team	Not considered	Not considered	Not considered
Launching a product	Implementation /Evolve – not further described	Idea realization – not further described	Implementation – Introduction, Regular manufacturing, Improvements and Elimination	Launch – detailed description (i.e. defining the right target market, pricing strategy)
Sequence of phases and iteration	Non-linear, complex sequence; phases can be performed at the same time - the more iteration the better the results	Linear sequence; no iteration	Linear sequence – iteration possible	Non-linear, complex sequence; stages can be neglected or performed at the same time – iteration and loops are natural

[220] Own illustration

Summary of the comparison

One stand-out innovation by IDEO (at that time Hovey-Kelley[221]) was the first Apple mouse in 1982 where the company already used the human-centered approach to come up with the best solution[222]. The term Design Thinking was used for this approach when the d.school and IDEO were linked to the birth of Design Thinking[223]. Compared with the traditional innovation processes in chapter 3.7 it can be seen that IDEO used methods that are similar to Cooper's model already at the time when Thom published his approach. Also, the only model that considered a human-centered approach at this time was Holt's model.

Cooper's model has the most points in common with Design Thinking and focuses on similar factors such as cross-functional teams, non-linear process, user orientation or prototyping. The main differences between the two approaches are first, the influence of the working environment on the outcome of a project and second, the emphasis on launching a product. While in Design Thinking the physical space around the team is crucial to the working behavior and the accompanying results of the work, no other model takes the environment into account. On the other hand bringing a product to the market does not get much attention by Design Thinking whereas in the other investigated concepts this is a very important part of the whole innovation process. The reason why Design Thinking neglects the launch of the product might be because the method comes from a design firm (IDEO) and their task is to create a new product for a company. Consequently it is the company's task to launch the product.

3.8 Conclusion

To evaluate if Design Thinking fits to the Product Innovation Project a comparison of the four innovation processes to the challenges and framework of the Product Innovation Project (see chapter 2.5) is made. Table 3-4 shows which of the specifications are covered in each innovation process. An "X" indicates that the specification is considered and described in the approach while an "O" indicates that there the topic is mentioned but not further described. A "-" illustrates that the aspect was not considered at all.

[221] Cf. VanHemert (2014), available online at www.wired.com, accessed on 23.03.2015
[222] Cf. Kelley/Littman (2004),p. 256
[223] Cf. Hassi/Laakso (2011), p. 4

Table 3-4 – Comparison of the innovation processes to the specifications of the Product Innovation Project

Product Innovation Project specifications	Design Thinking	Thom	Holt	Cooper
Cross-functional teams	X	-	-	X
Creativity enhancing working environment	X	-	-	-
User orientation	X	-	X	X
Rapid prototyping	X	-	O	X
Non-linear approach	X	-	O	X

4 Application of Design Thinking in the Product Innovation Project

The workshops and methods described in chapter 2.5 were conducted with the teams during the academic year 2014/15. Each team got an introduction to Design Thinking in order to understand the method and to be able to apply it. In coordination with the project managers the dates were selected.

Table 4-1 shows a list of all conducted workshops and working sessions over the course of this thesis. Feedback and outcomes are discussed one by one in the subchapters 4.# (# is the number according to Table 4-1).

Table 4-1 – List of all conducted workshops[224]

#	Workshop/Session	Facilitator	Date	Duration	Participants
1	Design Project Zero – The Gift-Giving Experience	Alexander Hehenberger	14.01.2015	1h 45min	7
2	Design Project Zero – The Gift-Giving Experience	Alexander Hehenberger	21.01.2015	1h 30min	16
3	Design Project Zero – The Ideal Wallet	Alexander Hehenberger	28.01.2015	1h 30min	4
4	Working Session – Prototyping	Alexander Hehenberger	23.02.2015	7h	3
5	Working Session – Idea Generation	Alexander Hehenberger	04.03.2015	6h 15min	5
6	Working Session – Idea Generation	Alexander Hehenberger	17.03.2015	1h 45min	7
7	Working Session – Testing	Alexander Hehenberger	19.03.2015	1h 30min	3

[224] Own illustration of conducted workshops

Each conducted workshop ended with a debriefing and was evaluated by the participants with a feedback form (see Appendix E). After working sessions where the students are just supervised they are not asked to fill out this feedback form. Instead a small discussion was raised to get to know the opinion of the participants.

4.1 Workshop #1 – Design Project Zero

The first workshop was “Design Project Zero”, conducted for just one team. Seven members of Team Voest took part and to have an even number of participants the facilitator also had to take part.

Feedback

Figure 4-1 shows the rated level of detail of the content on a scale from one to four, where one is “very good” and four is “bad” and how many participants felt the workshop was helpful.

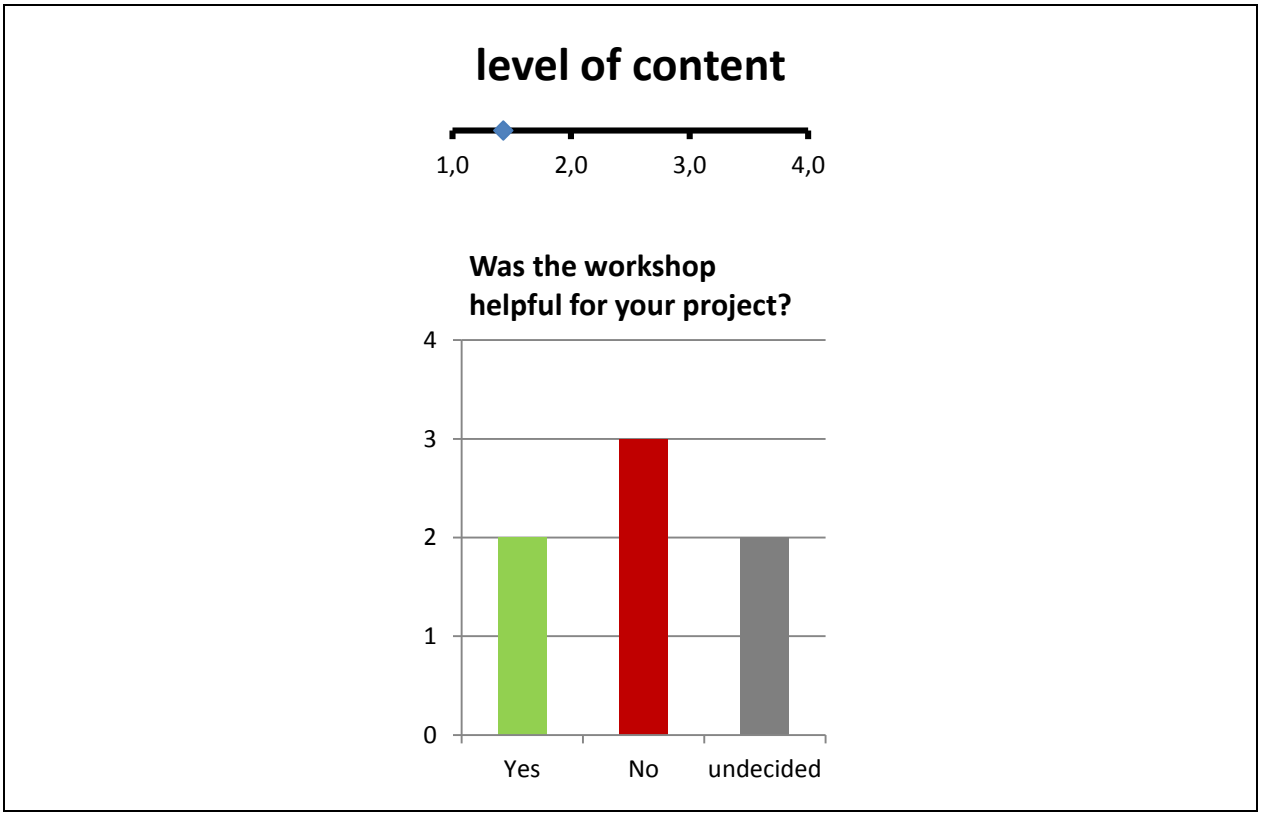


Figure 4-1 – Outcome of the feedback form of workshop #1[225]

[225] Own illustration based on the feedback forms of the participants

The average level of detail of the content was rated with 1.4. A change suggestion to improve the level of detail was to have more time in order to catch the real problems of the users.

Only two students felt that the workshop was helpful for their project while three said it was not and two were undecided (one checked both and another no answer). To the question “Why not?”, two participants stated that their project is different, meaning their task is very technical and they cannot apply this human-centered approach to their problem. The three students who stated no declared that they actually don’t know if it will be helpful.

Most of the students mentioned the process (five students) and the interaction with another person (three students) as well-working. Three students suggested changing the topic in order to fit better to their project and two would decrease the noise ratio that raises during the interview parts.

Discussion

Three students had to leave early, so the discussion was moved to the end of the session. After the first question one student pointed out that it is hard for them to apply these methods to their project because they have a highly technical project and that the time was not sufficient enough. The task is “finding failures in hot steel” which is not done by people because the machine would work autonomously.

Further input was given to clear misunderstandings; the students mentioned that empathizing is not possible in their project and that is why the method is not helpful. They are right that for such a technical problem observing people can’t be implemented but people can be asked what could work and what will definitely fail. Reducing the empathizing step to *“collecting data by asking experts”* was an appropriate solution for the students.

Another discussion point was that the problem statement was already precisely defined by the company. The team members stated that they had an idea which wouldn’t solve the initial problem but it was a very creative approach to tackle the problem. The advice given to the team was to look again on their task description and think about if it is the “real problem” and rephrase the question (task description). In such a case it is important to take one step back and question the problem statement to get a different point of view.[226]

[226] Cf. Kelley/Kelley (2013), p. 99 ff

Outcome and Learnings

For a project with a highly technical task it might be better to have a different topic than “The Gift-Giving Experience” for the students to find a better connection to Design Thinking.

4.2 Workshop #2 – Design Project Zero

In the second workshop a total of 16 students of four teams participated. In order to compare if the topic “The Gift-Giving Experience” is not well received by only one team it was not changed for this workshop. Before filling out the feedback forms there was a short debrief.

Discussion

The discussion was initiated by the question “How did the interaction with another person change your way of working?” The students stated that it was *“easier to start”* and they got “*better insights and explanations”*. The pace was commented as *“good”*, *“not time wasting”* and they felt to be *“more creative and efficient”*. The pressure was good but it was also mentioned that they had the feeling they *“maybe miss something”*. The next question was if the students could do the same workshop over again, what would they change? They would focus on getting more input through the interview and on testing their prototype. It was also noted that an extra step to get input from external people would have been helpful. The participants had to show unfinished prototypes to their partners and when asked about this they stated that *“extra explanations were needed”*. In the end the students were asked if they can implement parts of the workshop in their projects. The opinions were mixed, ranging from *“using it 100%”* to *“maybe in the end of the project”*.

Feedback

In Figure 4-2 the evaluation of the workshop is illustrated. On the one hand the average level of content decreased to 2.1 from the last workshop, on the other hand the percentage of students who felt the workshop was helpful increased to over 80%.

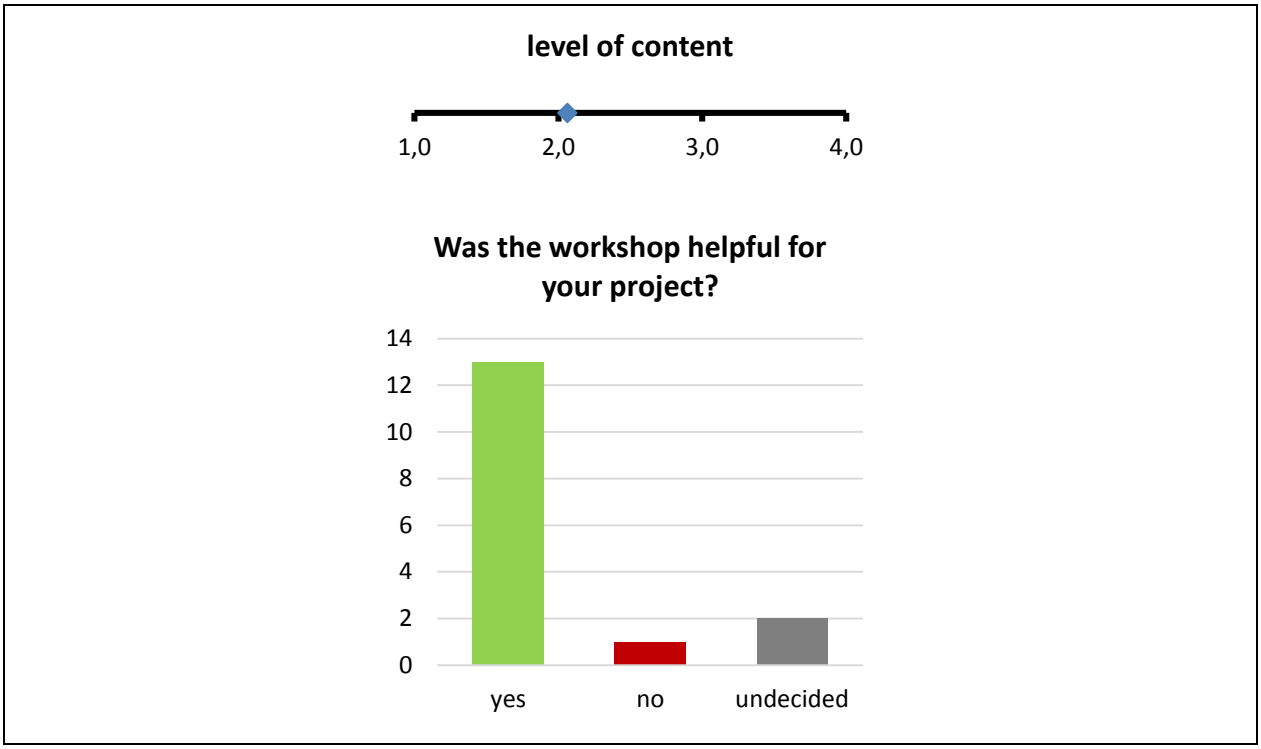


Figure 4-2 – Outcome of the Feedback form of workshop #2[227]

There were some suggestions to change the content of the workshop; most often mentioned were more detailed explanations and providing more examples to have a better understanding what the supposed outcome of the step is.

13 out of the 16 participants felt the workshop was useful while the other three (one “no”, two “undecided”) stated that the method is not applicable to their project because their problem is different. These three students were working on different projects. This fact leads to the conclusion that their expressed opinion does not depend on their project rather it is their personal opinion. Their interpretation was that Design Thinking is one fixed method that can’t be adapted. However, it is not a strict process and can be customized for certain projects which should be mentioned during the debriefing.

What the students liked most was the overall concept and that it was a funny and fast workshop. They wished for clearer instructions and a different topic. These two improvement suggestions are connected since a lot of students don’t know what to do with the topic and it is hard to explain the steps in detail and still be within the time frame.

[227] Own illustration based on the feedback forms of the participants

Outcome and Learnings

In the two conducted workshops the participants mentioned to change the topic to a more tangible one. Therefore, for the third Design Project Zero workshop the topic was changed to “The Ideal Wallet”.

During this workshop some students mentioned that it was not always completely clear what they were expected to do. To get a better understanding some of the handouts were collected and were taken as examples for the next workshop.

4.3 Workshop #3 – Design Project Zero

The last workshop to introduce the students to Design Thinking was conducted with a different topic. “The Ideal Wallet” should be a more tangible task for the participants. Although only four students took part in it there were some interesting outcomes.

Discussion

The question “How did it feel to go through a whole cycle in this short amount of time?” started the discussion. One student explained that he had some expectations for the design but when he was going through the steps he realized that his expectations were not met and he should have been unbiased from the beginning. He also mentioned that time was short and if he could he would go back two steps to get to a better solution. One student commented that it is hard to find the real problem within this time. At this point it was clarified that the participants just went through one cycle of Design Thinking and iterating is a very important aspect of it. Not only going back to ideation or prototyping but also start again with empathizing with the user and defining the problem has to be considered. Another student noticed that he mixed his own ideas with the ones of his partner.

The participants were asked what they can take from this workshop. It was stated that in one team they never tested their prototype and they will implement this step in their project. Another student remarked that they will schedule enough time for testing their prototypes in their future project plans.

Feedback

Changing the topic was not mentioned in the feedback forms, only an idea to give two different tasks to the partners in order to not be biased from the beginning. Prototyping a wallet felt easier than something to improve the gift-giving experience which results in a better outcome for the participants. Figure 4-3 shows the results of the feedback forms.

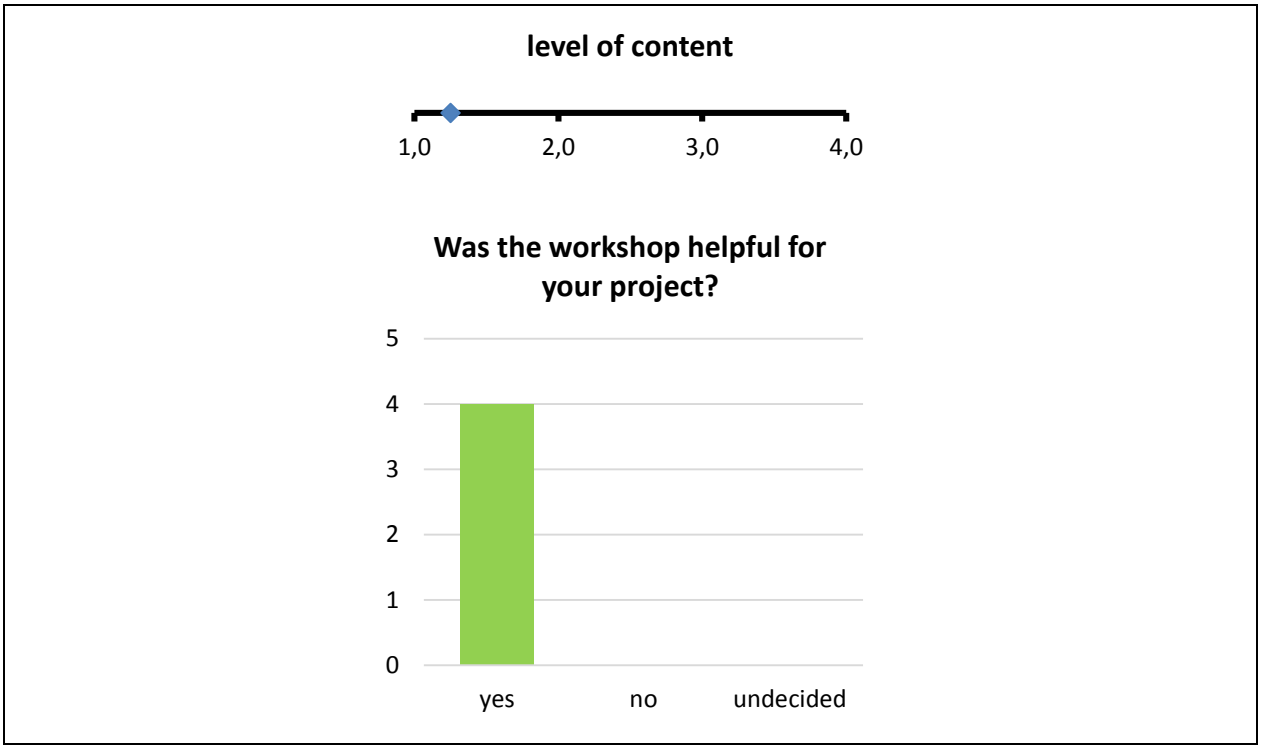


Figure 4-3 – Outcome of the Feedback form of workshop #3[228]

In general the feedback was very positive and the impact of changing the task can be seen. The participants could relate better to this design challenge. In their feedback they focused mainly on the outcomes and what they can take away, compared to the previous workshops where a lot of criticism concerning the topic was voiced. The students listed prototyping and testing as points they liked about the workshop and valued the input on this. Also the whole concept of Design Thinking was praised as practical and something that can be applied to the projects.

Outcome and Learnings

The idea of offering two different tasks for the partners in this workshop can be a good approach to point out certain differences. This should be taken into account when preparing design workshops.

As already mentioned, the task of the project was not criticized which leads to the conclusion that the more tangible task “The Ideal Wallet” was more effective for projects in which a product was developed.

Another aspect worth to be discussed is the time available for each step. Depending on the purpose of the workshop the time frame can be extended, i.e. if the workshop is an introduction in the beginning of the semester before the projects starts it can be stretched.

[228] Own illustration based on the feedback forms of the participants

4.4 Working Session #1 – Prototyping

The first working session with a student team was conducted with Team Space that was sponsored by Magna. As a start the participating team members presented the status quo of their project. This was followed by working out a plan for the day, which included prototyping, testing and evaluating the results. The whole timetable with approximate durations can be seen in Table 4-2. The goal of the team was just to move forward and get things done in their project.

Table 4-2 – Schedule of Working Session #1[229]

Start time	End time	Action
12:00	12:30	Presentation of Status Quo
12:30	13:00	Working out a Plan for the Day
13:00	13:30	Lunch Break
13:30	15:00	Prototyping Existing Concepts
15:00	15:30	Preparation for Interviews
15:30	17:00	Conducting Interviews
17:00	19:00	Analyzing Outcomes and Evaluation

Starting Point

The previous step of the team was to decide upon which concepts they should follow out of the numerous ideas they created during brainstorm sessions. They chose six ideas by voting for those that the team members found promising and developed concepts out of them. The team split up into groups of two to work on each concept and create a first prototype. Some of the groups already finished their mock-ups while others only created a first draft. In the working session the team decided to not only focus on the three concepts they are responsible for but to go for all six to move forward in the project.

Prototyping

After creating the plan for the day the participants set their own time frame for prototyping. Since they already had finished some before the working session they decided to not spend more than an hour and a half on prototyping. The instruction the team received for this step was to build “quick and dirty” prototypes in order to just show the idea of their concept and get feedback on the idea itself. The six concepts chosen by the team should

[229] Own illustration

then be tested with the users to get feedback on each idea. Therefore, a quick and cheap prototype to explain the concept is the best way to get answers[230]. Technical details don't matter at this stage, showing the rough idea is enough. For example, Figure 4-4 shows one of those prototypes. The card board frame illustrates the whole trunk and the folded paper is a flexible layer in the trunk.

Figure 4-4 – Prototype of Team Space[231]

In this way, quick and cheap, the team created six mock-ups for their concepts which could be shown to users. The goal was to get feedback on them in order to evaluate if they should follow the idea or dismiss it.

User Testing

Some preparation time was needed before asking the users about their thoughts. The audience for the interviews was easy to find, since everyone who has used a car's trunk can give their opinion. A total number of 10 – 15 people should be interviewed. The team decided to go to people they already know. They divided roles among them, one led the interview and gave explanations to the mock-ups, another one looked at the people's reactions and facial expressions and the third wrote down everything notable what the interviewed person said. To make the analysis easier the two team members who were taking notes on which prototype the feedback was and if it was "something they liked",

[230] Cf. Kelley/Littman (2004), p. 113
[231] Author's picture

“something they didn’t like”, “a question” or “an idea”. Those were indicated with “+”, “-“, “?” and “!” respectively. This system followed the “Grid-Model” used in the Design Project Zero (see Appendix A, p. A-3). The team also prepared some questions to be able to keep the flow of the interview.

Each prototype was first explained to the interviewee to understand what the main function would be. The interview leader mainly asked questions about if the presented feature would be practical for the people and if they would use it. To gain more empathy it was also asked for what else they might use it or how they would improve their idea. The result was a total of seven interviewed people, which was not the intended goal but the team felt good about the quality of the feedback and stopped at this point.

Analysis and Evaluation

The first step of the analysis was to rewrite all the gathered feedback on post-its and pin them to the grid. For each mock-up there was one flipchart paper reserved where all the appendant post-its were put to have an overview for making the decision “What to do next?” Figure 4-4 shows one of those flipchart papers with the grid and the next steps for this concept at the bottom. Looking at the post-its and the overall impressions of the interview the team members decided what the next steps could be, i.e. going deeper into the concept and think about how to realize it, combining two ideas or even dismissing one entire concept because the reaction to it was not good.

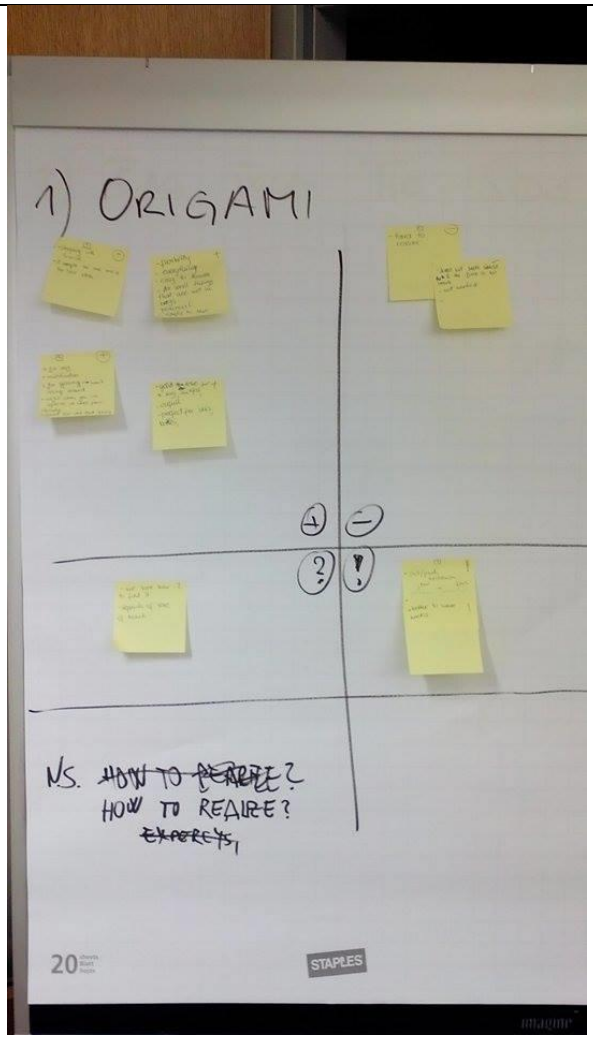


Figure 4-5 –Grid made by Team Space[232]

Feedback

At the end of the working session the feedback was collected to assess if the goal was reached by applying Design Thinking methods. All three of them mentioned that it was fun to work together on the project and with the plan it felt easier to get things done. The interviewer stated that it was hard to lead the conversation and which questions should be asked. But on the other hand he explained that if he feels positive about one idea the feedback finally tells him if the idea is really worth following or not. Those different opinions help the team getting forward and filtering out which concept they should realize and which they can neglect.

Another point that the participants agreed on was that in this half-day they got more work done than in the past few months and they moved forward by simply having a plan and getting things done. With the time frames they set they got pushed to work on their actual

[232] Author's picture

prototypes which are better to show to people than just explaining the ideas. They also mentioned that it would be necessary to create better prototypes in order to get better feedback for the concepts.

Lessons Learned

After this first working session some points have to be mentioned that are essential for a project like the Product Innovation Project. First of all, this half-day workshop confirmed how effective simple prototypes can be. By just showing the idea with a physical model the interviewed people could imagine what the idea behind it was and could immediately give feedback on it. However, sometimes it happened that people misinterpreted the mock-up and even with some explanations they judged on what they saw. A more precise model might have helped in this case.

The observation of the interview and especially the interviewers led also to some insights. Even with the prior preparation it has been observed that the team got stuck and some points or didn't catch stories that the interviewees could have told. These stories could result in higher empathy for the users and understanding of why they do things in a certain way. For example, one person already started a story of how he put his wet umbrella into his car. This would have been a great opportunity to dig deeper and let him tell his story in order to gain empathy.

Another improvement point for the interviews would be to ask "Why?" more often. The team members sometimes tried to find the reason for some answers but stopped at one point where they could have gotten more out of it. For example, during another interview, a person told of how she basically puts everything on the floor. Understanding why she is doing that and if this pattern could be improved might have resulted in new ideas for the project.

The two previous outcomes can help improving the quality of the interview. Also the prototype should answer a specific question[233] which should be declared before starting to prototype. This way the analysis and evaluation would be done faster and more effectively.

The main goal, to move forward in the project, was reached according to the feedback the participants gave. Some improvement points were determined but as a conclusion it can be said that for this project it was very useful to apply the methods of Design Thinking.

[233] Cf. Kelley/Littman (2004), p. 106

4.5 Working Session #2 – Idea Generation

As a continuation of the first working session with Team Space (sponsor: Magna) the team decided to have another session which started at the exact point where the first session ended. Since different members of team participated in this working session the first step was to update everyone to the status quo. The six concepts and their prototypes were presented to the whole team, followed by a summary of the feedback the team gathered during testing. Based on this, the decision how to proceed (Understand, Ideate, Prototype or Test) with each concept was made by the whole team and one new concept was added. Table 4-3 gives an overview of the seven concepts and the decisions.

Table 4-3 – Name and decision of the phase of the seven concepts

Nr	Concept name	Decision
1	Origami	Prototype
2	Shelf-to-shelf	Prototype
3	Bag	Prototype
4	Shell	Ideate
5	Back-bag	Ideate
6	Umbrella	Prototype
7	Widget	Test

The team decided to go for Ideation in this session and improve the two existing concepts (Shell and Back-bag) where questions raised during the feedback sessions.

Introduction

Before having any brainstorm sessions the team was introduced to the ideation method. First, the rules of brainstorming (cf. Figure 3-11) were clarified and discussed so everybody agrees on the rules. A facilitator was picked who was in charge of leading the brainstorm session and who made sure that everybody stuck to those rules. He was also responsible to keep the goal in mind that was set by the team.

Idea generation

After the evaluation of the last working session some negative points and questions raised for the two concepts. Based on these data the team had to identify the problems

that need to be solved for each concept. The clustered feedback was analyzed to find out the main problems for each concept which were rephrased into “How might we …?” questions. By answering these questions possible solutions for the problems can be generated. The team spotted three problems for the Back-bag and two problems for the Shell. They decided to spend 10 – 20 minutes brainstorming per question and set a goal of 60 ideas in total.

Analysis

The team clustered their ideas to each problem, putting together similar solutions and defining the main principle behind it. This procedure was first performed for every question of the Back-bag concept. The outcome of this step can be seen in Figure 4-6. Afterwards the team split up into two groups to create new concepts for the Back-bag by combining the principles and developing technical details for them. After 30 minutes both groups presented their results to each other. The last step was to vote for the concepts and deciding which one to follow. This approach was executed again for the Shell concept.

Figure 4-6 – Clustered overview of the first concept ideation[234]

Next Steps

At the end of the working session it was discussed how to proceed further. After this session six out of the seven main concepts required prototyping which the team decided on doing as the next step.

[234] Author’s picture

Feedback

The session was closed with a short feedback discussion about the methods the team used during the day. The overall impression was really good and the method was described as *"very helpful"*. The participants were very enthusiastic about the whole day and appreciating.

The analytical approach of taking one step after the other with clear instructions, defined goals and a tangible outcome was an efficient working structure for the participants. Especially the procedure of analyzing three different problems of one concept (as in the Back-bag concept) separately and combining the possible solutions afterwards to a new solution was remarked as productive. As in the first working session with this team it was again stated that having one scheduled day to work on the project helps getting forward.

One person noted that having such workshops or sessions in the beginning of the project as a lecture would help tremendously because they wouldn't waste time finding out how to start with the project. Also, that a facilitator who is familiar with the methods helps getting things done during such working sessions.

Lessons Learned

During this session the Design Thinking for Educators Toolkit was used as a guideline and the exact execution of each step was adapted. Having an overall picture of how to get creative ideas during a brainstorming session already helped in composing and organizing the steps. Some important factors for a brainstorming session were pointed out such as the brainstorming rules or phrasing "How might we …?" questions.

A discussion about the brainstorming of the team revealed that it was not easy to follow certain brainstorming rules. They mentioned that they had a hard time to come up with wild ideas and building on the ideas of others. Those rules shouldn't be taken as strict standards, rather as guidelines that give a structure to a brainstorming session and to create a more creative environment.

The participants were very excited about how the methods can be easily applied to their project and about getting a lot of work done within one day. They also mentioned the need of a facilitator who is pushing them to work on specific tasks and who tells them how the methods work. The idea of having at least one person in the student team, who is familiar with the methods and knows how to apply them, could be a key factor for projects in the future.

4.6 Working Session #3 – Idea Generation

This working session was conducted with the team sponsored by Voestalpine. It has to be pointed out that the project they were working on has a very technical background and

a prototype is hard to realize for them. The team's task was mainly to come up with new possible solutions of how to solve the task and they gradually understood that out of the box concepts are the ones that their sponsor was looking for. This was also the reason and topic for this working session, to come up with new out of the box ideas. Previous concepts were neglected during the session for an unbiased view on the problem.

Preparation

A clear plan was made for the evening on what the team wants to do and what their goals were for the session. The first task was to define brainstorming questions ("How might we …?") where everyone felt comfortable with finding answers to it. Due to the limited time frame they focused only on three of their six concepts. The formulated questions were written down on big papers that were fixed on a wall in order for everyone to see them. There was a discussion within the team of how the questions should be phrased. One participant stated that they should keep restrictions in mind and not to have too open questions. He used a metaphor to describe it: *"If people stand on a high platform without a fence, they won't go to the boarder but if they would have a fence they would immediately look over the fence to see what's there."* This input got the team stuck at finding a "fence" (restrictions) for their questions. However, they broke up discussing about it because they couldn't identify any which in the end turned to be a good choice. The team came up with four questions:

1. How to separate two things?
2. How to destroy things without touching them?
3. How to make things more obvious?
4. How to make things less obvious?

These were very open questions which could lead to any answers and spark out of the box ideas.

Idea generation

There was a short preparation time to arrange the room for a good brainstorming session which included putting the papers (with the four questions plus one for open ideas) on the walls, getting idea cards and pens ready as well as finding a comfortable position in the room. This setup can be seen in Figure 4-7.

Figure 4-7 – Setup of the room and team Voestalpine brainstorming[235]

For the brainstorming itself three external people were asked to join for fresh ideas. Those three were members of team Magna who already had such an idea generation and knew how they have to tackle the questions.

Before starting, a short introduction to some rules and guidelines were discussed. A facilitator was chosen who was in charge of making sure that the team stuck to the rules and to keep the goal in mind. Going through the seven brainstorming rules (see Figure 3-11) by explaining them and letting the whole team agree on them. After that a time frame and a goal of how many ideas they want to generate was set. With the help of the three external people a total of 75 ideas within 45 minutes was agreed. The team also chose to work on each question at the same time and not going through them one by one.

The brainstorming itself started quickly and after 25 minutes the team decided to stop because they had already generated 88 ideas. As a next step it was decided to explain the generated ideas in order to understand the thoughts behind it. During this explanation phase the team was reminded to just go through the ideas and to judge and cluster the ideas later. Also, they were encouraged to share some stories of how they came up with the idea and to build on the ideas presented and immediately develop them further. It was observable that most of the wild and not task related ideas came from the three external people. As more wild ideas were put on the wall the member of team Voestalpine

[235] Author's picture

also started generating some. For example, to question 3 “How to make things more obvious?” one external person had the idea of *“asking a professor during an exam about the questions in order to make them more obvious”* and to question 2 “How to destroy things without touching them?” one team member then had the idea of *“making them radioactive because people or animals die of it”*. Those ideas are obviously not applicable but they fulfilled the intended purpose to generate out of the box solutions.

Next steps

After explaining all ideas the team was shown on how they can proceed further. They agreed on clustering the ideas with the same basic principle and vote within the team on some concepts which should be further investigated. With some research about the concepts they can brainstorm again on how to realize the ideas by phrasing more detailed questions.

Feedback

The feedback round was started with the question if there were completely new ideas generated or if most of them were the same. The immediate response was *“definitely”* and it was stated that it was the best out of the box brainstorm session they had in the project. Although there were a lot of vague ideas the main principle behind them is very good and something they can use to create more solutions. It was also mentioned that they reached their intended goal which was not the 75 ideas but coming up with completely new concepts for their problem.

Since the team already had some brainstorming sessions before the question “Did this method help you?”. One participant mentioned the brainstorming questions that were defined in the beginning as the key to this successful brainstorming session. However, the team agreed that the fourth question was not well-articulated because they weren’t aware of how important the question would be. For another idea generation the team would know how to phrase them.

Another aspect why the session was successful was that there were three external people helping to find new paths. It has to be pointed out again that those three already had such a brainstorming and learned a lot from it how to tackle problems. This inspired the team and with three well-articulated questions a good starting position was given.

The team stated that there was one part of the brainstorming session that they would do differently after experiencing their first one. Instead of generating ideas for all four questions they would go for one after the other, explain the solutions and try to build on the ideas of others.

The last point mentioned by the participants was that it would have been better to have these sessions in the beginning of the project, more precisely in November. The team

was certain that with this method the previous brainstorming sessions would have had better results.

Lessons Learned

One big part of a brainstorming session is the facilitation of it. It could be observed that the team easily lost focus at some points and the chosen facilitator was joining and didn't lead the team back on track. A clear definition and understanding of the goal might be necessary for the facilitator to keep the focus on topic. The balance of serious talks and jokes should also be weighed to have a good flow in the session.

With the very openly phrased questions the team encouraged themselves and the external people to think differently and create more out of the box ideas. This might be well applicable in the beginning of the project, especially because most partner companies are looking for such out of the box ideas. By narrowing them down through voting and the decision of the partner companies the following brainstorming questions will be more detailed and will result in more detailed concepts.

The last point that should be mentioned is the number of brainstorming questions at the same time. In this working session the team decided to find ideas for all of them at once. However, in the Design Thinking for Educators toolkit it is suggested to find solutions for just one question at a time[236].

4.7 Working Session #4 – Testing

This working session was conducted with team sponsored by Fronius who already finished two working prototypes and a small amount of other design related prototypes in order to clarify designing issues. During their project they also had to define the target group of their product where the team identified four different groups. Due to the limited time they had to focus on one group which was called "the Apple user", defined as people who buy more expensive products as a status symbol and who identify themselves with the product. The goal of this session was to prepare a testing phase and get feedback from outside on their prototypes. The team invited student colleagues for the next day to give input.

Preparation

After a short introduction to the current status of the project the team got some input on how they can get the most valuable feedback for their prototype. They already decided

[236] Cf. N.N. (2012) *Design Thinking for Educators Toolkit,* available online at www.designthinkingforeducators.com, accessed on 28.01.2015, p. 52

the target group for this interview and the prototypes were finished as well. The next step, framing interview questions was taken.

This was the first time in the project that the team turned to outsiders for feedback. In order to find out on what they want to get feedback the team set together and had a brainstorming session. One participant wrote each topic down on a whiteboard without discussing or judging its details and importance. Applying the rules of brainstorming helped to find out small details they hadn't thought of before. In the next step they had to cluster all keywords into a few main subjects. At first, this wasn't very clear to the team why this could be useful but they realized that it could be helpful while leading the conversation during an interview to not get lost or confuse the interviewee. As in a brainstorm the team found new questions that need to be answered during the clustering and discussion of the topics. The last step was to rephrase some questions and arrange them to have a clear structure.

Interview

During the preparation of the testing phase the team had a small discussion about what to look out for during the interviews. Some key points were explained such as dividing roles among the team members (i.e. a person who leads the interview, a person who takes notes, etc.) or having a clear structure during the interview in order not confuse the participants. Another topic was to have on the one hand specific questions to get feedback on certain details but on the other hand to ask very open questions in order to get unbiased views on the prototype which can give valuable insights on how people might use the product.

The interviews were conducted in a room where all prototypes were exposed to the participants at once. The leader of the interview asked the gathered questions in the predefined order. Other participants were invited to have drinks and snacks before and after their interview.

Feedback

After the interview a small feedback session was held to evaluate the applied methods. The inputs on how to lead the interview were not fully adopted due to the settings and environment. However, the team was satisfied with the results and pointed out that especially the preparation of the subjects and questions helped a lot to get valuable feedback from the participants. They also mentioned that the space helped in that matter because people stayed after the interview and came back to them with new ideas.

The interviews were not conducted with the intended target group of their product. To gain more valuable feedback on their product, representatives of this target group should be invited for another testing session.

The project manager also mentioned that he would include the user feedback from the very beginning if he could have started over again. For the start he would have just built some “quick and dirty” prototypes to get input on small ideas such as handle bars. For the more advanced models with greater detail he would have spent more time on preparing the interview to get even more valuable feedback.

Lessons Learned

The preparation for the interview was rather short and since the topic changed quite a lot during the discussions. A more structured approach for facilitating this type of working session would improve the quality of the outcome.

One important point was missed during the preparation which was the environment of the interview. A better option would be to interview the participants in their natural surrounding but the team decided to conduct the interviews in a neutral space. It was pointed out that in this case the testing environment should be as authentic as possible. With one person of the team watching the interviewee interact with the product and writing down notes would provide valuable insights of the behavior.

Similar to the statement in the previous working session one participant mentioned the timing of the working session. Giving the teams more input in the beginning of the project could give them a quicker start and therefore, better end results. The team learned very fast the crucial points of getting feedback with only little input. This structure could be realized in the following years of the Product Innovation Project.

4.8 Conclusion

The overall goal of the conducted workshops and working sessions was for the teams to make a significant step forward in their project. Before the working sessions the teams set their own deadline and defined the milestone for each session. It could be observed that after each working session the teams were very satisfied with the results. The time frame that the teams scheduled for the working sessions was sufficient to reach their defined goals even with a small group of three to four team members.

The sessions were moderated by a facilitator who had already applied Design Thinking. This helped the teams to understand the approach and tools that were applied. To ensure that students who participate in the Product Innovation Project can apply Design Thinking they should be introduced to the methods and tools before they have to perform them.

This leads to the conclusion that a project team can reach narrowly set deadlines if they thoroughly plan their working sessions. Therefore, following suggestions should be considered while making a plan for such a working session:

- Define a date and a time frame for the team.
- Set a clear schedule and tasks for the session.
- Define one facilitator who has prior knowledge of Design Thinking.
- Define the outcomes and their requirements for the session.

It is not a requirement to have the whole project team available for one working session to reach the goals. As it was in each conducted working session, it is sufficient to have only a small group to work on the defined tasks. With such a setting the university could set more deadlines throughout the project.

5 Implementation of Design Thinking

Applying Design Thinking to the Product Innovation Project in different ways and asking the participants for their feedback on the approaches showed that the methods helped the teams make significant progresses. The quality of the outcome of the working sessions was satisfying for the students which resulted in requests for further sessions.

The approach of Design Thinking to focus on product or process innovation and the environment around it is identical to the purpose of the Product Innovation Project. The lecture is still in development such as the physical space or team selection. However, currently are no methods suggested which the students can apply to their projects. As Design Thinking has the same setup, introducing the students to the methods could help them increasing the quality of their results which is beneficial for all three parties, students, university and industrial partner. With a great outcome of the project the industrial partners will be more likely to cooperate again and provide more challenging tasks, the project itself will be more popular among the students, which helps the university promoting it and developing the lecture.

The outcomes of applying Design Thinking to the projects in the academic year 2014/15 support the vision of the Product Innovation Project (cf. chapter 2.3). Based on these outcomes and processes in similar courses (cf. chapter 2.4) suggestions for how to implement Design Thinking into the lecture are given in this chapter. Since the overall target of the Product Innovation Project, to give students the chance to start a business with their own ideas, is different from the current setup of the project short-term goals need to be defined. The first steps should include implementing Design Thinking into the project while for the long-term a different structure might be needed.

5.1 Short-term implementation

The working structure of the Product Innovation Project is constantly developing. Even when the industrial partners are satisfied with the results of the project team there is still room for improvement. One example for this was the team sponsored by Fronius, from the company side as well as the university side the outcomes were very good. However, the team never took the chance to test their prototypes with the defined target groups. By letting the target users test and interact with the product the team could have gotten valuable feedback on their design, technical specifications and overall needs.

5.1.1 Structure

To ensure that Design Thinking can successfully be applied the environment and the structure of the project should follow the values of Design Thinking. One of these factors would be the physical space in which the teams operate. Prof. Ramsauer stated during

the interview (see chapter 2.3) that the building that is planned for the Product Innovation Project in the future will be built upon the standards of IDEO. Therefore, this topic is not covered in this chapter. On the other hand, factors that support the implementation of Design Thinking are discussed such as checkpoints which allow the university staff to follow the progress of the teams.

Project manager selection

The role of a project manager in the Product Innovation Project includes teambuilding activities, keeping an overview and to manage the team. Besides organizational skills these tasks require socials skills as well. Currently, students can apply to the position of the project manager and the university decides after interviewing them who will be chosen for which project taking their preferred choices into consideration. A significant drawback in this process is that it might be hard to determine the best fitting project manager for each project according to their organizational and social skills. Social competence is a success factor for leaders[237]. Therefore, the process of the selection of the project manager needs to be improved and the roles have to be defined.

Bohinc defines the tasks of a project manager including accomplishing tasks, representative of the team, project management, team leading and others[238]. These match the current responsibilities of a project manager in the Product Innovation Project. To make sure that future project managers are aware of their tasks and are able to fulfill them a different selection process might be more suitable. One possibility could be to let the team itself decide who the project manager will be. If a team doesn't have an assigned leader there will develop one over the time[239]. After forming a team the members can decide who has the best qualification of leading the team and fulfilling the required tasks. This implies that everyone in the team is aware of these tasks and knows what the responsibilities of the project manager are. An advantage of this method is that the whole team agrees on the project manager.

Team recruitment and formation

In the Product Innovation Project the teams are formed after an application period where students from all universities can apply. The institute then decides the constellation of each team considering the topic of the project, the prioritization of the students and their field of study. In this way the diversity in each team can be assured.

The student recruitment is similar to the process in other comparable courses. However, the team constellation differs a lot. At the ME 310 class at Stanford University the students

[237] Cf. Jetter/Skrotzki (2005), p. 18
[238] Cf. Bohinc (2012), p. 2 ff
[239] Cf. Bohinc (2012), p. 52

get to know each other in small teams during the design challenges before they can form pairs of two which are considered in the team selection. The product development project at Aalto University has a completely different approach. The project managers and the students have to talk to each other and find the right partners. Each team has to have one person form certain fields such as electrical engineering, mechanical engineering, industrial design, etc. Thus, both sides, the students and project managers, have to make decision about the team.

To ensure a high diversity in teams the student could fill out a form that asks for their special skills besides their major field of study. At ME 310 this step is required for being assigned to a team. In their form skills such as metalworking/machining, wood working, graphic design software, etc. are checked[240]. The information about certain skills would help the university to form teams more easily. The form can be implemented as part of the application process. The teams should then be formed by the university to make sure that each team has a good mix of people. There is also the possibility to allow the students to form pairs that will be considered during the team formation.

Project selection

As part of the application process in the Product Innovation process the students can state their top three projects they want to work in. After this prioritization the university staff decides the teams for each project and ensures the diversity based on the resumes of the students.

The sequence of team formation and project selection is different in the product development project and the ME310 course at Stanford University. In both courses first, the teams are formed and afterwards the different projects are presented to the teams. Then they can prioritize a certain number of projects and state which projects they don't want to work on. With this information the university decides which team will work on which project.

A similar approach to this should be used for the Product Innovation Project. After the formation of the teams by the university, the project should be presented to them. After the teams decide on the roles within them (including the project manager) each of the teams should present those roles plus there top project and why they should work on it, two projects they would also work on without detailed explanations and one project they don't want to work on. This presentation should be given to the university staff but there is also the possibility to involve project partners for the presentations as well as in the decision of the project selection. In this way each entity of the cooperation in the Product Innovation Project is involved in the allocation of the projects.

[240] N.N. (N/S), available online at www.wikibox.stanford.edu, accessed on 02.04.2015

Deliverables and assignments

The teams in the Product Innovation Project have to hand in a report at every lecture throughout the year and at the final presentation at the end of the project these reports can be put together to a final report. This document is used for the evaluation of the project and the industrial partners can use this as a basis to continue the work. This report, the final prototype and a business plan are the only deliverables from the teams to the project partners in the Product Innovation Project.

A similar approach is used in the Product Development Project where project teams present the current status and progress to the university. Different topics and problems about the project are discussed to support the students. In the ME310 course many deadlines and assignments are given to the students and several deliverables are required such as user needs or prototypes (cf.

Figure 2-3).

The first working session that was conducted (cf. chapter 4.4) was focusing on prototyping. The session was dated in February (cf. Table 4-1) which is approximately halfway through the project. Compared to the ME310 at the same point in the project the teams already have to turn in their third prototype. This is achieved by setting deadlines for certain deliverables which have to fulfill certain criteria but are not too specific such as the “dark horse prototype” (cf. chapter 2.4). Such assignments including given deadlines would be a well-working instrument to control the progress of the teams and to increase the quality of the final outcome.

Checkpoints and project end

During the year the teams have to present their progress once a month where the university and other students of the Product Innovation Project can see how far the teams have come. Besides that only the supervisor of each team knows about this progress and can influence it. This is an approach with the most freedom for the students. At the end of the project the teams have to hand in their final report and present the results to a broader audience. After this event each team presents at their partner company where the official handover of the results takes place.

In the ME310 course the university has predefined checkpoints twice a year plus the final presentation where certain deliverables are required that are not related to the project topic rather than the organization of the topic. Such deliverables are cleaning the office space, handing in reports or updating the budget plan. The end of the project is a small event followed by the third checkpoint.

Such checkpoints have two main advantages. First, the institute can discuss the progress and financial status with each team. And second, the office spaces used by the teams have to be cleaned.

Summary

All above mentioned points cover the actual situation in the Product Innovation Project, other approaches at comparable courses and suggestions for changes in the future. Mostly the changes follow the methods at the comparable courses. Table 5-1 sums up the suggestions made in this subchapter and compares the topic to Design Thinking. For a better overview some of the points are further split up and the point “physical space” is added. As already stated above, this topic was not covered in detail because there already exists a plan.

Table 5-1 – Overview of the short-term suggestions

Topic	In Design Thinking	Implementation in the Product Innovation Project
Project manager	Person who is good at leading brainstorms or bring disparate teams together[241]	Team should agree on one person who will lead the team
Team recruitment	Given within the company	General application to the course where different fields of study are accepted
Team formation	Diverse teams	Diverse teams (form should be filled in by the students about a variety of skills)
Project selection	Employees choose the projects	Teams prioritize three projects
Deliverables	Not specified	Predefined deliverables (i.e. interview results, prototypes, budget plans, etc.)

[241] Cf. Kelley/Littman (2004), p. 9

Assignments	Not specified	Design Challenges in the beginning
Checkpoints	Regular meetings with customer	Checkpoint meetings for the teams with the institute
Project end	Presentation to the customer	Presentation at final event, presentation at project partner, final checkpoint meeting
Physical space	Creativity enhancing working place where each project has its own dedicated space	Dedicated spaces for each project and common areas (i.e. computer rooms, kitchen, workshop, etc.)

5.1.2 Process

Besides the structure and environment of the Product Innovation Project there is also the process itself which gets more attention in the academic sources of Design Thinking (cf. chapter 3.3 and 3.4). However, the process needs to be implemented as well where a number of challenges will be faced. The main target is to make students aware of Design Thinking and show them that the approach should be applied in their projects.

Format and Schedule

One of the most important improvement points is the format and the schedule of the Product Innovation Project. Except for the kick-off meeting and the monthly presentations plus lectures there are no predefined phases or deadlines.

A similar approach is used in the product development project where the teams have no defined phases but have monthly checkpoint meetings where the progress is presented. During these meetings the university makes sure that the teams are heading into the right direction, a final working prototype at the end. In contrast, at the ME310 course there are already defined phases that require the teams to work towards goals and deliverables. The roughly schedule during the year is set.

Predefined deadlines for deliverables give the teams an overview on what they should focus during their project. The first iteration cycle (Understand, Ideate, Prototype and Test) should be controlled by deadlines and deliverables. Afterwards a few deadlines should ensure the progress of the teams.

Lectures

The lectures in the Product Innovation Project are dealing with subjects in the area of innovation and the innovation process. Most of those presentations educate the students and a few of them provide input that can be applied to their projects.

In the very beginning of the ME310 course the students have several design challenges where they are put into teams and get a certain goal to reach within a short time frame. The first challenge only lasts one or two hours while the later ones can last up to two weeks. During these tasks the participants get to know the method of Design Thinking. After the teams are formed the students have a lecture where they get input on the upcoming phase and how the deliverables should look like at the end of it. They are also provided with tools they can use to achieve the goals. A different approach is used in the product development project. The students have weekly lectures about the whole process and all tools they might need until the whole content is presented.

Throughout the year the students need to get input on the stages that are coming up for them and what kind of tools they can use. In the beginning of the project some design challenges are useful to introduce the students to the method of Design Thinking, especially prototyping and testing. With lectures the students can get input on upcoming phases and different tools can be presented that support the teams in achieving the goals. These lectures should be very frequent in the beginning of the project (every week), after the project start it can be less frequent (once every two weeks) and in the second phase there should be just some checkpoints and deadlines for deliverables to ensure the progress (once every three to four weeks).

5.1.3 Overview

Figure 5-1 gives an overview how the whole process could look like in the future including deadlines, phases and checkpoints. This approach is very similar to the ME310 course at Stanford but is tailored to the framework at Graz University of Technology. One goal of the course is to teach the participants the methods of Design Thinking and its values.

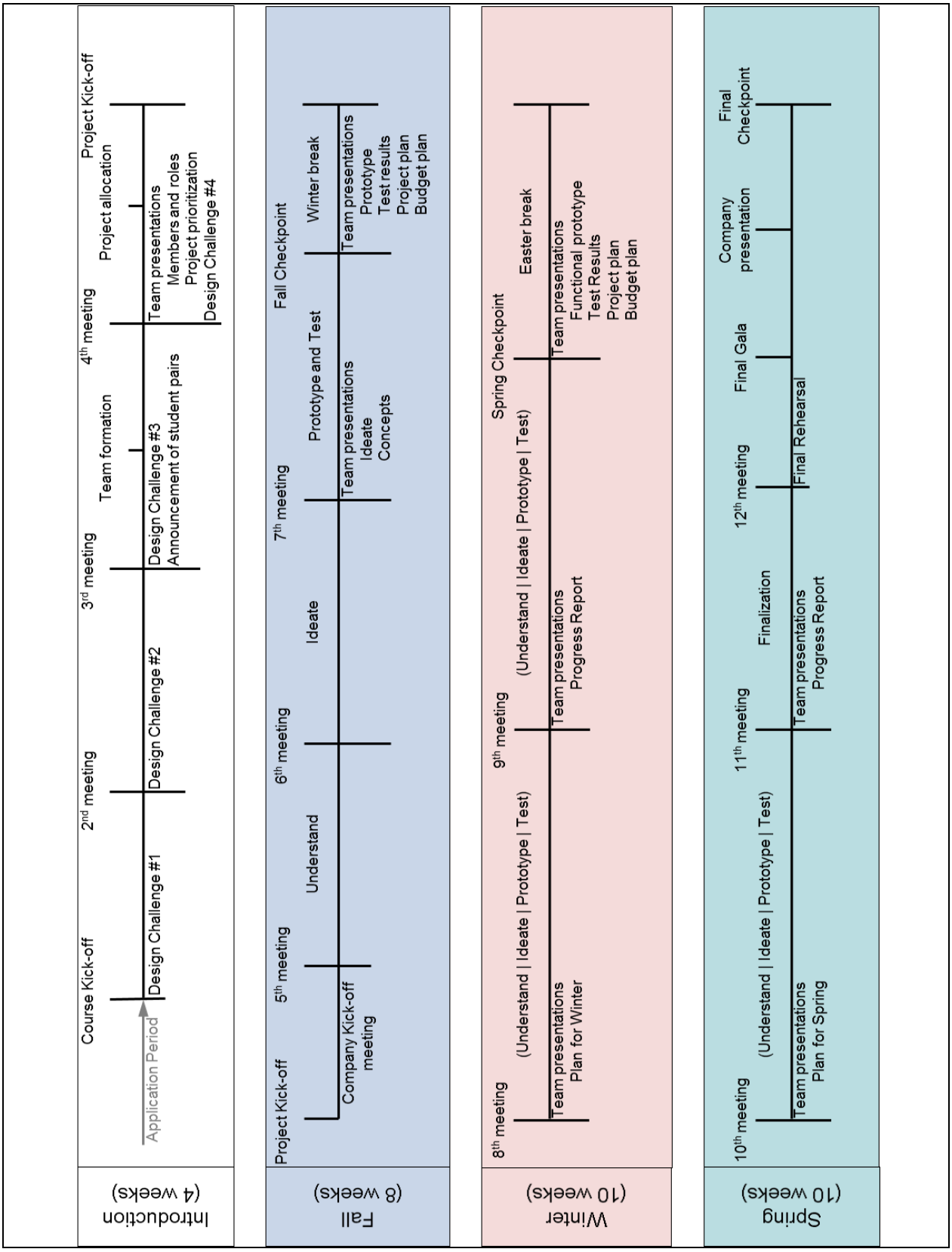


Figure 5-1 – Overview of the academic year in the Product Innovation Project [242]

[242] Own illustration

5.1.4 Limitations

The basis for the overview of the deadlines and deliverables in Figure 5-1 is ME310 at Stanford University. To be able to apply it to the Product Innovation Project some adaptions were made in order to fit to the given framework (i.e. academic year including holidays) at Graz University of Technology.

This approach implies also some limitations. The deliverables such as prototypes need further descriptions for the students to know what they have to hand in. Due to the different project tasks such prototypes might not be possible to realize. In the Product Innovation Project 2014/15 there was one project sponsored by voestalpine where a functional prototype would exceed the available budget by far.

As the phases are clearly defined the students need to have a high commitment to the project in order to meet the deadlines. Other limitations can occur if the partner companies insist on special contracts and requirements.

5.2 Long-term implementation

The long-term goal for the Product Innovation Project is to let student bring their own ideas to life and start companies during or after the course (hereinafter referred as the "new Product Innovation Project"). This challenge requires a different setting for the project. In the short term the students learn the process of Design Thinking and its values during the course. However, in the long-term, the students should be aware of the methods before the kick-off in order to apply them successfully during the project. To ensure that the students are aware of Design Thinking and are able to apply the tools different approaches can be used.

5.2.1 Design Thinking lecture

Before students take on the challenge of the new Product Innovation Project they should be taught how the main steps work and should immediately apply them. Two courses already exist at other universities, one at the d.school which includes the Design Project Zero workshop (see chapter 3.6.4) and the Design Thinking Week[243] at the Hasso Plattner Institut in Potsdam.

Creating either a lecture where Design Thinking is taught is essential to bring students closer to the methods. During the conducted workshops with the students of the Product Innovation Project 2014/15 it could be observed that the participants compared the methods of Design Thinking to their previous applied methods. Through this comparison

[243] Cf. N.N. (N/S), available online at www.hpi.de, accessed on 03.04.2015

the students identified some very important aspects of Design Thinking by themselves. After these insights they were able to use this approach without an external facilitator.

Besides a theoretical part about Design Thinking, practical examples and tasks to immediately apply the method should be covered. For a better understanding of the method the participants of this lecture should first tackle the given problems without any instructions. In a second round, the students should get theoretical inputs about Design Thinking and apply them to the same problem. With a discussion what the students experienced during the two approaches the differences and main aspects of Design Thinking can be pointed out. The outcome would be that the students understand why Design Thinking works and realize the important factors by themselves through this discussion. Such a behavior was observed during the conducted workshops when the teams compared their own approach to Design Thinking and realized what the main difference was and why it was easier.

5.2.2 Preparation phase

During the Design Thinking lecture the participants are made aware of the new Product Innovation Project and that they can present their own ideas which might be chosen for one of the projects. Through the lecture the students should be encouraged that their ideas can be put into practice and that they have the chance to start their own company. The students should present their ideas to the institute and external sponsors one by one and state why they should be funded. After all presentations the jury evaluates the potential of the concepts and decides which ones are chosen for the new Product Innovation Project.

The application period for students to join the new Product Innovation Project should start in the semester before the new projects kick off. Out of the pool of students, diverse teams with a size of four to six members should be formed by either the institute or by the students themselves. Each team should have at least two students who took part in the Design Thinking lecture and who are able to use the methods in the project in order to have a facilitating person in each working session.

The process starting from the Design Thinking lecture until the kick-off of the project or even a few weeks after can have different settings. In the following two different concepts are explained in detail from.

Concept A

The application period of the new Product Innovation Project begins with the start of the Design Thinking lecture. The day of the idea presentation follows after another longer time period to give students the chance to come up with concepts and engage others. At the start of the winter semester the students will present first to a jury (consisting of

institute, experts and external sponsors) where the most promising ideas are selected for the projects.

After the announcements which concept will be funded, a three day innovation workshop will take place. On the first day, the chosen ideas are presented to the students, called “idea hearing”. The applicants can then talk to the presenters and choose the project they would like to work in. A limit of team members per project (four to five) ensures that not all students work on the same concept. After the team formation the students should get to know each other in order to have a good working environment.

On the second day the Design Thinking process starts with the “understand” phase. If possible the teams can interview experts but the main focus in this phase should be to analyze the problem and to identify a clear task. With a successful problem statement the teams can generate ideas (“ideate” phase) which are then evaluated and if already possible prototyped (“evaluate/prototype”). During the day the teams may identify in which areas they still need more expertise. If this is the case the team can still include new members in their team. However, the size of the team should exceed six members to ensure a good working environment.

The last day should only be about prototyping concepts and testing models in order to get new insights. The supervisors of the workshop support the teams during the three days and make sure that each team finishes a prototype by the end of the workshop. At the end of day the team should also think about the roles within the team which might emerge during the workshop. The teams should at least decide on a project leader, a documentation responsible and a finance manager. To finish the workshop the teams have to present their results and insights they gained during the three days.

During the workshop supervisors should be present to keep the overview and support the teams if help is needed. The outcome of the workshop should provide a good start for the projects and an idea for the teams how to tackle the problem. Also the application of the methods and values of Design Thinking is a responsibility of the supervisors. An overview of this concept is illustrated as a timeline in Figure 5-2.

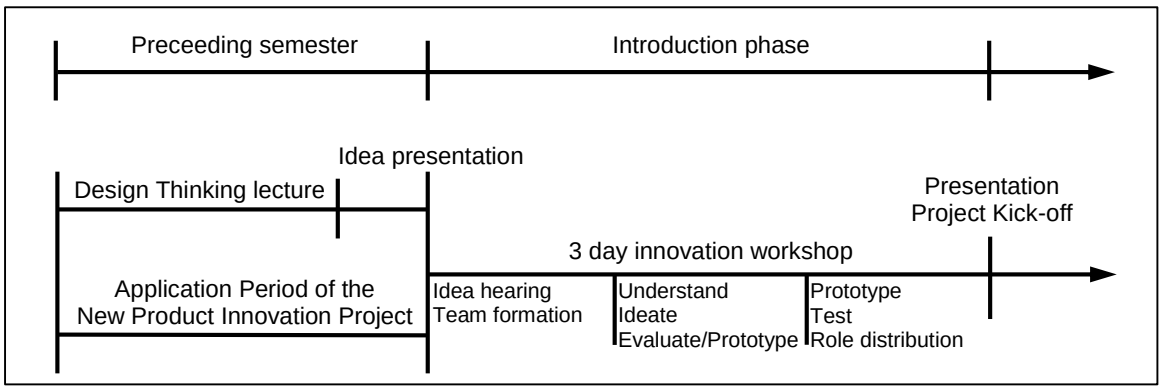


Figure 5-2 – Timeline of concept A

Concept B

The process until the idea presentation of the students is identical to the one in Concept A. The difference is in the time between this presentation and the project kick-off. After the concepts are selected and the application period is over an introduction phase will start the course. Similar to the short-term implementation the participants will get different design challenges as a warm-up for the project. Also it should teach the tools and values of Design Thinking to the students who have no prior experience in it. When the first design challenges are completed the ideas will be presented to all applicants by the presenters. Then the students can rank the concepts and a limited number of pairs who want to work together on one project can be announced, as in the short-term implementation. Taking these pairs into consideration, the institute forms the teams to ensure a high diversity within them. Figure 5-3 illustrates the timeline of this concept.

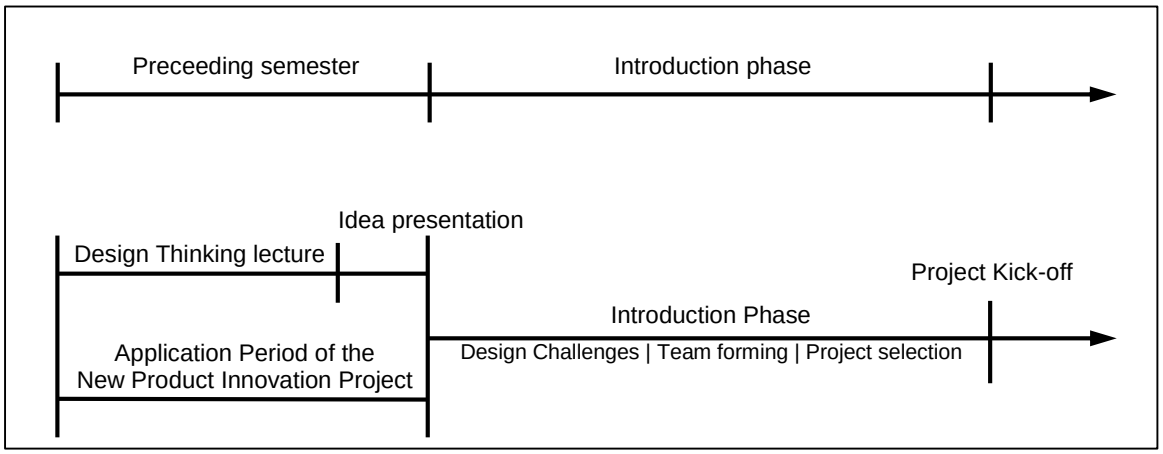


Figure 5-3 – Timeline of concept B

5.2.3 Project manager and recruiting

As in the short-term implementation discussed, the project manager of a team should have organizational as well as social skills to perform all tasks of a project manager. If the student with the idea that is funded by the university does not have these skills, it needs to be assured that the team around this student includes at least one person with organizational and social skills.

To get the right students for such projects a more detailed application process is necessary. Besides the field of study it is important to ask for other technical and soft skills of the participants to form diverse teams. This high variety can be achieved by including students from all universities in Graz and partner universities around the world. Not only the main disciplines at Graz University of Technology are required such as mechanical engineering, electrical engineering or informatics but also students from business, social science or design need to join the teams. A higher emphasis has to be

put on including students from non-technical fields of study in the project. The main issue might be to fascinate these students for the project. However, as there is the chance of founding a company and earn money this is a good selling point for students to apply.

5.2.4 Additional course

The vision of the Product Innovation Project is to change the format of the lecture where students present their own ideas which are then realized within the course. The tasks do not come from companies anymore but from student ideas. Instead of replacing the Product Innovation Project completely with this format change, there could be two project types performed at the same time. Project type 1 includes the short-term implementations where students learn the methods of Design Thinking by applying them throughout the year and the tasks still come from external project partners. Project type 2 includes the long-term implementations where the students realize their own ideas and the goal is to found a company.

Since in the project type 1 the students learn the methods of Design Thinking throughout the academic year there is no prior knowledge necessary. In the project type 2 the goal is to create a product that is accepted by the market. To increase the chance of success of the products the students should already have experience in applying Design Thinking. The basics can be acquired in the Design Thinking lecture, as described earlier in this chapter. More experience can be gathered by taking part in the project type 1. Therefore, offering two project types in the Product Innovation Project the students can take part in the project type 1 or in the Design Thinking lecture to gain first their experiences and have then the possibility to realize their own ideas in the project type 2.

The big advantage of dividing the Product Innovation Project into two different project types and an additional Design Thinking lecture is that more people will be aware of Design Thinking and more students who already know about it and applied the tools will participate in the Product Innovation Project. This increases the chance of success in the projects.

This setting also supports the transition phase when the new Product Innovation Project will be introduced. As it would be very difficult to change completely from one project to the other it is easier to offer both courses with similar settings and evolve the new Product Innovation Project to the new setting.

One drawback might be that students who once took part in one of these courses are not interested to spend more time on similar courses. Thus, the students need to understand the benefits of participating in them. One possibility is to let industrial representative point out why it is beneficial to gain the experience of working in an international and

interdisciplinary team and apply their knowledge in a project like the Product Innovation Project.

6 Conclusion

In summary, compared to similar courses at other universities such as the ME310 at Stanford University or the product development project at Aalto University, the Product Innovation Projects gives the student teams more freedom in their working structure. Implementing Design Thinking, which meets all the specifications of the Product Innovation Project, would increase the low number of predefined deadlines and deliverables but would also increase the chances for success of the projects.

The main difference between Design Thinking and the model by Cooper is that in Design Thinking the working environment such as the physical space is an important factor while in the model by Cooper puts greater attention on how to launch a product in a company. However, the Product Innovation Project does not deal with the topic of launching a product and creativity enhancing facilities are part of the framework in the Product Innovation Project.

By applying Design Thinking to the projects in the academic year 2014/15, feedback was gathered if the method is effective. First, the students were introduced to the basics of Design Thinking in a 90 minutes, hands-on workshop. Afterwards, certain steps of Design Thinking were performed with the teams to work on their projects. These working sessions lasted up to half a day in which different phases were conducted such as ideation, prototyping or testing. The outcome of the feedback of the students showed that Design Thinking is applicable to the Product Innovation Project in any stage.

To implement Design Thinking in the Product Innovation Project, the teams need to apply the method first in a smaller design challenge in order to understand the important aspects. The next step is to guide the teams through the first iteration cycle, understand, ideate, prototype and test. After completing this first cycle the teams have only a few deadlines and deliverables to ensure the progress within the given time frame.

The vision of the Product Innovation Project is to give students the chance to realize their own product ideas in this project with the goal to found a company. The institute would select the most promising ideas which are then funded and teams are formed.

The new format with the problem statement by the students and the existing format with the problem statements by external project partners would be two different project types of the Product Innovation Project. Project type 1 where students learn the methods of Design Thinking by applying them throughout the academic year and project type 2 where the students have the possibility to found a company.

7 List of references

N.N.: (N/S). Available online at http://pdp.fi/, accessed on 08.04.2015.

N.N.: (N/S). Available online at http://hpi.de/school-of-design-thinking/studierende/advanced-track.html, accessed on 02.04.2015.

N.N.: (N/S). Available online at http://hpi.de/school-of-design-thinking/, accessed on 03.04.2015.

N.N.: (N/S). Available online at http://hpi.de/school-of-design-thinking/studierende/basic-track.html, accessed on 02.04.2015.

N.N.: (N/S). Available online at http://www.ideo.com/work/shopping-cart-concept, accessed on 17.03.2015.

N.N.: (2012). *Design Thinking for Educators Toolkit*. Available online at http://www.designthinkingforeducators.com/toolkit/, accessed on 28.01.2015.

N.N.: (2012). *Design Thinking for Educators Workbook*. Available online at http://www.designthinkingforeducators.com/toolkit/, accessed on 28.01.2015.

N.N.: (N/S). Available online at http://www.fabfoundation.org/fab-labs/what-is-a-fab-lab/, accessed on 08.01.2015.

N.N.: (N/S). Available online at http://www.oxforddictionaries.com/definition/english/empathy, accessed on 26.01.2015.

N.N.: (N/S). Available online at http://www.stage-gate.com/trademark.php, accessed on 27.02.2015.

N.N.: (N/S). Available online at http://wikibox.stanford.edu/14-15/index.php/StudentWiki/HomePage, accessed on 02.04.2015.

N.N.: (N/S). Available online at https://dschool.stanford.edu/groups/designresources/wiki/de476/Project_Topic_Wallet_GiftGiving_or_other.html, accessed on 20.01.2015.

N.N.: (N/S). Available online at http://dschool.stanford.edu/use-our-methods/, accessed on 15.01.2015.

N.N.: (N/S). Available online at http://dschool.stanford.edu/crash-course-video/, accessed on 16.01.2015.

N.N.: (N/S). *Mindsets*. Available online at https://researchasdesign.files.wordpress.com/2011/05/mindsets.png, accessed on 04.02.2015.

N.N.: (2010). *Mode Guide BOOTCAMP*. Available online at https://dschool.stanford.edu/sandbox/groups/designresources/wiki/36873/attachments/8a846/ModeGuideBOOTCAMP2010.pdf?sessionID=f09d5133239666a893d9a07e69136079b6229dea, accessed on 26.01.2015.

N.N.: (2012). *Experiment Mixtape*. Available online at http://dschool.stanford.edu/wp-content/uploads/2012/02/experiment-mixtape-v8.pdf, accessed on 18.05.2015.

N.N.: (2012). *Gift Giving Facilitator's Guide*. Available online at https://dschool.stanford.edu/sandbox/groups/designresources/wiki/ed894/attachments/0132b/GG%20Facilitators%20Guide2012.pdf?sessionID=9a5d0a2a0cd5fb6c26a567b2636b19513b76d0f4, accessed on 20.01.2015.

N.N.: (2012). *Ideate Mixtape*. Available online at http://dschool.stanford.edu/wp-content/uploads/2012/02/ideate-mixtape-v8.pdf, accessed on 18.05.2015.

N.N.: (2012). *Steps of Design Thinking*. Available online at http://dschool.stanford.edu/wp-content/uploads/2012/02/steps-730x345.png, updated on 2/29/2012, accessed on 15.01.2015.

N.N.: (2012). *The Gift Giving Experience*. Available online at https://dschool.stanford.edu/sandbox/groups/designresources/wiki/ed894/attachments/6cfe1/TheGiftGivingProjectB%26W2012.pdf?sessionID=9a5d0a2a0cd5fb6c26a567b2636b19513b76d0f4, accessed on 20.01.2015.

N.N.: (2012). *The Wallet Project*. Available online at https://dschool.stanford.edu/sandbox/groups/designresources/wiki/4dbb2/attachments/e1005/TheWalletProjectB%26W2012.pdf?sessionID=f09d5133239666a893d9a07e69136079b6229dea, accessed on 20.01.2015.

N.N.: (2012). *Understand Mixtape*. Available online at http://dschool.stanford.edu/wp-content/uploads/2012/02/understand-mixtape-v8.pdf, accessed on 18.05.2015.

N.N.: (2012). *Wallet Facilitator's Guide*. Available online at https://dschool.stanford.edu/sandbox/groups/designresources/wiki/4dbb2/attachments/d5c91/Wallet%20Facilitators%20Guide2012.pdf?sessionID=9a5d0a2a0cd5fb6c26a567b2636b19513b76d0f4, accessed on 20.01.2015.

BOHINC, T.: (2012). *Führung im Projekt*. 2012nd ed., Berlin, HeidelbergSpringer Berlin Heidelberg.

BOTH, T.: (2013). *Bootcamp Bootleg*. Available online at http://dschool.stanford.edu/wp-content/uploads/2013/10/METHODCARDS-v3-slim.pdf, accessed on 24.03.2015.

BREM, A.: (2008). *The Boundaries of Innovation and Entrepreneurship*WiesbadenSpringer Fachmedien.

BROWN, T.: (2008). *Design Thinking.* In: Harvard Business Review, pp. 84–92.

BROWN, T.; KĀTZ, B.: (2009). *Change by Design*. 1st ed, New YorkHarper Business.

BUCHANAN, R.: (1992). *Wicked Problems in Design Thinking. Vol.* 8 (2), pp. 5–21.

BUSHNELL, T.; STEBER, S.; MATTA, A.; CUTOSKY, M.; LEIFER, L.: (2013). *Using a "dark horse" prototype to manage innovative teams..*

COOPER, R. G.: (2011). *Winning at new products*. 4th edition,

COOPER, R. G.; EDGETT, S. J.: (2008). *Ideation for Product Innovation: What are the best methods?* In: PDMA Visions Magazine, pp. 12–17.

DORST, K.: (2011). *The core of 'design thinking' and its application.* In: Design Studies. Vol. 32 (6), pp. 521–532.

FALLAST, M.: (2007). *Success Factors in the Success Factors in the Implementation of an Interdisciplinary Product Innovation Project*Graz.

HASSI, LOTTA; LAAKSO, MIKO: (2011). *Conceptions of Design Thinking in the design and management discourses*proceedings of the 4th World Conference on Design Research, IASDR.

HOLT, K.: (1988). *Product innovation management*. 3rd ed, London, BostonButterworths.

JETTER, F.; SKROTZKI, R.: (2005). *Soziale Kompetenz*Regensburg, BerlinWalhalla-Fachverl.

JOHANSSON-SKÖLDBERG, U.; WOODILLA, J.; ÇETINKAYA, M.: (2013). *Design Thinking: Past, Present and Possible Futures. Vol.* 22 (2), pp. 121–146.

KELLEY, T.; KELLEY, D.: (2013). *Creative confidence*.

KELLEY, T.; LITTMAN, J.: (2004). *The Art of Innovation*LondonProfile Books.

LINDBERG, T. S.: (2013). *Design-Thinking-Diskurse..*

MEUSBURGER, P.; FUNKE, J.; WUNDER, E.: (2009). *Milieus of creativity*Dordrecht, [Heidelberg]Springer; Klaus Tschira Stiftung gGmbH.

MYERSON, J.: (2004). *Ideo*. Rev. ed., LondonLaurence King.

RATCLIFFE, J.: (2009). Available online at https://dschool.stanford.edu/groups/k12/wiki/17cff/Steps_in_a_Design_Thinking_Process.html, accessed on 26.01.2015.

RATCLIFFE, J.: (2009). *Design Thinking Process*. Available online at https://dschool.stanford.edu/groups/k12/wiki/17cff/images/5af04.png#1346x454, updated on 3/19/2010, accessed on 26.01.2015.

ROETHEL, K.: (2010). Available online at http://www.sfgate.com/education/article/Stanford-s-design-school-promotes-creativity-3244664.php, accessed on 17.03.2015.

ROUSE, W. B.: (1991). *Design for success*New YorkWiley.

ROWE, P. G.: (1987). *Design Thinking*Cambridge, Mass.MIT Press.

THOM, N.: (1980). *Grundlagen des betrieblichen Innovationsmanagements*. 2., völlig neu bearb. Aufl, Königstein/Ts.Hanstein.

VANHEMERT, K.: (2014). Available online at http://www.wired.com/2014/08/the-engineer-of-the-original-apple-mouse-talks-about-his-remarkable-career/, accessed on 23.03.2015.

8 List of Figures

9 List of Tables

Appendix A - Handout for the workshop “The Gift-Giving Experience”

Your mission: **Redesign the gift-giving experience ...for your partner. Start by gaining empathy.**

1 Interview
8min (2 sessions x 4 minutes each)

Notes from your first interview

Switch roles & repeat Interview 1.

2 Dig deeper
8min (2 sessions x 4 minutes each)

Notes from your second interview

Switch roles & repeat Interview 2.

d.

Reframe the problem.

3 Capture findings 3min

needs: things they are trying to do*
*use verbs

insights: new learnings about your partner's feelings/ worldview to leverage in your design*
*make inferences from what you heard

4 Define problem statement 3min

_____
partner name/description

needs a way to _____
user's need

Surprisingly // because // but...
[circle one]

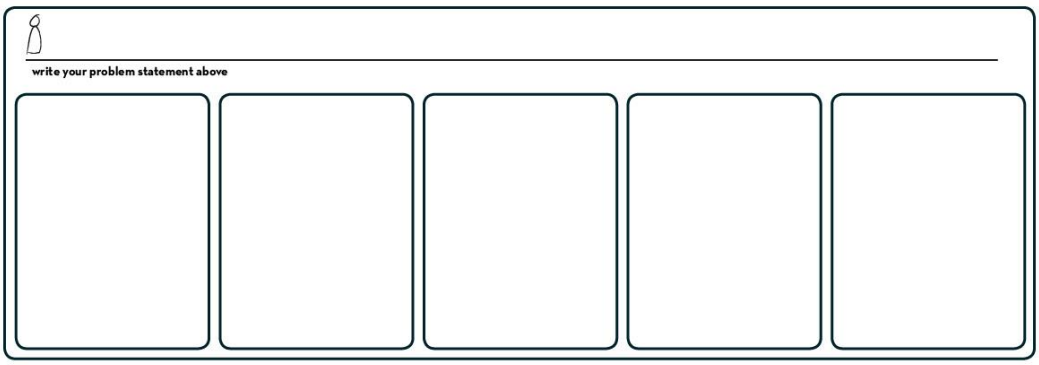
_____

_____
insight

d.

Ideate: generate alternatives to test.

5 Sketch at least 5 *radical* ways to meet your user’s needs. 4min



6 Share your solutions & capture feedback. 8min (2 sessions x 4 minutes each)

Notes

d.

Switch roles & repeat sharing.

Iterate based on feedback.

7 Reflect & generate a new solution. 3min

Sketch your big idea, note details if necessary!

d.

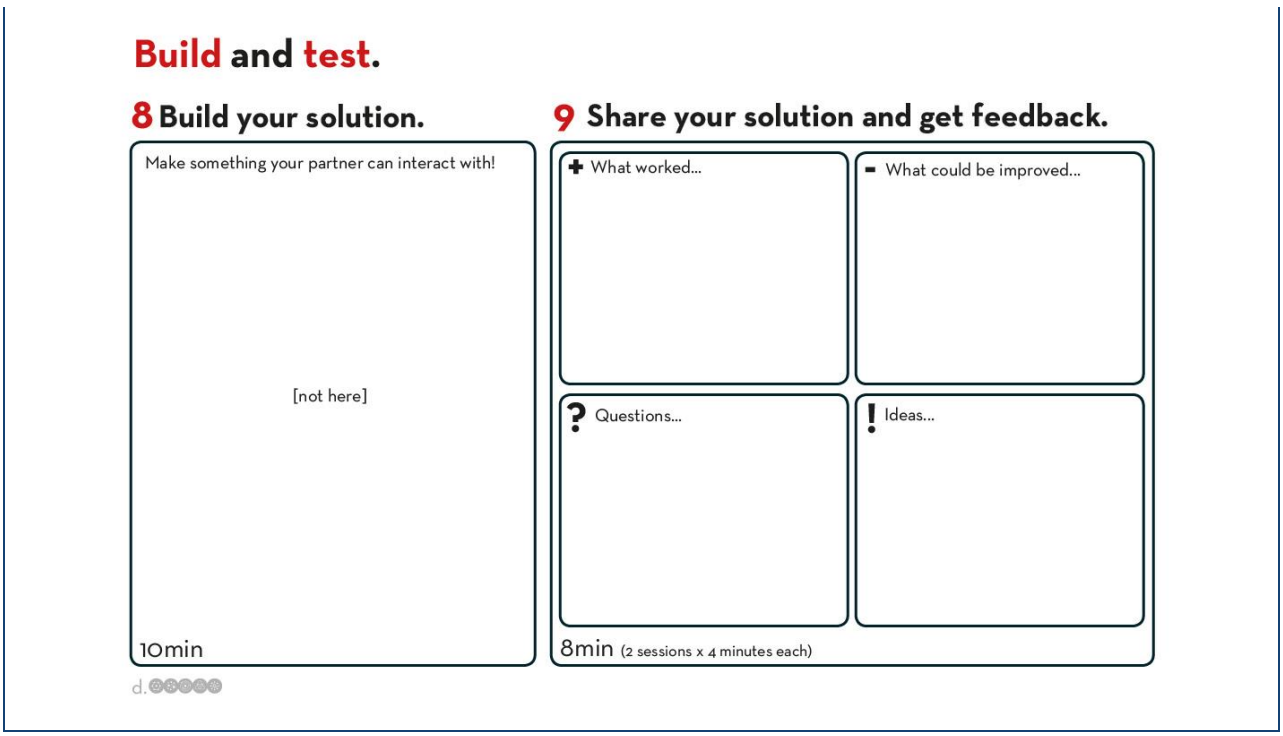
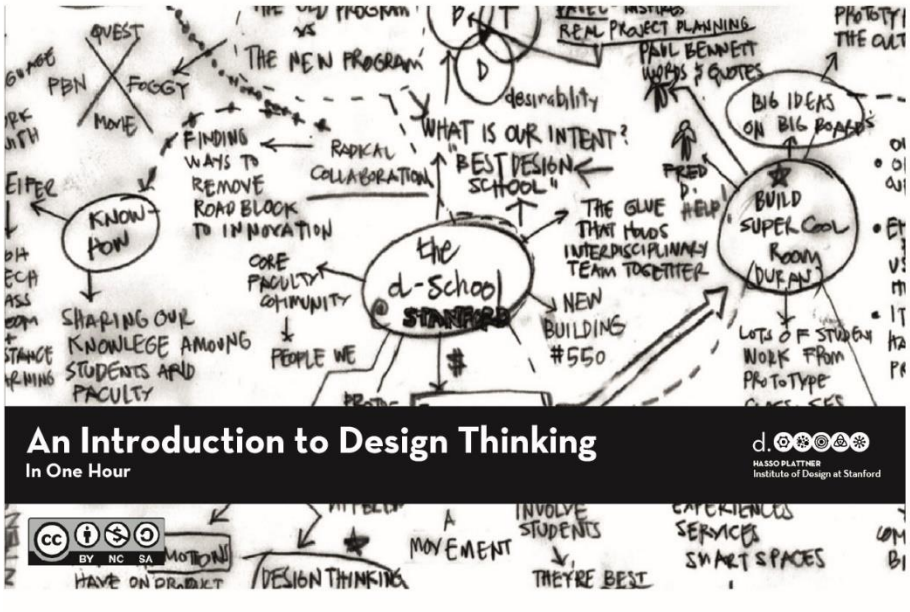


Figure A-1 - Handout for the workshop “The Gift-Giving Experience”[244]

[244] N.N. (2012) *The Gift Giving Experience,* available online at www.dschool.stanford.edu, accessed on 20.01.2015

Appendix B -

Handout for the workshop “The Ideal Wallet”



Design the IDEAL wallet.

Draw 3min

Sketch your idea here!

d.

Your NEW mission: **Design something useful and meaningful for your partner. Start by gaining empathy.**

1 Interview
8min (2 sessions x 4 minutes each)

Notes from your first interview

Switch roles & repeat Interview

2 Dig Deeper
6min (2 sessions x 3 minutes each)

Notes from your second interview

Switch roles & repeat Interview

d.

Reframe the problem.

3 Capture findings 3min

Goals and Wishes:
What is your partner trying to achieve?
*use verbs

Insights: New learnings about your partner's feelings and motivations. What's something you see about your partner's experience that maybe s/he doesn't see?*
*make inferences from what you heard

d.

4 Take a stand with a point-of-view 3min

_____
partner's name/description

needs a way to _____
user's need

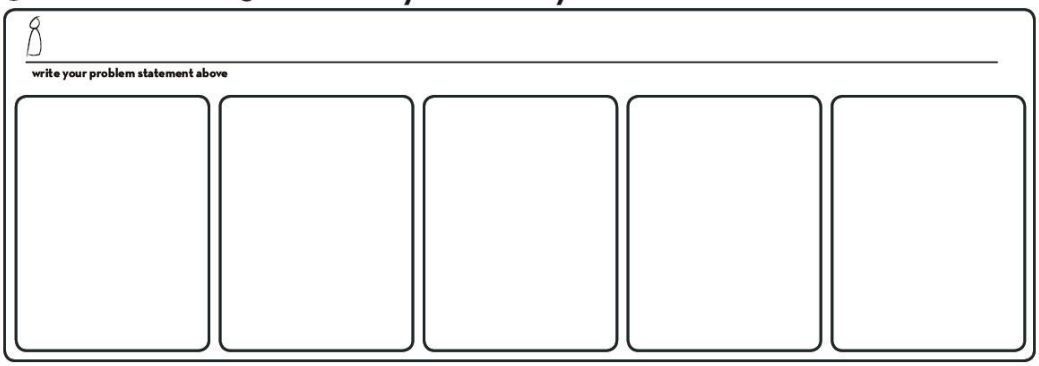
because (or “but . . .” or “Surprisingly . . .”)
[circle one]

_____

_____
insight

Ideate: generate alternatives to test.

5 Sketch at least 5 *radical* ways to meet your user's needs. 5min



6 Share your solutions & capture feedback. 10min (2 sessions x 5 minutes each)

Notes

d.

Switch roles & repeat sharing.

Iterate based on feedback.

7 Reflect & generate a new solution. 3min

Sketch your big idea, note details if necessary!

d.

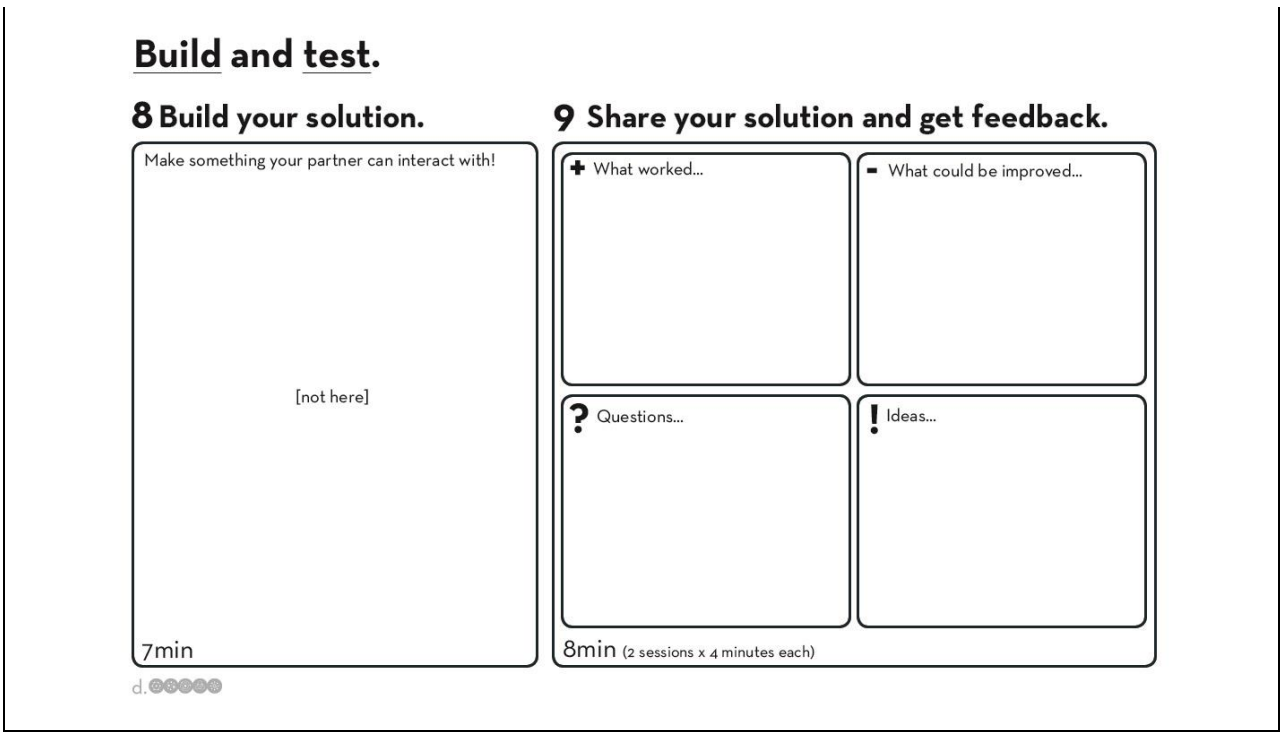
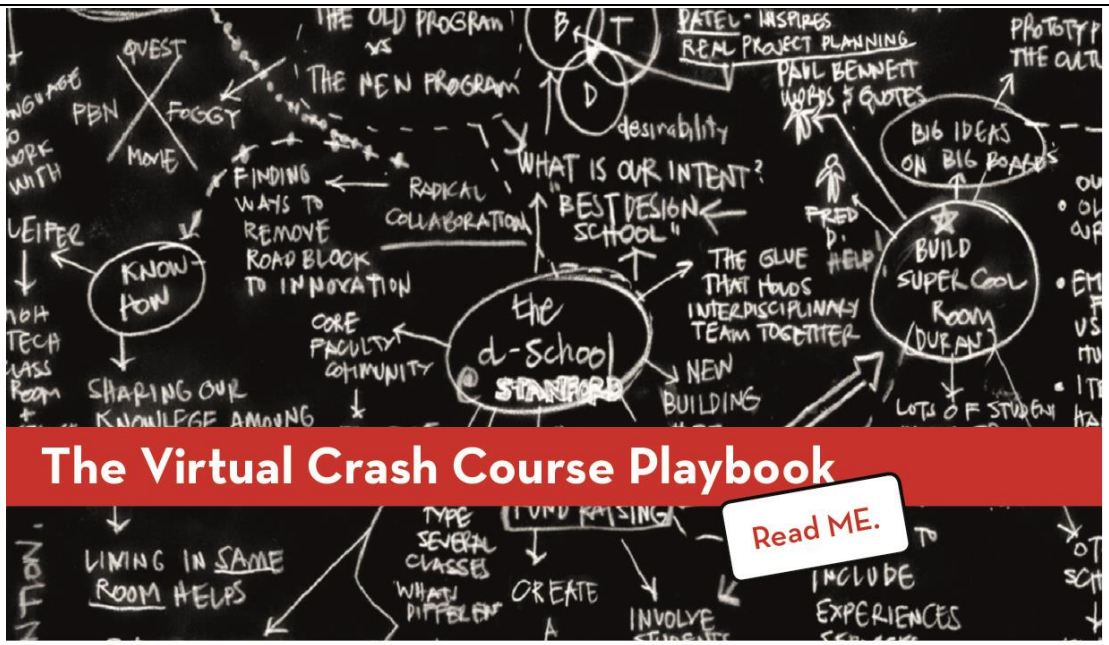


Figure B-1 - Handout for the workshop “The Ideal Wallet”[245]

[245] N.N. (2012) *The Wallet Project,* available online at www.dschool.stanford.edu, accessed on 20.01.2015

Appendix C - Handbook for the workshop “The Gift-Giving Experience”



Redesign the Gift-Giving Experience

Dear Facilitator,

You may use all of the prompts we wrote out below during the video to encourage engagement, build excitement around the workshop, keep the group focused, and drive the debrief after the exercise is complete.

Have fun!

d.

HASSO PLATTNER
Institute of Design at Stanford

The Kick-Off: What is Design Thinking?

Instead of just telling you about design thinking, we want to immediately have you jump right in and experience it for yourself.

We are going to do a design project for about the next hour.
This is going to feel rushed; that's okay. Roll up your sleeves and really lean into the project.

Ready? Let's go!

Start by gaining empathy.

Here is language to support how to facilitate these steps.

EMPATHIZE

1—Interview your Partner

- Your challenge is to design something useful and meaningful to your partner.
- The most important part of designing for someone is to gain empathy for that person.

Example: While there are lots of ways to gain empathy for someone else, a simple, easy way to do that is to have a conversation and ask open ended questions. “When was the last time you gave a gift? How did it go? What was your favorite part? Least favorite part? Etc”

2—Dig deeper

- Try to dig for stories, feelings, and emotion.

Ask ‘Why?’ often.

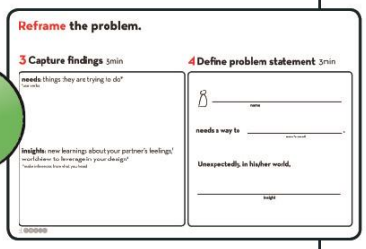
- Forget about the gift, find out what’s important to your partner.

Example: For example, if your user mentioned that it’s challenging to decide on which gift to purchase, ask why? Maybe it’s because they don’t really know what the other person wants; or maybe it’s because they’re afraid of what the gift says about THEM as the giver – any answer will lead you to understand your user (the gift giver) better. The key is to identify anywhere you’re making assumptions and then ask a question to test whether your assumption is valid.

DEFINE

3—Capture findings

- Try to synthesize your learning into a few ‘needs’ that you have discovered, and a few ‘insights’ that you find interest.
- Needs should be verbs – think about it this way – in the process of giving a gift, what is your user actually trying to accomplish? What does gift giving do for THEM?
- Insights are discoveries that you might be able to leverage when creating solutions.



Ideate: generate alternatives to test.

Here is language to support how to facilitate these steps.

4—Take a stand with a point-of-view

- This is your point-of-view.
- Take a stand by specifically stating the meaningful challenge you are going to take on.
- It should feel like a problem worth tackling!
- This is the statement that you’re going to address with your design, so make sure it’s juicy and actionable.

Example: Maybe you found that your partner is really trying to reunite the family; or reignite a lost love; or infuse adventure into a boring suburban existence; or reconnect with an old friend; or demonstrate his own creativity!

5—Sketch to Ideate

- Rewrite your problem statement at the top of the page.
- Now you are creating solutions to the new challenge you’ve identified.

GO FOR VOLUME! This is time for idea generation, not evaluation.

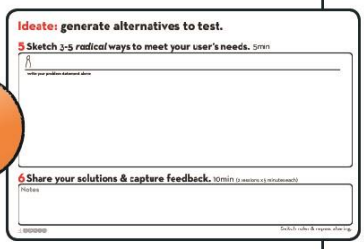
- You don’t have to draw well, stick figures and squiggly lines are A-OK!

IDEATE

6—Share solutions and capture feedback

Spend the time listening to your partner’s feedback.

- Fight the urge to defend your ideas. This is not about validation.
- This is an opportunity to learn more about your partner’s feelings and motivations (remember: empathy)



Iterate based on feedback.

Here is language to support how to facilitate these steps.

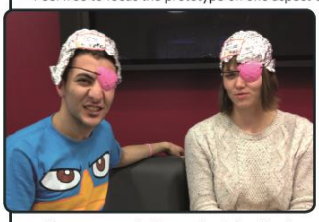
7—Reflect & generate a new solution

Now, take a moment to consider what you have learned both about your partner, and about the solutions you generated. From this new understanding of your partner and his or her needs, sketch a new idea. The solution may be a variation on an idea from before or something completely new.

Ask yourself: How might this solution fit into the context of your partner's life?

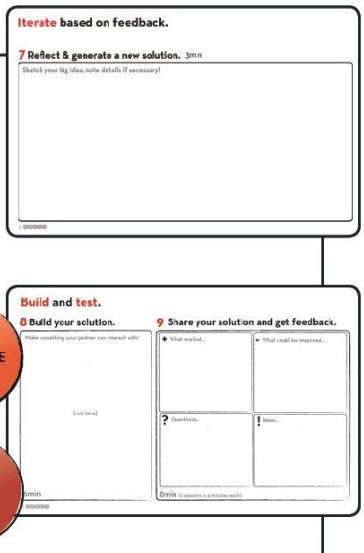
8—Build!

- Create a physical prototype of your solution.
- Create an experience or make something that your partner can engage and react to.
- Feel free to focus the prototype on one aspect of the overall solution.



9—Share your solution and get feedback

- Your prototype is not precious, but the feedback and new insights it draws out are!
- Don't defend your prototype; instead, watch how your partner uses and misuses it.



Reflection and takeaways.

Here is language to support how to facilitate these steps.

10—Group gather and debrief

These are questions prompted at the end of the video. Please spend 5-8 min on each question.

1. How did engaging with a real person, testing with a real person, change the direction your prototype took?
2. What was it like showing unfinished work to another person?
3. How did the pace feel? Quick, iterative cycles -- how did that feel relative to how you normally work?
4. Design thinking is an iterative, self-directed process. Based on what you learned -- what would you go back and do next? What would you do over again?
5. What principle, what tool, would you infuse into the work tomorrow?

After the video questions, try these exercises:

- Set all the prototypes in the middle of the room.
- “Who had a partner who created something that you really like?”
- “Who sees something they are curious to learn more about?”
- “Who wants to share their experience?”
- “What part felt most uncomfortable to you?”
- “What felt most natural?”
- “How did the time pressure impact your work?”
- “How did it feel to show someone else unfinished work / work in such a low-resolution?”
- “As a USER, how did you interact with your partner's lowly-resolved prototype; how did the level of resolution impact your experience as a user?”

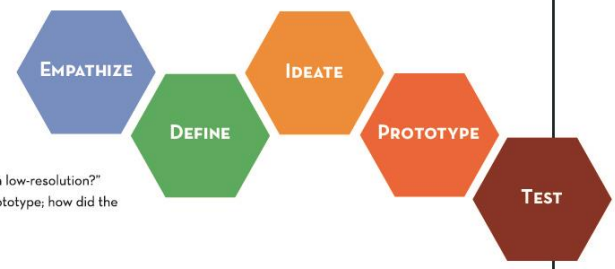
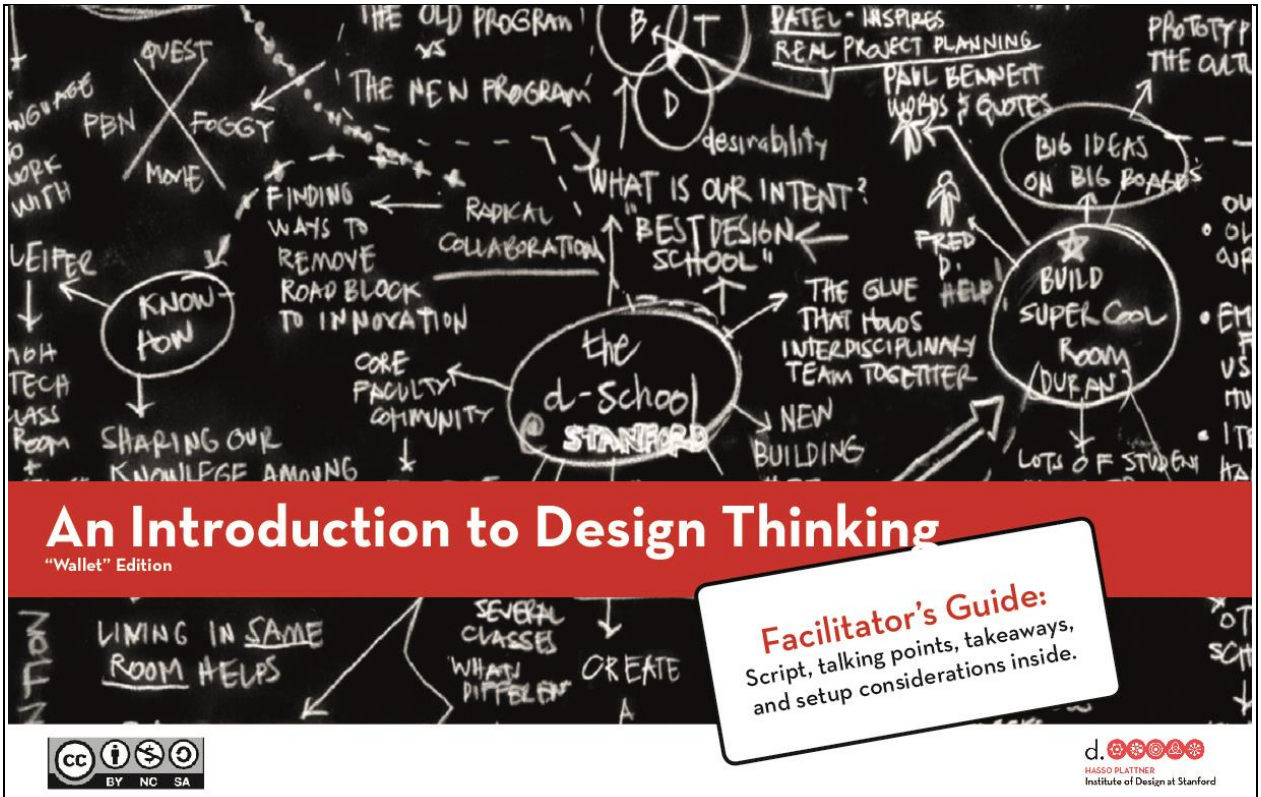


Figure C-1 - Handbook for the workshop “The Gift-Giving Experience”[246]

[246] N.N. (2012) *Gift Giving Facilitator's Guide,* available online at www.dschool.stanford.edu, accessed on 20.01.2015

Appendix D - Handbook for the workshop “The Ideal Wallet”



An Introduction to Design Thinking

"Wallet" Edition

Facilitator's Guide:
Script, talking points, takeaways, and setup considerations inside.

d. HASSO PLATTNER Institute of Design at Stanford

The Wallet Project

A little background on the project

The project you're holding in your hands is an iteration on the d.school's iconic "Wallet Project." The original wallet project was created as an introduction to design thinking for the d.school's inaugural Boot Camp class in the Winter of 2006. It has since been contributed to, modified, stretched, and evolved by many d.school collaborators.

The Wallet Project is an immersive activity meant to give participants a full cycle through the design thinking process in as short a time as possible. The project itself gives facilitators the opportunity to touch on the fundamental values of the d.school—human-centered design, a bias towards action, and a culture of iteration and rapid prototyping—without attempting to communicate all of the methods and activities that the term "design thinking" encompasses.

Why did we choose a wallet as the starting point for the introductory design challenge?

* everyone has experience with a wallet, or another way to carry cash, cards, and ID
* the wallet and its contents have the potential to evoke a range of meaning and the larger context of a person's life
* wallet as a starting point enables a wide range of potential innovation outcomes (we've seen objects, experiences, services, systems, and spaces!)
* having a physical artifact in-hand allows for immediate recall of experiences (participants can gain empathy for one another in the room)

It is certainly possible to facilitate a similar project with a different topic—and you may choose to in order to amp up a particular aspect you think is important for your group of participants. For example, we have done the "oral-hygiene project" to make it more personal and had partipants observe their partners in their homes previous to the beginning of the workshop. We also do a "redesign the gift-giving experience" version, with the aim to encourage participants to create services, experiences, and systems. If you decide to change the topic [you can simply change the instructions for the first two steps], be mindful of the considerations we listed above and scope it in a way that is both wide-open to possibilities but also managable for participants.

Why project-based, team-facilitated learning?

Having created learning experiences for students of all cultures, ages, disciplines, and industries, we have found that engaging in projects provides a much richer learning experience than listening to a "talking head" does. As such, our bias is to provide limited scaffolding to allow participants to **do**, and then to facilitate a reflection that invites the participants themselves to extract the meaningful learning opportunities from the experience. We teach in teams at the d.school because we have found that this approach tends to create a conversation in the classroom, as opposed to the one-way communication that often transpires in more lecture-driven formats. We relish the diversity of perspectives that emerge when faculty from diverse backgrounds instruct, and even disagree in front of, a class. One great way to run the Wallet Project with two people, is for one to take ***lead*** (concentrating on communicating the instructions, logistics, and timing), and the other person to provide ***color*** (communicating the nuances, offering encouragement, and providing helpful tips).

How to set up and kickoff the project

Set up the room so that participants are in an active posture (sitting upright, standing), with access to a horizontal space for note taking.

Space should be configured to allow for participants to pair up near one another easily.

Cocktail style—small, standing height—tables are nice to have.

Play upbeat music during all steps while participants work,
and turn it down to give instruction.

Make sure you have supplies on hand for prototyping (we recommend paper, pens, popsicle sticks, pipe cleaners, scissors, duct tape, and the like).
Print the participant worksheet on single-sided 11x17 paper.
Print the facilitator's guide on double-sided 11x17 paper.
Find a fun way to announce "Time's up!" (we use a gong at the d.school).

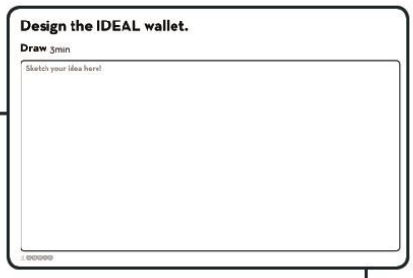
Be assertive about keeping the timing tight.

If possible, have a TEAM of coaches who are familiar with the project share the responsibility for facilitating the learning experience.

The kick-off:

"Instead of just telling you about design thinking,
we want to immediately have you jump right in and experience it for yourself.
We are going to do a design project for about the next hour.
Ready? Let's go!"

Design the IDEAL wallet.



How to facilitate this step

Draw

This is what we call the “false-start”.
Of course, you don't tell participants it is a false-start.

The intention is to contrast an abstract problem-centric approach (that may be typical for many people)
to a human-centered design thinking approach which participants will experience in the rest of the project.
Don't play music during this step, to accentuate the difference
between the false-start and the main part of the exercise.

“OK, let's jump right in.”

“This is going to feel rushed; that's okay. Roll up your sleeves and get ready to lean into the project.”

“Come up with some ideas for the ‘ideal’ wallet.”
“Go ahead and draw an idea for a better wallet.”

Let them know how much time they will have.
It is normal for people to feel stuck and delay putting anything down on paper.
Reminding them of the time they have left can push them to start.

. . . At the end of the step:

“How did that feel? My guess is, ‘Not great.’”
“That was a typical problem-solving approach, taking on a given problem, working using your own opinions and experience to guide you, and with a solution in mind to be designed.”
“Let's try something else—a human-centered design thinking approach.”

Start by gaining empathy.

How to facilitate these steps

EMPATHIZE DEFINE IDEATE PROTOTYPE TEST

1—Interview your Partner

Have participants partner up in pairs.
It helps to refer to “Partner A” and “Partner B” to simplify your language in these interactive steps.

“Your challenge is to design something useful and meaningful to your partner.”

“The most important part of designing for someone is to gain empathy for that person.”

“One way to do this is to have a good conversation.”
Be clear about the logistics of the interviews:
“Partner A will have four minutes to interview Partner B, and then we will tell you when to switch.”

“As a starting point, ask your partner to walk you through the contents of their wallet.”
“When do they carry their wallet? Why do they have a particular card in there? What do the things in their wallet tell you about their life?”
Tell them to take note of things they find interesting or surprising.

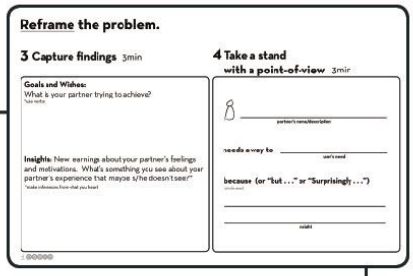
“Let’s begin!” (Don’t forget to start playing the upbeat music now.)

2—Dig deeper

After the first set of interviews, tell them to follow up on things that intrigued them during the first interview.

“Try to dig for stories, feelings, and emotion.”
“Ask ‘WHY?’ often”
“Forget about the wallet, find out what’s important to your partner.”
“Why does he still carry a picture of his ex-girlfriend? When was a time he carried a lot of cash? What does she remember most about her first paying job?”
Remind them you will let them know when time is up.
. . .“Time to switch! Again, make note of any unexpected discoveries along the way, capture quotes!”

Reframe the problem.



How to facilitate these steps

EMPATHIZE DEFINE IDEATE PROTOTYPE TEST

3—Capture findings

Tell them to *individually* take three minutes to collect their thoughts and reflect on what they’ve learned about their partner.

“Synthesize your learning into two groups: your partner’s goals and wishes, and insights you discovered.”

“Use verbs to express the goals and wishes.”
“These are his needs related to his wallet and life. Think about both physical and emotional needs.”
“For example maybe your partner *needs* to minimize the number of things he carries . . . or needs to feel like she is supporting the local community and economy.”

“‘Insights’ are discoveries that you might be able to leverage when creating solutions.”
“For example, you might have discovered the insight that buying with cash makes your partner value the purchase more and take more care with decisions.”
“Or, that she sees a wallet as a reminder and organizing system, not a carrying device.”

4—Take a stand with a point-of-view

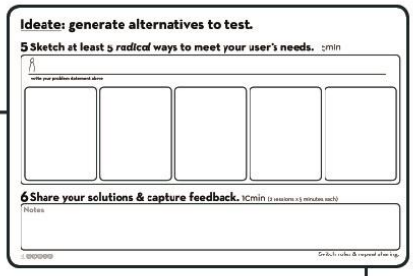
Now tell them to select the most compelling need and most interesting insight to articulate a point-of-view.

“This is your point of view.”

“Take a stand by specifically stating the meaningful challenge you are going to take on.”

‘This is the statement that you’re going to address with your design, so make sure it’s juicy and actionable!”
“It should feel like a problem worth tackling!”
“Your point-of-view might be:
‘Janice need a way to feel she has access to all her stuff and is ready to act. Surprisingly, carrying her purse makes her feel less ready to act, not more.’
Or ‘Arthur needs a way to socialize with his friends while eating healthy, but he feels like he isn’t participating if he isn’t holding a drink.’”

Ideate: generate alternatives to test.



How to facilitate these steps

5—Sketch to Ideate

Have them rewrite their problem statement at the top of the page.

Remind them they are now creating solutions to the new challenge they've identified.

They them to sketch a lot of ideas, and to try to create a number of different ideas.

“GO FOR VOLUME!”

“This is time for idea generation, not evaluation—you can evaluate your ideas later.”

You can even suggest a friendly competition to come up with the most ideas --
“See if you can come up with at least 7 ideas!”
Remind them they are not necessarily designing a wallet; instead they should create solutions to problem statement they just created.

“Remember to be VISUAL—use words just when necessary to call out details.”

... “One minute left! Try to sketch at least 2 more wildly different ways to address your problem statement!”

6—Share solutions and capture feedback

“Now it's time to share your sketches with your partner!”
“Partner A, share your sketches with Partner B first, and then we will tell you to switch after four minutes.”
Tell them to note likes/dislikes and builds on the idea, but also listen for new insights.

“Spend the time listening to your partners reactions and questions.”

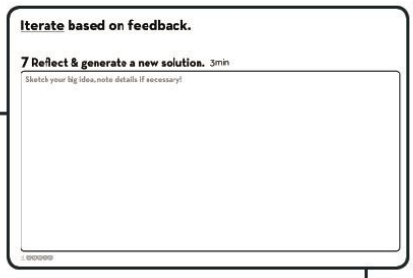
“This is not just about validating your ideas.”

“Fight the urge to explain and defend your ideas.”

“This is another opportunity to learn more about your partner's feelings and motivations.”

Tell them to switch after time is up for the first session.

Iterate based on feedback.



How to facilitate this step

7—Reflect & generate a new solution

They've had a chance to share their sketches with their partners and collect feedback.

“Now, take a moment to consider what you have learned both about your partner, ***and*** about the solutions you generated.”

“From this new understanding of your partner and his or her needs, sketch a new idea.”

Tell them this solution may be a variation on an idea from before or something completely new.
They are still addressing a problem statement that *they* articulated, but you might point out that their previous problem statement may need to change to incorporate the new insights and needs they discovered.

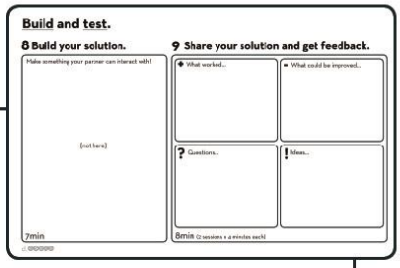
“Try to provide as much detail and color around your idea as possible.”

“How might this solution fit into the context of your partner's life?”

“When and how might they handle or encounter your solution?”

While participants are working, grab the prototyping materials if you have not already.

Build and test.



How to facilitate these steps

8—Build!

Tell participants to use the idea they just sketched as a blueprint for a tangible manifestation of their solution.

“Create a physical prototype of your solution.”

Explain that they should not simply make a scale model of their idea to explain the idea.
They should create an experience that their partner can react to.
They could decide to test just one aspect of the overall solution.

“MAKE something that your partner can engage and interact with.”

“If your solution is a service or a system,
create a scenario that allows your partner to experience this innovation.”

“Use whatever materials are available to you—including space!”
Provide some urgency and excitement in your voice—you want to get them building immediately.
“Be scrappy and quick—you only have a few minutes!!”

9—Share your solution and get feedback

Explain that one partner will have time to share and collect feedback, and then they will switch so the other partner can share.

“Now you’re going to have the opportunity to share your prototype with your partner.”

Validation of the prototype is not the point—it should be an artifact that facilitates a new, targeted conversation.

“When you test, LET GO of your prototype, physically and emotionally.”

“Your prototype is NOT PRECIOUS, but the feedback and new insights it draws out are!”

“Don’t defend your prototype; instead, watch how your partner uses and misuses it.”

Tell them to jot down things their partner liked and didn’t like about the idea, as well as questions that emerged and new ideas that came up.

Reflection and takeaways.

How to facilitate this step

10—Group gather and debrief

This step is important! A well facilitated reflection has the power to turn this exercise from simply a fun activity to a meaningful experience that could impact the way participants approach innovation in the future.
Quickly pull together a few tables that everyone can gather around.

Tell everybody grab their prototypes and
set them on the table in the middle of the room.

“We’re going to huddle around and see what innovations you’ve created for your partners!”

“Who had a partner who created something that you really like?”

“Who sees something they are curious to learn more about?”

Ask for the person who created the prototype and engage them in the conversation.
“How did talking to your partner inform your design?”
“How did testing and getting feedback impact your final design?”
“What was the most challenging part of the process for you?”
The key to leading this conversation is to relate the activity to the big takeaways you want to illustrate.
Some of core values of design thinking that would be great to draw out include:
Human-centered design: Empathy for the person or people you are designing for, and feedback from users, is fundamental to good design.
Experimentation and prototyping: Prototyping is not simply a way to validate your idea; it is an integral part of your innovation process. We build to think and learn.
A bias towards action: Design thinking is a misnomer; it is more about doing that thinking. Bias toward doing and making over thinking and meeting.
Show don’t tell: Creating experiences, using illustrative visuals, and telling good stories communicate your vision in an impactful and meaningful way.
Power of iteration: The reason we go through this exercise at a frantic pace is that we want people to experience a full design cycle. A person’s fluency with design thinking is a function of cycles, so we challenege participants to go through as many cycles as possible—interview twice, sketch twice, and test with your partner twice. Additionally, iterating solutions many times within a project is key to successful outcomes.

Figure D-1 - Handbook for the workshop “The Ideal Wallet”[247]

[247] N.N. (2012) *Wallet Facilitator's Guide,* available online at www.dschool.stanford.edu, accessed on 20.01.2015

Appendix E -

Feedback Form

FEEDBACK FORM

Team name: _____

Person

1. Was the information presented in a way that it was easy to understand?
   O Yes O No
   If no, what can be improved? _____
   _____

		very good	good	fair	bad
2.	About me, how was:				
a.	Overall impression	O	O	O	O
b.	Speed of speech	O	O	O	O
c.	Expression	O	O	O	O
d.	Volume	O	O	O	O

Content

3. How was the level of detail of the content?
   O O O O
   What would you change? _____
   _____

4. Was the workshop helpful for your project?
   O Yes O No
   If no, why not? _____
   _____

5. About this workshop,
   a. I like:
   _____
   _____
   b. I wish:
   _____
   _____

6. Anything else you want to tell me?
   _____

Figure E-1 – Feedback Form[248]

[248] Own illustration