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Hoftijzer, J.W.

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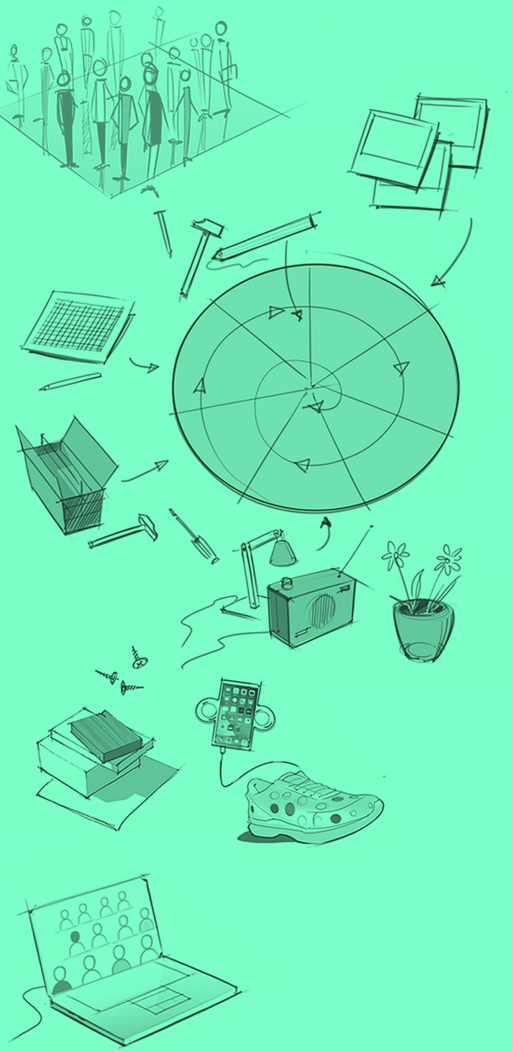

TU Delft | Industrial Design Engineering

J.W. Hoftijzer, 2024

Democratizing Design, by Designing for Do-It-Yourself

JanWillem Hoftijzer

Democratizing Design by Designing for DIY

JanWillem Hoftijzer

Democratizing design, by designing for DIY

Dissertation

for the purpose of obtaining the degree of doctor

at Delft University of Technology

by the authority of the Rector Magnificus prof.dr.ir. T.H.J.J. van der Hagen

chair of the Board for Doctorates

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by

Jan Willem HOFTIJZER

Master of Science in Industrial Design Engineering,

Delft University of Technology, The Netherlands

born in Asten, The Netherlands

This dissertation has been approved by the promotors.

Composition of the doctoral committee:

Rector Magnificus	chairperson
Prof. dr. MSc. D.V. Keyson	Delft University of Technology, promotor

Independent members:

Em. Prof. dr.ir. F.E.H.M. Smulders	Delft University of Technology
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Prof. Ir. D.J. Van Eijk	Delft University of Technology, reserve

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Contact:

j.w.hoftijzer@tudelft.nl; hoftijzerjw@yahoo.com

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'All men [read human beings] are designers. All that we do, almost all the time, is design, for design is basic to all human activity. The planning and patterning of any act towards a desired, foreseeable end constitutes the design process. Any attempt to separate design, to make it a thing-by-itself, works counter to the fact that design is the primary underlying matrix of life' (Papanek, 1985, p. 3).

Figure 1 shows various types and purposes of DIY practices.

Figure 1: Clockwise from the top left: Ivory perforated baton for making ropes (Conard & Rots, 2024) (DIY skatepark (Critchley, 2023); Kintsugi (The Ceramic School); self-produced weight lifting gear (Metropolis)

Voor Madelief en Fee

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Summary

Issues, criticism, problem statement (Section 2, Section 3, Section 4)

In short, this thesis starts with the introduction of an underlying societal problem (Section 3). It starts with the observation and indication of what some would call the 'bifurcation' between (1) the industry, institutions and markets who produce and (2) the end users, the so-called consumers who purchase, consume and use (Edwards, 2006). It concerns how producing and consuming have drifted apart and continue to do so. Various developments in history have caused this split, among which industrialization and consequential human behaviour in a market driven society were decisive. Industrialization was criticized from the start and this criticism still seems valid today. The thesis concludes that this industrially induced split has led to severe negative consequences for both humans and nature. The system of mass production and consumption has become traditional and is now common practice. The original problem statement of this thesis is: 'Given the industrially induced gap and the designer's responsibility, how can 'design' and 'use' be more closely integrated?'

Opportunities (Section 5)

There are, however, opportunities for improvement of the unsustainable system with which we produce and consume. Given the notion that sustainability is an existential problem (Ehrenfeld, 2008), see Section 4.1 and Section 7.5.3.1, a range of democratizing developments and technological advancements, in combination with certain societal and human principles, have helped to define a solution direction. This section discusses developments in technology and society that, apart from being promising for the entire field of industrial design, clearly help in providing an alternative scenario to today's strict separation between production and consumption. Various rather new digitally based manufacturing possibilities, available to end-users, allow for small volume (one-off) manufacture of items without high tooling investments. These technologies, together with a general growing interest in making, tend to democratize making, which aligns to people's innate urge for self-sufficiency and independence.

Do-It-Yourself (Section 6)

The preceding sections have provided reasons to suggest a closer relationship (1) between production and consumption and (2) between people and the product they consume. When considering ethics and *'Human Being'* (awareness), the Do-It-Yourself scenario (merging making and consuming, hence shortening the distance) appears to be reasonable and sensible, providing great opportunities for people's personal development and for a better consideration of sustainability. Historical analysis of the DIY phenomenon and the drivers of past DIY activity endorses/supports the relevance and value that DIY could have in today's context.

A vision to facilitate Do-It-Yourself (Section 7)

Subsequently, a vision was established: 'the support and facilitation of DIY activity by laypersons'. In this, all three of Ehrenfeld's (2008) sustainability areas (Figure 2) of ethics, human beings and nature are addressed in a positive sense: (1) DIY helps people to know the consequences of their actions, it provides a better human-product connection, (2) DIY addresses

human needs and people's creativity, and provides pride of authorship and joy in the DIY process, and (3) DIY's conjunction of making and using increases awareness, supports small scale, care and product attachment, and hence serves the natural environment. Given that DIY activity greatly aligns with the elements of sustainability as described by Ehrenfeld (Ehrenfeld, 2008), and the designer's responsible role, this section proposes to assign the responsibility of creating a better connection between the user and the maker of products to the designer. This is because (1) it is part of today's design job to offer suitable solutions, by designing products or services and experiences, and (2) morally, it is the designer's job to serve people with sufficient solutions, to re-connect people to what they really require, and to involve them. Not solely to serve the client company's wishes.

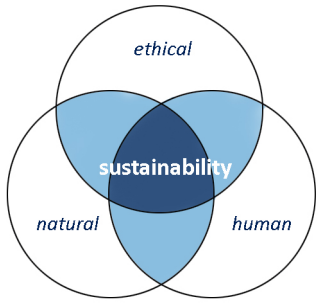


Figure 2: Domains of sustainability according to Ehrenfeld (2008)

Gaining insights into Design-for-DIY through a series of Design-for-DIY studies (Section 8)

To explore what the concept of Design-for-DIY could entail in practical terms, based on insights from previous sections, Section 8 presents a series of four explorative Design-for-DIY studies. These studies were conducted to deepen understanding of the Design-for-DIY process and to lay the groundwork for a foundational 'Design-for-DIY framework.' The studies were carried out by students as part of their graduation projects.

The studies included: (1) the DIY design and assembly of a coffee maker, in which participants were asked to choose and assemble their own coffee maker from various second-hand jars, cans, lids, and rings available; (2) the DIY design of a desk lamp, featuring a tangible, 'deformable' form that enabled participants to explore shape in a 3D design space and translate their designs into a producible form; (3) a Design-for-DIY study of headphones, which provided an accessible toolkit template allowing laypersons to create a personalized, wearable design using ready-made hardware components; and (4) the 'Reusing Plastics at Scrap' study, which focused on designing tools to assemble parts and materials from 'Scrap' and providing instructional sheets to facilitate DIY activity by laypersons. The studies helped answer the research questions defined for this series, focusing on the division of tasks between designer and layperson, the provision of design freedom for the layperson, and the feasibility of a generic framework.

The Design-for-DIY framework (Section 9)

The previous sections provided the foundation and rationale for a final proposal of a methodological theoretical framework (Figure 3). This framework is explicitly linked to existing educational, DIY-related, and widely recognized design process models as references. This section aims to clarify and describe in greater detail the proposed framework, including its structure, form, and components. The Design-for-DIY framework follows a spiral shape, consisting of multiple concentric design cycles, each containing a range of design steps.

The cycles include:

1. The Project Cycle (or project brief cycle), in which the designer (and layperson) addresses the project's purpose, target audience, reason for initiation, and product category.

2. The Pre-Design Cycle, which serves as a reference and draft product design for the project, providing an example for the layperson.

3. The Toolkit Cycle, a fundamental element of the framework, as it includes task allocation, specific tools and instructions, and a designated design-space.

4. The Platform Cycle, which consolidates key design-support elements that a layperson may need when undertaking a DIY project. This includes designer support, physical and digital materials for inspiration, examples, peer and community networks, potential material suppliers, and more.

5. The DIY Design Cycle, which invites the layperson to engage in the actual DIY activity. This activity is guided to varying extents by the facilitating designer within the environment as prepared and provided by the designer.

Assessment of the Design-for-DIY framework (Section 10)

This chapter describes a series of design experiments in which 12 participants test the Design-for-DIY framework. The participants, all professional designers, worked in pairs to carry out the Design-for-DIY experiments, using the provided framework as their starting point. The experiments were important in evaluating the effectiveness of the proposed framework: how it helps designers set up a DIY project and, in doing so, facilitates the DIY activity itself. At the same time, the tests generated valuable suggestions for improvements to the proposed framework.

When reflecting on the Design-for-DIY framework design, it seems reasonable to conclude that participants evaluated the Design-for-DIY framework as relatively complete. Specifically, the framework offers design freedom, allows for exploration, and guides the designer in considering essential design criteria and the consecutive design cycles (pre-design, toolkit, and platform). The arrangement of these cycles within the framework is both accurate and flexible, and the instructional video is clear. Most participants felt comfortable starting their designs, and they were generally positive about the suitability of this process for other Design-for-DIY cases. Another conclusion is that participants recognized many of the merits of Design-for-DIY and the use of the framework, such as fostering pride, skill development, low cost, and self-sufficiency. At the same time, they also acknowledged the barriers people might face, including the high effort required, lack of time, and limited skills. While participants generally felt free to manoeuvre, some suggested a more flexible path to follow

and expressed interest in having project examples as references. The outcomes of the experiment allow the conclusion that a Design-for-DIY framework was created that can sufficiently help the designer to develop and establish a DIY project. Though, as the findings of the experiments are based on a relatively small sample of participants, this may limit the generalizability of the results.

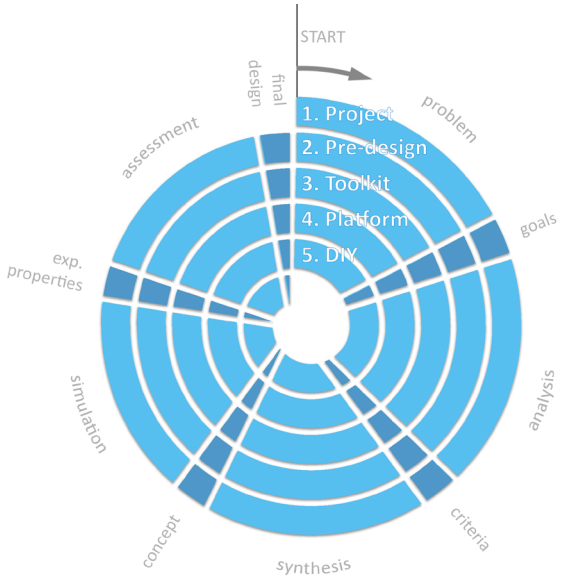


Figure 3: The design-for-DIY framework

Conclusions and discussion (Section II)

The final chapter discusses the conclusions and implications regarding the previously mentioned Design-for-DIY vision, the scenario, the Design-for-DIY framework and its validation, and what these could mean for the field of design, the human-product relationship, the broader implementation of the Design-for-DIY concept, and design education. The following topics are addressed in turn: a reflection on the overall research objectives, the answers to the research questions, the value of the research for design practice and theory, its impact and limitations, the implications of the findings for design education, the propositions developed and approved for the dissertation, and suggestions for future research.

The outcomes of this research seem to align with the ambition of the study: deducing and proposing a scenario that would help counter today's unsustainable user-product relationship. This is achieved through the provision of a scenario and method for facilitating DIY activity via a Design-for-DIY approach.

Samenvatting

Context, kritiek, en probleemstelling (hoofdstukken 2, 3 en 4)

Kort samengevat begint deze scriptie met de introductie van een onderliggend maatschappelijk probleem (Sectie 3). Het begint met de observatie en aanduiding van wat sommigen de 'splitsing' zouden noemen tussen (1) de industrie, instituties en markten die produceren, en (2) de eindgebruikers, de zogenaamde consumenten die kopen, consumeren en gebruiken (Edwards, 2006). De eerste hoofstukken behandelen hoe productie en consumptie van elkaar zijn verwijderd en dat lijken te blijven doen. Verschillende historische ontwikkelingen, waaronder de industrialisatie en het resulterende menselijke gedrag, in een markt gestuurde samenleving, zijn hierin doorslaggevend geweest. Deze door industrialisatie veroorzaakte splitsing heeft ernstige negatieve gevolgen gehad voor zowel mens als natuur. Het systeem van massaproductie en -consumptie is de standaard geworden. Toch werd industrialisatie al vanaf het begin bekritiseerd, en is deze kritiek ook vandaag de dag nog accuraat. De oorspronkelijke probleemstelling waar dit proefschrift zich over buigt luidt als volgt: 'Hoe kunnen 'ontwerp' en 'gebruik' dichter bij elkaar worden gebracht, en hoe kan de ontwerper daarin verantwoordelijkheid nemen?'

Kansen en oplossingsrichtingen (hoofdstuk 5)

Er zijn echter kansen die verbetering kunnen brengen ten aanzien van het huidige systeem van produceren en consumeren. Met duurzaamheid in brede zin als referentie (Ehrenfeld, 2008; zie Sectie 4.1 en Sectie 7.5.2) hebben een reeks democratiserende en technologische ontwikkelingen, in combinatie met universele menselijke drijfveren, bijgedragen aan het aandragen van een oplossingsrichting.

Deze sectie bespreekt technologische en maatschappelijke ontwikkelingen die, naast hun relevantie voor het vakgebied van industrieel ontwerpen in het algemeen, kunnen bijdragen aan een verbeterde relatie tussen productie en consumptie, en daarmee tussen mensen en de producten die ze gebruiken. Verschillende nieuwe digitale productiemogelijkheden, beschikbaar voor eindgebruikers, maken kleinschalige (unieke) productie mogelijk zonder grote investeringen in gereedschap. Deze ontwikkeling, samen met een groeiende interesse in het (ambachtelijk) 'maken', kunnen bijdragen aan de democratisering van het ontwerpproces en de productie van gebruiksvoorwerpen. E.e.a. lijkt aan te sluiten op de universele menselijke drijfveren met betrekking tot o.a. creativiteit, zelfvoorzienendheid, en onafhankelijkheid.

Doe-Het-Zelf (Hoofdstuk 6)

De voorgaande secties hebben argumenten aangedragen voor het nastreven van een nauwere relatie (1) tussen productie en consumptie, en (2) tussen mensen en het product dat ze gebruiken. Vanuit zowel een ethisch perspectief, een ecologisch perspectief, als een menselijk bewustzijnsperspectief, lijkt het scenario waarin het ontwerpen en maken enerzijds, en het gebruiken anderzijds samenvallen; kortom waarin de afstand wordt verkleind, zinvol. Met andere woorden, het concept van 'Doe-Het-Zelf' biedt kansen voor een betere adressering van duurzaamheid in al zijn facetten. Letterlijk betekent 'Doe-Het-Zelf': een activiteit die mensen in staat stelt om een deel van hun omgeving zelf ter hand nemen terwijl dat normaal gesproken door anderen wordt gedaan (Wolf & McQuitty, 2011).

Een historische analyse van het concept 'Doe-Het-Zelf' (Engels: *DIY*), de achtergronden en de drijfveren in eerdere periodes waarin *DIY* als concept hoogtij vierde, bevestigt de relevantie en waarde die dit principe in de huidige maatschappij zou kunnen hebben.

Een visie: facilitering van Doe-Het-Zelf (Hoofdstuk 7)

Aan de hand van het bovenstaande is een toekomstvisie en -scenario beschreven, met als thema: 'het ondersteunen en faciliteren van 'Doe-Het-Zelf' activiteiten'. In deze visie worden alle drie de duurzaamheidsdomeinen van Ehrenfeld (2008) (*Figure 4*) – ethiek, mens en natuur – op positieve wijze geadresseerd. (1) *DIY* helpt mensen om de gevolgen van hun acties te zien en begrijpen, en biedt een betere mens-product relatie, (2) *DIY* beantwoordt aan universele menselijke waarden ('*needs', 'attributes of Being',* o.a. behoefte aan autonomie, controle, zeggenschap, en aan het uiten van creativiteit (Maslow, 1998; Max-Neef, 1992)), en biedt de amateur trots en plezier in het *DIY*-proces. (3) De integratie van ontwerpen, maken en gebruiken (het concept van *DIY*) vergroot het bewustzijn, ondersteunt kleinschaligheid, bevordert aandacht en hechting aan het product dat je gebruikt, en dient daarmee de natuurlijke omgeving.

Dit hoofdstuk beargumenteert dat de verantwoordelijkheid voor het creëren van een betere mens-product relatie bij de ontwerper ligt. De redenen hiervoor zijn (1) dat het bieden van passende oplossingen (producten, diensten, ervaringen) behoort tot de algemene taakomschrijving van de ontwerper, en (2) dat de ontwerper zich vanuit een moreel standpunt moet richten op de belangen van de gebruiker, en niet uitsluitend op de wensen van de opdrachtgever.

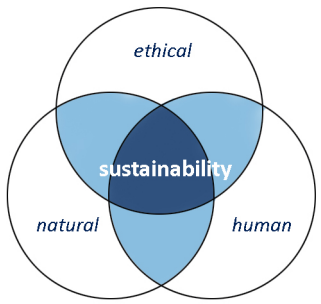


Figure 4: De drie duurzaamheids-domeinen volgens Ehrenfeld (2008)

Een reeks *Design-for-DIY* studies (Hoofdstuk 8)

Om te verkennen wat het *Design-for-DIY* concept praktisch zou kunnen inhouden, zijn vier *Design-for-DIY* studies uitgevoerd. Deze worden in Hoofdstuk 8 behandeld. De studies werden uitgevoerd om meer grip op het *Design-for-DIY*-proces te krijgen, en de basis te leggen voor een proces-beschrijvend *Design-for-DIY framework*. De studies werden uitgevoerd door studenten in het kader van hun afstudeerprojecten.

De studies omvatten: (1) het *DIY*-ontwerpen en assembleren van een koffiezetapparaat, waarbij deelnemers werd gevraagd hun eigen apparaat samen te stellen uit verschillende tweedehands potten, blikken, deksels en ringen; (2) het *DIY*-ontwerpen van een bureaulamp (*de 'Sculptur'*), met een tastbare, manipuleerbare dummy die deelnemers in staat stelde om ruimtelijk vorm te geven aan hun lamp; (3) een *Design-for-DIY*-studie van koptelefoons, die een toegankelijke template bood waarmee amateurs een gepersonaliseerd, draagbaar ontwerp konden schetsen en ontwerpen; en (4) de studie '*Re-using Plastics at Scrap*', die zich richtte op het ontwerpen van hulpmiddelen voor Scrap klanten om te kunnen werken met 'Scrap' materialen, en op het bieden van instructies.

De studies hielpen bij het beantwoorden van de onderzoeksvragen die voor deze reeks waren gedefinieerd, met de nadruk op de taakverdeling tussen de ontwerper en de amateur, de ontwerpvrijheid voor de amateur, en de haalbaarheid van een generiek framework.

Het *Design-for-DIY framework* (Hoofdstuk 9)

De voorgaande hoofdstukken hebben de basis gelegd voor een definitief voorstel van een methodologisch framework (*Figure 5*). Het framework beschrijft het *Design-for-DIY* proces, en is bovendien expliciet gerelateerd aan bestaande educatieve, '*DIY*'-gerelateerde en erkende ontwerpprocesmodellen. Dit hoofdstuk licht het ontwikkelde framework nader toe, inclusief de structuur, vorm en onderdelen. Het *design-for-DIY framework* heeft een spiraalvorm, bestaande uit meerdere concentrische ontwerpcycli, met binnen elke cyclus een reeks ontwerpstappen.

De cycli omvatten:

1. De Projectcyclus (of projectbrief-cyclus), waarin de ontwerper (en amateur) het doel, de doelgroep, de aanleiding en de productcategorie van het project bepalen.

2. De Pre-design cyclus, die als referentie en voorlopig productontwerp dient voor het project, en die een voorbeeld biedt voor de amateur.

3. De Toolkit-cyclus, een belangrijk element van het framework, aangezien het de taakverdeling, specifieke hulpmiddelen en instructies, en een aangewezen ontwerpruimte omvat.

4. De Platform-cyclus, waarin belangrijke ontwerp-ondersteunende elementen worden samengebracht voor de amateur, waaronder fysieke en digitale materialen ter inspiratie, voorbeelden, community netwerken, potentiële leveranciers van materialen, enzovoort.

5. De '*DIY*'-cyclus, waarin de amateur wordt uitgenodigd om een '*DIY*'-project op te pakken. De '*DIY*' activiteit wordt in meer of mindere mate begeleid door de faciliterende ontwerper, binnen de omgeving die door de ontwerper is gecreëerd en beschikbaar gesteld.

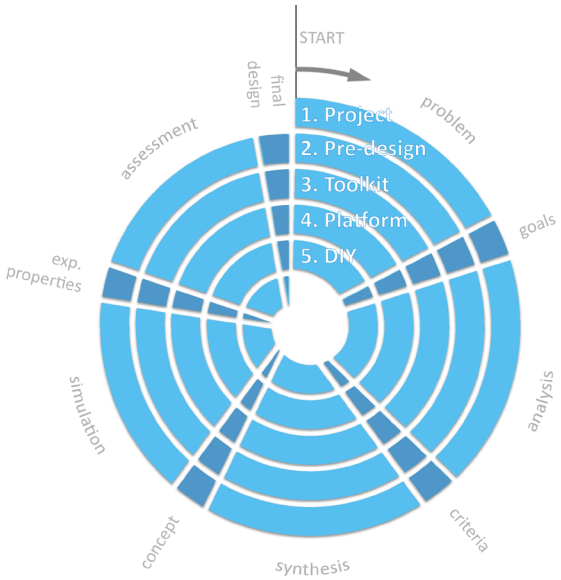


Figure 5: Het *Design-for-DIY framework*

Testen van het *Design-for-DIY framework* (Hoofdstuk 10)

Dit hoofdstuk beschrijft een reeks ontwerpexperimenten waarin 12 deelnemers het *Design-for-DIY framework* testen. De deelnemers, professionele ontwerpers, voerden in duo's de *Design-for-DIY* experimenten uit, waarbij het geboden *Design-for-DIY framework* als uitgangspunt diende. De experimenten hielpen om de kwaliteit van het voorgestelde *framework* te beoordelen: hoe het de ontwerper ondersteunt bij het opzetten van een *DIY*-project, en daarmee Doe-Het-Zelf-activiteit faciliteert. Tegelijkertijd leverden de tests suggesties op voor verbeteringen aan het voorgestelde *framework*.

Reflecterend op *Design-for-DIY framework* kan worden geconcludeerd dat de deelnemers het *Design-for-DIY framework* als vrij compleet beoordeelden. Het framework biedt ontwerpvrijheid, stelt de ontwerper in staat om te exploreren, en begeleidt hen bij implementeren van ontwerpcriteria en van de opeenvolgende ontwerpcycli (*pre-design-, toolkit- en platform* cyclus). De opzet van deze cycli binnen het framework is zowel passend als flexibel, en de instructievideo is duidelijk. De meeste deelnemers voelden zich op hun gemak om met hun ontwerptaak te beginnen en ze waren over het algemeen positief over de geschiktheid van het ontwikkelde framework voor andere *Design-for-DIY* projecten.

Een andere conclusie is dat de deelnemers ook *Design-for-DIY* als concept herkenden als iets positiefs: dat het trots kan opleveren voor de ontwerpende amateur, de ontwikkeling van vaardigheid, lage kosten, en ook zelfredzaamheid. Tegelijkertijd erkenden ze ook de obstakels waarmee mensen te maken kunnen krijgen, zoals de inspanning die vereist is, tijdgebrek en het gebrek aan vaardigheden. Hoewel deelnemers zich over het algemeen vrij voelden om binnen het framework te bewegen, gaven sommigen aan een flexibeler traject te prefereren, en toonden ze interesse in projectvoorbeelden. Aan de hand van de resultaten van de experimenten kan worden geconcludeerd dat het voorgestelde *Design-for-DIY framework* aan de beoogde ontwerper voldoende hulp biedt om een *DIY* project te kunnen ontwikkelen en op te zetten. Aangezien de bevindingen uit de experimenten zijn gebaseerd op een relatief kleine groep deelnemers, kan dit de generaliseerbaarheid van de resultaten beperken.

Conclusies en discussie (Hoofdstuk 11)

Het laatste hoofdstuk bespreekt de conclusies en implicaties ten aanzien van de eerdergenoemde *Design-for-DIY* visie, het scenario, het *Design-for-DIY framework* en de diens validatie, en wat deze zouden kunnen betekenen voor het vakgebied van het ontwerpen, voor de mens-product relatie, voor een bredere implementatie van het *Design-for-DIY* concept, en voor het ontwerponderwijs. Achtereenvolgens worden behandeld: een reflectie op de doelstellingen van het gehele onderzoek, het beantwoorden van de onderzoeksvragen, de waarde die het onderzoek heeft voor design-praktijk en -theorie, de impact en de beperkingen, de implicaties die het beschrevene kan hebben voor het ontwerponderwijs, de stellingen die bij het proefschrift zijn opgesteld en goedgekeurd, en suggesties voor toekomstig onderzoek.

De uitkomsten van dit onderzoek lijken aan te sluiten bij de ambitie van de studie: het afleiden en voorstellen van een scenario dat kan helpen bij het verbeteren van de relatie tussen mens en product. In deze studie wordt dit bereikt door het aanbieden van een scenario en methode ter bevordering van Doe-Het-Zelf activiteit aan de hand van een *Design-for-DIY* benadering, concreet: een *Design-for-DIY framework*.

Preface

This thesis is positioned in the context of Industrial Design Engineering, referring to the profession, the educational programme, and the academic research area. Industrial design concerns the design of products – in the broad sense - for a certain audience and specific stakeholders. By definition, design concerns both the process and the result thereof. Industrial design offers the service of developing and prescribing integrated solutions regarding the design - from ideation to the embodiment, manufacturing process and implementation of a product.

This context, and specifically the industrial designer perspective, was the starting point for writing this thesis. I was educated as an industrial designer, worked as designer at different places and companies, and, in hindsight, was always most involved with the creative aspect, and the aesthetic and mechanical beauty.

With the beauty of the field in mind, which concerns creativity, people, society, technical solutions, aesthetic value, and art, I felt the urge to delve deeper and research and explain the sometimes harmful consequences of the industrial system of which we are all part. I feel a responsibility, without drama, to suggest a sensible scenario to contribute to the discipline of design.

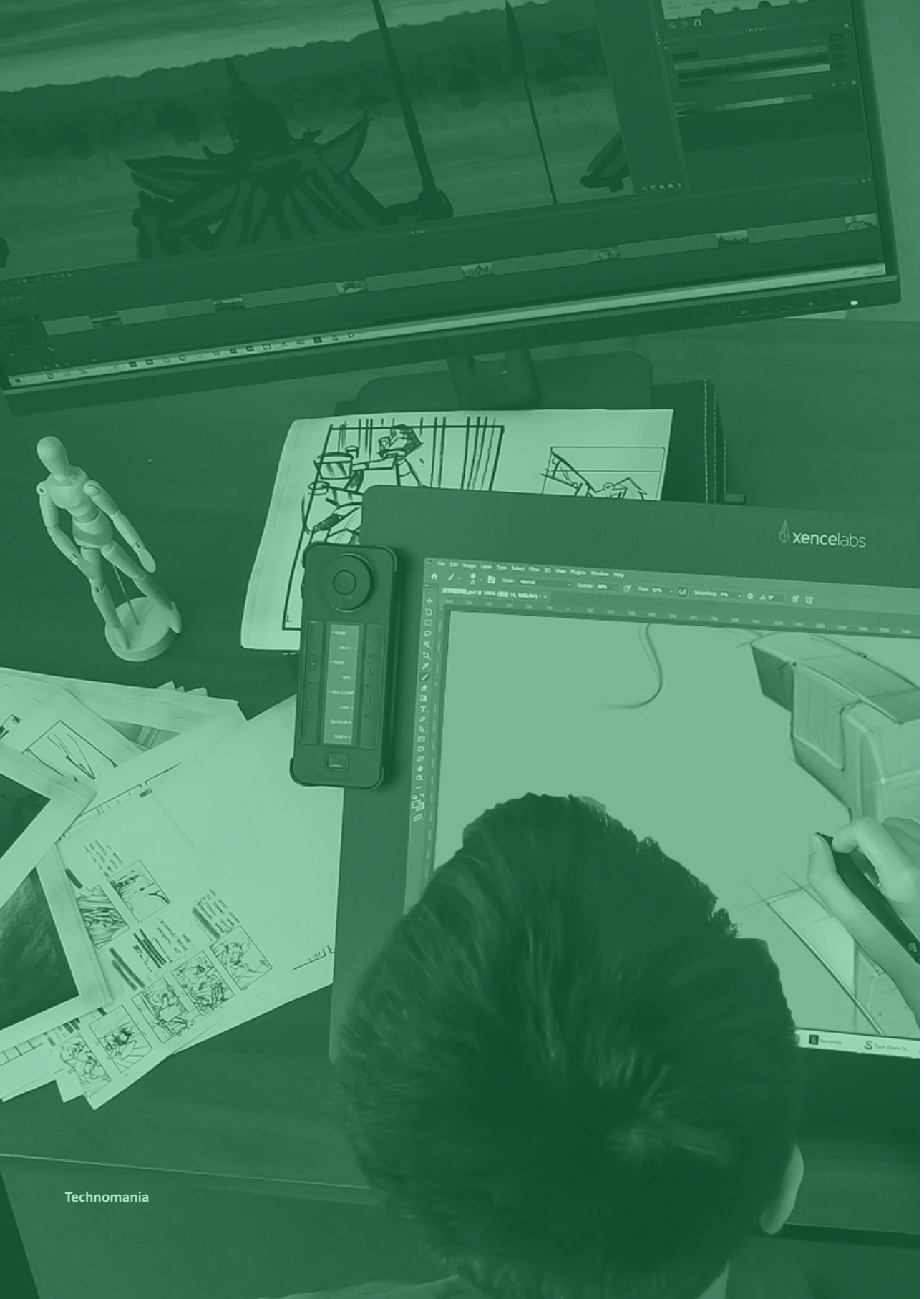
PART I - Context

Section 1 concerns the introduction to this study, its context, followed by a description of the context of industrial design in Section 2 and Section 3. Section 4 presents the problem statement (an unsustainable human – product relationship), and Section 5 addresses the opportunities that can help us solve the problem at hand. These opportunities concern changes in the techno-, info- and socio-sphere.

'Without recovering our sense of Being and ethical responsibility, it is virtually impossible to start to take care of the world and our own species [...]' (Ehrenfeld, 2008, p. 7).

'What design designs are the relations between things and persons and things and nature' (Dilnot, 2009, p. 183).

Bankok mall



Technomania

Section 1. Introduction

1.1 Industrial design field as a context

Although people in today's society are used to its industrial and commercial character, reflected in the way objects (things, tools, consumables) are mass-produced, distributed and mass-consumed, and in the way making and using are separated, this economic situation is rather new in relation to the history of mankind.

In fact, during almost our entire history, except for the past two to three centuries, people made many of their own tools and produced items to fulfil their own needs within their extended family (Achterhuis, 2010, 2011; Toffler, 1990), rather than purchasing them or selling them to others.

According to Hans Achterhuis (2011), household production was common in New England until 1810; within the *'οικία'* (home, families, land), people produced food and candles, wool was made, clothes manufactured, and cattle kept. Since then, a transition has taken place from a subsistence economy to a market economy; farmers started to sell their stock on the market, men started to work for someone else (wage labour), and consumer goods were increasingly sold for money (instead of trade). Today, wage labour is common, and many people earn their living in this way. Originally, this was not common at all.

Taken from a historical perspective, this self-making activity in the past made a lot of sense because creativity and the ability to make things are essential assets of human beings (homo faber); these aspects are what distinguish humans from other species (Csikszentmihalyi, 1998; Ehrenfeld, 2008; Sennett, 2008). Due to economic efficiency and commerce and thereby striving to reach a large audience, there has been a continuous focus on upscaling and a continuous increase of labour division, even more so since the beginning of the industrial age. Until today, the industrial design profession has mostly had a commercial character: from an industrial perspective, it serves to help add value to raw materials and commodities. For companies and organizations, it serves to innovate or deliver the next version of an item, for example, focusing on cost reduction and feasibility, and the contextual service and system.

Because tooling and machinery for mass-manufacturing typically require high levels of investment, batch sizes usually need to be large. The design and manufacturing of products in large quantities actually originates from the emergence of industrialization.

The Industrial Revolution was the fundament of the industrial design profession, referring to the task of linking the (until then) craft of design to the challenge of mass manufacturing, to build a bridge between creativity and craft on one hand and cost and feasibility on the other. Today's field of industrial design still builds on its original starting points: design for industrial production (see Section 2).

1.2 Problem in short: the unsustainable relationship between user and product

Introduction/ problem definition

Figure 6 below illustrates why, given the broad challenges concerning sustainability and new possibilities provided by technology, it is worth analysing and exploring an alternative relationship between making and using, preferably bringing making and using together again.

Today's global context of mass-produced items has resulted in an increasing distance – or alienation – between people and the origins of the items they buy and use: an unhealthy human-product relationship. What's more, consumerist behaviour (Baudrillard, 1998; Mayell, 2004; Sennett, 2008) seems to have led to a degraded relationship between people and nature, thus maintaining an unsustainable situation (Boradkar, 2010; Chapman, 2005; Ehrenfeld, 2008).

The so-called 'distance' between the person who manufactures and the one who purchases and uses the item, which grew along with the scale of mass production, seems to have resulted in a worsened relationship between manufacturing and consumption. In fact, many of today's environmental and humanitarian problems could be partly attributed to this worsened relationship. For example, in most cases, people do not know the origin of a product and are largely no longer capable of repairing it. Products today often do not lend themselves to easy repair and people may lack the skills required to fix or make things.

The extremely simplified historical timeline of Figure 6 illustrates the difference between a society of a Sector A economy (mainly making for oneself or close family) and a society of a Sector B economy (making for someone else) (Achterhuis, 2011; Toffler, 1990). Section A is strongly related to subsistence society and self-sufficient living, whereas Sector B society relates to industrialized society. Simply put, we now live in a society in which production and consumption are highly separated, whereas this was not the case during most of our history. Moreover, this separation opposes the nature of human beings, who distinguish themselves through creativity and the ability to make.

Although designers might have had and currently may have the most positive of intentions, design has merely focused on satisfying the increasing need for consumption, even though a higher level of consumption does not elevate the perceived happiness of people (Lipovetsky, 2006; Porritt, 2003).

Salvia (2016), referring to Cooper (2005) and Thorpe (Thorpe, 2010) suggests an alternative interpretation of well-being, an interpretation that does not rely on the perceived need to increase consumption.

Reasoned along Ehrenfeld's (2008) definition of sustainability, the industrial split between production and consumption has led to a threefold problem. It has (1) resulted in people's unawareness and so-called alienation, (2) people's creative capabilities are left unused, their Being disregarded, and (3) what remains is an unhealthy relationship between people and nature, which might result in pollution and deforestation.

Maintaining the capitalist (economic) principles of growth and profit promotes and accelerates the exhaustion of nature; it interferes with a proper relationship with nature. This economic system has been dominant since colonial times and today it still forms a mandatory

Figure 6: Graphic representation of the Agricultural Age (orange) and the Industrial Age (blue)

element of policy, stipulated in international free trade agreements (Hirsch & Pauw, 2022).

These starting points have led to a society of large-scale mass production and mass consumption, causing many problems of which globalization is an integrated part.

From a designer's viewpoint, in order to search for solutions to these problems, it is necessary to involve and examine the entire system of production and consumption in which we live. There is a need to view things from a higher perspective, a higher level of abstraction.

Aligned to the above stated, today's relationship between the production of a product and the consumption of it is mostly built on the heritage of industrialization that originated two centuries ago: a system characterized by division of labour, marketization, standardization, specialization, scale (Edwards, 2006; Mintzberg, 1983). According to Alvin Toffler (1990, p. 37), this so-called 'Second Wave' split caused by industrialization 'drove a giant invisible wedge into our economy' […] 'The two halves of human life that the Second Wave split apart were production and consumption', he states. Until the industrial revolution, most of people's food and goods were consumed by the producers themselves. Toffler refers to Braudel (2023)indicating that in the sixteen's century '60 percent or perhaps 70 percent of the overall production of the Mediterranean never entered the market economy' (Toffler, 1990, p. 38).

As a result, our society has increasingly turned into a consumption society. In fact, people today have gotten used to and become addicted to buying things instead of putting effort into making or mending them. People's resulting passive consumption behaviour (Press, 2007) is in contrast with some of the most essential and unique characteristics of humanity: people's creativity (Ehrenfeld, 2008; Sennett, 2008) and people's need for autonomy (Maslow, 1998; Max-Neef, 1992). At the same time, people's connection with the world and nature that surrounds them seems lost; commerce and globalization have worsened our awareness of where things come from and how things are made. Both tendencies, which are closely related as they both refer to people's 'Being', could be regarded as undemocratic, as the majority of people seems not involved in the conception of objects and tools (or systems) that surround them.

To counteract the consequences of the unsustainable situation as noted by Ehrenfeld (2008), one could assume that it is important to address the original cause of the harmed relationship and not search for an end-of-the-pipe solu-

tion. As briefly discussed, one of the main causes appears to be the split between production (industry, design) and consumption (people): Sector B society, as Toffler (1990) names it. The establishment or recovery of a healthy relationship between these two elements would seemingly help solve the issues as mentioned above. Furthermore, such a reconnection would align with the views of various scholars (Ehn, 2008; Pacey, 1992; Papanek, 1985) who have advocated for a new partnership, and with Manzini (2008, p. 274) who suggested that designers can no longer aspire to 'a monopoly on design'.

1.3 Scope

1.3.1 Sustainability: human, ethics, and nature

When considering sustainability, most people would merely think of nature and our natural environment. Literally, the term 'sustainability' refers to maintaining and sustaining a certain (desired) situation: to ensure that contextual circumstances enable nature to survive and even flourish. As some respected scholars state, this sustainability cannot be reached through short-term or incremental changes only (Ehrenfeld, 2008).

The change should come from questioning and altering the distant relationship between people and the things they use and need. It requires a change in people's behaviour, attitude, and awareness. Ehrenfeld says that sustainability is rather an existential problem, which is why we need to consider the elements of *'Human Being'* and 'ethics' to be able to establish a better relationship between people and the environment they live in (Ehrenfeld, 2008). Section 4.1 will elaborate on this definition of sustainability, an elementary aspect of this thesis.

1.3.2 People

The human aspect is of major importance in this thesis, both in a direct sense (helping the layperson to exert his/her creativity, etc.) and in a rather abstract sense (suggesting a democratized and sustainable structure). The consideration of people plays a central role in this thesis, since they are the key factor when striving for a better user-product relationship when striving for sustainability in general. In Ehrenfeld's words: 'Without recovering our sense of Being and ethical responsibility, it is virtually impossible to start to take care of the world and our own species […]' (Ehrenfeld, 2008, p. 7).

On the one hand, people suffer from the consequences of today's unsustainable systems of production, but they are also the ones who should solve it. Increasing people's awareness seems to be a key aspect.

This thesis also considers people as a unique species and considers their motivations, emotions, drive, and innate needs. These *human needs* refer to the attention that should be paid to people's Self and to human 'Being' (Max-Neef, 1992) and are an important reason to strive for a situation in which people can address and express creativity, develop themselves and be involved in decision making.

1.3.3 Democracy

Closely related to the paragraph named 'people' - and central to the discussion this thesis seeks to facilitate - is the concept of democracy. 'Democracy is a system of government in which laws, policies, leadership, and major undertakings of a state or other polity are directly or indirectly decided by the "people", […]' (Shapiro, Froomkin, & Dahl, 2024). In *Models of Democracy*, Held (2006) describes democracy as a system designed to promote citizens' welfare by giving them a voice in decision-making and safeguarding their fundamental rights.

Fundamentally, democracy is about the accurate representation or direct involvement of the people (members, citizens) within a community. Dahl (Dahl, 2020, p. 38) refers to the following requirements for democracy: effective participation, voting equality, enlightened understanding, control of the agenda, decision on who qualifies as a member.

In this thesis, the term 'democracy' refers to the involvement of people in decision-making in general, and specifically to their involvement in the conception of products. The aspect of democracy will be discussed throughout the thesis, particularly in Section 4.2.2.3, Section 5.2.2.9, and Section 7.5.2.

1.3.4 Technology

This thesis specifically addresses technology as an enabling phenomenon by definition and as an area that is developing rapidly, offering lots of opportunities for design in general and for the democratization of design in particular. Technology not only supports mass manufacturing factories but has been and can continue serving the layperson's making and mending activity as well.

Recent developments that have brought about (digital) making tools (3D printing, laser cutting) allow non-designers, or laypersons, to create and make things on their own. Technological developments are also the fundament of new and fast-evolving information technology and availability; information about nearly everything can be found everywhere, and instantly.

The original *Τέχνη* refers to art and craft, and resonates with 'bringing forth' ('*tevoorschijn-brengen*'), to 'poiesis', in Greek *ποίησις*, which means 'creation' or 'making', or the process of poetic or artistic creation (Heidegger, 2014, p. 14). Technology, traditionally, is associated to forth bringing and uncovering. The possibility of forth-bringing production, Heidegger (2014, p. 14) says, is enabled by the so-called uncovering (*Αλήθεια* in Greek, meaning '*ontbergen, waarheid*' in Dutch).

Τέχνη is traditionally closely related to *επιστήμη* (knowledge). Heidegger refers to Aristoteles who specifically regarded *Τέχνη* and *επιστήμη* as two important ways to uncover. Both words are synonyms of 'knowing' in its broadest sense, meaning 'to be aware of things', and 'to be able to consider', describes Heidegger (2014, p. 14). And this 'knowing' provides resolution, he describes. Hence, art, craft, creation, and knowledge help to uncover, which are all necessary for bringing forth production.

1.3.5 Role of the designer

The field of industrial design, and therefore the designer, has a clear responsibility in this sense: (1) since, for example, the producers of things (objects, consumption goods, consumables) have in the past and undoubtedly still contribute to today's unsustainable situation and the resulting negative consequences (Kruk, 2022), and (2) the discipline of industrial design claims to be an expert in developing solutions for complex problems, of which our consumer society is one.

Despite historic and recent criticism of the industrial system, the field of industrial design engineering has not succeeded in establishing a better balance between people and the items they use (Hirsch & Pauw, 2022; Kruk, 2022; Luttikhuis, 2021; Noort & Brink, 2023) (Boradkar, 2010, pp. 12, 14; Ehrenfeld, 2008, pp. 22, 210; Schwarz & Krabbendam, 2013, p. 13). This thesis suggests that it is the designer who has the position, skills, and knowledge to improve the situation. For this reason, the designer should take responsibility.

It is the designer who will serve as the principal character for this study. The study aims to support the designer in his/her attempt to help solve the situation, anticipate changes, and bridge the gap between production and consumption.

Specifically, designers could make (design) choices at the beginning of a product development process. These choices have a big impact on the entire process and on the end result, according De Wagenaar (Pijpker, 2023).

To understand relationships between things, systems, and people clearly, a designer specifically needs to cross interdisciplinary boundaries and view things from a broad perspective. Such a broad view also helps to discover historic relationships, which is needed to explore causes and consequences. Inventions, choices, and phenomena from the past have led to new states and traditions and might have caused the problematic issues of today.

1.4 Relevance of this thesis

The work in this thesis considers problematic issues in, and partly caused by, the profession and field of industrial design, and it analyses and questions the traditional structure that it represents. Instead of approaching the situation from an operational design level (i.e. the product level) or a tactical or organizational design level, it views the field from an existential level. The thesis strives to find answers that surpass the level of incremental improvements or adaptions.

The relevance of this research further lies in the proposition of an improved relationship between the producer and the consumer - between the maker and the user of a product. The proposition anticipates societal and technological changes and changes in people's behaviour and awareness.

In many ways, the proposed scenario of Design-for-DIY will be the opposite of traditional product design: instead of a top-down relationship between designer and user, the proposed scenario concerns a relationship of guidance, even a bottom-up relationship. Whereas the traditional scenario concerns production on a large scale, the proposed situation heralds on-off, unique outcomes for each layperson. The envisioned situation focuses on active user involvement, the opposite of the passive consumption attitude in a mass production situation. For deeper insights into the changes as proposed in the vision of this thesis, and hence the relevance of the subject, see Section 7.

1.5 Adjacent fields and areas of interest

This study not only concerns the question of 'how' or 'what' should be designed, it will also cover the 'why' and 'who' questions. It questions the reason things are made and why things are organized the way they are, and it challenges common views of design and the system under which it resides.

This research addresses DIY product design, considers things from a wide perspective and concerns many different aspects and factors, which is why this thesis touches upon various fields of expertise, as outlined below.

The philosophical point of view (ethics) - The thesis addresses ethical considerations that concern the relationships between people and the things they use. It also addresses people's awareness of the consequences of their actions. By doing so, it poses fundamental questions regarding the essence of product design, people's role therein and the values of DIY. It criticizes and refers to criticism of the existing industrial society and reasons for an alternative approach and system. See – among other sections - Section 2.3 and Section 4.2.

Sociology, politics - In suggesting that today's structure of mass production and mass consumption is harmful to people and the planet we live on, this thesis is not unique. In fact, a wide range of scholars confirms that the system of mass production as well as people's consumption behaviour need to be reconsidered. See Section 3.4.

Psychology – The thesis cites various scholars who help in understanding the psyche and motivations of people. I refer to these authors when I write about the *human needs* and aspects of human 'Being' that go far beyond superficial consumer needs or behaviour. See – among others - Section 4.2.2 and Section 6.5.3.

The area of 'Design history' - Design history analyses the contextual factors of an era and studies 'the process of conception of mass-produced consumer goods and of their reception in the social environment', in order to be able to explain how and why goods look the way they do (Saumarez Smith, 1989). 'Design reflects society' is a common and valid expression that helps indicate what design was in the past and could be in the future.

To be able to define a clear picture of industrial design and the way it is structured today, and why it is organized as it is today, its recent and historic contexts need to be analysed. See Sections 2 and 3.

Design management - As will be discussed later in this thesis, the changes and questions that form the basis of this study relate to a view from a rather visionary level. The changing structures are well relatable to existing design management models and design strategy (Best, 2006; Borja de Mozota, 2003; Kootstra, 2006). The thesis regards (1) the strategic (visionary) level of design, through its suggestion of an alternative relationship and system, (2) the organizational (tactical) level since DIY requires reorganization, (re-)division of tasks and assigning DIY projects to the laypersons, and (3) the Design-for-DIY scenario's regard for the operational level: DIY projects concern a different scale and other purposes than traditional design projects.

Participatory design – There are various names for research methods in which a representative group of people is assigned and asked to be involved in the design trajectory. Participatory design is one such name. Participatory design (PD) emerged as a design and research practice that stemmed from a Scandinavian approach to systems design, which emphasized designers and users actively working together in a process aimed at improving the quality of working life (Halskov & Hansen, 2015). PD analyses and processes participant input to be implemented in a design project of a specific scale; the final product outcome is generic.

(Customer) Co-creation and co-design – Used sometimes interchangeably with participatory design, co-creation has various meanings since the term was adapted as a practice for design collaboration in general. Ramaswamy (2018) defines it, rather elaborately, as 'enactment of interactional creation across interactive system-environments (afforded by interactive platforms), entailing agenting engagements and structuring organizations'. Others defined co-creation as 'collaboration with users as innovators' (Von Hippel, 2005), or 'efforts of users in customizing products to their needs' (Franke & Piller, 2004; Syam & Pazgal, 2013). In general, the term co-creation and its definition seem to have shifted in the past 15 years from a promising 'power to the user' concept to a practice of collaboration with end users (and other stakeholders) in (e.g.) both the marketing and design research realm, concerning the development of both software and hardware.

Codesign - Sanders and Stappers see co-creation as a broad term: 'any act of collective creativity, i.e. creativity that is shared by two or more people'. They describe co-design as a specific instance of co-creation: 'collective creativity as it is applied across the whole span of a design process' (Sanders & Stappers, 2008).

Mass customization – Similar to the objective of DIY design, mass customization provides the layperson with the opportunity to make design choices and thereby create a unique version of a product. However, whereas DIY design's focal aspects concern guidance, the development of skills and offering a reasonable amount of design freedom, these aspects are addressed limitedly through mass customization. After all, mass customization focuses on automated personalization options 'with mass-production efficiency' (Piller, 2011). The phenomenon of mass customization could perhaps be of help in finding a solution to the relationship problem, but presumably less so when it concerns awareness and involvement. See Section 5.4.2.2.

Design methodology – As will be illustrated in this thesis, this study strives to describe the context and situation in which industrial design finds itself, conclude from it the negative consequences (concerning sustainability), and seeks a solution scenario. To support this envisioned scenario, the study will deduce and synthesize from the findings a framework for designers to utilize when facilitating DIY activity: when designing for DIY. The framework is to be considered a design methodology that supports designers in establishing DIY projects; however, the emphasis of the thesis is on the awareness of the need to change the roles, hierarchies, and system we are all part of - that of industrialism and 'industrial thinking'.

1.6 Objectives

The field of industrial design claims to consider the end-user or groups of end-users, or even society, as the main stakeholders, though the reality of product design and development is not always like that. The field mostly focuses on short-term NPD (new product development), on industry's requirements that concern turnover, profit, and maintaining and growing their business, and not on larger issues that concern society as a whole, nor on the fulfilment of people's, consumers', true needs. The practices of planned obsolescence, reliance on cheap labour, exploitation of scarce resources, proliferation of unnecessary products, and promotion of conspicuous consumption all provide evidence of this.

Therefore, a non-biased and objective view could help in taking a step back and analysing what the real problem is. Such a wide perspective helps in realizing that large-scale problems and issues require more than just incremental product and technical adaptations and updates: they require a vision and an overall solution that considers contexts, relationships, and systems, instead of new products.

In support of the profession of design, the goal of this thesis is to anticipate, find and try to implement answers to the problems that industrialized society is facing (after causing them). Since the latter statement is rather ambitious, a shorter and more accurate initial goal would be:

'To deduce and propose a design scenario that would help counter today's unsustainable user-product relationship.'

1.7 Research questions

After pointing out today's 'unsustainable relationship' (Section 1.2 and 1.3.1, and to be discussed in Section 3) as the initial problem statement, this relationship serves as the main ingredient of an overarching -main - research question (Section 1.7.1). This starting point was then used to subdivide the main research question into more concrete and specific (sequential) research sub-questions (Section 1.8.2) to help answer the initial main question. The thesis, in that sense, is structured along a path that becomes more and more concrete. Section 7.5.1, based on the preceding sections, considers the most concretized research sub-question D: 'What would be a suitable methodology and framework model for the implementation of the intervention?'

Practically, the research sub-questions (Section 1.7.2) represent the questions this research seeks to answer, which in turn will provide an answer to the main research question of Section 1.7.1. Together, they help to (1) concretize the objectives of this study, and (2) help clarify the structure of the research process. They are defined as follows:

1.7.1 Main research question

Main research question:

How to establish/ re-establish a sustainable relationship between people and products?

To be able to answer this question, several research sub-questions need to be answered first. These sub-questions correspond to the subsequent thesis sections.

1.7.2 Research sub-questions

Research sub-questions:

A. 'Which key factors have caused today's troublesome relationship between people and

products?' ~ Section 2, Section 3, Section 4

B. 'How to democratize design?' ~ Section 5

C. 'How should design anticipate? What would be the role of design?' ~Section 6, Section 7

D. 'What would be a suitable methodology and framework model for the implementation of the intervention? ~Section 8, Section 9, Section 10

Addressing the research questions

The thesis will analyse factors and developments and will include experimental studies to address these research questions. Today's DIY practices, cases and reactions to historic phenomena will be explored. The study will help define how to Design-for-DIY, the requirements that apply, the dimensions, boundaries, and positive factors. The study will address the question of how the designer should anticipate changes and start to Design-for-DIY.

1.8 Approach

The thesis starts from a bird's eye perspective of considering the context and factors that form the fundament of today's structure of product design and development.

This thesis provides a critical view of today's system, of the role industrial design plays in this: the design, development, and production of items for consumption and how this is organized. That system concerns the chain from delving for raw materials and resources to manufacturing and production, consumption behaviour of people, the profession of industrial design and development, the natural environment, society as an important stakeholder, and how these elements relate to each other. To be more specific, the thesis considers the troublesome aspects within these relationships and will seek options and suggestions for how to address the production-consumption relationship.

Although there are many small-scale and large-scale initiatives, programmes, regulations, and resolutions that seek answers and solutions to unsustainable situations and that aim to solve issues concerning the environment and so-called climate change, most of these initiatives seek answers *within* the system. This thesis, however, suggests rethinking *how* and *why* people produce and purchase, referring to the above-stated wide perspective approach and the real problem rather than to the consequences, as noted by Ehrenfeld. He notes that most of today's attempts to reduce unsustainability do not necessarily create sustainability (Ehrenfeld, 2008). So-called 'green innovation' or 'green growth' is criticized accordingly by various organisations and scholars (Noort & Brink, 2023; Verweij & Van der Wielen, 2023).

Based on the notion of people's true demands, the so-called human 'Being', and anticipating technological and informational opportunities, the thesis presents a vision that concerns a different relationship between maker and user; in fact, it seeks to reconnect them. Subsequently, this vision has resulted in an alternative approach to product design: a proposal for a methodology that helps designers enrich the human-product relationship, aiming to reconnect production and consumption through DIY facilitation for laypersons.

1.8.1 Process

As mentioned before, it is necessary to approach the problem matter of this thesis from a wide perspective to take an unbiased, objective, and open position, to not be limited to either the field as it is now or by traditional thinking or systems. Hence, the first part of the thesis (the parts that concern analysis and reasoning) will address the wide perspective. After the definition of a vision, a search starts to synthesize, through design studies, a process model that will help concretize the vision. In later stages, the scope narrows and focuses through the proposition of a concrete process model: a framework. The structure of this thesis is illustrated in Figure 7. The process description reflects characteristics of models such as the *Double Diamond* model (Moll, 2024) particularly in its emphasis on convergence, divergence, its distinction between the analysis and synthesis phases, and the iterative refinement of the design brief. Additionally, the structure aligns with models by Roozenburg (1998), Smulders (1996) – especially regarding the stages from analysis to evaluation - and Hekkert (2014), with its focus on contextual change.

1.8.2 Overview of actors as part of this study

The study presented here focuses on the design steps that a designer can perform to facilitate the layperson's DIY process. The process description encapsulates Design-for-DIY design methods for the facilitating designer in creating

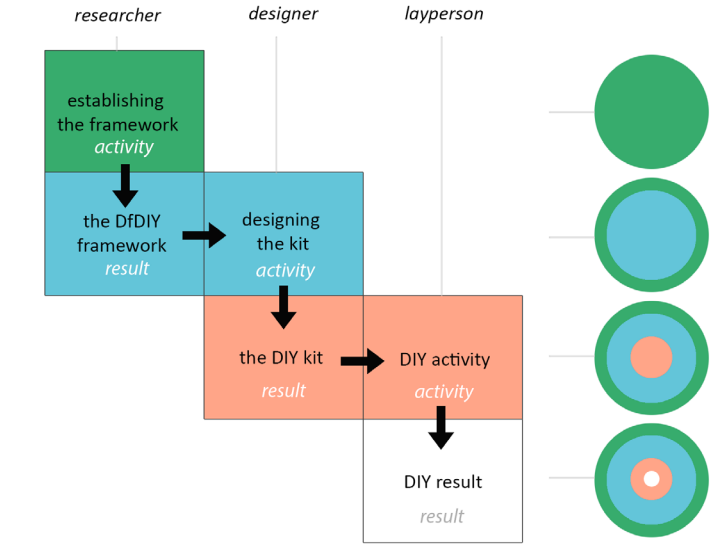


Figure 8: The three levels involved in the Design-for-DIY research

DIY projects, through a Design-for-DIY structured framework. Figure 8 indicates the three levels involved in this study: (1) the researcher establishing a framework for Design-for-DIY, (2) the facilitating designer, using the framework and providing DIY projects for the layperson, and (3) the layperson executing a DIY project (Figure 8).

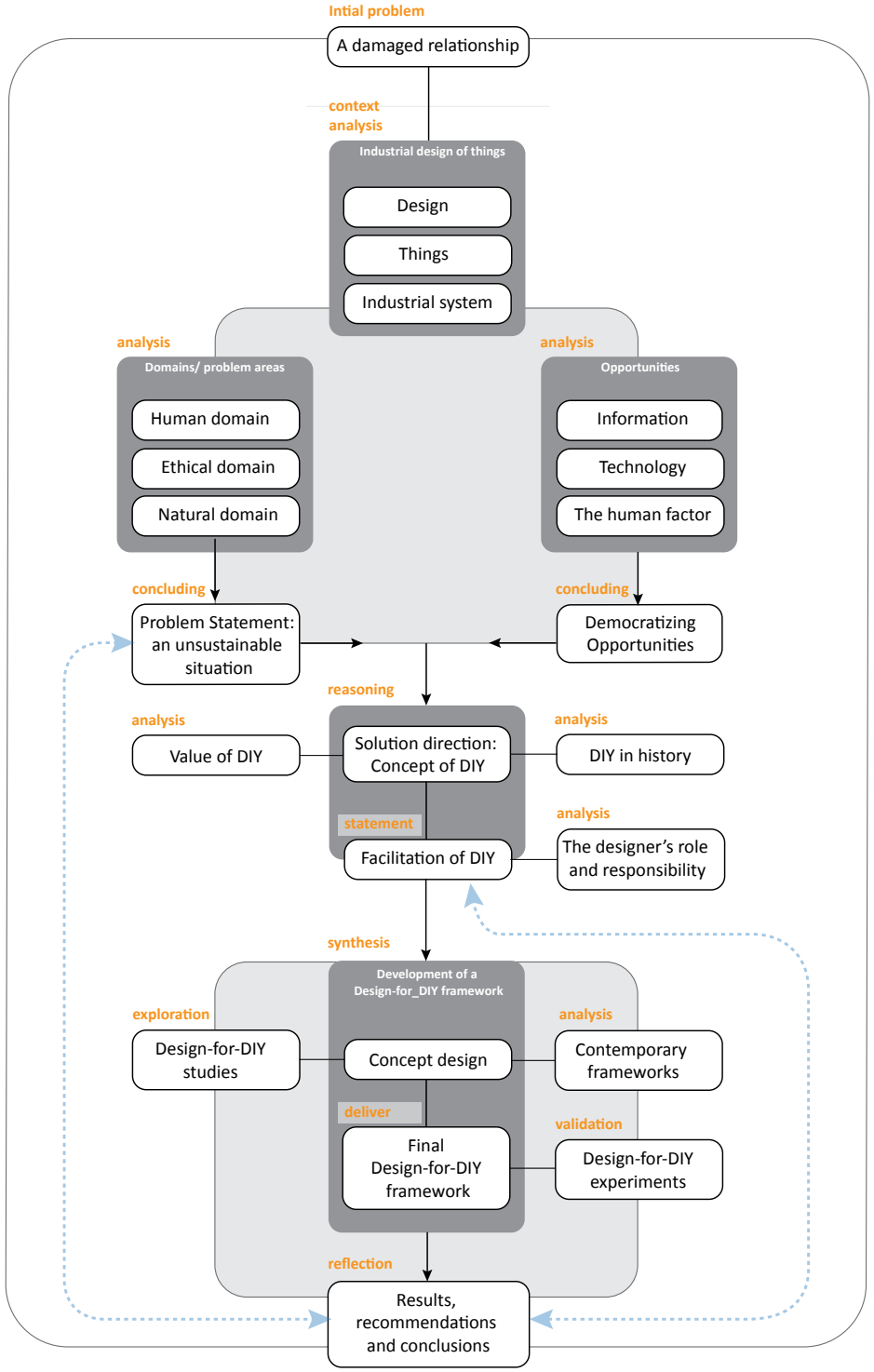


Figure 7: Depiction of the structure of this thesis

Designer, Photo by Parthimos

Section 2. The industrial design context

2.1 Point of departure: industrial design of (consumer) products

The industrial design field has its roots in the industrialization of production, initiated around two centuries ago, and in the industrial-led society in general. What industrialization exactly meant, and why it is relevant for the thesis, will be discussed in Section 3. It is, however, important to consider that, dating back to 1750, industrialism has been associated with large-scale production of items while trying to reach a large and global audience and focusing on profit. Industrialization was the effect of technological changes in manufacturing, and it had an enormous effect on economies and societies.

As referred to in the previous section, the field of industrial design is the starting point for this thesis. The industrial design of so-called consumer products will serve as a reference for observations, analysis, developments, suggestions, future visions, statements, propositions, and the studies that follow. The relevance of the field of industrial design will be addressed in the next paragraphs.

2.2 Definition of industrial design

Design commonly refers to a creative and defining activity and the result thereof. It is a discipline that involves the conception of new things or the improvement of existing situations. Etymologically, the definition of design in Dutch is a *plan, opzet, ontwerp*. The word 'design' stems from the old French *dessing, desseing*, and the verb *dessiner or désigner* (1529) and *desseigner* (before 1552). A *dessin* is the result of such a process. Literally, in English, design (*designare* in Italian) means to mark out, devise, choose, designate, appoint, or determine.

In the case of industrial design, the origin of the subject is rather specific. As the word says, industrialization was what created the field of industrial design. Industrial literally means 'systemic labour' (Merriam-webster, 2020), 'manufacture of goods in factories' (Stevenson, 2010), 'making goods and services for sale' (Macfarlane, 1815), and 'the people or companies engaged in a particular kind of commercial enterprise' (Free-Dictionary, 2003-2022)

Since the introduction of industrialization, the artist and his or her object of creation got increasingly separated, both geographically, in time, and regarding a product's conception and ownership. A product and its design needed to be established and documented by someone else than the person who made it. The industrial production required a specific manufacturing instruction provided by the designer.

Design historian Penny Sparke writes 'Design is the message between the producer and the consumer' (Sparke, 1987). She refers to the role of the designer: the supplier of knowledge and expertise to the corporate company that traditionally requires the design result to attract consumers in order to make a profit. Design refers to the actual implementation, an artefact's role in society, its usage, to the rituals and context surrounding the object, including the entire product life up to disposal and demise.

Archaeologist Olsen refers to the *aryballos*, an ancient Greek oil-containing flask, to explain that design is not solely a meaningless object, but an assembly of (1) the effort and expertise of the maker, (2) 'acts of exchange and consumption' (Olsen, 2012, p. 180) and (3) the use

and experience of utilizing (Olsen, 2012). The latter definition indicates the mere complex and interactive function that could be assigned to the design of an object.

2.2.1 The traditional design process

Design refers to a process of ideation and creation and is also the result of this process. Although there are many models and methodologies for design, most align to the generic design process as depicted by Roozenburg and Eekels (Roozenburg & Eekels, 1998; Van Boeijen, Daalhuizen, & Zijlstra, 2020) or the Design Council's *Double Diamond* model, both of which include the stages of analysis and synthesis. Figure 9 shows the generic basic design process as depicted by Roozenburg and Eekels.

As can be seen in Figure 9, a generic design process starts by identifying a function or a problem that needs solving, mostly stemming from a company's or a brand's strategy. These starting points are part of the so-called design brief: the initial assignment. The following analysis stage traditionally concerns an internal part (the manufacturing company and its competences and desires) and an external part: contextual factors (developments, principles). A better

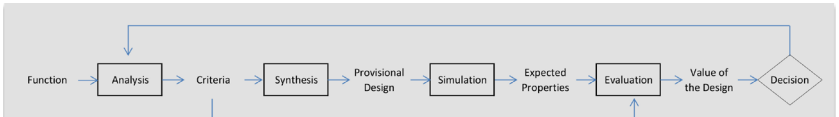


Figure 9: Basic design process (Roozenburg & Eekels, 1998)

and rather focused assignment description follows of which a list of product criteria is an important part: the contract for product development. The consecutive stages concern the synthesis stage of developing concepts, in which insights, methods and creativity help to conceptualize potential solutions, and various steps regarding simulation and assessment. It is a process of divergence and convergence, in which stakeholders are involved throughout the process.

2.2.2 The added value of design

After a brief introduction of the definition of design, it is relevant to know what design *does*, or what the added value of design is. This section will cover this question from different viewpoints.

The interpretation of what the added value of design is has changed over time. Not only the result of design activity has changed (see Section 2.2.4.1), but also the phenomenon of design' itself, its purpose and value, has changed. Shove (2005) distinguishes periods in time in which the added value of design was considered in different ways.

Referring to Meikle (2010), Shove notes that in the 1930s the purpose of design was to improve sales through styling and appearance, and to take care of the function and performance of household appliances such as radios and refrigerators. In the 1980s and 1990s, design focused on corporate identity and brand image to align products under a corporate umbrella, all contributing to the system of production (Julier, 2007). Globalization, or 'spatial dislocation' of design, production and consumption, is what characterizes design in the early stages of this century, says Molotch (2004).

Shove (2005, p. 2) states that 'by implication, designers increase competitiveness by endowing objects with extra doses of style, functionality, brand identity or global salience'. She concludes that product design has continued to be strongly related to 'political economy of production'. Design's function in today's society is to facilitate production, she states.

Interestingly, the historic change of interpretation concerning the added value of design, as discussed here, discloses the changing society and the system we are part of; whereas basic product design forms the basis, the role of branding has increased in recent decades. The same holds true for spatial dislocation as the geographic distance between design, production and consumption is continuously increasing.

2.2.2.1 Seen from a production point of view

Traditionally, the term 'added value' is used to indicate the value that is added in between two steps of the supply chain. Technically, design is the activity in a product conception process between the sourcing of raw materials and the fabrication of an item. However, design activity has a broader function than only one stage in the value chain; design activity considers choices that also impact the sourcing of materials, the involvement of suppliers, and the materials and production facilities needed for the manufacture of an item. Design tends to have an overarching function as it affects choices made at all levels, in all stages of the product life cycle chain.

Shove addressed the political viewpoint regarding product design. In the political scenario of mainstream industrial design as it is today, i.e. mass production/ consumption society, design and the value it aims to add focus on increasing sales and brand value (Shove, Watson, & Ingram, 2005).

2.2.2.2 The maker point of view

According to both Csikszentmihalyi and Sennett, 'making' is what makes the human species unique. 'Human intelligence is actually shaped by "homo faber"; it is rooted in our capacity to "make things", such as tools, and through this material creation we are re-thinking the world. […] reusing this old idea of Man as the maker of himself, shaping his own life through his concrete actions', says Sennett (2018). Sennett refers to Homer's *Hymn to Hephaistos* by adding that civilization was initiated when people started to make tools (Sennett, 2008). 'Man is not only homo sapiens or homo ludens, he is also "homo faber", the maker and user of objects, his self to a large extent a reflection of things with which he interacts', says Csikszentmihalyi (1981, p. 1). Sennett (2008, p. 15) indicates that 'thinking and feeling are contained within the process of making'. According to Dougherty (2016), making is learning, making is working, and making is caring.

Looking at it from a rather holistic point of view, the value of an object and its design process refers to what the origin (story) or background is, who made it, its 'reason of being' (narrative, biography). Section 2.3.3 discusses the so-called *biography of things*.

2.2.2.3 Seen from a consumption point of view: meaning

The value of a design for the user refers to the use, the interaction experience, or the appearance itself, or to the things or persons that surround it. It could also refer to a specific brand, designer, or belief, i.e. religious, political, or societal, and of course to the product's function or purpose, its product category.

In defining the meaning of a designed product to the user, McCracken distinguishes three locations of meaning. Although his model (Figure 10) is not recently depicted, McCracken (1986) accurately explains how consumption and people's choices are rooted in the 'culturally constituted world. Design is involved in the transfer and mediation between the culturally constituted world, consumer goods and the individual consumer. Most consumers are unaware of this: they mostly associate the products they purchase with the retailer or brand from whom they purchase it.

McCracken takes the fashion industry as an example in Figure 10, in which the meaning behind a consumer product is mapped.

2.2.3 Design as a profession, designers

To answer the question of what industrial design is (Section 2.1), one needs to address the actor, the performer of design. There are as many areas of expertise as there are different kinds of designers. There are, for example, fashion designers, web designers, interior designers, garden designers, furniture designers, game designers, book cover designers, wallpaper designers, car designers, food designers, medical device designers, home appliances designers, UI designers and UX designers. This thesis focuses on industrial design and product designers. To be able to run the various process stages and manage different kinds of projects, the profession of an industrial designer involves a broad range of

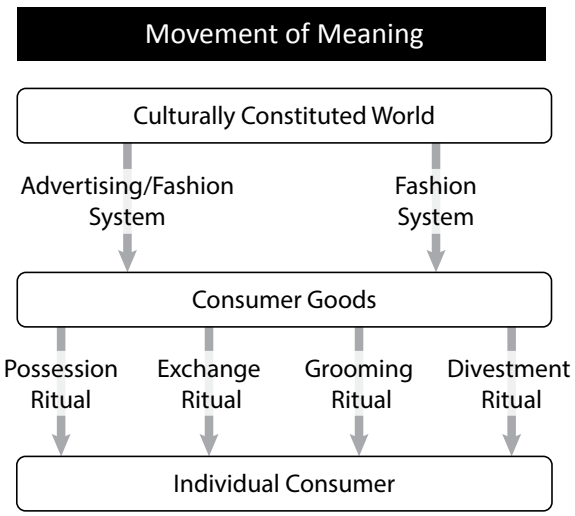


Figure 10: Locations of meaning (McCracken, 1986), in which the frames refer to locations of meaning, and the arrows to instruments of meaning tansfer

competences. Product design areas of expertise include engineering, production, technology, creative skills, aesthetics, ergonomics, usability, anthropometry, strategic product design, management of product design, economy, design for user interaction, electronics, consumer behaviour and psychology.

The common knowledge of an industrial designer refers to the areas typically included in a product design process, from strategy and analysis to implementation. In particular, skills such as communication, collaboration and empathy are some of the key assets of a designer (Invision, 2019; Pal, 2018). The designer may act as the so-called spider in the web within a design team. He or she may know the language of most of the stakeholders and team members as well as the client company representative, the engineer, manufacturing experts, fellow designers, suppliers of materials or modules, etc. Such a designer is creative and technologically savvy and has sufficient communication skills, using speech, text, and visuals. Hence, the actual job of an industrial designer varies a lot, even more so in today's extending field of Industrial Design. His or her task depends on the context: the agency or company he or she works for, the character and size of the project at hand, the designer's role and stature within the project or organization, etc.

2.2.3.1 Design driven vs demand driven

Closely related to the previous section, this section considers the difference between two approaches of designing, or one could say two *cultures* of designing.

Similar to fashion's difference between ready-to-wear and haute couture, product design distinguishes between the opposing poles of (1) functional 'Anglo-Saxon' design and (2) 'high design' (Julier, 2007) or 'Italian' design (Gommer, 2009). This distinction introduces the difference between author-driven design and demand-driven design (Eggink, 2011).

The distinction obviously closely relates to the brand involved, the product category, the target audience, the manufacturer, culture, batch size, etc. The first category focuses on things such as functionality, performance, and efficiency (user-driven design), and is mostly anonymous. The second type of design, being author-driven design, relates to products that have a certain designer signature and focus on specific statements, aesthetics, or brand coherence (e.g. Philippe Starck, Alessi, Apple, Renault). This distinction is also related to the philosophical distinction between a *romantic* understanding (immediate appearance, feeling, intuition) and a *classical* understanding (underlying form, reason, laws, underlying thought, behaviour) (Pirsig, 1974).

On the author driven side of the spectrum, some designers are very well-known due to their entrepreneurial skills (e.g. Raymond Loewy) or the design principles they disseminated (Dieter Rams, Figure 11) (de Jong, Klemp, & Mattie, 2017). Some designers have established themselves as a brand (examples are Starck, Alessi) or present themselves through the vision of sustainability and circular design they propagate, such as *Material Mastery* (Bruyne, 2022) or through experiments with innovative materials and technologies, of which Joris Laarman is an example (Figure 12).

Figure 11: Dieter Rams, Hans Gugelot Radio-Phonograph (model SK 4/10) 1956

Figure 12: The Cumulus Table; a cloudlike Stratio Olympico marble, slightly translucent at the edges when lit by sunlight (Laarman, 2022)

2.2.4 Design as a representation

2.2.4.1 Society, culture

Apart from design's definition as a process, or as the result thereof, it also represents the location and period in history in which the design was manifested. According to Lees-Maffei (2009, p. 362) citing Fry (1988), 'Design is essential in the economic and cultural production (the encoding) of our world as well as in its economic and cultural consumption (the decoding). These two moments are not separate poles, they are, in fact, brought together all the time, they exist in relation to each other and in the same moment.'

Besides the fact that design shapes and produces our consumer world (Fry, 2010), it is obvious that design, as a result, also reflects society at a certain point. Historically seen, the production of design forms a clear indication of what society has been about, e.g. consumer products from former East Germany, 1960s cars in the U.S, industrially produced food and packaging in Chinese supermarkets, electric vehicles today, sports equipment over the years, Nintendo screws, plastic cutlery, plastic packaging, unrepairable phones, Bakelite radios, characteristics such as quality, form, use, meaning, context factors such as politics, economics and technology, etc. Summarized, design and culture are

communicating vessels. When society changes, design changes, and vice versa.

2.2.4.2 Design/ brand-driven design

To provide a complete picture of industrial design, it's essential to include the specific definition of design discussed in this section.

Apart from the strict process which design refers to, and the result thereof, design is also associated with phenomena such as 'designer shoes', 'designer clothes', 'design furniture' or a 'designer watch". Closely related to what was said in Section 2.2.3.1, branding refers to the common practice of people in buying a branded product, mostly because they associate a specific brand with the qualities, culture or other specifications they prefer (Baudrillard, 1998; Best, 2006). One could say that a brand enriches a product and guarantees a certain quality. People get used to a specific brand or are convinced that it is better than other brands, through brand promises, marketing, and relations.

In fact, as was stressed in the previous paragraph, a commercial item for sale is surrounded by many different aspects and assets that should help the consumer decide. From a brand and company point of view, this is common and part of a strategy and the design process. For the end user though, the identity and quality of an item gets distorted, diffused. Branding and marketing make it harder to judge objectively.

Today, the design of an item often depends on brand-led decisions; the product needs to fulfil a specific purpose within the brand's portfolio and must meet consistency requirements specifically set by the brand and the mother company.

2.3 Things and relationships

As referred to in Section 1.2, by increasing the distance between the making and use of products, industrialization has worsened the relationship between people and products. For that reason, this section considers how that relationship is defined. It explains how products are not just passive objects but co-exist with people.

The industrial design field stems from the industrial design and manufacture of physical objects: consumer goods, things. 'What design designs are the relations between things and persons and things and nature' (Dilnot, 2009, p. 183). Olsen has noted that the word 'thing' or 'ting', in Old Frisian and Old English, means an assembly or parliament (Olsen, 2003). 'A thing or ting was a day or matter that brought people together. So the focus on thing, as opposed to object or material, is on how things bring people together', according to Hodder (2011, p. 177). This nicely indicates that a thing or object always relates to its use, and so to the person using or making it. However, things represent much more. Citing Csikszentmihalyi, 'Things embody goals, make skills manifest, and shape the identities of their users' (Csikszentmihalyi & Halton, 1981, p. 1).

2.3.1 What kind of things?

There are many ways to categorize things or objects. A 'thing' could be anything. It seems accurate to distinguish between (1) products for use, i.e. employ, and (2) products for consumption, i.e. usage. This distinction immediately forces us to consider the definition of con-

sumption, in general, throughout history, and in today's context. The word 'consuming', in an industrial society context, refers to the act of purchasing rather than to what a consumer will do with the item he or she purchased.

Despite the possible confusion regarding the definition of consuming, industrial design mostly focuses on the design of products for use. Categorization of these things-for-use could concern the size, objective, audience involved or the purchase considerations (Jha, 2017), or the distinction between commodities and differentiated products, generic and branded products, or high design and utilitarian products (Julier, 2017). Another distinction is between action objects, i.e. instruments for 'doing', and 'contemplation objects' (Arendt, 2013; Csikszentmihalyi & Halton, 1981).

2.3.2 The meaning of things

French sociologist Latour emphasizes this user-product relationship by approaching things as matters of concern: '…how many participants are gathered in a thing that make it exist and maintain its existence' (Latour, 2004, p. 246).

Among other authors, Csikszentmihalyi addresses the creative role of the maker of things in his book *The Meaning of Things* and, in doing so, he describes how things and their creators are bound to each other. In Section 2.2.2.2, he referred to the interaction between (1) homo faber and 'the things with which he interacts'. (Csikszentmihalyi & Rochberg-Halton, 1981, p. 1).

Authors such as Reckwitz (2002) and Schatzki (1996; 2010) emphasize the active part things play in establishing everyday practices. Things shape our 'cultural values of use and exchange' (Shove, Watson, & Ingram, 2005, p. 1).

Boradkar couldn't describe the definition of 'thing' more accurately than he did in his book *Designing Things* (Boradkar, 2010, p. 1). He does so by immediately emphasizing the relationship between people and things. 'The things we use […] mediate our experience of the world', he states. 'All things […] are essential components of the culture of everyday life.' This introduces the concept of cultural and ideological perceptions and positions in relation to things, clearly corresponding to Shove (2005) who states that things are the result of, and part of the system of, the 'political economy of production' (see Section 2.2.2).

Boradkar also refers to the fact that most things are made and designed by humans, which then immediately relates to the role of humans on this planet and to how humans have evolved into what they are now. The genus *homo habilis* (handyman) and the stone arrowheads they made formed a very early relationship between men and things, 2.5 million years ago.

2.3.3 Biography of things

Closely related to the definition of a thing as 'an assembly of activities and meaning' (Section 2.2.2), Kopytoff has described the biography of a thing as 'the story of the various singularizations of it, of classifications and reclassifications in an uncertain world of categories whose importance shifts with every minor change in context' (Kopytoff, 1988, p. 90). A thing's biography considers the thing's background, its creator, its career so far and what an ideal career would be (Figure 13). It would consider the periods in the thing's life, how it changed, and its

cultural markers (Kopytoff, 1988) (Lees-Maffei, 2009). Hence, such a biography of a thing also concerns the use, the interaction, and the relationship with its user during its life, often indicated by physical traces of that use. Such traces (or adaptations) make an object personal and may support product attachment. Section 2.3.7 addresses product attachment, and Section 6.4.3.5 discusses the Japanese *Kintsugi* philosophy, a specific kind of 'traces of use'.

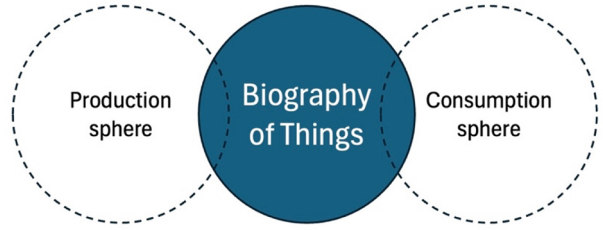


Figure 13: *Biography of Things* adapted from Kopytoff (1988)

2.3.4 Human-technology relationship

Philosophically, humans and technology have a specific and well-described relationship. This relationship, which is of importance for this thesis as it suggests how users and products might or should co-exist, can theoretically be viewed in several ways. Verbeek (2015) has described the following categories.

I. Extension theory

a. Tools and instruments

In this view, things enable human beings to do specific things: they are neutral and facilitate human activity, rather than actively help shape them (for example, a hammer).

b. Extended mind theory

Complementing the first category of physical tools and instruments, Verbeek refers to Clark and Chalmers (1998) when suggesting that people's minds are also extended to the things people use (for example, a watch or calendar).

2. Dialectics

The dialectical view on the human-technology relationship emphasizes the opposition between humans and technologies.

a. One dialectical view (Verbeek, 2013) sees technologies as alienating, with human beings as the victims.

b. Another version of the dialectical approach considers technologies as externalizations of specific aspects of the human being. Technologies are seen as projections of human organs (Kapp, 2015). Verbeek refers to the example of a hammer as a projection of the fist. Taking this idea further, the historic devel-

opment from tool to machine to automation can also be seen as an externalization of human capacities (Schmidt, 1954).

3. Hybrids

This approach considers technologies as an element of human nature. Reality is being mediated by technology (for example, telescopes, MRI scanners). Such mediations are not merely neutral intermediaries: they are required for the perception and understanding of reality.

Related to the extended mind theory (1b), various other scholars and philosophers have explored and described the way how objects become part of, extensions of, people's self. Section 6.5.3.2 considers the views of Belk and Sartre who consider the creation of an object as one of the three ways through which an object becomes part of one's self, the other two ways being: appropriating it and knowing it (Belk, 1988; Sartre, 2015).

2.3.5 Human-product relationship

Similar to people being inseparable from the world around them (Ehrenfeld, 2008), things are much more than just objective, value-free artefacts. Citing Olsen (2012, p. 159), '...human creativity and innovation always involve delegation and cooperation, a concerned exchange with things and their affordances. People make manifest their human being in labour and work, []'. People and things are co-produced, he states, and things are heterogeneous because both acts of making and using are combined within them; things involve connected matters of achievements, goods, experiences, materials, and psycho-political commitments.

Weightman and McDonagh (2003) refer to how products answer supra-functional needs concerning, e.g., emotional bonding, symbolic representations, tribal connections and subculture references. These help in establishing product personality and product semantics. Literature that concerns the so-called product experience (Desmet & Hekkert, 2007, pp. 3-5) distinguishes three levels of product experience: (1) aesthetic experience, i.e. 'a product's capacity to delight..', (2) experience of meaning, i.e. 'our ability to assign personality…' and (3) emotional experience, i.e. 'experiences … typically considered in emotion psychology'. These levels affirm that the relationship between a product and its user or owner goes beyond its value for use.

These aspects consider the human-product relationship from a user perspective. Notably, the maker-product relationship has for a long time received less attention. This maker-product relationship will be further discussed in this thesis, for example in Section 2.2.2.2.

2.3.6 Human-things entanglement

Hodder's theory of entanglement argues that 'human–thing entanglement comes about as a result of the dialectic between dependence, i.e. the reliance of humans and things on each other) and dependency, i.e. a constraining and limiting need of humans for things' (Hodder, 2011, p. 175). He describes how humans and things have become 'entangled' in such a way that it has affected people's evolutionary path. Archaeologists agree that people depend on things, not only concerning 'subsistence', 'technology' and 'exchange', 'but also in terms of social relations and structures, meanings, ideologies and embodiments' (Hodder, 2011, p. 177). From a thing's point of view, archaeometrists state that 'things need maintenance and care,

they run out and fall apart. Their physical materiality and chemical processes engage people in complex systems of relationships with other people and other things—that is, people and things get trapped in entanglements that themselves direct the way further change can occur' (Hodder, 2011). According to Hodder, our world is not only a passive expression of human culture. Things ('material non-human actors') act upon us people and help construct what we are becoming, says Introna (2014).

2.3.7 Value and attachment

Because of the various ways in which people and their environment are connected (Section 2.3.3), some even say that people and products are 'one', it is appropriate to reflect on product value and product attachment, in relation to people's self. These parameters are relevant because they can have positive effects on people's care for the products they use and own.

Product value

Product value defines in what way someone values a product (or not). According to Perdeck (2015), product appreciation can concern *economic* (monetary) value, functional value or *emotional* value (psychological, social). Similar to the second and third category, the traditional distinction of value types assigned by consumers to a product is based on (1) form (hedonic) versus (2) function (utilitarian) (Chitturi, Raghunathan, & Mahajan, 2008). Holbrook (1999) introduced a framework of 3 dimensions: intrinsic – extrinsic, self-oriented – others oriented, and active – reactive. In line with Holbrook, Kumar (2016) added the element of self-expressiveness that includes two distinct value sub-dimensions (social and altruistic), resulting in four value themes: social, altruistic, functional and aesthetic. Functional value in a product's design concerns the way it meets the practical or utilitarian needs of the consumer. This category relates to Norman's *behavioural* design, and to Bloch's *utilitarian* benefits. Aesthetic value concerns the perception of pleasure and attractiveness that the consumer perceives from the product appearance. Aesthetic values relate to Norman's emotional design category of *visceral* design (Norman, 2004), and to Bloch's *hedonic* benefits (Bloch, 2011).

Kumar's categories of *social* values and *altruistic* values both align to Norman's *reflective* design category and to Bloch's *symbiotic* design. He considers design as a 'vehicle for self-expression and self-identity' (2016), for which he refers to Belk (1988). Kumar's *social* value in a product design concerns the product's promise to help consumers increase their perceived status and improve their self-esteem. Altruistic value in a product design refers to 'the consumer's perception of how it enables them in helping other individuals and the society at large', often related to issues of environmental and social sustainability (Kumar & Noble, 2016, p. 616).

Norman's *reflective* design is concerned with people's self-image, with how others see him or her and with the associations and memories created by the product, referred to as a deeper meaning of the physical product (Beltagui, Candi, & Riedel, 2012).

Product attachment

Product attachment refers to the emotional bond a product user or owner experiences in relation to that product (Schifferstein & Pelgrim, 2003). In case such product attachment,

the person involved is 'more likely to handle the product with care, to repair it when it breaks down, and to postpone its replacement as long as possible', according to Govers (2004). Product attachment can help to extend a product's usage and lifespan.

According to Mugge (2007), people tend to protect the products they are attached to. She distinguishes self-expression, group affiliation, memories, and pleasure as the four most important factors that influence attachment to products. According to Perdeck (2015), and in accordance with Mugge (2007), increasing a product's value helps to foster attachment. A rather personal connection occurs when people assign emotional value to an item ('I love my bike because I've had it for so long'), which may foster emotional attachment. The more specific or unique the appreciation for an item is, the more personal and emotional the relationship between person and product.

Product attachment and the 'Self'

Csikszentmihalyi (1981), and Belk (1988) indicate a third dimension of people's relatedness to a product (or a place or a person): this concerns the extension of people's 'self'; the product becoming part of the person who uses and/or owns it, the product becomes an extension of the person's 'self'.

Ahuvia (2005) refers to the correlation between the love for a certain object and the important moments and relationships it reflects, and the fact that these products support the identity of the owner. Accordingly, Schifferstein (2008) deduced that products that accumulate memories are more enjoyable, which will result in a higher product attachment.

In Figure 14, Perdeck (2015) suggests the link between product value, product attachment and the extension of one's self in Figure 14, and how these parameters can foster better care by people for the items they use or own.

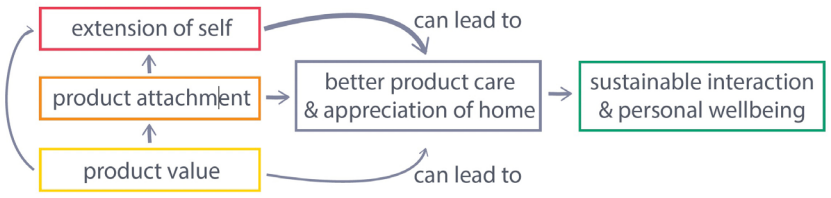


Figure 14: Relation between product value, product attachment and people's self (Perdeck, Hoftijzer, & Kuipers, 2015

2.4 Conclusion

Section 2 addressed the various definitions of design and what it represents. A thing is much more than its utilitarian functionality. People and the things they design, make, use, or consume are entangled. Things are representations of the various stakeholders and elements involved: the designer, the maker, the consumer, and the user. In fact, section 2.1 introduced how they have together formed culture and society.

One of the lessons learned from Section 2.1 is the fact that objects are an intrinsic part of people's life, and that they form extensions of people, that help achieving the things people want to achieve. 'All things […] are essential components of the culture of everyday life', says Boradkar (2010, p. 1). Design considers the relationship between people and objects or products. Ideally, this relationship is close, as a stronger connection increases product attachment and care. Additionally, considering an object's 'biography' - its creator, its life, its changes, and its interactions with people - can further strengthen and appreciate this connection between people and objects.

And, Referring to Shove (2005), things are the result of, and part of the system of, the 'political economy of production' (Shove, Watson, & Ingram, 2005, p. 2). The next section will discuss how the strength of such a relationship depends on internal and external factors that concern economics, politics, ethics, social aspects, ideologies, and design choices.

Cargo ship (photo public domain)

Section 3. Industry and criticism

A critical note to the industrial (design) practice

In order to provide a clear picture of the context of industrial design and the production and consumption of designed items, Section 3 addresses the omnipresent industrial framework and how that context affects the relationship between people and the products they use and purchase. Although the field of industrial design has changed a lot since the early days of industrialization, the system of mass manufacturing still largely defines why, where, how and by whom things are made (Hirsch & Pauw, 2022).

This section will help to clarify the fundaments of the system to which the profession of industrial design contributes, of the system that has shaped the field of industrial design. This section will simultaneously address the consequences that arose from industrialism and the industrial society in general.

3.1 Putting things in perspective

Product design and its position in the evolution of the human species

In relation to the extensive history of mankind, the Industrial Age only represents a short period (Figure 15). This illustrates that the troubled relationship between people and products referred to in Section 1.2 of this thesis is a relatively new problem. For that reason, the following paragraphs will offer a rather wide perspective, to better interpret and position industrial design and industrial society in the course of history.

3.1.1 Waves of society

Generally, it is only since the Industrial Revolution that mostly self-sufficient communities of the so-called First Wave society changed into a so-called Second Wave society that focused on high productivity and mass-production of cheap consumer goods for the market, accompanied by mass-distribution and mass-consumption (Toffler, 1990).

The mechanism that was needed to facilitate the emerging trade and exchange is called 'the market', which in its turn has set the rules and goals for industrial societies ever since; it promoted commercial values, economic growth, a further division of labour and increased productivity. People became increasingly

Figure 15: Graphic representation of the Agricultural Age (orange) and the Industrial Age (blue), copy of Figure 6

dependent upon the marketplace rather than on their own productive skills, ever since the split between production and consumption (Toffler, 1990). The industrially induced 'pecuniary transactions were a fringe on the world's natural economy [of the first Wave society]', according to R.H. Tawney, cited by Toffler (1990).

3.1.2 From a pre-industrial society: household production

As referred to in Section 1.2, the period in our history in which Sector B, i.e. producing for trade or exchange, was predominant, is just a very short period on the timeline graph (Figure 15). 'Only a trace', says Toffler (1990). It is also important to consider that industrialism introduced the wedge in the economy between making and using, a split between production and consumption, only a short time ago.

For the organization of production, distribution and consumption in traditional (pre-industrial) societies, Polanyi describes 3 mechanisms: reciprocity (symmetry), re-distribution through a central government, and common household, or autarkism (Polanyi, 1957). Polanyi's common household refers to Aristoteles' extended household called *οἶκος (oikos),* of which the management was called *οἰκονομία* (*oikonomia*, the etymologic origin of economy), being today's subsistence economy. This subsistence economy, or direct subsistence, has historically always been the basis of people's living and was more or less complemented by the other two mechanisms above, and later also by the market (Achterhuis, 2010; Klamer, 2009).

The subsistence economy referred to the so-called commons (Latin: *communis*, Dutch: *meent*), which was used for livestock farming, producing fertilizer, wood, and crops. It was common ground: anyone in the community had access to it. In general, the common, or shared, rights of people were considered much more important than individual rights for the cultivation of specific pieces of land. Referring to the pre-industrial, or Sector A, society, Toffler (1990, p. 39) writes that 'production and consumption were fused into a single life-giving function.'

As a result of the industrial transformation, society shifted to manufacturing and factories and to producing for the marketplace (Sector B), whereas people previously focused on production for their own survival (Sector A society). Since the beginning of modern times, at the time of the introduction of the market, there was an increase in the undervaluation of the care in the *οικία* (*oikia*, house, dwelling). An increasing number of people started to depend on paid labour for their subsistence (Achterhuis, 2010).

The industrial transformation took place much quicker in the U.S. than in Europe. Achterhuis (2010) provides an example: In 1810, people in New England traditionally produced for their common household. However, by 1830 farmers largely sold their harvest produce to the market, working for a wage had become standard for all men, and money was needed to buy consumption goods.

For a free man, labour traditionally took place inside one's own household (Achterhuis, 2011, pp. 4-6). Historically, wage labour was a new phenomenon; it was seen as a humiliating position for someone to leave the household and work for someone else. Being dependent on wage work was seen as a kind of slavery. People described it as wage slavery even until the nineteenth century. The change into a market economy (which can be considered a deliberate choice rather than a consequence of the course of history (Achterhuis, 2010) also

caused societal problems; it resulted in a struggle for people to maintain their means of subsistence (Achterhuis, 2010). Kotler (Kotler, 2010), referring to Toffler's (1990) Second Wave, describes the different positions of producer and consumer in the industrial age: the first attaining efficiency, and the second showing indulgent consumer behaviour.

According to Toffler, with the Second Wave and its characterizing labour division, people lost parts of their autonomy. Toffler (1990, p. 37) argues that this created 'a way of life filled with economic tensions, social conflict, and psychological malaise'.

3.2 The Industrial Revolution and industrial production

To be able to delve into the topic of this thesis, namely the search for a better relationship between human and product, one should first consider the field of industrial design itself and its roots. In Europe and the U.S., the origins of the industrial design field lay in the industrialization of the production of consumer products since the Industrial Revolution in the eighteenth century.

The first Industrial Revolution ran from about 1750 to approximately 1850 (see Figure 6 and Figure 15) and started the transition from relatively small-scale, hand-made production to industrial manufacturing processes, including mechanization, in Europe and the United States. Industrialization introduced machines, mechanization, new production processes and an increased use of non-human and non-animal power, i.e. steam or coal power (Figure 19).

Josiah Wedgwood and Matthew Boulton are examples of early industrial manufacturers and entrepreneurs. They were important contributors to the mechanization and industrialization of pottery and tableware and silverware and the minting of coins in Europe, respectively. Boulton was known for the installation of enormous amounts of steam engines, together with his partner James Watt. Typically for the industrialization transition, apart from being manufacturers, both were first and foremost businessmen. Wedgwood is well known as a pioneer of modern marketing; he experimented with so-called direct mail, money-back guarantees, free delivery, self-service, special promotions and illustrated catalogues. His earthenware was much cheaper than the porcelain that was sold to upper-class society.

Whereas so-called First Wave agricultural societies (see section 3.1.1) only exploited energy that was renewable (e.g. tidal water power, forest, people, animals), the upcoming Second Wave society, i.e. the industrial society, started to draw its energy from coal, gas and oil, together known as fossil fuels (Toffler, 1990).

The second Industrial Revolution (1850-1914) was characterized by new innovations such as mass production, large-scale machine tools, steel casting processes, factory assembly lines and the emergence of the electric grid. The enormous technological advancements helped industries to thrive, including coal, textiles, and railroads (see Figure 16, and Figure 18).

In a later stage, steel, auto manufacture, aluminium, chemicals, and appliances arose. Consequently, the world's industrial centres (e.g. Lille, Detroit, Manchester, Essen) started to produce millions of identical products (e.g. shoes, soap, automobiles) for the consumer market based on mass production (Toffler, 1990). Industrialization took place in a colonial time of increasing global trade and business, and of technological inventions. Industrialization caused changes in every aspect of people's lives: employment, culture, education, and soci-

ety. The Industrial Revolution also led to an unprecedented rise in the rate of population growth.

Toffler describes the changes taking place across various spheres with accuracy (see Figure 19): energy sources shifted from 'living batteries' like animals to non-renewable sources such as coal, gas, and oil, and eventually to electricity. Family structures transformed from extended, static families to dynamic, nuclear families. The economy, initially based on land and agriculture, evolved to focus on mass production, industrialization, fossil fuel energy, urbanization, and standardization. Additionally, a simple division of labour was replaced by an extremely specialized division of labour. The decentralized or 'natural' economy of the First Wave, where each community produced most of its own

Figure 16: Interior of Magnolia Cotton Mills Spinning Room (Rawpixel.com)

necessities, gave way to the centralized economy of the Second Wave, which emphasized large-scale, centralized production and distribution.

3.2.1 Industrial production and the increasing distance

In recent centuries, the distance between production and consumption increased due to the emergence of industrialization and the market; sales and bartering took place outside the agricultural community and people bought goods instead of making them (Hudson, 2008). As a consequence, the distance between maker and user grew and has grown continuously ever since (Botsman & Rogers, 2010; Kelly, 2011b). Together with industrialization, the so-called division of labour (Smith, 1819) became generally accepted and common, and in many cases, the relationship between supplier and consumer became rigid and composed in a top-down manner (Winsor, 2004).

Industry's mechanization and later automation required only a fraction of the labour in terms of the skills and knowledge required when there were no machines involved. This resulted in a decrease of the skills and knowledge (Morris,

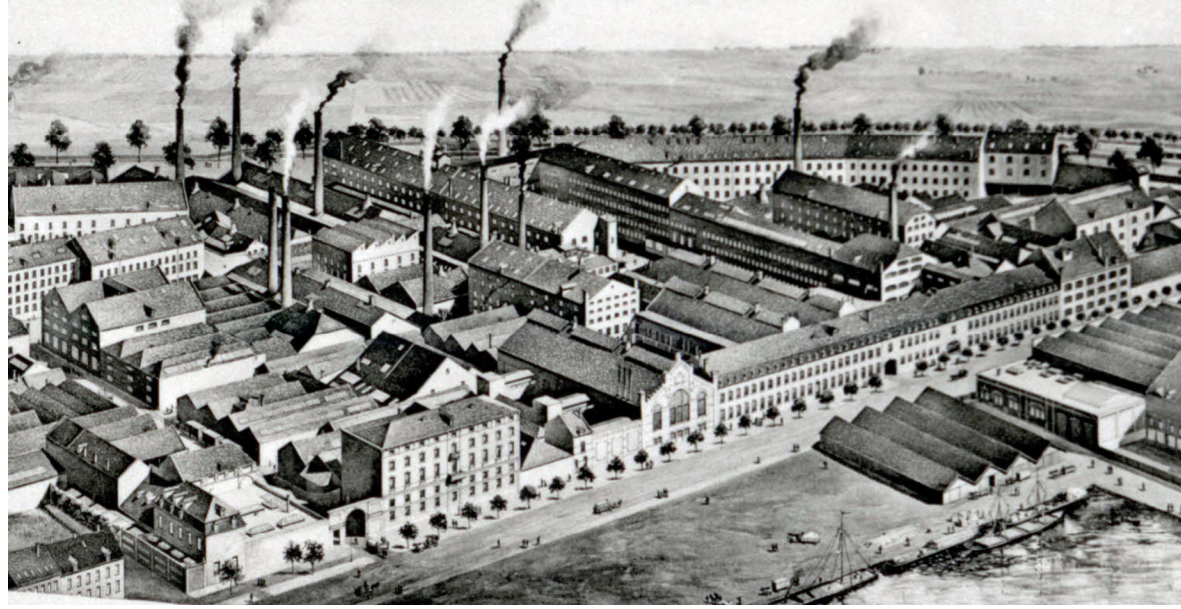


Figure 18: De Sphinx ceramics, Maastricht, The Netherlands, 1905 (Wikimedia creative commons)

2007; Nieuwenhuys, 1969) needed to make or mend: a 'deskilling' (Atkinson, 2006). The industrial context has made people largely incapable and unaware of making or mending things for themselves, this is also referred to as deskilling (Brugger & Gehrke, 2018).

Human beings' unique characteristics are, amongst others, their ability to cook, make fire and talk about fiction (Harari, 2014). Homo sapiens originally had a wide, deep, and varied knowledge of their surroundings: it was wider, deeper and more varied than ours today. Where today's humans collectively know far more than their ancestors did, individuals know far less. '[…] ancient foragers were the most knowledgeable and skilful people in history' (Harari, 2014, p. 55), since they were trained to be self-sufficient, they knew how to survive. 'What do you really need to know to get by as a computer engineer, an insurance agent, a history teacher, or a factory worker?' asks Harari (2014) rhetorically. Harari (2014) mentions there is evidence that the size of the average Homo sapiens brain has decreased since the time of the foragers, 11,000+ years ago.

All the above regard choices that concerned the increase of scale and the separation between the industrial owners of production and normal people, i.e. consumers. Today, most product development projects still start from a mass-production basis, aiming to please as many people as possible with the same solution.

3.3 The industrial system

The Industrial Revolution not only led to an industrial way of manufacturing. It was all part of an entire industrial system that arose.

The consumer revolution (Hudson, 2008), which was a direct consequence of industrialization, introduced mass-produced consumer goods entering the marketplace (Achterhuis, 2011). Since then, people have increasingly purchased their goods instead of making them. Pre-industrial Sector A (self-sufficient) (see Section 1.2) communities changed into an industrial civilization

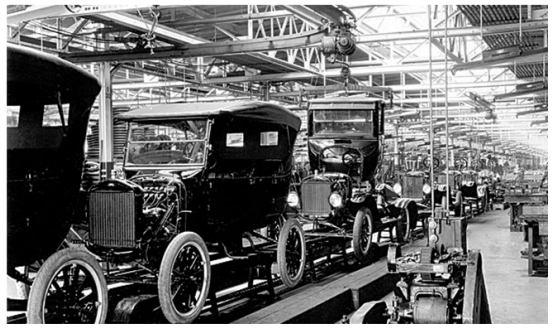


Figure 19: First and Second Wave society, according to Toffler (1990), Plowing in 1912 (MNOpedia), Ford assembly in 1913, respectively (Ford Motor Company)

(mainly Sector B: making for someone else), instigating commerce and 'massification', or mass culture, or even consumer culture (Julier, 2007). Consumption became routine; in many parts of today's world, people live in this culture of consumption. Today, people barely make or repair things by themselves, not even when it concerns very simple objects. This also says that most of today's society is structured conforming to a Sector-B kind of division of making and using, as described by Toffler (1990).

Sector B also brought about mass distribution, which, along with production and energy use, is part of the so-called Technosphere. Consequently, things changed dramatically within the socio-sphere as well; family life changed from multigenerational households into small nuclear families, education was moved to schools to prepare for roles in industrial society, and care for the elderly was turned over to nursing homes. Individual or family businesses changed into corporations and, following factory principles, even schools, hospitals and governments took on hierarchal structures and industrial impersonality. Artists and musicians started to turn out their works for anonymous culture consumers through intermediates such as impresarios and businessmen who sold the tickets. In the music scene, this automatically resulted in the need for more seats, which was, according to Curt Sachs (1940), the reason why small music salons were replaced by enormous concert halls and multi-player symphony orchestras to produce the necessary volume (Toffler, 1990).

Within the Infosphere, the producing and distributing of information, changes instigated by industrialization were also very clear. Whereas in pre-industrial times elite messenger services, crossing throughout Europe, were inaccessible and sometimes even forbidden for ordinary people, the industrial society required 'massive movements of information that old channels simply could no longer handle' (Toffler, 1990, p. 33). Postal services and post offices emerged. The invention of the telephone made communication much quicker, and, following the factory principles, the invention and emergence of mass media was the next step, including newspapers, radio, and television.

In fact, the changes that happened in Toffler's Technosphere, Sociosphere and Infosphere created the world we live in today.

The Industrial Revolution and industrial society brought about a segregation between the rich and the poor. It created a bifurcation between the people who had the means for production and the ones who didn't. Workers were employed

in poor conditions, which was related to desire of factory owners to make a profit and save costs on wages (Heijne & Noten, 2022). The position of workers got worse, since the move from Sector A to Sector B caused their dependency to grow (see Section 1.2). As a consequence of industrialism, not only *products* became items for sale, but labour and art did too (Figure 20). Toffler notes that this easily led to situations in which people could receive money in exchange for a commercially desired painting, or in which they pay service in return for a specific gift. Toffler states that this 'is inherent in the divorce of production from consumption' (Toffler, 1990, p. 42). Today, the phenomenon of globalization, representing an ultimate means to reduce costs and maximize profit, tends to contribute to poor working conditions, and to a global increase in inequality (Dollar, 2005; Van der Hoeven, 2020), see Section 4.2.2.2.

Figure 20: Production facility in the U.S.('sweatshop'), in 1890 (photo pubic domain)

3.3.1 Capitalism

With industrialization came an industrial-class society consisting of capitalists and wage workers (Trentmann, 2016). A capitalist economy is based and built on privately owned means of production, run for profit by the capitalist class, in which employees (workers) work for a wage and do not own the capital, nor the tools, nor the product (Zimbalist & Sherman, 2014). Important characteristics of capitalism are, according to Heilbronner (1994), the accumulation of capital, a price system, competitive markets, private property and wage labour. Additionally, it concerns a free and unregulated system of economic exchange and minimal government intervention (Heilbronner & Boettke, 2023).

Early promoters of free market capitalism were, among others, Friedrich Hayek and Milton Friedman. Hayek, who has been honoured with the Nobel Prize in economic sciences in 1974 and received the U.S. Presidential Medal of Freedom, was mostly concerned about economic freedom, for example, to accumulate as much wealth as possible. He considers a strong government governing economy and society as a threat, as a step towards totalitarism and repression, and has shown that he prioritizes economic freedom (for example, free market capitalism) over democracy and over rather social freedoms that concern: freedom of speech, of religion, of poverty and of fear (Heijne & Noten, 2022).

3.3.1.1 Problem of capitalism

Referring to Marx's *Capital*, Michie (2020, p. 148) notes capitalism's 'success as an economic system in driving capitalists to out-compete each other, insatiably re-investing their surpluses to generate ever-greater profits to accumulate still further, extending the working day, using child labour, and bringing workers together in factories and mills so that modern machinery could be utilized to its fullest potential, and the work which had previously been performed by artisans could be subsumed within and tied to the workplace's ever faster work rate'. Despite Keynes' establishment of new economic policy for a deregulated and co-operative economic regime, capitalism has turned into a system of deregulation, privatization and free-market globalization, according to Michie (2020). As a characteristic of the modern industrial (capitalistic) system, the relationship between producer and consumer has become even more diffuse since shareholders have become the most important stakeholders for the producing corporation, not consumers or employees.

3.3.2 Inequality

There are various reasons why people have criticized capitalism, throughout history. According to Heilbronner and Boettke (2023), some of these reasons are: (1) the unreliability and instability of capitalist growth, (2) the production of natural harms, such as pollution, (3) the production of social harms, such as inhumane treatment of workers, and (4) forms of inequality, attributed to capitalism, such as mass income disparity. Dahl, in Section 4.2.2.3, refers to the inequalities in the access to political resources by people as a consequence of a market-capitalist economy (Dahl, 2020, p. 158). Some historians relate capitalism (and mercantilism), to the rise of slavery, colonialism, and imperialism. Adam Smith himself, one of the forefathers of capitalism, feared that division of labour (an important element of capitalism) would lead to repetitive and numbing work (Heilbronner & Boettke, 2023). Smith wrote in 1776: 'The man whose whole life is spent in performing a few simple operations, of which the effects are perhaps always the same, or very nearly the same, has no occasion to exert his understanding or to exercise his invention in finding out expedients for removing difficulties which never occur. He naturally loses, therefore, the habit of such exertion, and generally becomes as stupid and ignorant as it is possible for a human creature to become' (Smith, 1801, p. 91).

3.3.3 Dynamics of Industrial Society

The hidden code of the Second Wave

Industrialization was based on a specific range of principles that helped structure, even 'scientifically ground' (Taylor, 1911), the mass production system. Toffler (1990, p. 46) names this the 'hidden code' of the Second Wave society. These aspects of industrialization are standardization, specialization, synchronization, concentration, maximization and centralization (Toffler, 1990). Mintzberg (1983) refers here to the 'design parameters' of an organization. Some of these parameters will be discussed in the next sections since these parameters are inherently linked to the essence of industrial thinking.

3.3.3.1 Standardization (of processes, skills, output)

Frederick Taylor decreed in the early twentieth century that, in order to reach the highest efficiency, 'there was only one best (standard) way to perform each job, one best (standard) tool to perform it, and a stipulated (standard) time in which to complete it' (Toffler, 1990). When the contents of the work are specified or programmed, the process is standardized, according to Mintzberg (1983). The work is coordinated beforehand: it leaves no room for the employee to manoeuvre. Standardization of the outcome concerns the dimensions or performance of a product or part). This standardization was required to standardize processes and jobs. For this, yet also apart from this, there was standardization of skills and training beforehand, to control and coordinate the work (Mintzberg, 1983). Essential elements of standardization also concern the process of manufacturing, especially the assembly line, and the concept of interchangeable parts, for which inventors such as Henry Ford (see Figure 21) and Eli Whitney are famous.

Figure 21: Standardization by Henry Ford (ANP)

3.3.3.2 Job specialization

Similar to the parameter of standardization (Section 3.3.3.1), job specialization is one of the clear properties of industrialization and industrial thinking. Contrary to integration, specialization generally has a negative effect on the relationship between the items produced and the workers producing.

The term 'job specialization' refers to Adam Smith who in the eighteenth century wrote *The Wealth of Nations*, in which he presented the 'trade of the pin maker': describing the multiple specialized tasks within the process of making a pin. It helped him to make his case that productivity would increase if tasks were specialized. He argued that if '...they had all wrought separately and independently, and without any of them having been educated to this peculiar business, they certainly could not each of them have made twenty, perhaps not one pin in a day..' (Smith, 1801). This kind of job specialization is called horizontal job specialization.

Vertical job specialization refers to a separation of performance and the administration of it. The control of the work is the responsibility of the manager, who has an overview, needed to coordinate, and directly supervise.

Specialization results in (1) people getting very good at a specific task and (2) differentiation of power between people. Even more importantly, specialization takes away the opportunity for someone to create an entire object or product him- or herself, since he or she is only specialized in one specific part. It blocks the opportunity for job satisfaction.

3.3.3.3 Synchronization

People's jobs and working times started to depend on factory jobs: they became interdependent. If one person was late in completing his or her task, the next person down the line would be too.

The introduction of synchronization also affected social life; the length of vacations, holidays and coffee breaks became dependent on and adapted to machine requirements, which were interspersed with the work schedules (Achterhuis, 2011).

3.3.3.4 Division of labour

Closely associated with job-specialization

Historically, the term 'division of labour', which is closely related to job specialization and intrinsically an element of industrial production, has a political and even moral connotation. It refers to the workers' control over and subsequent relationship with what they produce.

The growth of the division of labour was historically closely related to the growth of trade, and later with the rise of capitalism and industrial processes (Forty, 1986; Hudson, 2008; Morris, 2007).

In pre-industrial societies, as was addressed in section 3.1.1, production was still limited and simple; therefore, the number of specialized crafts was low. The family was the basic unit of production. All its members were part of a cooperative set of activities (Britannica, 2023). Pre-industrial division of labour was rather primitive; people were not very interdependent. Within a production unit, all people performed various tasks and continuously changed roles depending on the season and circumstances. Work was performed at home or in the field. Most of what was produced was meant for consumption within the village. Home and work life were fused, being a 'fused economy' (Toffler, 1990). When, with the Second Wave, work shifted from home and field to the factory, the interdependency between people and cooperation increased: it required coordination and meant an increased division of labour. Many of the workers would never see many of their colleagues. What followed were subsequent phases of development of capitalist manufacture, which were largely based on stages of increasing labour division. The stages are well defined by the three production eras, originally described by Marx (Forty, 1986; Morris, 2007). During the first stage, each craftsman worked for himself, sometimes, for example, sharing a workshop and purchasing their materials collectively. This was the true 'craft'. During the second stage, different tasks of hand-manufacture were divided among the workers and supervised by an employer. The individual craftsman lost control. The third stage, which took place in the second half of the eighteenth century, came about with the introduction of machinery and the factory system.

In order to increase production efficiency and output, people's tasks became segmented and specialized (Morris, 2007). The ever-increasing subdivision of jobs was strongly supported by the theories of Taylor who 'invented' 'Scientific Management' at the end of the nineteenth century. Taylorism prescribes that the scientific rationalization of labour implies a breaking down of jobs, increasing the output of the worker (Taylor, 1911).

Walter Crane and William Morris, as well as Karl Marx, were among those who criticized the industrial way of production, not only for its presumed inability to create any aesthetic or artistic quality (Section 3.7) but also because of the extended division of labour (Crane, 1894; Marx & Engels, 1844; Morris, 2007) causing alienation. Even capitalism forefather Adam Smith was worried about the consequences of labour division concerning the mental health of the workers (Smith, 1801), as was described in Section 3.3.2.

3.3.4 Globalization

Globalization is actually a specific kind of job specialization (job division). This labour division takes place not on a factory scale, e.g. assembly lines, differentiation of tasks, or an inter-factory scale (specialized manufacture of product parts per location or company), but on the largest scale possible: global, seeking the lowest wages and the highest efficiency (Van der Hoeven, 2020). Molotch's (2004) definition of globalization, as referred to in Section 4.2.1, concerns: 'spatial dislocation' of design, production and consumption.

Along with industrialization and the inherent division of labour came the geographical spread between the various elements and stages of the production and assembly process, being globalization or hyper-globalization (Van der Hoeven, 2020). Globalization is what characterizes the design field in the early stages of this (twenty-first) century, says Molotch (2004), see also Section 2.2.2.

Some of the consequences of globalization are as follows:

(1) Consumers buy things that were made on the other side of the globe, which means the item has to travel a long distance and, for one specific product assembly, parts are sometimes made on various continents (Figure 22). Van Der Hoeven (2020) mentions the example of Continental (tire company), which has factories in 35 countries and uses 2,000 suppliers. A reference to Read's *I, pencil* (2008), in which he describes the biography (i.e. the materials and manufacturing) of an ordinary pencil, is accurate in this context. The large amount of cargo vessels needed to enable such globalized trade crosses the oceans using waste oil as fuel. According to Christian Eyde Moller, general manager of the DK shipping company in Rotterdam, '[it is] just waste oil, basically what is left over after all the cleaner fuels have been extracted from crude oil. It's the cheapest and dirtiest fuel in the world. It's tar, the same as asphalt' (Pearce, 2009).

(2) The continuing quest by companies for countries and regions that offer the cheapest labour and prices (for example, sweatshops). This international quest for the lowest wages has moved production from one place to another. An example of a recent trend is Ethiopia, where sometimes the monthly wage for workers is only 23 Euros, the lowest in the world. H&M recently moved its production there (Van der Hoeven, 2020). Another example of the search for the cheapest labour is the ship beaching and ship breaking, the end of life of large freighters and ocean liners in countries like Bangladesh and India (https://www.youtube.com/watch?v=ia7xnmcQbNg).

(3) Closely linked to the increased distances involved with globalized trade and production, is people's lack of awareness of where his or her purchase comes from, how it was made, resources used, who made it, etc.

(4) Globalization has contributed to increased wage inequality (Dollar, 2005), polluting the environment and a worsened human-product relationship. Furthermore, it makes countries and local economies and regions dependent on the world economy. According to Van Der Hoeven (2020), this global system of outsourcing has proven vulnerable, especially in times of crisis.

Figure 22: Cargo ship (Pxhere, Creative Commons, CC0 public domain)

3.3.4.1 Does local production provide the solution to the problem?

One needs to consider that the so-called de-industrialization in Western countries said to have taken place in recent decades was in fact the moving of industrial production to cheaper continents. In Western countries, factories disappeared for the benefit of the service industry (Haegens, 2023). According to Haegens, economic and energy crises and, for example, the COVID-19 pandemic have in the recent decades increased the awareness among Western policymakers that more attention was and is needed for independence: strategic autonomy. This resulted in the re-appreciation of local production, i.e. once again supporting manufacturing in one's own country. Recent USA and European policy indeed show an increased attention to strategic autonomy. However, the ambition to support local manufacturing (as an alternative to global) in the Netherlands, for example, suffers from industry's bad reputation, since people are becoming increasingly aware of the negative health-related consequences of industry, noticeable in the Dutch cases of Tata Steel in Ijmuiden and Chemours (formerly Dupont) in Dordrecht. Tata emits 8% of total Dutch CO2 emissions, together with other emissions such as nitrogen, particulates, heavy metals and polycyclic aromatic hydrocarbons (PAHs) which can cause cancer, and Chemours emits PFAS (poly- and perfluoroalkyl compounds) (Haegens, 2023).

3.3.5 Planned obsolescence

This section relates to the phenomenon of planned obsolescence, which negatively affects sustainability. Although one would expect differently, design projects do not generally originate from a specific consumer's need or request. In today's consumer society, many consumer purchases, and consumer behaviour in general, are mostly not induced by strict needs, but led by market trends, social factors, and mere consumerism.

From an industry point of view, brand or company investments and projects depend on brand strategy, marketing plans and in many cases on shareholders' interests rather than mainly on consumer wishes. The specific practice of deliberately shortening a product's lifespan in order to increase sales is called planned obsolescence. According to Prasad Boradkar (2010), the early advocators of planned obsolescence, which include manufacturers and designers, reasoned that the planned 'replacement of that which was *passé* with that which was *en vogue*' (Boradkar, 2010, p. 182), would promote innovation and economic progress. The practice of planned obsolescence is still commonplace today and may concern (Kessler & Brendel, 2016):

(1) Qualitative (or functional) obsolescence refers to products with a short functional life, little possibilities to repair, and fast wear and tear (Guiltinan, 2009).

(2) Psychological obsolescence occurs when the design changed to a new generation of the same product (also called fashion or style or aesthetic obsolescence).

(3) Technological obsolescence concerns the upgrading of product features to make new products seem more desirable (Guiltinan, 2009). Both the psychologic and technological type of obsolescence could be regarded 'voluntary', although technological obsolescence could, in case technologies have become outdated and incompatible, also directly result to the disposal of the product.

(4) Regulatory obsolescence concerns restrictions to the lifespan of products or certain components, for example, for safety reasons.

(5) Additional to Kessler's four types of obsolescence, it seems valid to mention so-called systemic and software obsolescence, which concerns the system or infrastructure around the product that turns obsolete.

3.3.5.1 Inaccessibility: prohibiting access for the end user

The section that concerns inaccessibility is closely linked to Section 3.3.5 about planned obsolescence as the prohibition of access to a product, for the purpose of opening, adjusting, maintaining, or repairing it, may very well concern a deliberate decision made by the producer, to increase sales. Today's car drivers cannot easily repair their vehicles, and the same applies to many other devices that need repair. See also Section 3.3.5.

Continuous industrial developments have resulted in consumer products that are optimized with regard to size (miniaturization), manufacturing costs, efficiency, weight, assembly time, etc. This optimization is sometimes prioritized over usability, accessibility, repairability and the general quality of the product. Manufacturers in many cases seal and 'close' their products, making them inaccessible to the actual owner, i.e. the user, by prohibiting the disassembly or repair of an item. Examples are Nintendo who utilized screws that are hard to turn, and Apple or Samsung phones which are also hard to disassemble (rated 2/10 reparability score according to iFixit) (Wiens, 2022). Some of the reasons why companies might support this inaccessibility are: to have better control over service contracts (guarantee, etc.), to promote aftersales and resale, and sometimes to prevent the product from being repaired or mended for brand image and safety or accountability reasons. The consequence of these thresholds is a decrease in potential involvement by the user, and – directly or indirectly, an increase of resource use, greenhouse gas emissions and energy consumption (Guillot, 2022).

Legislation

These days, governments seem to recognize the harmful consequences of obsolescence and products that cannot be repaired: products that are designed to fail after a certain time or amount of use (Guillot, 2022). Section 6.2.4.4 discusses European legislation in-the-make that concerns the 'Right to Repair' (European-Commission, 2023a).

3.4 The consumer society: consumerism

Along with industrialization and mass production came the growth of consumption. In a sense, depending on the viewpoint that is considered, both the industrialized production and the consumption thereof have had a major effect on the human-product relationship. This section addresses the various definitions and aspects of consumption.

3.4.1 Design for consumption?

Interestingly, the word 'consuming' stems from *consumere* (Latin) meaning 'using up' and 'exhaustion of matter', referring to food, candles, wood, and to the human body when ill. *Consummare* (also Latin) means 'completing something', 'finishing'. These meanings together form a good explanation of what consuming originally represented. According to Trentman (2016), over time, and aligned with the introduction of industrialization, the definition of consumption changed from 'waste and destruction' to something positive. This is somewhat ironic, as (1) the positive connotation was clearly ideologically driven, while (2) consuming has turned out to be synonymous with 'using up' after all (Martin, 2016; Martin & Hoftijzer, 2017).

Economists increasingly started to argue that consumption is at the heart of a nation's economy, with Adam Smith (1801, pp. IV, 179) stating that 'consumption is the sole end and purpose of all production; […] in the mercantile system, the interest of the consumer is almost constantly sacrificed to that of the producer; and it seems to consider production, and not consumption, as the ultimate end and object of all industry and commerce'.

Consumption was no longer only about using up, but it comprised all kinds of goods including fashion items. Mass-produced standard items, sold in the marketplace, took off in the early twentieth century, and by 1960 our society was appropriately called a consumer society

(Trentmann, 2016).

3.4.2 The politics of consumption

When the U.S. emerged from World War II, they were determined to continue the economic recovery brought on by the war. Together with maintaining the military production (given the Cold War), it was the mass consumer market that would bring about prosperity. Military assembly lines (for tanks, munitions) were renovated and converted to produce cars and appliances for the consumer market. Governments, institutions, and media all conveyed the central message that mass consumption was a civic responsibility that would help improve the living standards of all Americans. 'Expanded consumer demand would fuel greater production' (Cohen, 2004). As mentioned in Section 3.1.2, Kotler (Kotler, 2010) distinguishes the two perspectives: (1) producers aiming for efficiency, and (2) indulgent consumer behaviour.

3.4.3 Factors involved in consumption

Consumption is not a stand-alone or objective activity or decision process. It is a large and complex construct of many factors: a two-way relationship rather than only a consumer activity. It concerns the producer and the brand selling a product (selling a promise), the consumer who seeks confirmation or improvement of his or her sometimes 'constructed' identity, who strives for psychological comfort, and unmistakably the contextual factors of community and society.

Fine (2002) names seven factors involved in consumption:

- Economic variables of price and income
- Sociological variables of family and status
- Psychological variables of motivation and habit: addiction, tradition, ritual
- Cultural variables of tastes and meaning
- Practical variables surrounding the activities of shopping, preparation, disposal, and repair
- Political considerations
- Ethical considerations

An obvious example of consumption rather than sovereign purchasing can be found in the world of fashion, in which garments have turned into fast-moving consumer goods instead of real wearables. Many more factors are involved than only wearing clothes to keep warm. According to Bonsiepe (2006, p. 28), 'More and more, design has moved away from the idea of "intelligent problem solving" […] and drawn nearer to the ephemeral, fashionable and quickly obsolete, to formal aesthetic play, to "boutiquization" of the universe of products for everyday life.' He says that 'Good Design' that pursues socio-pedagogical objectives opposes what so-called lifestyle centres do, namely pursue commercial and marketing aims.

3.4.3.1 Addiction

Neuroscientist Sterling (2016, p. 3) explains the addictive component of consumption very clearly: 'Certain items', he writes, '- sweets, greasy food, alcohol, nicotine, cocaine, amphetamines, opiates, gambling, novel products - satisfy instantly because they act rapidly on the brain to increase the level of dopamine. The consumer feels this increase briefly, but soon these primary rewards engage the [brains'] circuit's intrinsic tendency to adapt, which is why they are so dangerously addictive.' Whereas hunter-gatherers were fully submerged in their natural environment in which any moment could bring something new, with industrial production and industrial society this diversity shrunk (Sterling, 2016). Csikszentmihalyi (1981, p. 239) points out the paradox of consumption, where addictive behaviour opposes people's true needs: 'The habit of acquisition and the addiction to consumption will motivate […] [people's] expenditure of energy even though these are not the source of their most significant rewards'. Figure 23 shows an example of excessive consumption behaviour.

3.4.3.2 Conspicuous consumption

Conspicuous consumption is the practice of acquiring and displaying products or goods to publicly display one's wealth, demonstrating economic power, to attain social status, at various social levels (Baudrillard, 1998; Boradkar, 2010; Trigg, 2001; Veblen, 1965). The term 'conspicuous consumption' today mostly applies to items of fashion which depend on trends that sell the promise of a good life and higher status.

Veblen's theory of conspicuous consumption (Veblen, 1965), originally from 1899, stems from the emergence of the leisure class of which the members desired to distinguish themselves from the working class (Trigg, 2001). Private property and status became increasingly linked. According to Veblen there are two ways for individuals to display wealth: (1) through leisure activities, and (2) through excessive consumption of goods and services. Veblen found that '…the utility of both [conspicuous leisure and consumption] alike for the purpose of reputability lies in the element of waste that is common to both. In the one case it is a waste of time and effort, in the other it is a waste of goods' (Veblen, 1965, p. 40). Through both of these activities, members of the leisure class exhibited their wealth. According to Veblen, conspicuous consumption was the most decisive factor for consumer behaviour, for all social classes (Trigg, 2001; Veblen, 1965). However, conspicuous consumption is not always to be regarded as a conscious act (Trigg, 2001).

Over the course of the twentieth century, under the development of the consumer society (Baudrillard, 1998; Mason, 1998), the structure of division by social class was, when consumption is concerned, at least partly replaced by a division, a disaggregation, on the basis of lifestyle groups which cut across the social hierarchy (Mason, 1998; Slater, 2013; Trigg, 2001).

3.4.4 Marketing and the creation of needs

A fundamental problem of the system of mass production is the fact that it is based on selling the enormous number of products that have been mass-produced, and the surplus, regardless of the consumers' needs. According to Galbraith (1998, p. 124), 'One cannot defend production as satisfying wants if that production creates the wants'.

In fact, rather than finding people's true needs, the term market research could be defined,

Figure 23: Excessive consumption (Brazil, Sebastião Moreira/EPA)

according to Ansoff's matrix (Ansoff, 1957), as a quest for business opportunities, either by extending the company's offer, addressing a different target group, slightly changing the product or penetrating the market that already exists. In many cases, the consumer's need is artificially created (in cases such as branded cosmetics, fashion items or reduced-price items you'd normally not buy) with the help of advertising, promotion, branding, etcetera. The resulting act of consumption in these cases is a passive act; the user was not involved in the process of product conception and sometimes may not even really desire it. Today, some manufacturers, of which Apple is an example, help consumers limit their addictive consumption behaviour by providing warnings in case a certain usage time is exceeded.

In literature, the core interests of consumption studies are threefold: (1) the consciousness of consumers' actions, (2) the deliberate manipulation of consumers' desires through marketing and sales experts and (3) the interaction of people with goods of which the function is hidden beneath symbolic meanings and imagery (Daunton & Hilton, 2001). Scholarly interest in consumption is attributed to (1) the political emphasis placed on consumerism by Conservative and Republican governments of the 1980s (Section 3.4.2) and (2) earlier critiques of consumer society offered by scholars such as Debord (2021) and Baudrillard (Baudrillard, 1998; Lees-Maffei, 2009).

In *The Culture of Design*, Julier describes two ways of approaching consumption: (1) through manipulation theories and (2) through consumer sovereignty (Julier, 2007). He sees consumer sovereignty as closely related to enterprise culture, with consumption being an entrepreneurial activity in itself, suggesting heroic individualism (Julier, 2007).

According to Galbraith, it is a common practice of manufacturers to cultivate consumer demand for new products and to sustain the demand for existing products through the use of advertising, salesmanship and consumer manipulation, thereby attacking consumer and market sovereignty (Galbraith, 2004). Cited by (Penin, 2021, p. 91), Galbraith (2004) states: 'In the real world the producing firm and the industry go far to set the prices and establish a demand, employing to this end monopoly, oligopoly, product design and differentiation, advertising, and other sales and trade promotion'.

This illustrates the clear distinction between two ideologically opposite views. Similar to Julier, Trentmann, in *The Empire of Things*, distinguishes two political camps (Trentmann, 2016). The first being progressive critics who attack the power of shopping, advertising, branding, and easy credit. They feel that 'artificial wants have replaced authentic needs' (Trentmann, 2016, p. 5). The other being so-called champions of consumption who cherish freedom of choice. The latter view is held in relation to neoliberalism (Trentmann, 2016).

3.4.5 Passive consumption behaviour: the unused potential of people

Not only should one be aware of the manipulation theories (Section 3.4.2) and the creation of needs (Section 3.4.4), but one needs to be specifically aware of the consequences of passive consumption, which is in turn closely related to the industrial society (Section 3.3). Passive consumption is in contrast to people's aspirations and needs (Atkinson, 2006; Max-Neef, 1992; Press, 2007). Referring to the consumer culture, Csikszentmihalyi states: 'Instead of liberating psychic activity, the things bind us to useless tasks' (Csikszentmihalyi & Rochberg-Halton, 1981, p. 53). In fact, remarkably enough, this is contradictory to how we raise our children. Throughout the stages of a person's childhood, people are raised and taught to be and become creative, to utilize creative skills, to put things together and make things work with glue, cello tape, and paint. Skills and knowledge that concern art and handicraft can be considered to be of major importance. However, in practice, in 'real life', once primary school is over, manual skills, knowledge of materials, of how things work, or how to create and repair, seem to become irrelevant; people take a passive position in terms of exercising creativity.

3.4.6 Alienation, the decrease of involvement

Division of labour as an element of Taylor's Scientific Management (Taylor, 1911) resulted in a dramatic decrease of involvement in the design and making of items, hence leading to the alienation between the maker and product, as was mentioned in Section 3.3.3.4. Besides 'alienation' from a production point of view (a consequence of labour division), there is also 'alienation' that concerns the worsened relationship or distance between production and consumption. Both types are actually part of the same continuum (see Section 3.4.6.1).

The latter 'alienation' concerns a decrease of involvement in different ways: (1) the split between making and consuming (Edwards, 2006; Toffler, 1990), and (2) an ever increasing distance (both physically and mentally) between production and consumption. Both have a negative impact on the relationship between people, either workers or consumers, and the products they manufacture or use.

During the last century, automation and information technology enabled the most recent steps of labour division. The so-called cybernation revolution introduced the automation

of production processes, using computers to control automated systems (McKown, 1993).

Alienation can be caused by global distribution distances, the split or distinction between maker and consumer (Sennett, 2008; Toffler, 1990), subdivision of labour, anonymity of the maker (companies and (sub-) brands) and of the consumer, automation (Salvia, Bruno, & Canina, 2016a; Söderberg, 2013) or by replacing animal and human power (using fossil energy) with mechanization. People are mostly not aware of how things are made, where they were made, by whom, and why they were made the way they are. It concerns a product's background, origin, fabrication, materials, resources, social awareness, methods, techniques, etc. Today, systems and services that originally were invented to support people's daily activities and trade have gotten too complex to be comprehended, let alone controlled. In some cases, people no longer know how a mechanism that seemed under control actually works (Meerman, 2013). This applies to system algorithms that promise to solve administrative tasks efficiently and safely but fail due to a lack of control or accessibility (for example, in the case of national social security problems in the Netherlands in 2020).

From a consumer point of view, Miller considers artefacts as intrinsically alienating: 'Within an industrial context', he writes, 'the very scale of the institutions which construct and distribute its products may make alienation an intrinsic condition' (Miller, 1988, p. 354). 'Consuming is an anonymous act', concludes Julier (2007, p. 60) as one of the reasons: the is scale too large, the distance to far, and the consumer holds no social relationship with their producers.

Van Abel (2012) states: 'The complexity of our economies, and the complexity of our products, has distanced us from the physicality of the products around us, the visible matter that is an essential part of the environment we live in. How can we expect people to understand these complexities and be actively involved in them, feel ownership and take responsibility?' He refers to a 'synthesis of complexity and alienation […]'. The critique of alienation is closely related to the philosophical dialectical view on the human-product relationship (Section 2.3.3). Within the economic system of capitalism, as referred to in Section 3.3.1, the private ownership of the means of production is being supported, hence the alienation between the maker and his produce. The separation between production and consumption, which characterizes industrialized society, created a big gap between the industry and the people who consumed products. Publicist Kevin Kelly (2011b) refers to this as 'the asymmetry of knowledge and power'.

3.4.6.1 Stages of increasing distance

In a rather abstract sense, the distance, or lack of involvement, between the decision maker and the actual user seems to be ever-increasing. The following - incomplete - range of stages conveys the increasing distance between the person making something and the person using it.

- In pre-industrial times, people mostly created their required items and objects themselves, or had them made by their family, rather than purchase them from someone else (Achterhuis, 2010). The relationship between maker and user was very close. In Toffler's words (1990, p. 266): 'During the First Wave People consumed what they themselves produced. They were neither producers nor consumers in the usual sense'.

- In the second production era (Section 3.3.3.4), the design and making of items became

concentrated and executed by craftsmen on commission. There was a personal connection between the maker and the customer.

• Eventually, surpluses were sold to others. Barter complemented the subsistence economy (Section 3.1.2 and to be discussed in Section 6.3.2). As referred to in Section 3.1.2, 'in 1830, farmers largely sold their harvest produce to the market, wage work had become standard for all men, and money was needed to buy consumption goods' (Achterhuis, 2011, pp. 31-32).

• As referred to in Section 3.3.3.4, during the second production era, different tasks of hand-manufacture were divided among the workers and supervised by an employer. The individual craftsman lost control.

• The Industrial Revolution in the second half of the eighteenth century brought about engines and mechanization, which replaced human and animal skills and power. As a consequence, the distance between the making and the using of an item increased since the making was done by a machine (Section 3.1.1).

• In order to increase production efficiency and output, people's tasks became segmented and specialized (Morris, 2007), which resulted in even more distance between the customer and the producer. After all, production was divided between many individual workers and tasks (Section 3.3.3.4).

• Mechanization and industrialization brought about mass production, which resulted in an even stronger split between the rather anonymous worker and the many similar products made with the help of production machinery. With mass production came also mass distribution (Section 3.3), which resulted in a longer physical distance between a product's origination and the actual purchase and use of it.

• Globalization represents a next step in alienation, as it equals the ultimate kind of job-specialization on a global scale (Section 3.3).

The subsequent phenomena do not necessarily have a chronological relationship:

• Some manufacturers purposely design for inaccessibility, aiming to prevent anyone from opening or repairing the products they sell. They do that, for example, through the use of irreversible screws (see Section 3.3.5.1) or by gluing parts together. Although such measures might be taken for security or safety reasons, such a threshold for disassembling a product decreases the connection, or relationship, between the user and the device itself and the distance tends to increase.

• Intermediaries aim to facilitate the consumer's search for the best possible purchase or fit. However, the intermediary is positioned between the product that is for sale and the consumer who seeks the right offer. Such an intermediary position cuts off the direct connection between the offer and the consumer, which worsens the relationship between them and increases the distance. Furthermore, such an intermediary manages prices, processes and what is offered (ticket offices, supermarkets and lease companies) (see Section 5.4.1.3).

• In general, automation, or the substitution of people by machines or digitization, causes an increase in the distance between the offer and the consumer involved. Whereas a human intermediary would offer the option to answer questions or provide specific information, this is less the case with a machine.

• Most people do not have the knowledge to understand what they exactly do when operating a phone or computer, when browsing the internet or when pushing a digital button. The underlying digital mechanism is too complex (see Section 6.4.3.2) and too small to physically notice for people to truly control their actions and sense what is happening. This knowledge gap creates a distance between people and the item they use: they can't really connect with it.

• Along with digitization came algorithms, used as specifications for performing calculations, data processing and automated decision making. Many decisions and services run on algorithms. Although very smart and efficient, automated decision making using algorithms decreases the understanding of, and accessibility to, the process of decision making and thereby increases the distance (see Section 3.4.6).

• In some cases, the shareholder value, or the value for short-term speculation, of a producing or retail company is considered more important than solid and longer-term quality and sustainable management (see sections 3.3.1 and 3.3.5). The relationship between the shareholders who decide the company's strategy and the consumer who purchases things from the store is distant (J. Fox, 2013).

3.5 Our natural environment

The system of mass production and mass consumption, both intrinsically part of Western consumer culture, has serious consequences for the natural world in which we live, as was discussed extensively in the previous sections. This section seeks to distinguish the different ways in which our industrial society has an impact on our natural environment.

As described, the growing distance between the people using a product and the production of that product has led to the alienation and unawareness of people. It is exactly these consequences, together with the persistence of the industrial system of mass production and consumption, that are the main source of many of today's environmental problems. For example, the abundant production and spread of consumer products and packaging led to lots of litter and the emergence of the well-known plastic soup. The production of these same consumer products uses up large quantities of fossil fuel energy, as the distribution and transportation of these same items also do.

Here follows a brief summation of environmental issues caused by, among others, industry:

Causes:

1. Production of goods

2. The use of consumer products such as cars and machines causes damage to the environment (air-, and water pollution),

3. The disposal of consumer products (waste, pollution) (litter, plastic soup) (see Figure 24)

4. Depletion of scarce materials.

People still throw away 90% of what they have used, according to the most recent Circularity Gap report (Wit, 2021), 75% in the Netherlands (in 2021). In fact, the world became a bit less circular in 2020 and 2021. The world's population needed 100 billion tons of raw materials to fuel the economy, which is a new record (Luttikhuis, 2021).

5. Distribution of items and people, through transport, on a global scale, which causes air- and water pollution.

Consequences:

1. Exhaustion of natural sources as energy and materials, deforestation

Extracting and processing of the Earth's resources causes 70% of the world's CO2 emissions, according to Luttikhuis (2021). According to recent studies, 'Humanity uses so many natural resources that we would need almost 1.5 Earths to cover our needs' (Ecavo, 2022). Trentmann (2016) refers to Krausmann (2009) who found that, in 2009, the total amount of materials extracted per year had increased to ten times the amount in 1900. Also, a shift took place concerning the kind of materials that were extracted, they found: from renewable biomass (wood, crops) and energy (so-called throughput) to cement and metals (so-called accumulation materials).

Data from the World Energy & Climate statistics yearbook 2023 (Enerdata) indicate that the world's energy consumption (million tonnes of oil equivalent) is continuously growing, for which they distinguished the consumption by different continents and broke down that energy consumption by energy type, see Figure 25 and Figure 26.

2. Water Pollution

Although fresh water is crucial to life on earth, human activities cause more water sources to be polluted each year; 46% of the lakes and 40% of the rivers in the U.S. contain too much pollution for fishing, swimming and life in the water (Ecavo, 2022). In addition to carbon dioxide and plastics, there are chemicals, heavy metals, and pesticides.

3. Land & Soil Pollution

Land pollution is caused by chemicals such as pesticides and by irresponsibly exploiting minerals through mining. Another category concerns the leaking of underground septic tanks, sewage systems, harmful substances from waste and wastewater from industrial plants. Intensive agricultural activities can cause the soil to lose its nutrient value and structure, which causes soil degradation.

Iittala has coined the term of 'Throwawayism' (Iittala, 2022), which indicates a society in which people throw away all they have used, referring to a decrease in care about products.

4. Deforestation

A specific but very important kind of land degradation and soil erosion is caused by deforestation. The removal of vegetation and forests (80,000 acres of tropical forests per day) leaves land in harsh conditions: it destroys ecosystems and habitats. Deforestation reduces the capacity of the Earth to reduce carbon in the atmosphere, naturally taken out by vegetation (Ecavo, 2022).

5. Air Pollution

Apart from exhaustion of natural resources and production of waste, human activity such as traffic, agriculture and industry pollute the air (Grymonprez, Sengers, & Vos, 2017), see Figure 27. The WHO (World Health Organization) has found that 80% of people living in

Figure 24:
Littered beaches (Wikimedia commons)

urban areas suffer from unhealthy air quality levels (Ecavo, 2022).

Pijpker's (2023) article which describes the impact of the production certain fashion items, serves as an accurate indication of the consequences of mass production and consumption. They indicate that the production of one pair of jeans (500 g) requires 3000 to 5000 litres of water. Growing the cotton for the pair results in the emission of the equivalent of 3 to 5 kg of CO2. This is similar to what the production of a polyester fashion item emits. Before the pair of jeans is ready to be sold, it has travelled large parts of the world, according to Pijpker. The impact of the dyeing and other chemical processes are not taken into account here. Also, the use of such items has a huge environmental impact: i.e. washing, drying and ironing. The growth of the industry is the next factor: in 2015, brands and retailers sold 100 Billion garments, twice the amount sold in 2000. The increased frequency of newly released fashion items has an accelerating effect. The DPSIR model (EEA, 1999; UNEP, 2006) indicates how these different elements of environmental issues relate, in the context of optional response policies (Figure 28).

Section 3.3.4 addressed the consequences of industry polluting people's living environment and health, and people's growing awareness that emerged from it. In general, people's awareness of industry's and their own impact on Earth's natural environment has increased. It has been recognized more and more (Cohen, Eames, Hammond et al., 2022; UN, 2015). However, the necessary transition to a more sustainable way of living and consuming is moving very slowly (Hirsch & Pauw, 2022). Referring to the consequences of globalization, which were briefly discussed in Section 3.3.4, it is relevant to note that, according to the CBS (Dutch Central Agency for Statistics, or 'Statistics Netherlands') consumption in the Netherlands produces one-third more greenhouse gases than the country's manufacturing activities do (Haegens, 2023). Haegens (2023) notes that this means that the Netherlands is an 'exporting country' when it concerns air pollution.

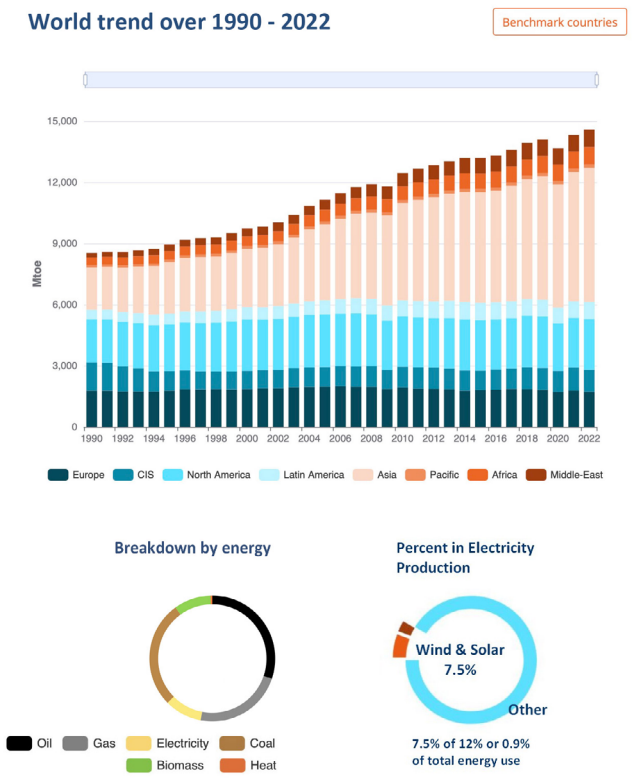


Figure 25: world energy consumption (Enerdata, 2023)

Figure 26: Breakdown of electricity production in 2018 (Rescuetheworld.net)

According to Hirsch and Pauw (2022), maintaining the economic principles of growth and profit promotes and accelerates the exhaustion of nature; it interferes with a proper relationship with nature. This economic system has been dominant since colonial times, and today it even forms a mandatory element of policy stipulated in international free trade agreements, they add. Similarly, according to IPBES , the descent of ecosystems around the world has been caused by the dominant and persisting world view in which humans rank themselves

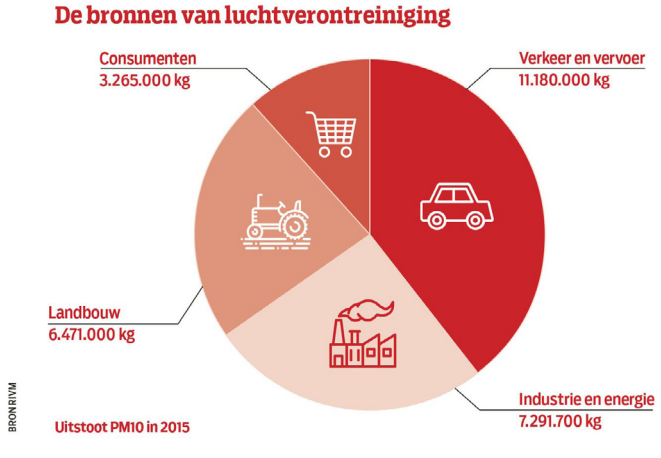


Figure 27: Sources of air pollution (Grymonprez, Sengers, & Vos, 2017): Consumers; Traffic and distribution; Industry and energy; Agriculture.

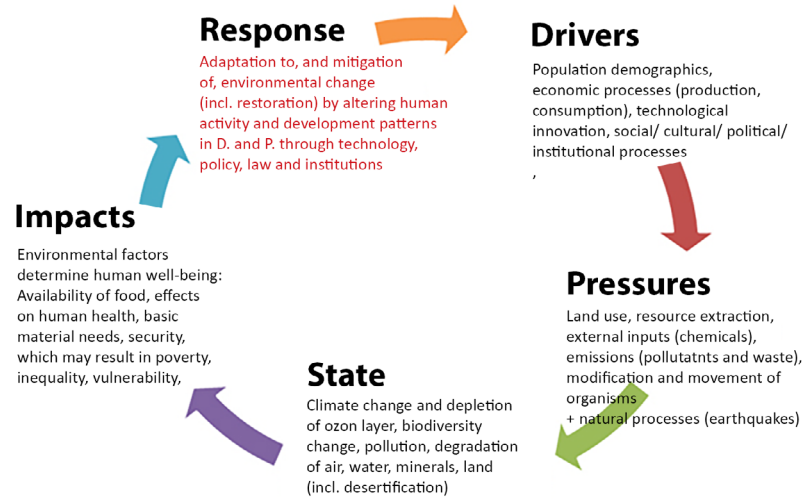


Figure 28: The DPSIR model (Driver-Pressure-State-Impact-Responses), adapted from the European Environment Agency (EEA, 1999) and the UN Environmental Programme (UNEP, 2006)

above nature, and in which people use natural resources abundantly (Díaz, Demissew, Carabias et al., 2015). This persisting world view includes short term profit and economic growth (Brugh, 2023). According to Maria Tengö, studies of indigenous societies prove that it makes sense to consider, and learn from, a world view that is based on 'living *with* nature', and 'living *in* nature', instead of only 'living *from* nature' (Brugh, 2023).

3.6 The designer's contribution to unsustainability

Following Section 2.2.3, this section further considers the designer's role in the context of industrial design. Designers, while fulfilling their job, inherently answer to the demands of the client company in order to design for feasibility, efficiency, and profitability. At the same time, designers are trained and educated to design conforming to end-user requirements and wishes. These together can easily lead to contradictions and conflicts of interest.

Shove asks the question: 'Are designers inadvertently but inevitably contributing to patterns of capitalist advance and unsustainable consumption or are they providing a necessary service in humanising technology and increasing welfare, for instance by designing for all?' Shove wonders whose interests are taken care of by designers: 'whose values are being added?' (Shove, Watson, & Ingram, 2005, pp. 2-3).

Industrial designers have always been representatives of the industrial manufacturing of products. As an employee or manager of a producing company or of a design agency, assigned a specific project, their task was and still is to develop a product that conforms to the requirements of the initial project brief. Some would say that, considering the position they are in, designers are not responsible for more than the work they have been assigned: i.e. the quality and feasibility of their produce. Others would say that designers, being part of the system that focuses on mass production, are definitely accountable for whatever leaves the factory, which also concerns scale, the pollution caused

by the production, the future litter as a residue of product and packaging, and maybe their contribution to an unsustainable consumer society. As much as they are accountable for the beauty and usefulness of the items they have designed.

'Much recent design has satisfied only evanescent wants and desires, while the genuine needs of man have often been neglected. The economic, psychological, spiritual, social, technological, and intellectual needs of a human being are usually more difficult and less profitable to satisfy than the carefully engineered and manipulated '"wants" inculcated by fad and fashion', according to Papanek (Papanek, 1985, p. 15). In his *Design for the Real World*, he states: 'As long as design considers itself with confecting trivial "toys for adults", killing machines with gleaming tailfins, and "sexed-up" shroud for typewriters, toasters, telephones, and computers, it has lost all reasons to exist' (Papanek, 1985, p. x) From a *Design for the Real World* point of view, Papanek considers it wrong to make money from the needs of others, and he similarly considers the system of patents and copyright morally unjust.

He considers industrial design one of the most harmful professions, maybe except for advertising, which he defines as: convincing people to buy things they don't need, using money they don't have, to impress people who don't care. His view was that the designer has a great responsibility for what is designed and produced for society and for the people. Papanek stated that the design profession had separated from the real world and that 'Any attempt to separate design, to make it a thing-by-itself, works counter to the fact that design is the primary underlying matrix of life' (Papanek, 1985, p. 3).

Apparently, the industrial designer never gave much thought to the consequences in terms of sustainability. People are considered a target rather than a client and mass production, together with mass distribution, and consequently mass consumption, has mainly had a negative effect on the environment in which we live. In Manzini's words: 'In the last century, even when designers have been driven by the most positive intentions, considered as a whole, i.e. as the design community, they have been active agents in oiling the wheels of a catastrophic machine or more precisely, active agents of an un-sustainable idea of well-being' (Manzini, 2006, p. 10).

3.7 Artistic quality and craft

Another kind of criticism, although closely related to criticism from the previous sections, concerns the artistic quality of the design outcome and how the design is affected by the industrialized approach.

Since the Industrial Revolution, there has been much criticism regarding, for example, the division of labour and mechanization (see Section 3.3.3.4), initially concerning social, aesthetic and craft issues. Nineteenth-century design reformers stated that machines had separated the responsibility for the appearance from the responsibility from fabricating: resulting in a deteriorated quality of design (Forty, 1986). Morris wrote in 1888 that 'machine production leads to ugliness and degeneration of human existence' (Morris, 2007). Besides the disappearance of craft, Morris also criticized the disappearance of people's control and role in product design and development (Morris, 2007).

In his essay titled *Art and Industry*, Walter Crane referred to art and the word 'artistic', stating that the word, in contrast to industrialization, includes harmony and consensus with its environment. The word 'artistic' expresses the joy of the maker, something personal, addressed

to a specific individual, directed to a certain place or thing. Heidegger's view, in which he distinguishes craft and modern technology, relates to this (see Section 4.2.3). Crane criticises industry, the designer who does what his manufacturer tells him to do, and the public that buys what they're supposed to buy instead of purchasing an object that suits them (Crane, 1894).

In a different manner than the representatives of the Arts and Crafts movement, the Luddites, a nineteenth-century movement of English textile workers and craftsmen, which was not a well-organized movement, opposed the use of some types of machinery that would save costs, replace skilled labour, drive down wages and produce inferior goods. Luddites often destroyed the machines as a form of protest (Conniff, 2011).

According to Anderson (2010, p. 67) reflecting on the rise of the factory in the industrial age, 'The economies of scale of industrial production crowded out the individual. Although the benefits of such industrialization were lower prices and better products, the cost was homogeneity.' Notably, Fuchs (2015) found that consumers prefer handmade over machine-made products: the 'hand-made effect', which refers to 'the producer's love in the production process (the product is perceived to be made with love) and the love that is imbued in the product (the product is perceived to contain love in a symbolic sense' (Fuchs, Schreier, & Van Osselaer, 2015, p. 100). Industrialization introduced the fabrication of similar items by machines and tooling that were distantly determined by the human designer. It meant that a craftsman would no longer be part of the making process and the craftsman's skills, dedication and judgement were no longer part of the produced item. A valuable relationship and connection ceased (see also Section 2.3.3). Whereas the craftsman was involved in the creation of an artefact, this was impossible for machines. In his book *Craftsmen*, Sennett (2008) notes that society today suffers from the historic split between technology and expression, and between maker and user.

Somewhat contradicting this critique, Mayer Thurman (1983, p. 197) describes how it is the specific task of the designer to translate the artistic quality of the handmade object into the mass produced object. She substantiates this by indicating that 'artists focused their talents on products which reach more than a select few'.

3.8 Conclusion

Reflecting on design, things, and industry

The so-called mass culture, characterized by mass production and even planned obsolescence on the one hand, and conspicuous consumption on the other, has had quite a few negative consequences, both for people and for nature. Since the origin of industrialization, the situation has worsened rather than improved. The way in which today's society produces industrially fabricated products, parallel to the extensive consumption behaviour of people in the Western world, has become a culture, a way of life.

3.8.1 A culture of consumption

As briefly touched upon in the introduction, the ground on which mass production is based implies a minimum batch size of items to be produced in order to be profitable. Because of the mostly high investment needed for the tooling and machinery required to manufacture

a product, batch sizes are usually large. That means that lots of products are produced with the sole aim of selling them, independent from the potential need for this particular product. A common explanation for today's consumer society is that consumers are the ones who require the availability of everything: choice, innovativeness, endless services and low prices. However, Western production and consumption culture is exactly what industry strategically aims for: pushing and marketing products and services onto the market, which is 'creating' a so-called need. As was mentioned in Section 2.2.2, Shove (2005, p. 2) concludes that product design has continued to be strongly related to 'political economy of production'. Design's function in today's society is to facilitate production (Shove, Watson, & Ingram, 2005). Section 3.4.4 refers to Trentmann stating: 'Artificial wants have replaced authentic needs' (Trentmann, 2016, p. 5), and to Galbraith (1998, p. 124) explaining 'One cannot defend production as satisfying wants if that production creates the wants'.

Since the onset of consumerism, consumers in large parts of the world have gotten used to the system of abundant offers and choice. Industry and the forthcoming consumption society have a very strong influence on Western culture (Baudrillard, 1998). The so-called 'industrial complex' not only starkly contrasts with people's (historical) tendency to be creative, to make (being Homo Faber) and to be involved, but it also contrasts with the potential role these items could play in the lives of the individuals producing or utilizing them. As referred to in Section 2.2, design is not solely a meaningless object, but an assembly of (1) the effort and expertise of the maker, (2) 'acts of exchange and consumption' (Olsen, 2012, p. 180) and (3) the use and experience of utilizing (Olsen, 2012). In other words, a thing or product, and the relationship people have with those objects, concerns the perspectives of both 'making' and 'using'. See also Section 2.3.3, Figure 13 and Figure 29.

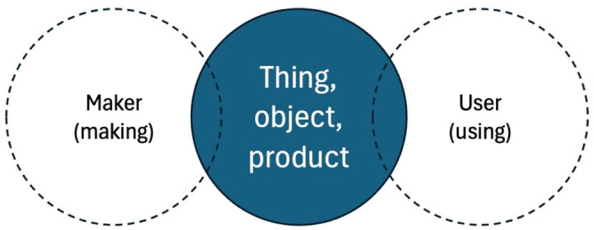


Figure 29: The separate activities of making and using, related to the 'biography of things' (see also Figure 13)

Photo: rts, Canada

Section 4. Problem statement: an unsustainable situation

Concerns about consumption and production, and the harmed relationship between them

As discussed in earlier sections, the way in which today's society produces industrially fabricated products, in combination with the consumption behaviour of people in the Western world, has become a culture, a way of life. This so-called mass culture, characterized by mass production, has continued to have clear negative consequences. For a product designer, the 'creator' of consumer goods, it is not a pleasant sight or idea that the profession of industrial design is so strongly related to industrialization and its non-sustainable aspects. Although, it must be said that industrial designers *have* also created great solutions and useful or beautiful products, which have positively contributed to today's society.

However, most items are produced in masses, instigated by marketing mechanisms. People tend to purchase things they don't need. The Earth's resources are exploited, parts and products are being transported all around the world, and production employees are sometimes forced to work in dangerous and inhumane conditions. As a teacher and researcher with an industrial design background, taking into account the troubles caused by the industrial approach of design, I feel accountable. I feel that I have the responsibility to consider ways to help solve the problematic situation. Referring to the problems addressed in Section 3, we live in a situation in which people and the planet cannot sustain.

Since the production-consumption system relates to all of society (Section 3), this study requires a wide perspective. Such a wide-angled view should then concern the world we live in, the way we make and consume things, recent natural environmental issues (see Section 3.5) and, last but not least, people themselves. That is why this paragraph introduces the broad definition of sustainability, which goes beyond our natural environment.

Further, Section 4 and Section 5 will contain an in-depth discussion on the problems to overcome and some potential near-term solutions.

4.1 A sustainability definition

Today's sustainability measures, taken by governments and individuals, concern a long range of seemingly helpful solution directions. Some of the measures are to decrease waste, pollution and damage, support reuse and circular design, limit climate change, etc. None of these attempts addresses sustainability as a 'system approach' though: none of the attempts reaches the core of the problem. And, speaking in Ehrenfeld's terms, these attempts to decrease unsustainability do not employ the wide perspective that is required to truly solve the problem as described (Ehrenfeld, 2008).

Literally, sustainability means a situation's 'ability to sustain', more specifically the degree in which today's circumstances are able to endure or stand. Another definition of sustainable would be to 'be able to be used without being completely used up or destroy natural resources' and 'be able to last or continue for a long time' (Merriam-webster, 2020). Such a definition already indicates that it requires a long-term vision in order to reach sustainability. When the field of industrial design is considered, it seems evident that the behaviour and needs of consumers should be addressed, along with the surrounding natural environment, and the relationship between people and the items they use and buy. Hence, sustainability concerns more than only nature: we first need to consider people, their awareness, and the

consequences of their actions.

Ehrenfeld (2008) approaches sustainability as an existential problem, not only as an environmental or social problem. According to Ehrenfeld, 'Without recovering our sense of Being and ethical responsibility, it is virtually impossible to start to take care of the world and our own species in ways to produce flourishing' […] 'Being is a doorway to sustainability', says Ehrenfeld (2008, pp. 6, 121). The concept of 'Being', or 'Dasein' ('being-in-the-world'), was originally developed by Heidegger (2010), and it refers to human beings as conscious, connected and inseparable from the world.

The awareness 'of their existence and care about understanding that existence […]', Ehrenfeld describes, '[…] provide Being its special features' (Ehrenfeld, 2008, p. 115). Ehrenfeld's three domains of sustainability concern: (1) the human domain, (2) the natural domain, and (3) the ethical domain.

For the field of design as described in the previous sections, Ehrenfeld's description of sustainability is accurate and very useful, given its wide-perspective and all-encompassing point of view of sustainability. Section 4.2 will explore and explain Ehrenfeld's sustainability domains in more detail, and how and why it is relevant to the issues addressed in this thesis.

4.1.1 The problem of reducing unsustainability

One could say that nearly everyone (people, institutions, governments, and companies) takes sustainability seriously into consideration these days. Corporations and even entire branches seem to emphasize their dedication to the subject: sustainability legislation, sustainability labels, compensation of emissions, carbon footprints, C2C, circular economy, the Green Deal, renewable energy, biomass energy, etc.

Traditionally however, addressing the issue of sustainability is symptom-focused. Despite their good intentions, many of the approaches and models that aim to address the negative consequences of industrialized society do not address or criticize the problematic system: the origin that brought about the problems in the first place.

This doesn't mean they are ineffective or irrelevant, but in the long term these measures seem to be fighting a losing battle. One should not expect a solution to come from small and superficial changes while maintaining today's behaviour and the troublesome system in which we live (Luttikhuis, 2021): that would be end-of-the-pipeline problem solving, as discussed in Section 1.2.

In search for a way to counteract these consequences of the unsustainable situation/system, it is above all necessary to identify and address the original cause.

John R. Ehrenfeld's definition of *un*sustainability is as follows: 'Unsustainability is an unintended consequence of the addictive patterns of modern life' (Ehrenfeld, 2008, p. 71). He criticizes (among other things) the way people consume, the ways we produce and how people relate to their environment and belongings. Common attempts to counter unsustainability would only mitigate the consequences of people's addictive behaviour and would not change the production system that causes them.

Those approaches to decrease unsustainability do not consider the wide perspective that is required to really solve the problem as described. Ehrenfeld states that most of today's

attempts to reduce unsustainability do not necessarily create sustainability. '[..] sustainable design methodologies lack philosophical depth, adopting a symptom-focused approach', is how Chapman (2005, p. 9) puts it. Sennett (2008, p. 21) emphasises the fundamental change that is required to be able deal with today's physical crisis of climate change and the exhaustion of natural resources, by stating that 'we are obliged to change both the things we make and how we use them […] which requires a more radical self-critique '.

4.1.1.1 Alternative models for sustainability

Whereas Ehrenfeld's domains of sustainability concern people's needs, their awareness and behaviour, and nature, indicating and covering the relationship between these most relevant domains, many of today's perspectives on sustainability include the element of economic growth. The United Nations' Sustainable Development Goals form an example (UN, 2024): #8 in Figure 30. Furthermore, the UN model does not explicitly consider the *'Human Being'* factor as a potential lever to support forms of natural sustainability.

Similarly, the European Commission's model (Figure 31) as presented in their Annual Sustainable Growth Survey (European_Commission, 2022) incorporates the quadrants of productivity and stability, both referring to the support the EC wants to offer to 'a strong industrial base', to 'efficient and competitive markets', respectively to 'structural reforms and ambitious investments to boost productivity', besides the quadrants of environment and fairness.

Neither of these two impactful example policy models incorporate the notice that the policy of economic growth has for a large part caused the sustainability problems we are facing today (see Section 2, more specifically Section 3). They do not anticipate the contradiction between economic growth and sustainability, that was addressed by Stegeman (Noort & Brink, 2023), Schenderling (2022), Ehrenfeld (2008), and Sennett (2008).

Studies (Haberl, Wiedenhofer, Virág et al., 2020; Parrique, Barth, Briens et al., 2019) have revealed that the concept of 'sustainable growth' (i.e. economic growth while focusing on sustainability), or 'green growth', has not resulted in the environmental improvements governments hoped for: Schenderling (2022) found that the condition of the Earth in the last 35 years has worsened dramatically, while the economy has continued growing, and that there is no scientific grounding for the concept of 'green growth'.

Ehrenfeld (2008), Chapman (2005) and Schenderling (2022) are supported by Van Beek (2023) who indicates that climate policy often focusses on cost-effectiveness, taking the traditional economic system and economic growth as a given. Van Beek, in her recent dissertation, challenges the position of traditional IAMs (Integrated Assessment Models) commonly used by the IPCC (Intergovernmental Panel on Climate Change), stating that those models do not consider social, ethical, and political questions, nor elements of people's wellbeing or principles of social justice. In order to support, for example 'radical imagination' (Hammond, 2022), she suggests to explore ways to 'pluralise and democratise' the solution space of low-carbon futures (van Beek, 2023). Schenderling (2022) argues that the IPCC is under pressure from governments to present scenarios where - based on so-called '*unprecedented technologic progress*' - economic growth can continue alongside the achievement of climate goals (i.e. a maximum of 2°C temperature increase).

Figure 30: United Nations' Sustainable Development Goals (UN, 2024)

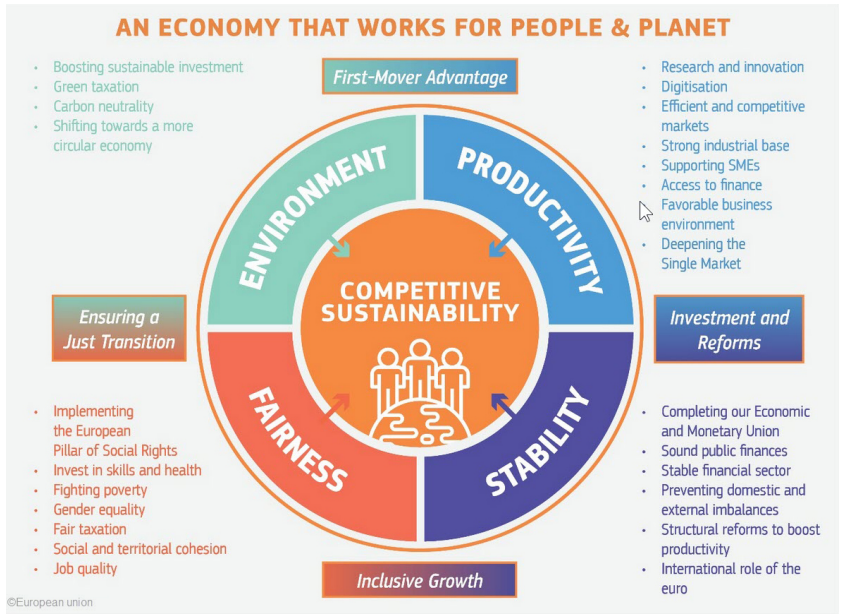


Figure 31: Sustainable growths according to the Annual Sustainable Growth Survey 2022 by the European Commission (European_Commission, 2022)

4.2 Sustainability domains

To delve into the topic of what truly encompasses in relation to our producing and consuming behaviour and our position in the world, this paragraph addresses the definition and its domains of sustainability according to Ehrenfeld. His definition serves as the fundament for considering sustainability in this thesis, since he accurately links people's behaviour and awareness to the consequences for our natural environment, by considering ethics, and our relationship with the world in which we live.

Sustainability, in any dimension, starts with people's awareness of what is going on in the world around them, with looking further than only living a passive consumer life. 'We must shift back to the flourishing fullness of "Being" from its impoverished modern form of "having"', says Ehrenfeld (2008, p. 6). People's awareness is an integral part of people's Being: the first element of Ehrenfeld's sustainability model, his 'Tao of sustainability' model, shown in Figure 32.

He distinguishes three domains (see Figure 32) to be addressed simultaneously (Ehrenfeld, 2008), of which restoring the human domain is most urgent (since it seems impossible to take care of the world around us without taking care of ourselves).

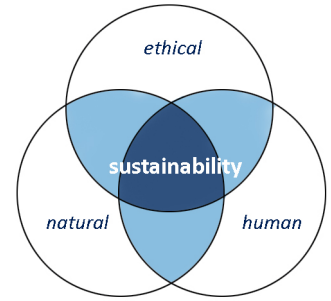


Figure 32: The three (closely related) domains of sustainability according to Ehrenfeld (the Tao of sustainability) (Ehrenfeld, 2008)

The human domain

This domain concerns our sense of ourselves as human *'Beings'* (capital 'B' because of the broad sense or act of 'Being'). Ehrenfeld relates this to the human dimension of flourishing: being free to live dignified, authentic lives; making unconstrained choices and being domination-free. This domain addresses, for example, the elementary *human needs* as also described by Max-Neef (1992) and Maslow (1998). This domain will be further addressed in Section 4.2.1.

The ethical domain

This concerns our sense of doing the right thing: our sense of responsibility for our actions and our relationships with others. Hegel, cited by Simon Blackburn (Blackburn, 2001), suggests ethics shapes our very identities. It gives us our standards of behaviour. This domain also addresses people's awareness and behaviour, and the consequences of, for example, scale and of a globalized production system. This domain will be addressed further in Section 4.2.2.

The natural domain

The natural domain refers to our sense of our place in the natural world. One of the obvious themes is environmental degradation. Ehrenfeld suggests new forms of production and reducing consumption. The focus on production and consumption on a massive scale has caused environmental problems, a selling-off of the natural environment. More details about the consequences of industry for the natural environment were discussed in Section 3.5. This domain will be further addressed in Section 4.2.3.

Through incorporating the existential notion and the components of ethics and *'Human Being'* , Ehrenfeld's definition of sustainability surpasses the Brundtland report (by the World Commission on Environment and Development) that primarily refers to (1) the essential needs of the poor and (2) the notion that technological advancements and societal behaviours can place constraints on the environment's capacity to sustainably fulfil the requirements of current and future generations (Butlin, 1989; Thomsen, 2013). Ehrenfeld's definition also exceeds Van De Poel's levels of 'measures to satisfy the responsibility for the environment' (being (a) at a product level, (b) at a process level and (c) at a business level) (Van de Poel & Royakkers, 2011). Whereas world institutions including the UN focus on the specific environmental consequence called climate change (UN, 2021), Ehrenfeld seeks to address the initial causes of all environmental problems.

4.2.1 The Human domain and product design

Let's first clarify that this thesis is not only written from an industrial designer's point of view, although industrial design forms the background of the author. It is even more relevant to consider the perspective of a human being. As was discussed in the section on the 'Industrial society' (Section 3.3), the end user's needs or requirements are mostly not the only starting points in an industrial product development project. What makes a corporation decide to start a development process and actually bring a product to the market, includes factors such as presumed market share and sales, shelf space, profit, brand visibility, customer relationship, brand value, company share value, other shareholder interests, etc.

In expressing his critique of industrial or Western thinking, Csikszentmihalyi writes: 'The modern culture of materialism, or the belief that the ultimate goals of personal life can be fulfilled by things and sensations, is losing credibility […]' (Csikszentmihalyi, 1981, p. ix). He states that the danger of such a life is that people cannot pay enough attention to the cultivation of the 'self', to the relationship with others or to the broader purposes that affect life.

But what is the actual need of people? As was introduced in Section 4.2, Ehrenfeld's Human domain refers to the concept of Being, and it is closely related to universal *human needs* such as those described by Maslow's *Hierarchy of human needs* (Maslow, 1943). Aligned to those universal needs, and closely related to the concept of Being, Manfred Max-Neef's system of (human) needs refers to features such as participation, creation, identity and freedom (Max-Neef, 1992), see Table 1. Maslow adds his 'attributes of Being' (Maslow, 1998) to this concept, including wholeness, uniqueness (individuality), honesty, joy and self-sufficiency (autonomy), see Table 2. According to Ehrenfeld, the concept of Being should be a starting point when striving for sustainability. Altering the relationship between the consumer and the things he or she needs, between user and supplier, as a result of an increasing awareness, could have a positive effect on humans and on the world they live in (Sennett, 2008).

Table 1: Max-Neef's system of *human needs* (Max-Neef 1992)

Max-Neef's system of human needs				
	Being	**Having**	**Doing**	**Interacting**
Subsistence	physical, mental health, equilibrium, adaptability, sense of humour	Food, shelter, work	Feed, procreate, rest, work	Social setting, environment
Protection	Care, adaptability, autonomy, equilibrium, solidarity	Insurance/health systems, savings, rights, social security, family, work	Cooperate, preent, plan, take care of, cure, help	Living space, social environment, dwelling
Affection	Self-esteem, solidarity, respect, tolerance, generosity, receptiveness, passion, determination, sensuality, sense of humour	Friendships; family, partneships/ with nature,	Make love, caress, express emotions, share, take care of , cultivate, appreciate	Privacy, intimacy, home, spaces of togetherness
Understanding	Critical conscience, receptivenss, curiosity, astonishment, discipline, intuition, rationality	Literature, educational policies, teachers, method, communication policies,	Investigate, meditate experiment, study, educate, analyse	Settings of formative live interaction, groups, community, schools, famiily, universities, academies
Participation	Dedication, respect, receptiveness, adaptability, solidarity, willingness, determination, passion, sense of humour	Rights, responsibility, duties, work, privileges	Cooperate, dissent, agree on, propose, become affiliated, share, express opinions, interact, obey	Settings of participative interaction, parties, associations, churches, communities, neighbourhoods, family
Idleness	Curiosity, tranquillity, imaginafion, sensuality, sense of humour, recklessness, receptiveness	Peace of mind, parties, clubs, spectacles, games	Day-dream, brood, dream, recall old times, give way to fantasies, relax, remember	Privacy, intimacy, free time, landscapes, surroundings, spaces of closeness
Creation	Passion, intuition, imagination, determination, boldness, rationality, autonomy, inventiveness, curiosity	Abilities, skills, method, work.	Work, invent, build, compose, design, interpret	Productive and feedback settings, workshops, cultural groups, audiences, spaces for expression, temporal frredom (time)
Identity	Sense of belonging, self-esteem, consistency, differentiation, assertiveness	Language, symboJs, religion, habits, values, norms, historical memory, work, sexuality, reference groups, customs	Commit oneself, integrate oneself, confront, decide on, get to know oneself, recognize oneself, actualize oneself, grow	Social rhythms, maturation stages, everyday settings, settings which one belongs to

4.2.1.1 Social circumstances

Industrialization brought about a migration to the cities and an enormous growth of those cities, as was briefly mentioned in Section 3.1.1. To the factory owners, industrialization, wage work and growth resulted in huge profits and flourishing businesses. However, most of the men working in the factories and their families had trouble keeping their heads above the water, and worked mostly 12 hours a day, 6 days a week. The world in general was still ruled by a small elite of factory owners, (industrialists), aristocrats and so-called dignitaries (Heijne & Noten, 2022).

From a psychological of view, Industrialization, along with the split between making and using and the division of labour in general, has increasingly blocked the creativity of people and their opportunity to develop their 'selves'.

Attribute	Detail
Wholeness	Unity, structure
Perfection	Just-right-ness, suitability, completeness
Completion	Justice. Fulfillment
Justice	Fairness, oughtness
Aliveness	Spontaneity, non-deadness
Richness	Complexity, intricacy
Simplicity	Honesty, nakedness, essentiality
Beauty	Rightness, perfection, honesty
Goodness	Rightness, oughtness, honesty
Uniqueness	Individuality. Novelty
Effortlessness	Ease, absence of striving
Playfulness	Fun, joy, humor, exuberance, effortlessness
Truth, honesty, reality	Nakedness, simplicity, purity
Self-sufficiency	Autonomy (but not being alone in the world)

Table 2: Maslow's attributes of Being (Maslow 1998)

Passive consumption is in contrast to people's aspirations and needs, according to Atkinson (2006) and Press (2007). See also Section 3.3.3.4. Nieuwenhuys (1969) foresaw that people would spend their increased leisure time, caused by the automation of the production process, on playful and recreative activities to free their energy surplus.

'The scientific organization of labour, or Scientific Management, increasing the separation between planning and execution […] has made it difficult for […] workers to secure promotion within the firm', says Georges Friedmann (1961, p. 109) in his Anatomy of work. In the context, Csikszentmihalyi refers to Max Weber who foresaw that rationalism and bureaucratization would threat people's freedom and creativity (1981, pp. 41-42).

4.2.1.2 Asymmetry

The mass culture that, two centuries ago, arose from the rules of mass production and mass consumption led to an asymmetry of power (Kelly, 2011a). People started to work *en masse* in the factory instead of fabricating their needs at home, which meant that people became more and more dependent on the job they had. People had less to say about their daily lives. Owners of factories and companies had the chance to strive for high profits and low wages.

From an employee's point of view, the - hierarchical - industrial system heralds an inevitable inequality: (1) When production is, as a result of further labour division, divided into even smaller pieces, there are fewer promotion opportunities for the individual employee (Friedmann, 1961) (Section 4.2.1), (2) Industry's vertical division of labour heralds a hierarchical power structure, putting the factory worker at the bottom of the pyramid (Mintzberg, 1983), with a knowledge concentration at the top, and (3) Globalization has created a race-to-the-bottom competition between low-wage countries, bringing down the salaries and people's working conditions. D. Ehrenfeld (2003) refers to 'social disruption', and 'spiritual disruption' when discussing the consequences of globalization. These issues will be further addressed under Section 4.2.2.

As people did not make or mend their own products anymore (while working

at the factory, for a wage, and for others), they started purchasing the things they needed. New production technologies raised productivity and led to a lowering of prices. The Economic History Society (UK) writes that 'New products and designs made manufactured products attractive to a wider range of consumers. Modern marketing and sales techniques, such as newspaper advertising, travelling salesmen and growing numbers of retail shops further encouraged what some historians have termed 'a consumer revolution' (Hudson, 2008).

According to Kelly (2011b), power is a result of the fact that there is an asymmetry in knowledge of technology. One could state that this is similar for product development, which is mostly approached as a top-down system. Everett Rogers' well-known representation of this system through the 'diffusion of innovation' model illustrates this one-way communication from supplier to consumer (Marseille, 2009; Rogers, 1962) (see Figure 34).

As an answer, and to cater for the tools people require, Olsen, author of *The Discipline of Things*, proposes 'a fundamental symmetry between people and things, materiality and immateriality, natures and cultures, in understanding how making things is all about reweaving our social fabric' (Olsen, 2012, p. 161).

4.2.2 Ethics and product design

Both the well-being of people and the condition of nature depend on ethical considerations. The considerations concern the management of work, the economic system, environmental issues, the relationship between people and products, etc.

These ethical consideration need to be addressed first '[…] without recovering the ethical dimension, sustainability will always be someone else's responsibility and job', says Ehrenfeld (Ehrenfeld, 2008).

Many scholars in the field of product design emphasize the relationship between product and user (Verbeek, 2000). In essence, as Dilnot (2009) has put it: design is about relations.

The ethical domain of sustainability (see Figure 32), which can be regarded to be the all-encompassing component, and at the same time closely related to the human domain, can be perceived as concerning the accountability for one's actions, 'the act of avoiding harm knowingly' (Ehrenfeld, 2008, p. 160). Ehrenfeld argues that modern technological life has made it difficult for people to know the consequences of their actions because of displacement in time and space, given the globalization and labour division in general. Being responsible for one's actions has for that reason become a problematic issue.

4.2.2.1 Division of labour as a major factor

The division of labour resulted in so-called alienation between the maker and the product, as referred to under Section 3.4.6.

Historically, Walter Crane and William Morris were among those who criticized the industrial way of production, not only for its presumed inability to create any aesthetic or artistic quality but also because of the extended division of labour, which is an inevitable part of industrialization (Crane, 1894; Morris, 2007).

In 1844, Karl Marx stated that, in order to live a truly human life, the free use of means of

production is an essential condition; people should be able to control their material survival. If the production tools are not owned by the man who uses them, he is related to the product of his work as to an alien object, according to Marx (Marx & Engels, 1844). 'His labour is […] not voluntary, but coerced; it is "forced labor". It is therefore not the satisfaction of a need; it is merely a "means" to satisfy needs external to it' (Marx & Engels, 1844, p. 30).

The distance between the traditional elements of the production chain - supplier/ manufacturer, producer, retailer, and user - of which one is often situated in an entirely different continent, year or societal circumstances than the other, increases this separation between intention/actions and consequences. As taking responsibility for those consequences is crucial for creating sustainability, it seems very tenable to strive for shorter distances between the person making and the person using a product.

4.2.2.2 Globalization: distances and differences in various dimensions

The further the distance between making and using, in whatever dimension, the less awareness and care. In addition to the elements mentioned in Section 3.3.4, D. Ehrenfeld (2003) enlists some of the consequences of globalization in relation to the moral aspect of sustainability. A (small) selection of these:

• An increasing difference in wealth between the rich and the poor (both individuls and nations). In 2003, the top 20% of richest people spent 86% of the world's wealth.

• Regional instability (for example, resource extinctions and rapid geographic shifts of production) as a result of globalization (i.e. the increase in power of multinational corporations and 'global interlinkage of financial markets').

• Democracy weakens as a result of globalization: governance processes increasingly have private or oligarchic forms, while neoliberal norms are threatening state-based governance in general, according to Cerny (1999). He states: 'Rather than a new pluralistic global civil society, globalisation is more likely to lead to a growth in inequalities, a fragmentation of effective governance structures and the multiplication of quasi–fiefdoms reminiscent of the Middle Ages' (Cerny, 1999, p. 1).

• Rise in numbers of environmental and economic refugees

• A decline of local democracy (i.e. decline of control over local events)

• The local loss of knowledge and skills

4.2.2.3 Democracy, accountability

Democracy is generally defined as 'a system of government in which laws, policies, leadership, and major undertakings of a state or other polity are directly or indirectly decided by the "people"' (Shapiro, Froomkin, & Dahl, 2024). Opposite to the institution of a representative democracy, in which a government is chosen and can be sent home in case the people or parliament demand that (Popper, 2001), corporations, and their decisions and policy, are not legitimized by any democratic procedure. Haegens (2022) argues that capitalism does not equate to a parliamentary democracy. Consumers have no true say about the offer or the company's behaviour. Dahl emphasizes the paradox that 'a market-capitalist economy inevitably generates inequalities in the political resources to which different citizens have access' (Dahl, 2020, p. 158). The reasons for this are inequalities in political influence, access to information, and political participation.

In other words, the global system of production is not democratically governed or chosen but privately owned, whereas at the same time, this same production system causes many of today's environmental and societal problems. It would be a legitimate question to ask whether the industrial complex, considering its impact on people and nature, should be left ungoverned by any democratic procedure, and left to the private sector.

Similar to political democracy that ideally concerns people's own sovereign vote and choices, Woodcock (2019) argues that consumption should also be about making sovereign, independent and unmanipulated choices. Commercial propaganda (advertising), he says, makes consumption undemocratic. Julier (2007) makes a similar point, see also Section 3.4.2. In a democratic system of production and consumption, the choice of consumers would decide which products are produced and which products are really preferred and needed. Woodcock refers to a situation in which individual people would solely base their behaviour and purchasing behaviour on accurate and sufficient information, not on commercial sources of information that mostly have sales and consumption in mind. Similar to political democracy, a solid and sensible production system requires sensible education and decision-making, it requires people's full knowledge and awareness of what is going on: knowing the consequences of their actions. Bonsiepe (2006, p. 29), who sees the concept of democracy as a reduction of 'heteronomy' (domination by external forces), formulates: '[…] democracy involves more than the formal right to vote. Similarly, freedom goes farther than the right to choose between a hundred variants of cellular phones […]'. He argues that the relationship between industry (the centres of power) on one side and the people on the other is deeply undemocratic since it negates participation. 'It treats human beings as mere instances in the process of objectivization (German: *Verdinglichung*) and commodification' (Bonsiepe, 2006, p. 30)

Democracy ('rule by the people', literally) in this context of design preferably means people who have an actual say in what is made. In Section 3.3.5, we saw that industrialized production, and the system around it, is particularly undemocratic: the system is not about the wishes and requirements of people, but most important are the suppliers' growth, profit and the company or brand itself, and the shareholders' value.

Moreover, even if it *were* democratic, the system of mass production would serve large groups of people at the same time, the majority. It would still not serve the individual's needs. This is why it is actually better, in a design context, to consider and aim for individual involvement and strive for individual service. Involvement in this sense would mean: being part of the decision process concerning the conception, availability and purchase of the thing or item you need, wish, or require, individually.

As outlined in Section 2.2, industrially-led companies and corporations have mostly a top-down structure. In Mintzberg's (1983) words, the jobs in such a structure are vertically split and divided. Relationships within a company are in many cases hierarchical, or vertically specialized, in line with some of the dynamics of industrialization, as discussed in Section 3.3.3.2. 'The internal "governments' of capitalist firms are typically undemocratic' (Dahl,

2020, p. 182). Semler (2015) reminds us of the contradiction: people demand a sovereign and democratic process for choosing a representational mayor or government, they want to choose the school for their children, however they seem to accept the undemocratic structure of the company they work for. It may make sense to seek a better procedure, whereby employees choose their leader for six months and then evaluate. Mason cites Thelwall, who, approximately 200 years ago, wrote 'Every large workshop and manufactory is a sort of political society, which no act of parliament can silence, and no magistrate disperse' (Mason, 2015).

4.2.2.4 Morality and industrial thinking

Various sections have addressed the moral tension that results from industrial thinking, which refers to approaching society in an industrial manner (see Sections 4.1 and 4.2). A clear example of industry's apparent lack of morality is, for example, the phenomenon of planned obsolescence (see Section 3.3.5), which entails products being deliberately designed to have a short lifespan (Boradkar, 2010).

Pine and Gilmore have accurately described the main principle of today's industrial society by stating: 'The history of economic progress consists of charging a fee for what once was free' (Pine & Gilmore, 2013, p. 30). The industrial complex, given its origin, reasoning, background and known negative consequences for the environment, tends to become morally controversial. Dilnot, in *Design Studies, A Reader* (2009, p. 182), emphasizes the need for 'ethics […] against the capitulation of human interests to those of the market'. This thesis' criticism of our industrial context can be considered as a moral attempt to document troublesome elements of it and suggest alternative solutions.

4.2.3 Nature and product design

Many scholars, each from a different perspective, observe and address today's problematic and unsustainable relationship between people and the products they purchase and use, which is strongly related to the unsustainable relationship between production and consumption (Baudrillard, 1998; Chapman, 2005; Ehrenfeld, 2008; Julier, 2007; Mari, 2003; Mason, 2015; Nieuwenhuys, 1969; Papanek, 1985; Schumacher, 2010; Toffler, 1990).

As a consequence of the industrial transformation (0), human and animal power were replaced by fossil fuel power. 'Fossil fuels formed the energy base of all Second Wave societies' (Toffler, 1990, p. 25), as briefly pointed out in Section 3.3. Industrialization as a concept is based on the presumption that all natural resources are endless. That is why we have lived and still live in a linear, so-called extraction economy, since industrialization started two and a half centuries ago. An 'Extraction Economy' is an economic concept that refers to the use of non-renewable resources and energy. It is extracted from the earth, hence it causes environmental degradation (Veltmeyer, 2013; Wit, 2020). In this context, elaborating on the definition of technology (see also Section 1.3.3), Heidegger (2014, p. 16), refers to 'modern' technology's 'demanding' ('*opvorderen*') as opposed to the '*ποίησις*' (creation or making) sense of forth-bringing ('*tevoorschijn-brengen*'). The first refers to the 'demanding' of nature to provide energy. Heidegger exemplifies this by referring to the delving of coal which includes the demanding ('*opvorderen*') of land and the ore, as opposed to the traditional caring and cherishing way of treating the land (Heidegger, 2014, p. 16).

In principle, Heidegger relates technology to the domain of 'uncovering' in which, he says, the truth ('*Αλήθεια*') resides. Technology belongs to forth-bringing, to the *ποίησις*, it is something poetic, he writes. He states that this definition applies to the original Greek thinking about technology, and to technology in terms of craft, but that it does not apply to modern technology (Heidegger, 2014, p. 15). Similar to this distinction, Plato distinguished *ποίησις* (creation) from *μίμησις* (imitation) (Griffith & Ferrari, 2000).

The extraction behaviour, also called 'resource-thinking', has, according to numerous scholars, caused the problematic relationship between the industrial society and nature, leading to the consequences that were named and discussed in Sections 3 and 4.2.2.2.

4.2.3.1 Unity

In Western thinking, humans and nature have always been regarded as strictly separated, just as spirit and matter have always been regarded as split. Scientist Stikker states that this caused alienation among nature, living, humans and spirit, which led to a cultural climate in which the use of natural resources was legitimate, was commonplace. The search for science and knowledge, through splitting physics from metaphysics, and splitting problems into small pieces, resulted in a society that wants to dominate nature, instead of merging with it (Stikker, 1986).

However, people do see and acknowledge the need for unity: to live together with our environment instead of 'at the cost of it'. Erich Fromm posed that the '[…] basic passions of man are […] rooted in […] the need to find a new relatedness to man and nature […]', as cited by Csikszentmihalyi (1981, p. 38).

Accordingly, Tao refers to this connection between the Universe or Cosmos, Earth and Humans. (Moeller, 2015). 'Humans are not in a position to impose their rules as "masters of the earth"', according to Taoist philosophy (Moeller, 2015, p. 100). Humans are capable of finding unity and order within themselves: enforced rules would automatically cause an opposite and contra-productive reaction, says Stikker (1986). Because of the interdependency and dynamic of this system, Tao does not have any hierarchy like the Western world does: humans are part of nature (Stikker, 1986). Both Western industrial concepts of (1) strict separation of all study objects, of humans, earth, and cosmos from each other and (2) strict hierarchy, are in deep contrast to the Tao. These concepts appear to be contrary to sustainability too.

4.3 Summary: the problem statement

Need for a better relationship

To counteract the consequences of the unsustainable situation as noted by Ehrenfeld (2008), it seems plausible to address the original cause of the harmed relationship and not search for an end-of-the-pipe solution. Seemingly, establishing or recovering a healthy relationship between these two elements would help solve the issues as referred to in Section 3 and Section 4. A reconnection would align with the views of various scholars (Ehn, 2008; Pacey, 1992; Papanek, 1985) who advocate for a new partnership.

According to Alvin Toffler, industrialism is what defines the Second Wave society in which we live. Seen from a broader perspective (see Figure 6), industrialism has, until now, only been around for maybe three centuries, a very short period. Reason enough to take the his-

tory of mankind, and the parallel development of tools that distinguished humans from their competitors and ancestors, much more seriously. Some reasons: (1) Yes, industrialism made the production of goods more efficient, advanced, and cheap, and made them widely accessible to many people, but people's and craftsmen's skills and knowledge have, by now, increasingly disappeared. People can't help themselves without the availability of electricity, electronic route assistants, supermarkets that sell pre-cut and pre-cooked food, to mention just a few. (2) Today's reason-of-being of a product is mostly not related to answering users' needs, but to supporting the economy: supporting producers' turnover and profit. (3) But more importantly, it has put people in a situation of lack of awareness, lack of self-sufficiency, de-skilling and addiction (see Sections 3.4.2 and 7.3) to the consumption of things they don't need, depending on what the undemocratic industry has to offer. Needless to say, nature suffers from all this.

With the indicated characteristics and problems of the industrial approach of design, manufacture and consumption in mind, and considering the overall ambition of people to sustain and flourish (Ehrenfeld, 2014), this paragraph heralds a conclusive problem statement. A persistent theme emerging from the prior Sections concerns the so-called distance or gap between making and consuming: in other words, the breach between those who produce and those who consume, and the forthcoming consequences. The main problem statement therefore concerns the so-called relationship between people and the products they use, a subject that was introduced in Section 2.3.

As described in Section 1.7, the main research question is: 'How to establish/ re-establish a sustainable relationship between people and products?'

Elaborating on this research question results in these themes:

- Anticipate technological opportunities
- Anticipate societal context
- Anticipate *human needs*, *'Human Being'*
- User involvement
- Bridging the knowledge gap
- Re-appreciate human creativity
- Support personal development, self-sufficiency
- Consider the responsibility of designers and industry

4.3.1 Problem statement

Given the industrially-induced gap and the designer's responsibility, how can 'design' and 'use' be brought closer together?

With this problem statement in mind, Section 5 will address the various phenomena, developments and views that help in finding and defining an optional solution to the initial problem.

Photo Fablab France: Le Fab Lab à l'école

Section 5. The promise of democracy: opportunities for bridging the gap

Developments (Techno- and Infosphere) & principles (Socio-sphere)

5.1 Introduction: opportunities and context

Section 5 discusses the opportunities that could help solve the problem as stated in Section 3 and Section 4, hence providing a solution direction to bring design and use closer together. The section provides insights that concern (1) the human factor, related to the Noosphere and Sociosphere (who are we and what drives us), (2) the practices, theories and models that help indicate changes and transitions and (3) it discusses the changes that occur in the different spheres: the Infosphere and the Technosphere.

Opposing today's increase in consumerism (Baudrillard, 1998; Chapman, 2005; Ehrenfeld, 2014; Mayell, 2004; Press, 2007; Sennett, 2008; Veblen, 1965), and despite the apparent continuation of the traditional and undemocratic (Section 4.2.2) user-producer relationship (Section 3.3) and its consequences, there are opportunities for improvement.

A comparison between today's contextual factors and the traditional context of industrial production and mass consumption helps to clarify and explain the developments and relevant principles, and the opportunities that result from them. Opportunities derive from changes and specific universal principles. Specific developments within the Techno- and Infosphere allow for changes in production, consumption, and the relationship between them, hinting at a democratizing tendency.

As design is a reflection of society (Saumarez Smith, 1989), the field of product design is constantly changing. But besides the normal changes in design, the recent changes of the last 20 years are much more spectacular. Apparently, the system itself is changing. The infrastructure of making, consuming, etc., and the relationship between user and maker as a consequence, is changing. The changes cause diffusion and question the line between the end user and the manufacture of consumer products (Prahalad & Ramaswamy, 2004; Von Hippel, 2005; Winsor, 2004).

The increasing availability of technology to anyone who is interested 'amplifies human potential' (Anderson, 2012, p. 14), to which Bonvoisin adds that 'the increasing access [...] to fabrication capabilities has […] inspired post-industrial production scenarios' (Bonvoisin, Galla, & Prendeville, 2017, p. 2). 'Today's maker culture is the idea of returning the methods of production to users, by sharing design knowledge and promoting access to methods of manufacturing', says Lupton (2014, p. 134).

'Innovation processes are shifting from open source software to open source hardware design […] while the Do-It-Yourself (DIY) movement embraces the "open" in design', describes Aitamurto (2015, p. 17). Boisseau (2018, p. 3) notices that 'Nowadays it is technically, knowledgeably, practically, and legally easier than before for the man in the street to gain access to the act of designing, i.e., to design.'

At the same time, communities aim for so-called de-growth, downshifting lifestyles (Salvia & Cooper, 2016; Tukker, Cohen, Hubacek et al., 2010), which aligns with the re-emergence of the value attributed to handmade and one-off items and to the related production activi-

ties and artisanship.

Perhaps even more importantly, widely accessible instructional media (websites such as *Instructables.com* and *Etsy.com*) accommodate manual artisanal techniques and tools. Furthermore, the spreading of physical and virtual places for creative activities supports the merging of individual creators in creative communities that develop innovative solutions for new ways of living (Manzini, in Boeuf et al., 2006).

Technology and information

Technology seems to catalyse the growth of today's democratizing options and practices, (1) by means of the availability of enormous amounts of how-to information, (2) by means of internet applications and platforms that facilitate participation (Piller, 2024) and (3) by means of the available one-off manufacturing facilities such as 3D printing and other technologies. Computer technology has lowered 'the barriers to entry' to a wide range of areas that were previously the territories of professional designer (S. Fox, 2013, p. 219; Fox, 2014).

Wide varieties of participation platforms and making facilities have appeared, which are available to the public. The level of optional participation has increased step-by-step: first with the help of increased amounts of information only (via the internet), consequently helped by platforms allowing user-generated content (such as Wikipedia), the 'open source' movement, then by more complex web applications (Web 2.0; participation platforms, configurators), and ultimately by offering all kinds a direct making options (see also Section 5.2.2.3). O'Reilly refers to an architecture of participation (O'Reilly, 2004). Along came the emergence of new and cheaper digital tools (such as 3D printers), production process changes in industry, new business models that focus on user-generated content and small scale (such as Ponoko), platforms for tutorials and exchange (such as *Instructables, Etsy*), open workshops (such as Fablabs), the emergence of the maker movement in general and other entrepreneurial shifts (for example, Kickstarter).

Technological advancements in recent decennia have resulted in new and 'scale-free' manufacturing tools, which refers to digital tools for manufacture that do not require specific and costly moulds or investments typically required for large-scale production (Anderson, 2010, p. 64).

The changes seem to offer opportunities for participation and a higher level of self-sufficiency, for the democratizing of this consumer-producer relationship, as can be observed in phenomena of, for example, sharing services, local currencies, self-help trends and the maker movement. The changes are the underlying basis for a growing influence of the end user of services and products: customization, co-design, customer co-creation or 'prosumption' (Piller, 2011; Tapscott, 1996).

These developments illustrate the potential for closing the traditional gap in knowledge and production facilities, between producer and consumer, as was referred to earlier in Section 3.8 and Section 4.3. The enabling role of technology will be further explained in Section 5.4.2.

A changing context

Technological advancements have eased communication and the spread of information.

As a result, society has also changed: collaboration, platforms for exchange of knowledge, emergence of distant (online) communities and likeminded, etc. Information and communication are everywhere.

But society dynamics are not exclusively the result of technological changes. Certain universal principles, for example those concerning human nature, apply and behavioural changes have emerged independent from technological changes.

Those principles help us explain the criticism of the industrial system that was described in 0. A variety of different and new business models emerges, promising the opposite of the traditional industrial, top-down culture (Press, 2007). Summarized, this section considers change and phenomena within the Technosphere, Infosphere and Sociosphere.

The ViP model (Hekkert & Dijk, 2014) helps to visually explain the above-stated. Figure 33 serves as a suitable image to represent a change from industrial design's old to its new context. One could position the problem as stated in Section 4.3, which concerned the relationship between people and the items they use, between consumption and production, at the 'interaction level' within the ViP model (Figure 33). Considering the old and new contexts, which concern both principles and developments, will ultimately result in the proposition of a new concept of interaction.

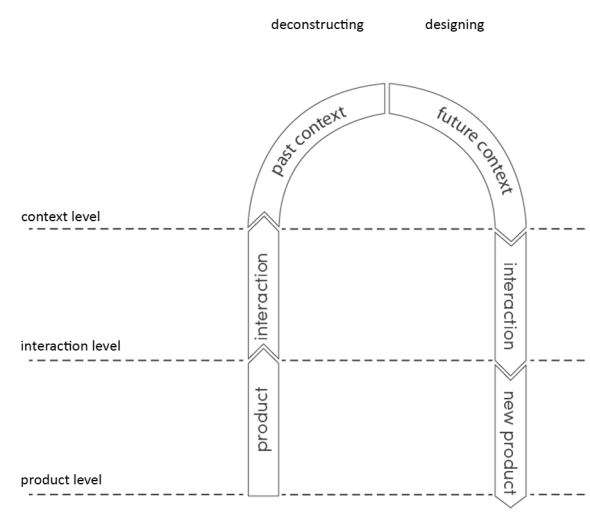


Figure 33: Graph of the ViP (Vision in Product Design) method (Hekkert & Dijk, 2014)

The feedback loop

When looking back at the history of consumer product sales, distribution and advertising, what is most striking is the extensive time and distance that was involved between production, sales and delivery. After distributing their product catalogues, which started in 1887 (Britannica, 2023), companies such as Sears & Roebuck delivered their items even to the most isolated customers. Consequently, the feedback loop was enormous. It took a long time before a product

catalogue, distributed by a horse-drawn carriage, had reached its potential audience, and then the entire process of ordering and delivery still had to come.

Today, infrastructure, information, technology and communication have all improved, along with increased speed and efficiency. The feedback loop has also become shorter, easier and faster these days. Internet platforms, comparison sites and online reviews all help the decision-making process. Compared to the early days of industrial society, people generally now have all kinds of options to see and test things before purchasing. In that sense, the power of the consumer has increased. However, this has also led to a situation in which 'hits' are prioritized over individual needs (Anderson, 2006).

In the recent decennium, criticism of the industrial and institutionalized system and people's need for more influence and democracy, helped by technological facilitation, have paved the way for movements and initiatives that envision and strive for a rather independent position of consumers, independent from big corporations and independent from the central government.

5.2 New models and the decline of traditional models

This thesis is not unique in observing and deducing the problems caused by yesterday's and today's industrial production, industrial society and industrial lifestyle. Numerous authors have announced or noted the need for a so-called paradigm shift: a change of today's system (societal, environmental, behavioural, etc., but most of all economic), as a means to solve issues, to re-think the system we are part of, as indicated in Sections 5.2.1 and 5.2.2.

5.2.1 The decline of traditional models

Most of the world around us, and the corresponding economic structure, economic thinking and economic society are solidly based on traditional economic principles that haven't changed in the last fifty years. Rogers' model of diffusion of innovation is a representative example, as it clearly prescribes a one-directional way of economic thinking (Rogers, 1962), see Section 4.2.1.2 and Figure 34.

In fact, Van Staveren, a professor at the Erasmus University in Rotterdam, has concluded that there seems to be a monopoly in economic scientific thinking. She argues that 90% of the economists support neoclassical economic theories such as the 'market is better than government', 'markets are always efficient and transparent' and 'people are rational beings who act according to their own interest' (Wetering, 2020). Most economists' views appear to be on the conservative 'neoclassical' side, she says. She mentions three elements of today's economic system that might disrupt a society's stability, of which two are: (1) The accumulation of money: investors and shareholders care about money, not about what is produced. (2) The competitive position whereby the market economy has resulted in oligopolies and monopolies, through fusions and market protection, which demonstrates the limits of free-market thinking: it leads to exactly what it claims to avoid. According to Haegens (2015), many economic principles seem to be no longer valid.

A specific way of thinking, named 'economism' also needs to be mentioned in the context of this paragraph. 'Economism, (...), is allowing the language and the frameworks of economics to permeate other fields. You get, overall, a sense that the world can be understood in

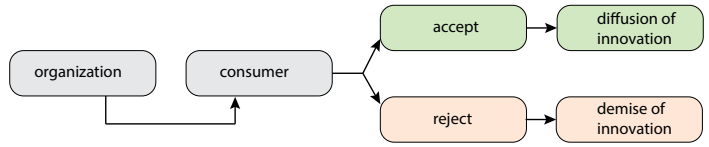


Figure 34: The diffusion of innovation (Rogers, 1962)

terms of costs and benefits, inputs and outputs', according to Wieseltier in *The Atlantic* (Garber, 2014). Economist thinking does not consider the non-monetary value one could assign to things, thoughts, or principles, which in turn results in a narrow perspective on the world.

At the same time, many authors mention the increasing power of the consumer, mainly accomplished by new information and communication technology, and forthcoming opportunities. The scenario referred to by these sources concerns an economy that no longer answers to Everett Rogers' traditional 'Diffusion of Innovations' model (Figure 34). On the contrary, the user increasingly takes the initiative (Marseille, 2009; Prahalad & Ramaswamy, 2004; Press, 2007; Tapscott, 1996; Von Hippel, 2005).

5.2.2 New models

This paragraph considers a brief selection of relevant theories and models that indicate or suggest a change in economic thinking. Alongside the changes occurring in both the Infosphere and Technosphere (Section 5.4), and the universal *human needs* as described by Maslow and Max-Neef (Section 5.3), these models help in describing democratizing opportunities.

5.2.2.1 Paradigm shift

Fox describes the shift from the existing mass-focused paradigm to a new paradigm. The traditional paradigm prescribes two situations, Fox says: either one of high economy and low originality (make to forecast) or one of high originality and low economy (engineer to order) (see Figure 35). The new paradigm, he states, 'enables high originality and high economy at the same time' (S. Fox, 2013). Fox's paradigm shift is strongly related to Anderson's Long Tail theory (2006), which emphasizes the economic relevance of small volumes of unique items to many customers.

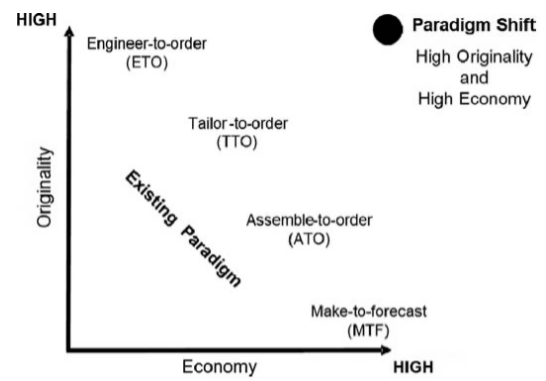


Figure 35: Paradigm shift - New-DIY (S. Fox, 2013)

5.2.2.2 The Long Tail

When searching for a book that was published years ago, in most cases the traditional bookshop cannot help anymore, while a short visit to Amazon.com gives one the opportunity to choose from twenty, mostly cheap (due to some of them being used), copies. This is what Anderson named the 'new economy' in his book *The Long Tail* (Anderson, 2006): the online bookstore (as an intermediary between the customer and a network of suppliers) profits from the fact that no storage capacity is needed: a digital retail platform connects offer and demand.

A long tail strategy allows companies to realize significant profit from selling small volumes of unique items to many customers instead of the traditional approach of selling of large volumes of a small number of hits or popular items (Figure 36).

Such an approach provides infinite choice possibilities, not limited by the goods in stock at the traditional shop. For example, Lulu.com enables people to publish their own book in a very small batch, thus contributing to the long tail of small amounts of book titles.

5.2.2.3 The long tail of things

'Transformative change happens when industries democratize, when they're ripped from the sole domain of companies, governments, and other institutions and handed over to regular folks', writes Anderson (2010, p. 63; 2012, p. 63), chief editor of *Wired magazine*. He compares the new and available tools of factory production, from electronics assembly to 3D printing, now available to individuals, with previous waves of democratization: the internet democratized publishing, broadcasting and communications, which resulted in a massive increase in the range of both participation and participants in everything digital, he states. 'Atoms are the new bits' (Anderson, 2010, p. 64).

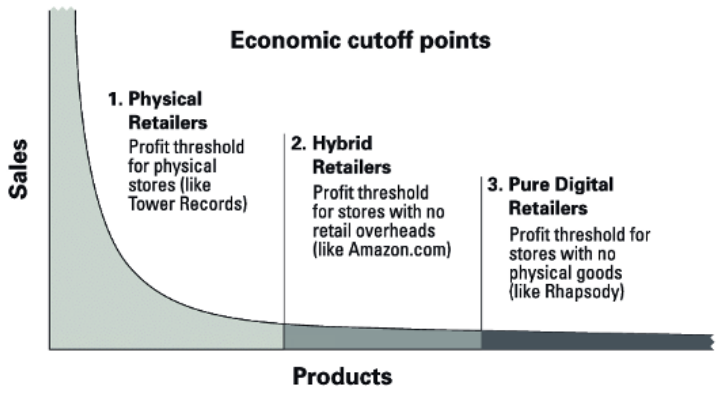


Figure 36: The Long Tail (Van der Velde, adopted from Anderson (2006)

He argues that the digital trends of the recent two decennia (maker fairs, local 'hackerspaces', peer production, open source, crowdsourcing, user-generated content, etc.) 'have begun to play out in the world of atoms, too. Hence, the comparison with the Long Tail in books and music.

5.2.2.4 Evolutionary product development

Eger (2007) states that products go through six evolutionary phases (see Figure 37), of which the last two product phases, called 'individualizing' and 'awareness', include the participating role of the user. In his book *Evolutionary Product Development* he writes that in these phases product development is aimed at mass customization or co-creation, allowing the customer to influence the final result. The model provides a positive preview of the next stage of product design: involve the end users as co-developers through a process of end-user participation.

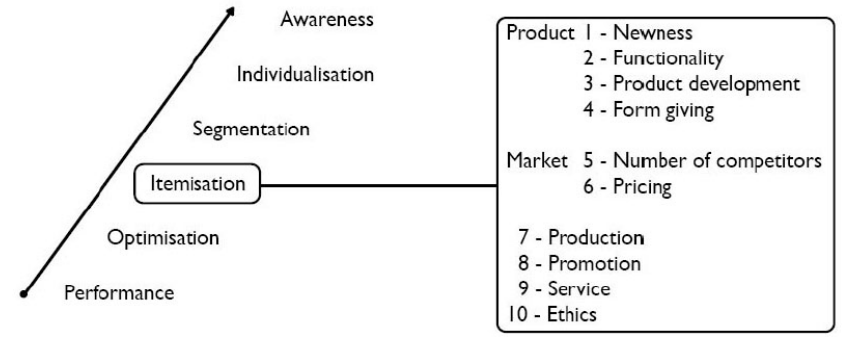


Figure 37: Eger's model that concerns Evolutionary Product Development (Eger, 2007)

5.2.2.5 Transition of society

According to Rotmans (2017), the deep transitions of today herald 'a change of era'. Similar to scholars such as Toffler (1990), Von Hippel (2005), Prahalad and Ramaswamy (2004), Press (2007), Leadbeater (2004), Troxler (2011b), Anderson (2012) and others, Rotmans foresees a transformation of today's power relations in education, healthcare, energy and finance. Since today's society prioritizes the system over people, he says, people have started to create their own solutions: a bottom-up movement that is essential for the transition towards a society and economy better attuned to people's lives (Rotmans, 2017). Rotmans concludes that society needs to take better care of the environment, simply by thinking more locally, decentralized and less hierarchical: (again) bottom-up rather than top-down (Rotmans, 2012). His view underpins the need for an existentialist approach to sustainability, a transition that goes beyond reduce, reuse or recycle.

Similarly, Maria Tengö, researching cultural ecosystem services and indigenous knowledge, states that today's societal model is untenable. According to Brugh (2023), we need to change our world view of disconnection between people and nature.

5.2.2.6 Post-industrial design

Although fourty years old, the definition of post-industrial society, as predicted by Bell (1976), is mostly related to the economics of information, as opposed to the (industrial) economics of goods. Additionally, post-industrial society was to include, for example, a change from goods to services and the growth of a knowledge class. Science was predicted to be the basis for innovation and of technological and social change. Resonating with some of today's progressive ideas and aims, Hall (1977) referred to a gradual transition into what he called 'good currency', which included: (1) Resource conservation, (2) Free tool use rather than machine use: appropriate and cheaper, (3) Autonomy for the human being, quality, individual values and (4) Social and economic life reorganized in small-scale units. According to Cross (1981), these elements would result in minimized movement of people and goods, a small and self-sufficient society, production in small units, reduced alienation and more autonomous behaviour.

Cross refers to Robertson (1983), an influential British politician, who suggested a new concept embodying a shift from the 'hyperexpansionist' (HE) vision of future society to a 'sane, humane, ecological' (SHE) vision, as is explained in Table 3. Translating these elements of post-industrial society into the field of design, considering that design also changes from industrial to a post-industrial character, results in a 'new paradigm for design' says (Cross, 1981). He mentions a reorientation of values, beliefs and designers' attitudes, but also of the design goals, the design of products and accompanying design methods.

The differences between traditional industrial design and post-industrial design, as described by Cross (1981), are listed below in Table 4. In brief, some of the changes mentioned concern: (1) from replaceable to repairable products, (2) from an autocratic to a democratic design process and (3) from professional to collaborative designers. Remarkable and worrisome is the fact that the call for these changes from some decades ago is still relevant and urgent in today's industrially-constructed manufacturing and consumption society.

From	To
· Economic growth	· Human growth
· Polarization of sex roles in society	· New balance between sexes
· Increasing emphasis on rationality and the 'left side' of the brain	· Increasing emphasis on rationality and the 'right side' of the brain
· Increasing specialization	· Increasing self-sufficiency
· Increasing dependence on big organizations and professional know-how	· Increasing self-reliance
· Increasing urbanisation	· A more dispersed pattern of habitation
· Increasing centralization	· More decentralization of power
· Increasing dependence on polluting technologies that waste reources and dominate people who work with them	· Increasing emphasis on technologies appropriate to environment, the availability of resources, and the needs of people
· An industrial concept of work as jobs provided and defined by employers	· A post-industrial concept of work as self-defined, self-fulfilling, socially useful occupation

Table 3: Robertson's proposed shift from hyper-expansion to sane, humane and ecological future (Cross, 1981)

Table 4: Comparing industrial and post-industrial design (Cross, 1981)

Contrasting features of industrial design and post-industrial design	
Industrial design	**Post-industrial design**
Products are:	***Products are:***
Specialized	Generalized
Single-purpose	Multi-purpose
Short-lived	Long-lived
Replaceable	Repairable
Mass-produced	Short-run
Standardized	Customized
Optimum	Satusfactory
Process is:	***Process is:***
Autocratic	Democratic
Exclusice	Inclusive
Rigid	Relaxed
Designer are:	***Designer are:***
Creative	Collaborative
Individual	Anonymous
Professional	Participatory

5.2.2.7 De-growth

A relatively recent - and closely related to the above – economic view concerns 'de-growth'. De-growth thinking has recently gained interest as a result of worrisome environmental degradation and climate change as a result of that.

Jason Hickel, one of the pioneers of the degrowth movement, has been criticizing the 'myth of green growth' for years, advocating for *less* economic growth and a targeted reduction of harmful sectors. In Hickel's words, degrowth is 'a planned reduction of energy and resource consumption, to bring the economy back into balance with the living world, in such a way that inequality is reduced and human well-being increases' (Noort, 2024).

Van Beek (Verweij & Van der Wielen, 2023) indicates that different organizations tend to take opposite (politically motivated) positions and perspectives when it concerns the search for solutions to today's environmental problems. She states that common climate policy is often based on politically driven climate models (van Beek, 2023), as was discussed in section 4.1. (1) So-called 'Green Growth', representing a rather conservative point of view, means fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies (OECD, 2023). (2) An opposite viewpoint concerns the notion that today's environmental crisis can only be solved by 'downscaling production and consumption, which increases human well-being and enhances ecological conditions and equity on the planet' (degrowth.org, 2023).

Organisations such as Research & Degrowth (degrowth.org) are examples of non-governmental organisations that attempt to share their view on how to approach sustainability alternatively.

People do not need economic growth to increase their well-being in the Netherlands, Triodos Bank chief economist Stegeman states (Noort & Brink, 2023). Whereas Stegeman takes a progressive position, his opponent emeritus professor Hoogduin, in the same article, considers the concept of de-growth to go against traditional 'economic thinking'. He considers de-growth to be dangerous and a potential form of 'eco-Marxism' or 'eco-socialism' (Noort & Brink, 2023). As a representative of traditional economic thinking, and therefore anti-de-growth thinking, Hoogduin says he does not believe in the ecological disaster scenario that is taking place.

This debate exemplifies the political and polarized way in which ecological and industrial problems are seen and approached. Referring to Maria Tengö, interviewed by Brugh (2023), people first need to look critically at their own assumptions and realize how deep-rooted they are, in order to solve the sustainability problems at hand.

n.b. This thesis does not take any political position. It does address the negative consequences of certain societal choices in the past though (see Section 2), and it seeks to learn from that past. Simultaneously, this thesis addresses sustainability as an existential phenomenon and utilizes Ehrenfeld's all-encompassing sustainability definition that considers human, ethics and nature (see section 4.1).

5.2.2.8 Post-capitalism

Mason names the longer-term mismatch between 'market systems' and an 'economy based on information', as the cause of the near end of the neoliberal economic model. He anticipates individuals pursuing their own self-interest (Mason, 2015). He states that today's technological advancements mean that capitalism (see Section 3.3.1) can no longer adapt to changes the way it normally did, resulting in a situation in which post-capitalism becomes necessary (Mason, 2015).

The digital revolution has the potential to reshape the idea of work, production and value; and to put an end to today's market economy based on private ownership (capitalism) (Mason, 2015). Representative phenomena of a post-capitalist society are, for example, parallel currencies, co-operatives, self-managed online spaces, platforms such as Wikipedia, etc.

5.2.2.9 Economic democracy

Economic democracy envisions that modern economic relations subordinate the general well-being to growth and profit, denying democratic input. Similar to post-capitalism, as a critical philosophy, economic democracy proposes a shift of power from shareholders and corporate managers to employees, customers, suppliers and a broader group of parties involved (Mason, 2015; Semler, 2015). As important elements of economic democracy, Schweickart (2016) names three defining institutions: '(1) a market for goods and services, (2) workplace democracy, which replaces the capitalist institution of wage labor, and (3) democratic control of investment, which replaces the capital markets' (Schweickart, 2014, p. 11). In an economic democracy , workers would become owners, rather than working for a wage (Schweickart, 2016).

5.2.2.10 Purpose economy

Hurst (2016) defines the 'purpose economy' as the 5th Economy, following the 1st (hunters and gatherers), the 2nd (agriculture), the 3rd (industrial) and the 4th (information/knowledge). The 5th Economy refers to 'purpose' as the driver of economic output; he mentions relationships, sharing, making, doing something greater than yourself, personal growth and experience. It emphasizes community, localized economy and, for example, back to the neighbourhood. He deduces that, in contrast to the industrial and information economy, in which work is detached from humanity, the purpose economy heralds a synergy of people's work and their spiritual beliefs. He envisions that people will be makers, not consumers, referring to an increasing interest in local produce and online sharing communities (such as Etsy). Aligned with the theory and observations concerning the purpose economy, Pink's (2009) three elements of motivation help describe what matters to people. According to Pink, the three elements that motivate people are (1) autonomy (the urge to direct our own lives), (2) mastery (the desire to get better at something that matters) and (3) purpose (the urge to do what helps us to achieve something larger than ourselves).

5.2.2.11 The family business as a role-model

Similar to growing one's own crops, referred to in Section 5.3, which is associated with better care as a result of increased awareness, involvement and responsibility, and requires anticipating future harvest, a balanced relationship with nature, family businesses have proven to have a more sustainable character compared to shareholder companies, since they tend to prepare better for future resilience. The reasoning behind this is that family businesses mostly hold business values and strategies that support savings and investing in the company, whereas shareholder companies might spend profits on disbursing bonuses. Recent years have shown that many firms do not have enough buffer. Family businesses, as a reference, tend to run a longer-term policy, do not immediately fire employees in times of crisis, practice anticyclical thinking and maintain their DNA, which helps to maintain a healthy organization and business model (Rabobank, 2021). This case is actually a plea for running a company in a personal and sensible way, taking care of personnel, and anticipating the future.

5.3 The Human Factor (the Sociosphere)

5.3.1 Self-sufficiency

After having introduced the so-called Infosphere and Technosphere in section 5.1, this section concerns the Sociosphere. In relation to the main research question of 'How to establish/re-establish a sustainable relationship between people and products?', this section concerns people's behaviour regarding their *human needs*, as described by, for example, Max-Neef (Max-Neef, 1992) and Maslow (Maslow, 1998), in section 4.2.1.

As referred to in Secties 3 and 4.2.1, the nature of people is an important factor; it concerns people's needs, wishes, desires and motivation - the so-called *'Human Being'* . People continuously search for autonomy, freedom, participation, understanding, creation, identity, etc. (Maslow, 1943; Max-Neef, 1992) which in turn serves as a permanent principle within a changing context. Max-Neef's and Maslow's elements of *'Human Being'* accurately serve as a fundament for future directions.

Autonomy, or self-sufficiency, is one of those needs. To be self-sufficient means 'self-sup-

portive': being able to feed and supply yourself, your organization, community or country. The concept of self-sufficiency has, in the context of today's globalizing policies and industrialization in general, lost much of the attention it used to get and probably deserves. Self-sufficiency refers to a state of independence: a state in which a person or organization can act and live autonomously (Kains, 1973). In the case of an autonomous or self-sufficient economy, one speaks of an autarky. Note that these definitions are closely related to making autonomous decisions, not depending on the decisions taken by someone else or by a foreign entity: in short 'sovereignty'. Note also that the issues discussed here all relate to the aspect of democracy (see Section 4.2.2.3): being accurately represented and having a say about the consequences of the actions for which one is responsible.

People's awareness of the virtues of self-sufficiency is growing, as can be concluded from phenomena such as the below-described cooperations (Section 5.4.3.2) and collaborative production (Section 5.4.3.1), and from the tendency of people increasingly buying their food directly from the farmer (for example, local farmer delivery and farm-shops), instead of the supermarket (Dekker, 2020). Taylor (2013) describes: 'Self-sufficiency is the quality of feeling secure and content with oneself, a deep-rooted sense of inner completeness and stability. On a superficial level, it's similar to secure self-esteem, it's an estimation of oneself as a worthy and decent person. But it goes deeper than secure self-esteem, in that it's not just a cognitive but also an affective state, that is, it's a feeling of fundamental wholeness and well-being.'

5.3.2 Human creativity

As discussed in Section 2.3, the human-product relationship can be positively affected by the energy and creativity that people invest in the product. This section concerns the fact that creativity forms an important characteristic of people and that people's creativity is mostly left unused in an industrialized context.

Creativity is what makes people different from their ancestors (Csikszentmihalyi, 1998; Ehrenfeld, 2008; Sennett, 2008); people experience a more intense life when they're involved in a creative process. People also generally want to express their creativity (Atkinson, 2006) and have the need for control over their actions and environment (Rompay, Galetzka, Pruyn et al., 2008; Thompson & Schlehofer, 2008).

According to Sanders, 'only being a consumer no longer appeases people: everyday people are no longer satisfied with simply being "consumers." They want to be "creators" as well' (Sanders, 2006b, p. 4). 'People need not only to obtain things, they need, above all, the freedom to make things among which they can live, to give shape to them according to their own tastes, and to put them to use in caring for and about others' (Illich, 1973, p. 20).

History seems to validate that people have an innate urge to be creative (Csikszentmihalyi, 1998; Ehrenfeld, 2008; Maslow, 1943; Sennett, 2008) and to be a prosumer (Friedmann, 1961; Huppes, 1985) rather than a passive consumer (Press, 2007). Regan (2006) suggests that 'creative activity or creative occupation is an innate need for human homeostasis and self-actualisation'. Section 7.5.4.1 considers the levels of creativity as they are defined by different scholars.

5.4 Changes within the various spheres; Toffler's Third Wave

Opportunities to re-invent Sector A

The notions and models of Section 5.2 all helped to deduce changes and opportunities for solving the problems at hand (Section 4.3.1). They indicate a shift from old economic thinking to new models and thinking. Changes concern matters of scale, purpose, sustainability, democracy, involvement, locality, etc. They occur in the various so-called spheres.

Section 5.4.1 concerns the changes in the landscape of information, referred to by Toffler as changes in the Infosphere (Toffler, 1990). Technological changes and developments, introducing the (post-industrial) Third Wave, he called changes in the Technosphere (see Section 5.4.2).

5.4.1 Changes in the Infosphere: availability of ('how-to') information

5.4.1.1 Introduction

As was pointed out above, one of the most important influences that acts on the user-supplier relationship is the increasing level of information technology. Since the start of this century, new steps in the emergence of information technology have changed the old user-supplier conventions. People's sharing behaviour has created a large repository of knowledge and information on the internet, available through company sites, community- and comparison platforms, forums, and the like. That means that information in general, and 'how-to' information in particular, is retrievable anywhere.

A culture has been established in which people are very willing to share thoughts and information with anyone, to share inventive and creative solutions, for reasons of social connectedness, reciprocity, personal display and to exhibit one's identity and achievements (Duman, 2020). The culture of information sharing, along with the technological facilitation of it, has decreased the gap size of information availability among people in general. Consumers' awareness of alternative solutions and products, such as quality, price, brand, spare parts, repair manuals, background information and availability, has the potential to grow. A critical note would be valid though: a new phenomenon called 'information literacy' introduces a new distinction between people who are informed (who know where to find the information they require) and those who are not. This Section 5.4.1 concerns the so-called Infosphere.

5.4.1.2 Communities of hobbyists

Similar to traditional groups of like-minded people with a certain interest or hobby, the current opportunities of communication allow for even more of these specialist community groups to grow among people who share interests. Both (a) the abundant amount of information through new media and platforms and (b) the inter-human connection that is established and supported through the internet and the use of smartphones in general, effectuate the existence and perseverance of multiple communities of like-minded individuals. This phenomenon has established and supported communities of concentrated knowledge and expertise through platforms and fora.

Communities of model train builders and miniature painting hobbyists (Figure 38) form

Figure 38: Miniature painting (StockCake, public domain)

suitable examples of groups of people who design, assemble and finish their personally customized items to their specific demands, using e.g. new technologies for making and new sources of information.

5.4.1.3 A direct relationship between people and offer

In many branches of our economy, agents and intermediaries have positioned themselves between the searching consumer and the supplier. *Thuisbezorgd, Uber, TripAdvisor, Deliveroo, Yelp, Foursquare,* and *The Fork* are examples of modern intermediaries that technically have a similar position as retailers as Albert Heyn: they have the power to control both the supplying party and what is offered to the consumer. The influence and power of the consumer tend to decrease because the intermediary will prioritize products with the highest profits and products for the majority and promote sales of specific items through marketing. In addition, consumers in such cases lose insight into where things come from and how things are made: that a pizza was made in an oven, that fish come from the sea, and that meat comes from animals.

However, a democratizing shift seems to have taken place, as a consequence of the increased availability of information. People search for and find their required, for example, medical information themselves before they consult a doctor (Giesen, 2009). Obviously, this internet information cannot replace the doctor, but it helps people inform themselves prior to their visit. Multiple direct services have emerged, organized by, for example, small-scale farmer cooperations that offer and deliver food packages to consumer's homes. Examples

in the Netherlands are '*Ambachtdelft*' or '*Kistje vol Smaak*'. The COVID-19 pandemic has signified even more the need for a better and closer connection between the farmer and the consumer: Dutch farm shops (*boerderijwinkels* or *landwinkels*, in Dutch) saw their income rise by 15 to 40 % (Van Olst & Scholten, 2020). Another example was indicated by an asparagus farmer, who, during the COVID-19 pandemic, chose to sell his crops directly to the consumer (Van Olst & Scholten, 2020). People choose to subscribe to such services out of care for their health, since small-scale crops (locally grown produce) are grown without pesticides and with care for nature.

5.4.1.4 The promise of the platform economy

The infrastructure that helped the emergence of the collaborative economy is largely based on technological developments, i.e. information, access, applications, tools and kits. The key element for many of the numerous so-called collaborative initiatives is the new kind of intermediary, often an algorithm that very efficiently brings together offer and demand. Examples are Airbnb, Uber, Shapeways, Zazzle, vliegtickets.nl, etc. What these platforms do is replace the human intermediary, which often includes 'inefficient' processes, with an algorithm that does the job of connecting people to services.

Seen from one point of view, these platforms seem to close the gap between offer and demand and make it easier and more accessible to find what one wants, even at times surpassing or replacing the traditional economy. Platforms can now efficiently offer their product on an on-demand basis, which seems to validate the democratic effect of removing the traditional companies or institutions as intermediaries.

But these platforms are not just passive phenomena. The digital mediation makes the interaction less personal, which could lead to indifference or worse service, and in any case to less chance of personal feedback and less involvement. It is therefore important to distinguish practices of (1) true democratization and (2) an increase of efficiency. Some negative effects of the shift to online platforms, including digital agencies such as Booking.com, Thuisbezorgd, Uber, TripAdvisor, etc., are clear as well. Some platforms (such as Uber) pursue a monopoly position, some platforms operate through charging lower than market prices and maintaining poor positions of contracted employees. These appear to be 'old-economy' issues, which indicates the persistence of traditional economic thinking (see also Section 7.3.1). The power of such a platform can mean the making or breaking of a restaurant or brand; suppliers may increasingly depend on their visibility and presence through specific platforms (Botsman & Rogers, 2010).

5.4.1.5 Instructions and social media

As was briefly referred to in Section 5.2.2.7 and Section 5.2.2.9, digitization has had a considerable impact on the infosphere. A shift has taken place towards viewing videos more and more, through platforms such as YouTube, Instagram and TikTok. Statistics for 2023 show that people, on average, are watching 17 hours of online videos per week and that they are 52% more likely to share video content through these platforms than any other type of content (Bump, 2023). The same goes for DIY instructions. Almost any type of instructional (or tutorial ~) video is retrievable online: from slipping plants to changing a car tyre or designing your own house or shoes (Youtube, 2023). Figure 39 shows an example project.

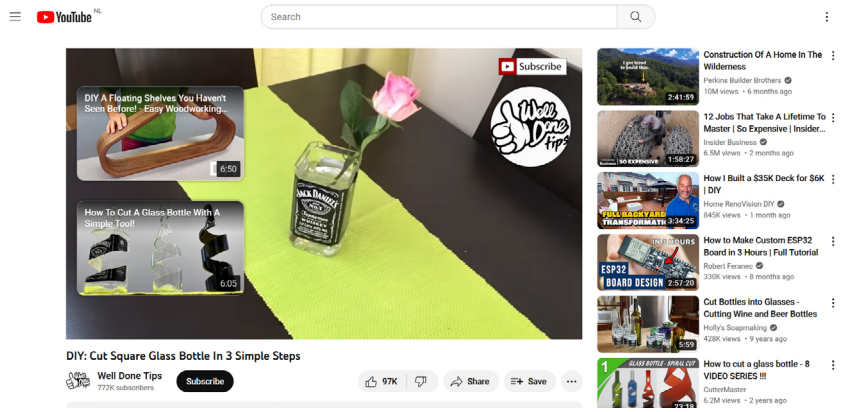


Figure 39: How to cut a glass bottle in 3 simple steps, on Youtube (https://www.youtube.com/watch?v=obZvrg-92M4M)

Instructables

Examples of community platforms that support and connect DIY enthusiasts, for example through videos, kits and instructional descriptions, include *Instructables* (Figure 40), *Ravelry* (knitting), *Adafruit* (electronics and kits), *Lettucecraft* (art, fashion, craft), *Dorkbot* (grassroots meetings, electronic art) and *Etsy* (from crafted jewellery to clothing). *Instructables.com* is a well-known example, it has its roots in the *MIT Media Lab (Squid Labs)*. Projects range from *Arduino* projects to remaking a legging into a bikini, cooking, 3D printing, furniture design, etc. The platform now offers about 100,000 projects, which indicates its purpose of sharing DIY projects.

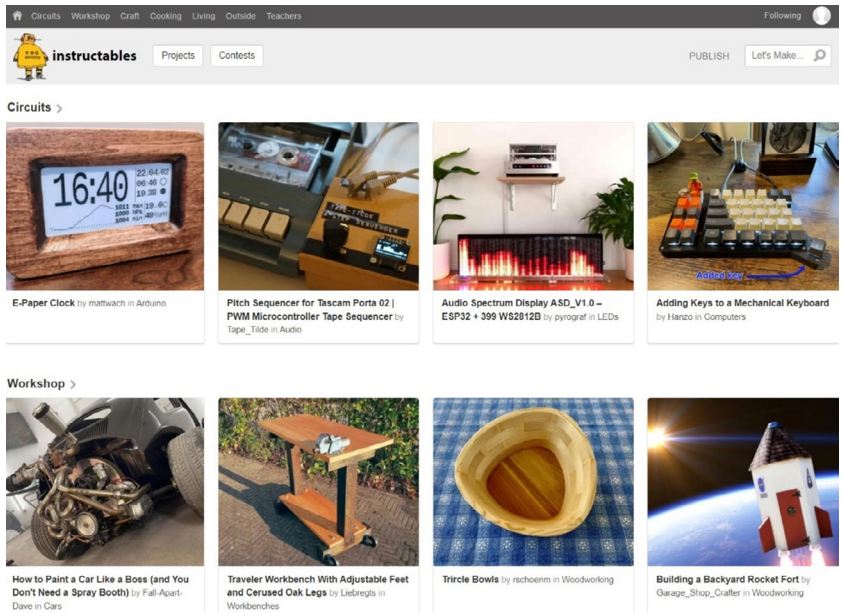


Figure 40: Website of Instructables

5.4.2 Changes and developments in the Technosphere: availability of tools for manufacture

5.4.2.1 Introduction

Considering this thesis' main research question of 'How to establish/ re-establish a sustainable relationship between people and products?', this section discusses the recently increased availability of tools for small-scale fabrication as a result of technological advancements. These small-scale fabrication tools have in their turn facilitated the potentially wider and easier accessibility and use by laypersons, hence promising a closer relationship between people's activities of making and consuming.

The broader availability of tools and other means for design and production is a noteworthy development in terms of potential democratization. Additive and abrasive techniques, or rapid manufacturing techniques (such as 3D printing, laser cutting, etc.), have changed the field of industrial design; these digital manufacturing techniques offer 'scale-free' solutions, which refers to digital tools for manufacture that do not require specific and costly moulds or the investment typically required for large-scale production (as injection moulding) (Anderson, 2010). Parallel to this, digitization has made assembly much more flexible, enabling many kinds of lean, agile and customizing strategies for production. This has also paved the way for layperson and hobbyist design activities. According to Anderson (2011, p. 91), 'makers can design and manufacture just about anything, from a wearable lightshow to custom bike components'. These developments take place in the so-called Technosphere.

Troxler (2011b, p. 86) refers to the 'Libraries of the peer production era', helping to distinguish the various practices that emerged from the rise of digital making, shown in Figure 41.

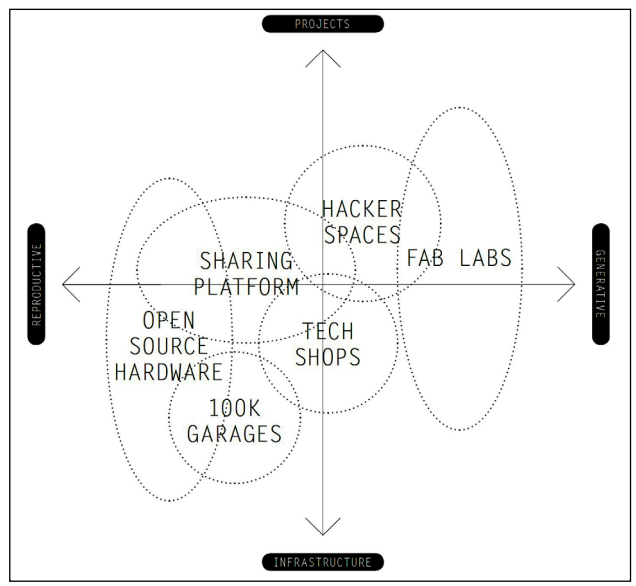


Figure 41: 'Libraries of the peer production era' (Troxler 2011)

5.4.2.2 Mass customization

The term 'mass customization' was first coined and described by Joe Pine in his similarly named book (Pine & Davis, 1999). Mass customization combines the opposite concepts of (1) manufacturing for a mass audience and (2) customization, which refers to optional adjustments. Piller's definition of mass customization is 'the production of custom items, produced with mass production efficiency' (Piller, 2011; Piller, 2004). Over the past 15 years, the term has gained a lot of attention, since it represents a complex though highly flexible (concerning the outcome) manufacturing and/or assembly process (see Figure 42).

Pine and Gilmore (1997, p. 91) state: 'Mass customization has been adopted by many companies to avoid the unnecessary costs of catering to each and every customer want.' They name the basic approaches of mass customization, either used separately or in combination: (1) 'Collaborative', referring to the communication (dialogue) between the company and its customers, (2) 'Adaptive', referring to the design of one standard that is to be adjusted (altered) by the customer; (3) 'Cosmetic', which refers to a variation in presentation of one standard, according to the type of customer and (4) 'Transparent', referring to different products made for different customers. This definition accurately clarifies how mass customization can – as a phenomenon – be approached from two opposite viewpoints: (1) from the perspective of the firm, the producing company - a technology-driven, flexible and lean approach for production and assembly and (2) from the customer (end user) point of view, providing lots of choices and design opportunities within certain boundaries.

Procedures of mass customization are used in the automotive industry and, for

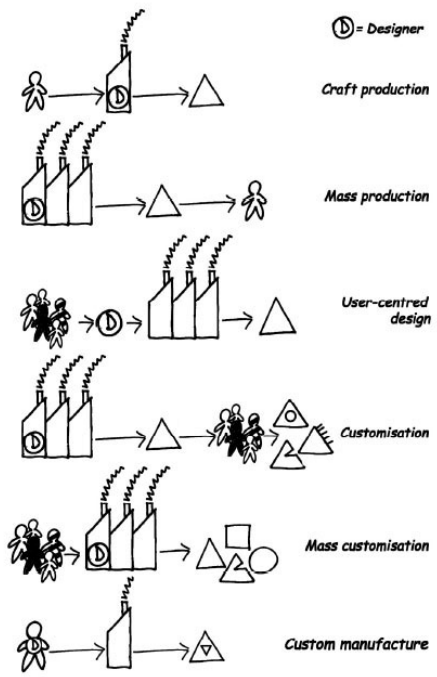


Figure 42: Evolution of product manufacture (Weightman & McDonagh, 2003)

example, in the production of jeans. 'Mass customization allows the customer to specify their individual requirements from a comprehensive list of options', is how Weightman (2003, p. 36) describes it. In these examples, the car or garment is 'built to order' before delivery. Other examples of mass customization can be found in books (lulu.com), clothes, shoes (NikeID, Zazzle, see Figure 48), etc. Many of these can be found in Piller's database called '*Configurator Database*' (Piller, 2024), see Figure 43, Figure 44 and Figure 45. An important aspect of mass customization is the modularity of components. In one way or another, product parts or options are to be fixed onto each other, connected, or mixed in such a way that combining and customizing can be done efficiently and accurately. See Figure 46. Boradkar (2010) positions mass-'customerization' (designed by the consumer, made by the corporation) in the top left corner of his manufacture-design matrix: designed by the consumer and manufactured by the corporation (Figure 47).

Whereas DIY, in this thesis, represents the ultimate and free activity of both design and making, mass-customization represents the most near-to-DIY but

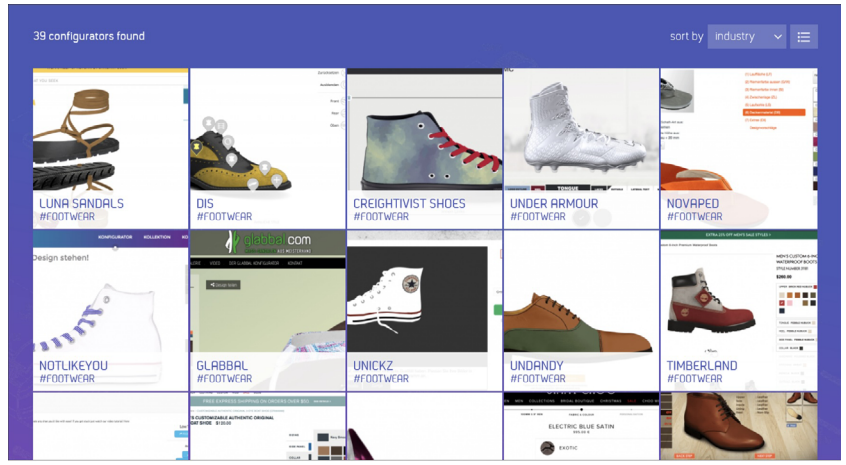


Figure 43: Configurator-database.com

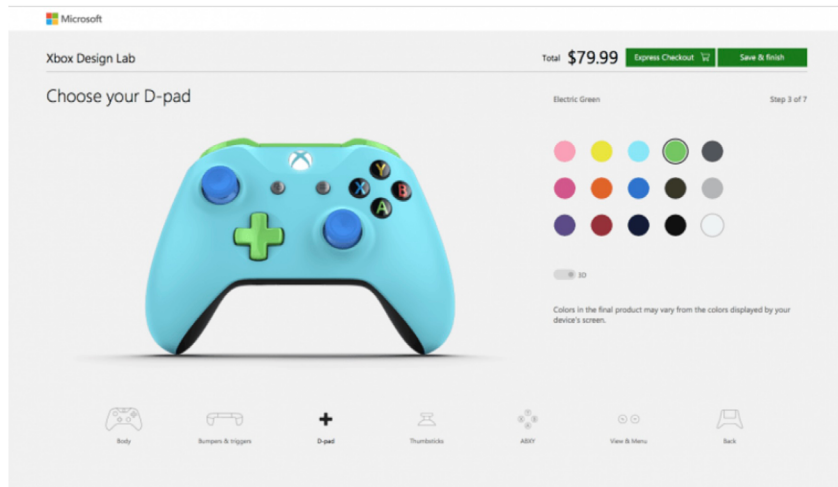


Figure 44: An example of a mass customization configurator (from Microsoft Xbox) found at Configurator-database.com (2024)

still commercially viable business model for producing goods. It combines the efficiency of mass production with individual choices people can make concerning the assembly or personalization in the conceiving of the product. The concept of mass-customization was described in Section 5.4.2.2.

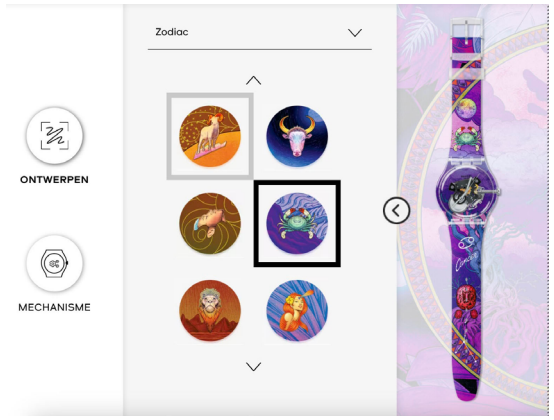


Figure 45: Mass customization example with the help of configurator by Swatch (Piller, 2024)

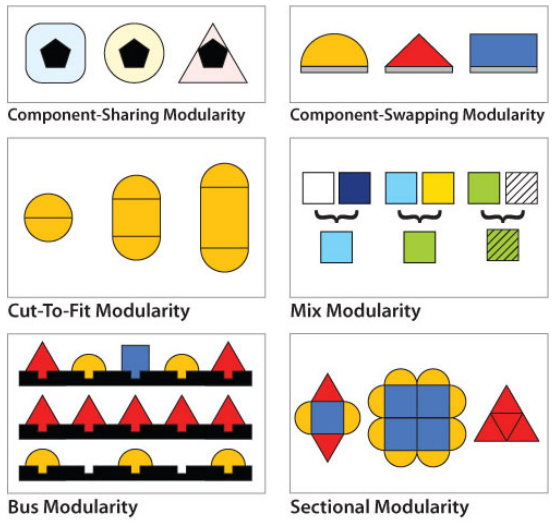


Figure 46: Six types of mass customization, according to Pine and Gilmore (1999)

The mass customization example case of Zazzle

The online platform of Zazzle (Figure 48) functions as an intermediary between the manufacturer (of custom printed items) and the end-user who has the opportunity to design the – to be printed - graphics him or herself or pick from a large range. Smart logistics that combine design (online, by the end-user), printing, assembly and manufacture make this possible within a reasonable timespan: it is called mass customization. As the example of Zazzle shows, mass customization of printed items can be done relatively easily. The innovation is in the platform. There are a lot of these platforms like Zazzle, such as Spreadshirt.com, Cafepress.com and many more. Interestingly, through time, these kinds of platforms tend to show and offer an increasing level of complexity.

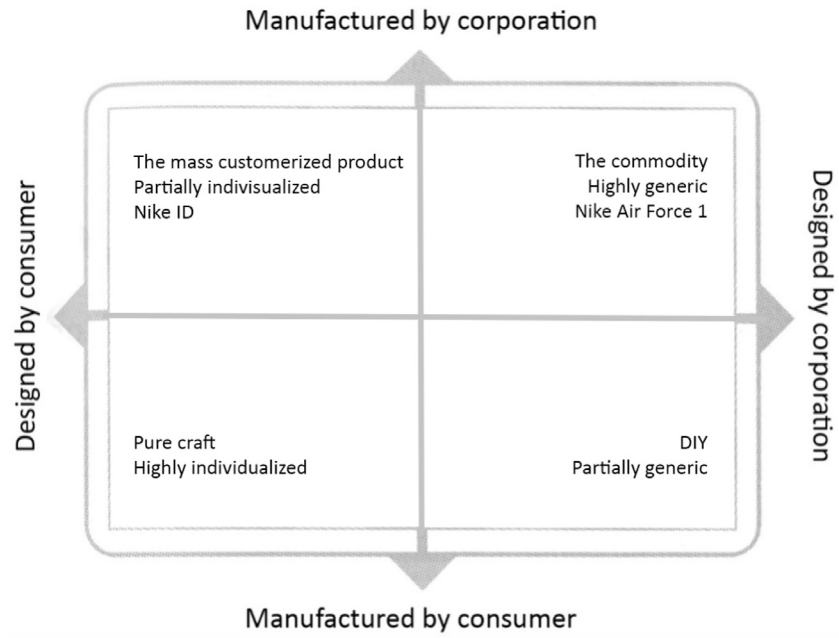


Figure 47: mass customerization, pure craft, commodities and DIY (Boradkar, 2010)

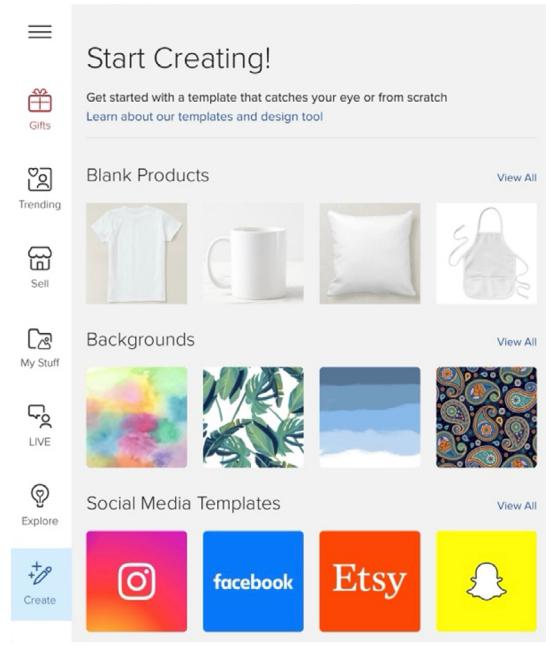


Figure 48: Zazzle

5.4.2.3 Additive and abrasive techniques

Rapid prototyping, rapid manufacturing, solid freeform fabrication, or additive/abrasive fabrication are all names for digital fabrication techniques that offer the possibility to make 'scale-free' single pieces (one-offs) of unique designs, the opposite of the traditional mass manufacturing machines such as injection

moulding.

'Consumer' 3D printing

Technological developments also allow people to have their own 3D printer at home for printing their own 3D computer shaped items: housing parts, missing pieces of domestic devices or aesthetic vases. *RepRap, Ultimaker* (Figure 49), Makerbot and Formlabs are examples of other commercially available 3D printers. Ultimaker (among many others) develops and sells 3D printers that are affordable for people to use at home.

Figure 49: Ultimaker 2

5.4.2.4 Digital and physical platforms for making

Maker spaces (and the re-appreciation of crafts and offline making)

As mentioned, today's digital technologies connect people from all over the world and bring production closer to consumption (Salvia et al., 2016; Fox, 2013; Fox, 2014; Bonvoisin et al., 2017; Anderson, 2012), supporting social relationships and collaboration. At the same time, as introduced in Section 5.1, communities aim for so-called de-growth, down-shifting and voluntary simplicity, which means integrating technological efficiency with sufficiency-driven lifestyles (Cooper, 2005; Salvia & Cooper, 2016; Tukker et al., 2010), aligned to the growing interest in making in general on the part of lay 'do-it-yourselfers' (Anderson, 2012; Comm, 2017; Hatch, 2013; Johansson, 2016; Peach, 2013). Concurrent with the growing availability of digital tools is the re-emergence of the value attributed to handmade and one-off items and to the related production activities and artisanship.

The presence of tangible and virtual places for creative activities such as maker spaces, supports the emergence of creative communities that develop innovative solutions for new ways of living (Manzini, 2006; Hector and Botero, 2022).

Well-known examples of such platforms are *Fablab, Ponoko, Shapeways, Instructables,* and *iFixit,* which offer DIY projects and communities (Wong and Lesmono, 2013; Wirth and Thiesse, 2016). The U.S.A. based '*DIY Network*' (now: *Magnolia Network*) broadcasts DIY projects such as '*Maine Cabin Masters', 'Barnwood Builders', 'Restoring Galveston', 'Bargain Mansions',* and posts lots of different YouTube movies concerning DIY projects.

The Maker Movement

Atkinson (2017) defines the Maker Movement by referring to an attitude of independence, linked to people's concerns about the increasing dominance of digital technologies. So-called Maker Spaces, such as fab labs (fabrication laboratories), provide access to shared facilities to people for small-scale making and production (3D CAD software, CAM equipment, 3D printers and laser cutters).

The emergence of DIY magazines such as *Readymade* (since 2002) and *Make Magazine* (since 2005) indicate the Maker Movement's growth at the beginning of this century (Atkinson, 2017). Dougherty, the founder of *Make Magazine*, notes that the magazine 'harkens back' to the *Popular Mechanics* DIY magazine (founded in 1902, most popular mid-twentieth century) (Dougherty, 2012). To describe the Maker Movement, Dougherty (2012, p. 11) states: 'We all are makers: as cooks preparing food for our families, as gardeners, as knitters.' And 'tinkering used to be a basic skill, and you could get a little bit more out of life than the average person if you had good tinkering skills—if you could fix your own car, for example, or improve your home or make your own clothes.' He writes that the emergence of the Maker Movement is a result of people's need to 'engage passionately with objects in ways that make them more than just consumers'.

One could regard the Maker Movement as a modern continuation of earlier Do-It-Yourself periods (Anderson, 2012; Dougherty, 2012) and even of communities from the past that criticised industrialism, such as the Luddites of the nineteenth century and the Arts and Crafts movement (von Platen & Kitani, 2023) (also see Section 3.7).

3D CAD for dummies

Professional engineering agencies, designers and architects have been using 3D CAD systems since the 1980s. 3D CAD has always exclusively been a professional's task, until the last couple of years. Today, easy-to-use computer modelling software is available to anyone. Google SketchUp and 123D are examples of freely downloadable CAD software. In many cases, 3D software has become a freely downloadable application, meant to enable and encourage users to design their own thing and to take the next steps in their service programme: having the modelled item made by a single-piece manufacturer. This shift has created a great potential for laypersons to establish their own designs and outcomes.

The case of Fablab

The Fablab rapid prototyping platform is a worldwide network that provides workshop studios with various computer-controlled manufacturing tools and machines at each of its locations, enabling individuals to design, make and exchange designs, prototypes, and models. The tools involved include laser cutters, computer-controlled milling machines, 3D printers, 3D scanning, large-format and precision machining, computer-controlled lasers and knives,

surface-mount electronics production, embedded programming and computing tools for design and collaboration. An indication of Fablab's relevance is the fact that Fablab makes it possible to locally fabricate products that are normally mass-produced, such as consumer electronics and furniture. Fablab has expanded into a global network of about 1,750 labs in over 100 countries (Figure 50).

Founder Gershenfeld's ambition is to empower local invention, engineering education and entrepreneurship by providing the environment, skills, materials, and technology to create and share things and knowledge anywhere in the world, on a local basis. Fablabs were established to inspire people (entrepreneurs, students, artists, small businesses) to design and make prototypes by providing access to digital manufacturing technology (Gershenfeld, 2012). Schelhowe (Walter-Herrmann & Büching, 2014) identifies five factors in Fablabs: (1) combining physical activity and abstract thinking, (2) providing a workshop environment that displays how things are made, (3) the availability of numerous tools and machines enables imagination, reinventing, refining, (4) it helps participants prepare for 'post-modern' society's conditions and (5) community learning and a participatory culture. Fablab supports the sharing of knowledge by its participants and collaborators; Fablab asks participating people to share their designs and plans to help the community and facilitate

Figure 50: Fablab at Aalto University and in Amsterdam (from their websites)

the accumulation of knowledge created by its users (Wolf, Troxler, Kocher et al., 2014).

Shapeways

Shapeways offers a higher level of output complexity: 3D printing, even 3D metal printing. The service allows product design input of a rather complex sort (Figure 51).

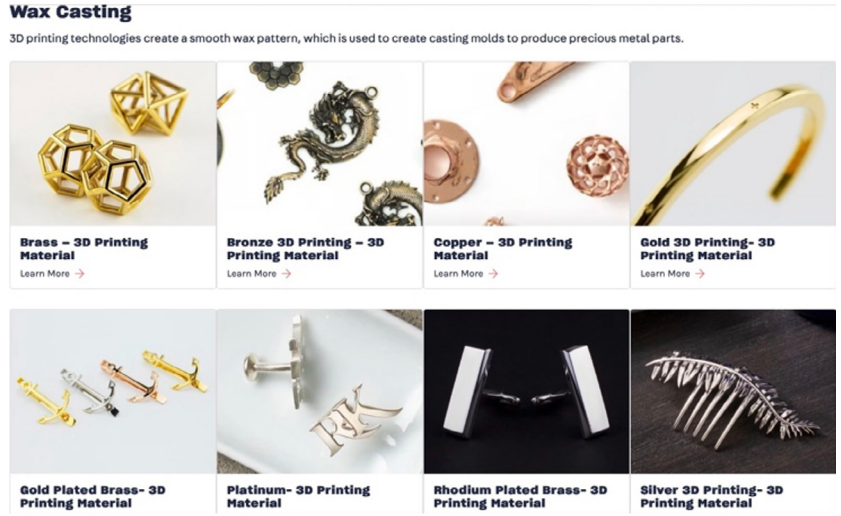


Figure 51: Shapeways platform for 3D printing

Materialise

Materialise offers software solutions and 3D printing to their clients in various fields: healthcare, automotive, aerospace, art and design, and consumer goods. Materialise's services include advanced medical 3D printing: patient-specific prostheses and orthoses. Their services ultimately exploit the 3D printing advantages of flexibility, speed and the option to design and make one-off unique physical prostheses, as shown in Figure 52.

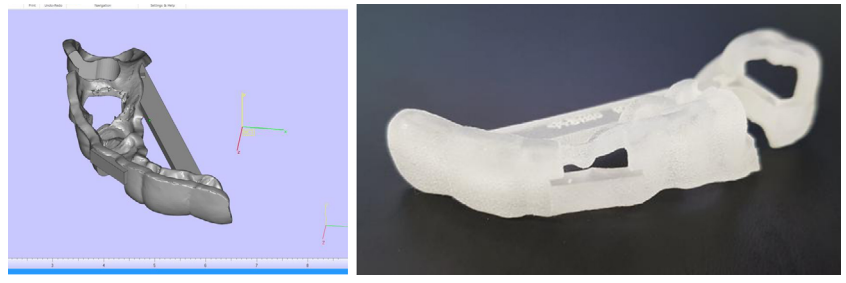


Figure 52: 3D printed OSSTEM dental implant products, by Materialise (materialise.com)

Etsy

https://www.etsy.com

Etsy is an example of both the virtues of online communication (and trade) and offline making. It forms an online global marketplace for handmade goods and vintage articles. A platform such as Etsy indicates the changes in the way people share and advertise their self-made DIY and/ or crafted objects, and in the way people trade, sell and buy those things (Figure 53). The platform links the craftsmen and women to a large, global audience.

Figure 53: Handcrafted article for sale at Etsy.com

5.4.2.5 Customizing after purchase

A specific kind of DIY activity is 'customizing after purchase', or simply 'customization', which is different from mass-customization. It concerns the customization of an item to one's own preferences: from minor changes to changes with a big impact. Customization after purchase has a strong cultural component. For example, as a subculture, specific cars get customized (tuned) by members of specific car clubs, who purchase and install specific modular features and components, provided by specific tuning suppliers, see Figure 54, Figure 55, and Figure 56, but there are many more similar clubs and communities.

A rather abstract and high-design example of 'customizing after purchase' is the Do-hit-chair designed by Marijn van der Poll (2000), for *Droog* (Figure 57). *Droog* adds: 'With the hammer provided and your own resources you shape the metal box into whatever you choose it to be. After a few minutes or hours of hard work you become the co-designer of Do hit.'

Figure 54: Customized Volvo 740, the kit advertised on Ebay as: Fender Flares for Volvo 740 240 Wagon Wide Body Kit wheel Arch 3.5" 90mm 4pcs

Figure 55: Body kits in Japan (Speedhunters.com)

5.4.2.6 Customer order decoupling point CODP; depth of involvement

The Do-hit-chair concept (Section 5.4.2.5) is an example of product customization by the end-user. More specifically, the end-user customizes after purchase. In some other customizing cases, such as Shapeways (Section 5.4.2.4), the point of end-user involvement (and purchase) is positioned prior to manufacturing. There are many variants.

Figure 56: Car tuning: VW Polo Club Hungary (https://www.facebook.com/VwPolo-ClubHungary/)

Figure 57: The Do-hit-chair by Poll (2000), for *Droog*

Traditionally, the term used to indicate the product development stage in which the customer is involved, is called the customer order decoupling point (CODP, or *klantontkoppelpunt*, in Dutch). In a business-to-business situation, it is defined as the latest point at which stock is being kept, or the point at which the process based on prognoses (speculation) is separated from the process of confirmed orders (customer-order-driven, or commitment) (Phipps, 2023) (Can, 2008).

Olhager (2003) defines the CODP (or order penetration point) as 'the point where the product is linked to a specific customer order in the manufacturing value chain'. Rudberg and Wikner (2004) define CODP as the point that

separates the decisions made under certainty from decisions made under uncertainty concerning customer demand. The different positions of the CODP specify different manufacturing situations, e.g. engineer to order, make to order, assemble to order and make to stock (see Figure 58). In a business-to-business situation, the position (and changing thereof) of the CODP is mostly strategically motivated. Moving the CODP downstream (forward, see Figure 58) results in a reduction of delivery lead time to customers and increases the manufacturing efficiency. Moving the CODP upstream (backward, see Figure 58), helps increasing the knowledge of customer orders before production, hence increases the certainty of the demand, and, for example, increases flexibility (Can, 2008; Olhager, 2003, 2012). Table 6 illustrates the effects of shifting the CODP forward respectively backward.

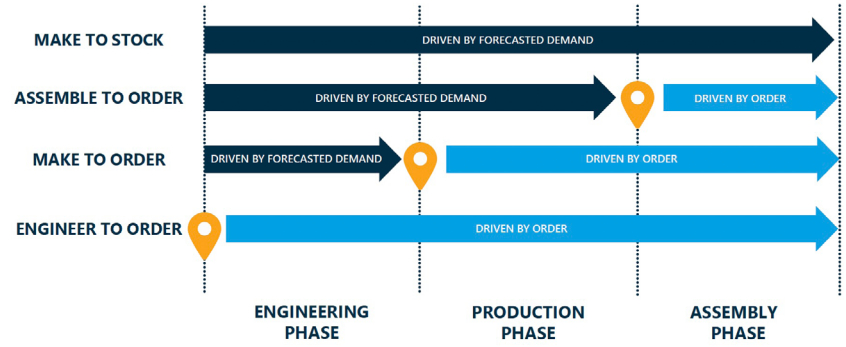


Figure 58: The CODP in different situations (Phipps, 2023)

From a customer perspective, hence, also from an end-user perspective, moving the CODP backward (see Figure 58) increases the process part that is driven by order, it allows more involvement by the customer. Table 6 illustrates this in the lower part: 'backward shifting' increases the degree of customization, and the risk of obsolescence of inventories is being reduced.

5.4.2.7 Postponement strategy

Van Hoek (2001, p. 161) defines postponement strategy as: 'delaying activities in the supply chain until customer orders are received with the intention of customizing products, as opposed to performing those activities in anticipation of future orders'. Postponement strategy is also known as delayed differentiation. Such a strategy helps to know and anticipate customer (and end-user) demands better before things are produced. Ultimately, both the manufacturer and the customer benefit from such a strategy: for the manufacturer it reduces stock and inventory, hence reduces the risk of obsolescence, while at the same time it provides better product-fit, flexibility and customization opportunities for the customer (Can, 2008).

Many authors have mentioned IKEA's self-assembly approach to offer consumer involvement in the process as a means to engage them more, to offer an additional experience. IKEA's approach provides, apart from the perception that

	Competitive advantage addressed	Reasons for forward shifting	Negative effects
Forward shifting	Delivery speed Delivery reliability Price	Reduce the customer lead time Process optimisation (improved manufacturing efficiency)	Rely more on forecasts (risk of obsolescence) Reduce product customisation (to maintain WIP and inventories levels) Increase work-in-process (due to more items being forecast-driven)
	Competitive advantage addressed	*Reasons for backward shifting*	*Negative effects*
Backward shifting	Product range Product mix flexibility Quality	Increasing the degree of product customisation Reduce the reliance on forecasts Reduce or eliminate WIP buffers Reduce the risk of obsolescence of inventories	Longer delivery lead times and reduced delivery reliability (if production lead times are not reduced) Reduced manufacturing efficiency (due to reduced possibilities to process optimisation)

Table 6: Positive and negative effects of shifting the COPD (Can, 2008; Olhager, 2003)

one saves money by taking care of assembly and transport oneself, the feeling of DIY achievement: being proud of the self-achieved result of one's efforts, which is called the 'IKEA effect' (Norton, Mochon, & Ariely, 2012). Technically, IKEA's model concerns 'assembly postponement': the product is sold before it is assembled (in this case by the customer).

A famous example of 'postponed manufacturing' concerns Benetton, the manufacturer of knitted garments. Whereas Benetton originally transformed and knitted coloured yarn to garment parts, they changed their manufacturing system: Benetton moved the dyeing process part downstream to postpone the dying process until after purchase. This new process helped them dye the knitted garments according to the consumer's wishes and avoid any risk of erroneous anticipation of consumer demand (unsold stock or sold-out garments in demand) (Lammers & van Amstel, 2009). Van Hoek gives an example that concerns the brand Mars: Mars postpones the design and production of their candy packaging in Christmas season, to be able to customize that packaging to the customer's wishes (Van Hoek, 2001). Such a strategy resonates with the 'form postponement' type of strategy described by Bowersox (1996, p. 274) that concerns '…delaying the determination of the form/function utility'.

5.4.3 Other democratizing developments in society

5.4.3.1 Introduction

This section discusses some additional examples of democratizing developments in relation to the factors referred to in Sections 5.3, 5.2 and 5.4.1. These examples form a relevant context to (1) the main research questions of this thesis: 'How to establish/ re-establish a sustainable relationship between people and products?' and (2) to the research sub-question of 'How should design anticipate?', both introduced in Section 1.7, by providing insights that concern a better relationship between people and their direct environment through local,

shared and collaborative approaches.

New forms of collaboration, power, labour and money are established (De Groot, De Graaf, Bloemen et al., 2016). These indicate a new way of thinking about citizenship and limits. De Groot refers to *Amsterdam Energie*, a local cooperation of renewable energy that is owned by its members. Another example he refers to is the abandoned airport of Tempelhof in Berlin, Germany, that now functions as a free and shared space for all inhabitants.

5.4.3.2 Social and collaborative innovation

Initiatives that represent a better involvement and more 'say' concerning the services people require are numerous. At various places in society, one can detect practices and initiatives of self-organization. There has been a rise in collaborative production, services, and organizations. Mason (2015) refers to new situations of 'peer production' and 'commons', when he says to believe that these phenomena offer an escape route from capitalism to post-capitalism, as referred to in Section 5.2.2.7.

Cooperations serve as suitable examples of initiatives in which people and entrepreneurs choose a structure of cooperation, mutual interest, shared risks and costs, and to have a democratic say and be independent from larger companies for the supply of certain goods and services. The International Cooperative Alliance (ICA) defines a cooperation as an autonomous and democratic organization, of voluntarily collaborating people, owned by the people, to defend their economic, social, and cultural interests (CERA, 2021).

This represents a counter direction to a society that merely focuses on a large scale. The amount of cooperations, i.e. collaborating individuals in healthcare and management of local 'ground', has grown substantially in recent years, according to the Dutch 'Nationale Cooperative Raad' (NCR). Cooperations are self-organized entities in which civilians gather to take care of local healthcare, revitalise the neighbourhood and run a local store. The number of Dutch energy cooperations grew by 6% in 2022 to the amount of 676 (Kiel, 2022).

In 2021, the Dutch chamber of commerce had registered 3300 active cooperations, and that amount was growing. Considering its growth of 30% in the past four years, the cooperative sector plays an important part in the Dutch economy, CERA (2021) stated in 2021.

Other examples concern local development cooperations and healthcare cooperations. As an alternative to large-scale healthcare organizations that strive for efficiency and even profit, an initiative such as '*Buurtzorg*' was set up: a locally based care institution that helps people in their homes, in which all healthcare workers are democratically involved in the organization.

Corporate cooperation

A specific kind of cooperation organization structure that strives for a rather democratic internal structure was referred to and specified by Ricardo Semler in Section 4.2.2.3. Semler (2015) criticises the traditional pyramid structure, which, he says, refers to a 'situation of slavery'.

5.4.3.3 Local, small-scale production

The above-described initiatives, platforms and systems are to be seen as a representation of a counter direction compared to the economy of scale: the opposite of the industrial economy.

The initiatives form examples of what a society of smaller scale and local collaboration could look like. At the same time, they represent options for a solution to the problems as discussed earlier (un-awareness, un-connectedness and unsustainability).

More and more, within government and financial institutions, policymakers seem to come to a conclusion and become aware that European post-war policies of increasing the scale of production, of which the agricultural sector is a valid example (in the Netherlands and Europe), have caused environmental exploitation, harming nature and our society (Baarsma, 2020).

Similar to agriculture and healthcare, the awareness appears to rise concerning the fact that large-scale industrial production has reached its limits. This notion is not new though, as Schumacher (2010) introduced the concept of 'Small is beautiful' back in 1973 (see Section 6.4.3.2).

As an example of a democratizing tendency in politics, Benjamin Barber (Barber, 2013) has advocated the transition of power from central governments to city governments; from the central parliament to a city's council, arguing for a better and closer representation of the people who have democratically voted.

A system of local production, or local economy, seems to provide an answer to the growing uncertainties of a globalized market, as was highlighted during the recent COVID-19 pandemic when essential (medical care) products were subject to a global game of who offered the most for them (see Section 3.3.4). A rather local economy would bring (back) production capacity to nearby locations, which would prevent a country from being fully dependent on distant global suppliers. Organizing production and capacity in a local and proportionate way would make countries and regions less dependent on global fluctuations in demand.

Other reasons to consider small-scale instead of mass production:

• The distance between a company's board or owner and the actual user of the produce is big in a mass production situation: the decision maker is not involved in the process, nor approachable or accessible.

• Employees of a large producing company do not serve the consumer; they serve their supervisor or higher management, to whom they will refer in case of consumers' complaints because they can't speak as a representative of the company.

• In a small-scale situation, the relationship between maker and user would be much closer and more direct: offering better opportunities for complaints/feedback and solving any specific problem.

5.4.3.4 Local currencies

Another interesting phenomenon in times of globalization and of the Euro currency is the emergence of local currencies (Figure 59). Small communities have in the past set up local currencies for their village, their region, etc. Local currencies are much appreciated in times of (and right after) an economic crisis like in 2008. Local currencies aim to raise the sense of independence, self-sufficiency, and resilience of local economies by encouraging local buying, supporting local food production and items, and local trade in general. The so-called 'Transition Towns' movement from the UK used local currencies in the face of

energy descent and to counter hypermarket chain trends (Bindewald, Martin, & McCann, 2015).

Figure 59: The local currency of the Eusko, issued and used in Basque Country (Spain) in 2013

5.5 Conclusion: the promise of 'doing it yourself'

Doing it yourself as an opportunity to bridge the gap

Recent developments (specifically technological developments) seem to pave the way to better transparency and better opportunities to act and have influence as an individual, as was referred to in the previous paragraphs. Opportunities are improving for individuals to be involved in decision-making, to have a say about their own life and environment and about the tools and items they use. This involves product design and making. 'DIY, hacking and craft […] democratize design and manufacturing', according to (T. J. Tanenbaum, A. M. Williams, A. Desjardins et al., 2013). Tanenbaum notices that this '*democratized technological practice* […] unifies playfulness, utility, and expressiveness […]', and indicates that '[…] users move more towards personalization and reappropriation'.

Today, the increased availability of information together with tools for people to participate could bring back the symmetry referred to in Sections 3.4.6 and 4.2.1.2.

It seems very tenable to strive for shorter distances between the person making and the person using a product, through integrating the acts of producing and using. This ultimately results in DIY design and production. In that sense, history is repeating itself; today's technology and societal context allow the production of items to move to the homes of individuals again, as was the case in earlier DIY periods in history.

This scenario in which people would create their own products appears beneficial and would help to bring designing and using closer and improve the relationship between (1) human and the product and (2) human and nature, which links back to the main research question of this thesis. Maslow's description of *'Human Being'* and Max-Neef's *human needs* (Maslow, 1998; Max-Neef, 1992), as will be further elaborated in Section 6.4.2.1, and a variety of other scholars (Franke, Schreier, & Kaiser, 2010b; Wolf & McQuitty, 2011) provide clear sup-

port for the above, to consider elements that could help people experience a 'good life', to answer people's inner needs and urges. People's inner needs simultaneously form opportunities for improvement: for example, people's pursuit for autonomy and self-sufficiency results in people searching for options to answer those needs.

Section 3 addressed the concept of industrialized production (and the issues that arose). Analysing the relationship between people and the products they use (Sections 2 and 3) helped to deduce potential reasons for the harmed relationship between people and products (concerning multiple domains) (Section 4), of which the industrially induced split was an important factor, as indicated by various scholars. 0 has subsequently led to the conclusion to explore further the scenario of 'Do-It-Yourself product design', as the concept of this scenario promises to tackle many of the problems represented by the old (but persisting) industrial society.

Because DIY product design seems to have, from the various viewpoints, many positive effects on people and the world they live in, the thesis subsequently focuses on the question of how to anticipate these changes and how to support DIY activity. In short, the analysis led to the decision to focus on the economic concept of DIY (or sector A), as opposed to the industrial approach (sector B society), as a solution area.

Section 6 will provide a better understanding of DIY as a concept by addressing its definition, history, and value to the various stakeholders, and in relation to the definition of sustainability (as introduced in Section 4.1).

PART II – D.I.Y

PART I concerned the introduction to this thesis (Section 1), the definition of the study's context, being the field of industrial design (Section 2), the problem statement, being an unsustainable human – product relationship (Section 4), and an indication of the opportunities that can help us solve the problem at hand (Section 5). The first section of PART II, Section 6, focuses on the solution direction that was proposed: re-establishing the relationship between people and the product they use (or the relationship between production and consumption) through Do-It-Yourself activity (DIY). While doing so, the thesis seeks to appreciate design's value, and even cherish the positive meaning and contribution design and products can have, and the role it can play. Built on Section 6, Section 7 deduces and describes a vision that concerns the facilitation, by the designer, of DIY activity: Design-for-DIY. Section 8 concerns a first step in studying the Design-for-DIY process, preparing for the establishment of a Design-for-DIY framework.

'All men [human beings] are designers. All that we do, almost all the time, is design, for design is basic to all human activity. The planning and patterning of any act towards a desired, foreseeable end constitutes the design process. Any attempt to separate design, to make it a thing-by-itself, works counter to the fact that design is the primary underlying matrix of life' (Papanek, 1985, p. 3).

Image used with permission

Cover of Time magazine, 1954

Section 6. A solution direction: Do-it-yourself

Linking problems and solutions

In search of solutions to the issues associated with industrial production, hence associated with the designer's role therein, given the opportunities as described in Section 5, Section 6 explores the practice and phenomenon of Do-It-Yourself as a concept scenario.

6.1 Introduction: why DIY?

As briefly referred to in Section 5.5, the various requirements and solution directions all assemble in the concept of Do-It-Yourself (DIY): such as a better relationship, higher involvement, active participation, self-sufficiency, supporting awareness, local production, etc.

The DIY concept utilizes the opportunities provided by societal and technological developments and principles (Section 5), and so promises to establish a better relationship and increase participation and involvement. The Do-It-Yourself scenario promises to counter matters of unsustainability and un-connectedness and prepare people for the twenty-first century (Kozbelt, Beghetto, & Runco, 2010).

As reasons why people would and should be involved in DIY activity, Lupton (2006) mentions: (1) to save money, (2) customize goods to one's exact needs, (3) independence from corporate manufacturers, (4) it provides pleasure and (5) sharing it with other people. These elements, among others, will be discussed further in this section.

This section discusses the concept of DIY in depth: through an inquiry of a (selection of the) history of DIY, DIY's value in general, how (and if) DIY indeed counteracts the negative industrial consequences, whether at aligns with Ehrenfeld's (2008) 'Tao of sustainability'(Ehrenfeld, 2008) and what we can learn from that.

6.2 Do-It-Yourself Definition

6.2.1 Basic definition

DIY was the predominant way things were produced in pre-industrial subsistence economies, before the emergence of industrial society (Achterhuis, 2011; Edwards, 2006). Do-It-Yourself (DIY) represents a method of building, modifying, or repairing things without the direct aid of experts or professionals', as Bonvoisin (2017) puts it. Literally, DIY (or self-production, or *Autoproduzione*) means people taking on parts of the realization (designing and making) of a product, interior or structure themselves, instead of having it done by a specialist.

DIY should always be considered as a relative situation or state; for example, comparing 'self-sufficient vs high dependency', or 'created autonomously vs created by someone else', or 'make vs buy'. In today's industrial Western society, DIY represents a counter direction to industrialized production, whereas DIY is a necessity in areas and countries that are less industrialized. The same applies to the historical perspective: in Western countries today, DIY appears as a critical culture, whereas it was commonplace prior to industrialization.

Hence, the specific definition of Do-It-Yourself (DIY) depends on its context and on which antipode is the topic of a discussion. Historically and culturally, the term Do-It-Yourself refers to a range of different meanings.

At first sight, some specific purposes could be attributed to DIY: the production of useful devices, learning about technology and the support of social activities (Salvia, Bruno, & Canina, 2016a). But the concept of DIY comprises more than only these basic assets. ´DIY allows people to take charge of a part of their environment that typically is controlled by others´ (Wolf & McQuitty, 2011, p. 164), it allows a certain 'appropriation' (Ackermann, 2013): becoming acquainted with and gaining interest in things by making them your own. As the opposite of passive consumption, designing and making things for oneself would align better with natural human motivations (Franke, Schreier, & Kaiser, 2010b). In short, DIY brings people closer to 'Being' (Helne & Hirvilammi, 2016; Maslow, 1998). Critchley (2023, p. 209), while analysing an amateur-built DIY skatepark case in Dulwich (London), affirms such a definition by concluding that 'DIY design has the potential to serve as a worldmaking agent', in which worldmaking refers to the way individuals or groups might construct their understanding of reality. In relation to the DIY 'infrastructuring', Critchley also refers to the relational qualities of 'commoning' (closely related to the 'commons', discussed in Section 3.1.2): collective, independent and democratic decision making and governance, and sharing responsibility and values (Linebaugh, 2009).

Mike Press (Press, 2007) wrote when initially commenting on co-creating developments: 'The user's role goes beyond passive consumption and connects far better to their aspirations and needs'. Atkinson (Atkinson, 2011b, p. 27) states: ´In open design, the cult of the connoisseur has given way to the cult of the amateur, those who know themselves what is best for them'. A return to *Sector A*, is how Alvin Toffler (1989) would have put it.

Clive Edwards (2006, p. 11) points out clearly the difference between what DIY stands for and the traditional process of product development: 'DIY is both a producing and consuming culture', whereas in traditional mass production, these two are strictly separated. Referring to pastimes of DIY, he describes how '...domestic work provides added meaning, thus enshrining the personal 'value added' to projects and objects and making DIY a fascinating conjunction of production and consumption'. Atkinson (2011b) defines DIY as 'productive leisure'. In addition, Hill (1979, p. 31) defines Do-It-Yourself as activities that are 'essentially a form of production on own account, and as such can be clearly distinguished from other activities such as eating, playing games or taking exercise which the individual cannot hire someone else to do for him'.

DIY also refers to specific periods in time/history that showed a rise in the popularity of DIY activity. For example, DIY was a phenomenon in the 1950s and 1960s, originated in the U.S. and instigated by specific societal and technological factors. Section 6.3 will further address the history of DIY.

Kuznetsov and Paulos describe DIY as a culture that aspires to explore, experiment and understand by doing things by oneself (Kuznetsov & Paulos, 2010b). Campbell (2005, p. 23) indicates that 'craft' [in craft consumption] is a term used to refer to 'consumption activity in which the "product" concerned is essentially both made and designed by the same person and to which the consumer typically brings skill, knowledge, judgement and passion while being motivated by a desire for self-expression.'

Considering the digital making trend (Section 5.4.2.3), Manzini (2015) states that the digital

making trend is a phenomenon of social innovation: dialogue and participatory work lead to collective intelligence. Bonvoisin refers to similar names for the DIY phenomenon: 'commons-based peer production', 'personal fabrication', 'direct digital manufacturing', 'bottom-up economy', 'distributed economy', 'design global, manufacture local' and states that these all 'position individual citizens with full control over the design and fabrication of their products' (Bonvoisin, Galla, & Prendeville, 2017, p. 3). According to Salvia (2016b, p. 2080), 'making encourages engagement with content, critical thinking, problem-solving and collaboration while sparking curiosity'. Instructables uses a very simple definition: 'DIY (Do-It-Yourself) is any creation, modification or repair of objects without the aid of paid professionals' (Kuznetsov, 2024).

DIY stores

Apart from the literal definition of doing something by yourself that is normally done by a professional, the word combination of Do-It-Yourself also refers to a specific trade/type of commercial activity, namely the DIY stores that provide 'laypersons' with semi-finished products or parts for home maintenance and repair (Figure 60).

Many people associate the term DIY with DIY stores that offer materials, tools and items for home maintenance and decoration, garden projects and all kinds of repair projects. These stores originated in the 1950s as an important element of the 'modern' DIY era, right after the Second World War ended (see Section 6.3.8). It has become common to purchase tools and materials for home improvement at the DIY store and to build, make or mend things or projects yourself. Reasons can be various: personal taste, sense of control, the joy of doing it (together) or to save money.

Figure 60: typical hardware store (*Doe-Het-Zelf-zaak*) (Dovey-Marine; Yeadon)

6.2.2 DIY compared

In his contribution to *Open Design Now*, Atkinson (2011a) has graphically noted this comeback of small-scale and a personal approach to design, as depicted in Figure 61.

Toffler (1989) refers to two consumer sectors: Sector A refers to a situation in which the user creates for him or herself, while Sector B refers to a situation in which things are made by someone else, with the user as a consumer in a passive role here (see Section 1.2). DIY enables people to change their personal environment, express their identity (Atkinson, 2006; Wolf & McQuitty, 2011). The concept of DIY refers to local distribution and represents the opposite of over-production: it refers to a demand-based instead of a supply-based situation. DIY activity increases awareness and product attachment, it provides meaning to a product (Csikszentmihalyi & Halton, 1981; Mugge, 2007; R. Mugge, J. P. L. Schoormans, & H. N. J. Schifferstein, 2009; Seldis, 2017), and by taking a rather active role, people increase their self-sufficiency; it brings them closer to 'Being' (Helne & Hirvilammi, 2016; Maslow, 1998).

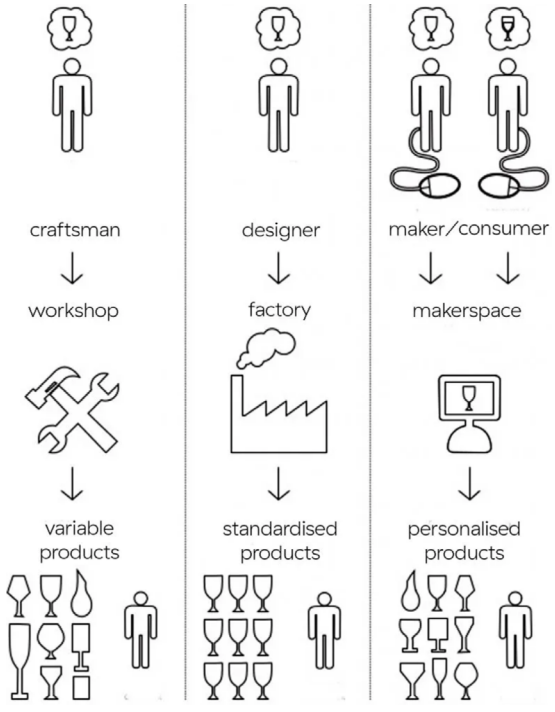


Figure 61: Back to the future: products become personal again (Atkinson, 2011a)

6.2.3 Make-or-Buy ratio

When considering a business-to-business situation, a company's 'make or buy' decision, to either make something yourself or to outsource, depends on multiple aspects. Some of these aspects include quality, dependency, capacity, skills, cost, flexibility, time, and design experience (M.J. Hoftijzer, 1988).

Historically, the 'MoB-ratio' (Make-or-Buy ratio) is decreasing (Bridgman, 2012; Hummels, Ishii, & Yi, 2001), as a result of companies' increasing tendency to outsource, i.e. apply vertical differentiation (or vertical specialization). The MoB-ratio concerns the ratio between (1) the added value of a company's activities in the supply chain, and (2) the value of the company's input. Simply put, companies have increasingly focused on specific vertical segments within the supply chain of production, taking a relatively small piece of the supply chain. Some reasons for vertical differentiation include declining trade costs, outsourcing in low-wage countries, globalization in general, technologically facilitated collaboration and communication across different stages, reduced barriers, focus on core competencies, and flexibility (Bridgman, 2012) (M.J. Hoftijzer, 1988).

When considering the above and projecting the 'make-or buy' consideration onto the relationship between a retailer and the end-user, vertical differentiation embodies the opposite of DIY. DIY would support vertical integration.

Vertical integration, a strategy that allows companies to integrate and own a larger share of a supply chain directly (increase the MoB-ratio), would, e.g., increase control of the supply chain, it would increase (the sense of) ownership, it would include greater efficiencies, it would provide independence, increase resilience, and it would increase knowledge.

This brief reference to the traditional approach of vertical segmentation illustrates the contrasting concept embodied by DIY. The Make-or-Buy decision factors, though, are also valid when considering DIY activity at layperson level, such as the factors mentioned above: quality, dependency, capacity, skills, cost, flexibility, time, and design experience, resilience and ownership.

6.2.4 The relevance of DIY: DIY versus industrialization

DIY means changes in the system of making and consuming and changes to the relationship between maker and user. Of what do these changes consist and what are the consequences? In what sense is DIY different from industrial design?

Sector A vs Sector B

It is the opposite of *Sector A* (Toffler, 1990) that characterizes industrialization: producing for the market, for someone else. In many ways, DIY represents the opposite direction of the traditional structures of industrial society. When comparing the characteristics of DIY to what the industrial system stands for, the main difference is in the basic approach, the starting points of both. Industry and industrial design produce homogeneous products, in high volumes, striving for a large market share and high profits. Whereas DIY's main goal is the design and making of a product or object that suits this individual the most (either concerning its fit, the activity, the satisfaction, or pride it provides). The thoughts, goals, approaches, and ethics behind the two are very different.

DIY as the opposite of labour division

Since the Industrial Revolution, there has been much criticism with regard to the division of labour and mechanization, with respect to social and aesthetic (and craft) aspects. Nineteenth-century design reformers stated that the effect of machines had been that the responsibility for the appearance and fabricating were separated: deteriorating the quality of design (Forty, 1995). Machine production leads to ugliness and degeneration of human existence, says Morris (2007). Besides the disappearance of craft, people's control and their part in

product design and development disappeared (Morris, 2007).

Whereas labour division prescribed the disappearance of any direct say or participation of the end-user, the Do-It-Yourself periods (DIY), especially during the 1950s and 60s, showed the opposite. Literally, DIY means people taking on parts of the realization (designing and making) of a product, interior or structure themselves, instead of having it done by a specialist. Clive Edwards clearly points out the difference between what DIY stood for and the traditional process of product development: 'DIY is both a producing and consuming culture' (Edwards, 2006, p. 11).

Job division/ specialization vs integration

Since the concept of DIY 'technically' represents a modification of the task division between oneself and the supplier (professional, someone else), it has a strong relationship with the managerial concept of job integration (or expansion), either vertical (enrichment, adding control) or horizontal (enlargement).

DIY, by definition, represents an expansion of your job. It may concern either a vertical expansion (take more responsibility) or a horizontal expansion (do more things at the same level), both opposed to job specialization (described in Section 3.3.3.2). Similar to the managerial situation of job integration (or expansion), which would, according to Mintzberg (1983), positively affect the worker's 'quality of working life' (QWL), DIY has a positive mental effect on the people concerned. '[Peoples'] growing need for self-actualization can be met only in enlarged [and enriched] jobs', according to Mintzberg (1983). A 'multispecialist', as Friedman calls him/her, would 'benefit from the integration (Σ dt) of a whole "series" of partial operations which he knows how to perform. And this integration, when backed by technical knowledge, can create a new and original type of skilled worker, one who can find satisfaction and take a pride in his work' (Friedmann, 1961, p. 153).

In other words, such a DIY job enlargement would establish or increase the direct and active involvement of the layperson in a development project. An example of horizontal expansion through DIY would be the painting and maintenance of one's backyard shed or a home administration job. An example of vertical expansion through DIY could be the management, buying and/or construction of a new house or boat. A simple visualization of the culminating distance (alienation) in the past between maker and user is shown in Figure 62. (1) People make everything they need for themselves. (2) A growing part of people's needs is bought from (hence made by) someone else. (3) Labour division concerning the production of the item a person wants to buy instigates an anonymous relationship: distance grows. (4) When even the (divided) tasks are taken over by computers and robots, that relationship disappears. Today's DIY might make us return to the Sector A situation (see Section 1.2).

DIY vs industrial design

Opposite to the system of mass production/-consumption

Compared to the (traditional) concept of industrial design, DIY represents a process that does *not* focus on a large audience, does *not* deal with a client company, and does *not* strive for financial profit; in fact, the design is (preferably) done by a layperson (*not* by a designer).

If the DIY layperson is indeed enabled to decide, design, and make (perhaps facilitated to a certain extent), it would change everything: on an operation level (What will be the design and process run?), an organizational level (Who will be the designer?) and on a strategic level (Why are we doing this?). Some differences between industrial design and DIY are mentioned in Table 7.

Figure 62: Increasing distance between maker and user: (Sector A (making for oneself) > B (making for someone else)

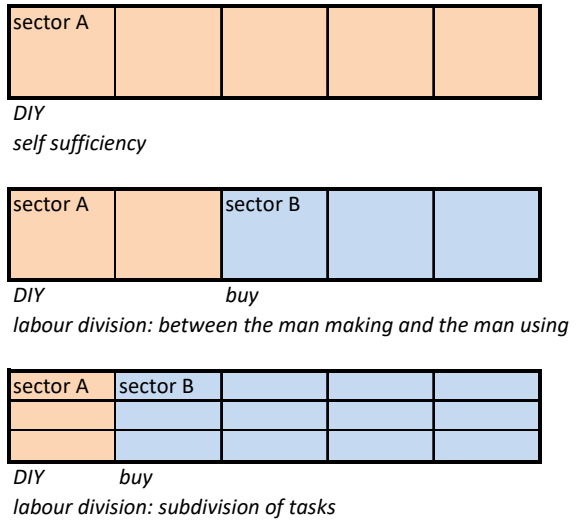


Table 7: Industrial Design vs DIY

Differences between industrial design and DIY design		
Aspect	***Industrial Design***	***DIY***
Batch size	Thousands	1
Target	Audience/ consumers	Oneself
Location	Global	Home
Purpose	Turnover/ profit/ consumption	Fit, joy, pride, criticism, learning
Actor	Designer/ industry	Layperson
Client	Client company	Oneself
Role of layperson	passive	active
Role of designer	active	(facilitating)
Requirements	Standardized	Personal and flexible
Sector (Toffler)	B	A
Organization (Mintzberg)	divided	Integrated
Sense of democracy	Choose from limited offer	Decide yourself
Input knowledge	(from market analysis)	Own preferences
Skills	high	various

6.2.4.1 The broader concept: DIY ethic, DIY culture and resistance

Apart from the literal and technical meaning of DIY, DIY refers to an anti-establishment attitude or culture, a DIY ethic, that criticises industrialization and commerce. The DIY ethic concept strives for independence and self-sufficiency.

DIY as a moral standpoint concerns an act of conscious behaviour of solving and making, repairing things yourself, on a small scale, inherently as a critique of the mainstream mass production and commercial 'system', and/or stemming from an urge to make and solve things independently. It concerns environmental care, local activity, and a non-corporate attitude. The DIY culture, in a way, refers to an anarchistic attitude towards anything organized or prefabricated. Section 6.3.15 addresses DIY activism.

DIY ethic represents a mindset and community culture that has its fundament, for example, in the so-called 'skiffle' movement of the 1950s, Avant-Garde art in the 1950s and the punk scene of the 1970s and 80s (see Section 6.3.15), and is still present in the current music scene (Spencer, 2008). Regarding the DIY ethics present in the music realm, Cuffman (2015, p. 4) says '[…] anarchic DIY practice constitutes a sort of inoperative community of circulation rather than production and profit'. Such a non-commercial way of working, similar to indie music (independent from record labels), relates to the ways in which music constitutes social and communal relationships, he says, and to the possibility it has to operate outside of commercial exchanges.

One could consider today's system of mass production as harmful to nature: harmful in terms of unsustainable behaviour. Or one could consider the system of mass production to not truly provide an answer to people's (individual) problems. There are various reasons why (communities of) people may have the urge to oppose the mainstream and set up communities of a different ethos: DIY instead of purchasing new items. 'DIY may have been pushed forward by different factors—such as ideological resistance to the dominant organization of work', writes Bonvoisin (2017, p. 3). Negative motivation also refers to the critical (anti-industrial) movement of the DIY culture scene. Various phenomena and signs refer to this critical notion of the commercial and not optimally managed society. These include, for example, self-sustaining communities and villages (Bakker, 2017), community-initiated cooperations (energy, housing), the indie music movement (Section 6.2.4.1) and local currencies, see Section 5.4.3.4.

This aligns with the findings of Atkinson (Atkinson, 2017, p. 1), who ascribes 'an element of resistance' to DIY design: 'a rejection of mainstream manufacture that emphasises unsustainable perfection in favour of a more personal, individual and "authentic" experience of objects imbued with emotion and personal investment as a more intrinsic part of the constructed self'.

And it aligns with the rather historical view by Friedmann, who considers 'certain tendencies shown in hobbies as […] reactions against being machine-paced and organized from above, against standardized and ready-made objects, against work on the assembly line, in the stubborn pursuit of self-fulfilment and meticulous art and craft work freely executed according to a personal rhythm' (1961, p. 111).

The element of resistance is most apparent when the products subject to DIY activity are associated with subcultural groups, describes Atkinson, for which he provides examples regarding musicians who reject 'the perfection of factory-produced instruments as lacking personal meaning', and of which some are concerned about the use of endangered hardwoods. Resistance is also one of the prominent reasons-of-being for the so-called fanzines in the 70s. 'A graphic language of resistance' is how Triggs (2006, p. 69) defines the fanzines. The zines were a platform for a DIY and underground culture, concerning music, football, politics, anti-capitalism and thrift store shopping (Triggs, 2006).

6.2.4.2 Self-sufficiency

Similar to its relation to resistance, the concept of DIY heralds a clear component of self-sufficiency: being able to solve your own problems, to do it on your own, i.e. resilience. The concept of self-sufficiency refers to an independent position of the user: independent from institutions, from supply and from external support. Lupton (2006, p. 14) refers to DIY as a means 'to feel less dependent on the corporations that produce and distribute most of the products and media we consume'. Self-sufficiency relates to autonomy (taking care of yourself) and to sovereignty ('the state of being free from the control or power of another' (Merriam-webster, 2020)). The aspect of self-sufficiency is closely related to the distinction between a Sector A and a Sector B economy, referred to in Section 6.2.4. Section 6.4.2 discusses self-sufficiency further.

As the title of Section 6.2.4.1 suggests, it is important to consider that DIY ethic has a cultural exponent: not all people adhere to a DIY ethic or see DIY as a practice of resistance. Nor do all people feel the need to be self-sufficient or to consume less.

6.2.4.3 Re-use

Reuse refers to various practices that are sustainably relevant: (1) the re-use of product parts in the design and construction/making of a new object, also related to hacking (Section 6.2.4.4), and (2) the re-use of raw materials, and (3) the re-use of ideas and to manipulate, copy or improve ideas and objects of other people.

Salvia relates Re-DIY, as it fosters product longevity through repair, reuse, repurpose and reappropriation, to patterns of 'sustainable consumption and production' (SCP, United Nations policy). 'Re-DIY practice fosters not only a reduction in resource consumption but has a positive impact on individuals and the social fabric, e.g. a preference for local resources and craftsmanship, skilling processes and environmentally conscious behaviour [...]', he says (Salvia & Cooper, 2016, p. 26).

Hacking

The term 'hacking' has a negative connotation because people associate it with illegal activities and hostile attempts to break into someone's computer or network. In the context of creativity and DIY, though, hacking means to adjust and modify (in a way re-use) existing products and things (Figure 63 shows an example), for the purpose of improving, repurposing, or conducting one's hobby. The Internet and online information have helped to

spread and amplify the hacking community and hacking activity. Examples are numerous and results are widely shared through videos and tutorials, helping other people to make and modify their own products and items according to their wishes (Duman, 2020). 'It [design for hackability] cultivates reciprocity between users and designers and supports transparency and graceful responses to unanticipated uses', according to Galloway (2004, p. 363). Also Figure 72 serves as an accurate example in this context.

When there is a situation that requires improvising, as the COVID-19 pandemic situation did, hacking activity helps to solve problems. In that specific situation, snorkel masks were turned into intensive care masks, which required slight adjustments of connections and functionality (Figure 64).

Figure 63: Tjeerd Veenhoven's air-powered iPhone (Noe, 2010)

Figure 64: Hacking a snorkel mask and using it as an IC mask during the COVID-19 pandemic (Anonymous, 2020a) and (TU Newsletter March 2020)

IKEA hack

IKEA hack refers to a practice in which participatory communities express themselves through sharing their personalized items and commenting on each other's design (Dodd, 2017; Duman, 2020). Hacking means that, for example, IKEA products are being modified by users who aim to repurpose these products to their needs (Figure 65 to Figure 68).

Figure 65: Hack of an IKEA lamp (Cult3d.com)

Figure 66: Ikea tables repurposed as game boards (nl.ikea-club.org)

Figure 67: Land Rover office desk: repurposed Landrover body (https://www.landy-zone.co.uk/land-rover/land-rover-defender-bed.323424/)

Figure 68: Skateboard chair (Bruthause.be)

6.2.4.4 Repair, maintenance

Repair is a typical form of DIY. Repair either of one's self-produced product or of an existing thing that is broken. To repair a product requires patience, ability, confidence, and a mindset that is ready for the things that might occur when starting the repair process. Joy and pride definitely play a part when deciding to repair and maintain a bike, a piece of your furniture or a car, which relates the subject to the customization (tuning) culture as well (Section 5.4.2.5).

Whereas thirty years ago most products were easy to disassemble (production techniques were less advanced than today), that is not the case anymore. Cases

such as Nintendo's, described in Sections 2.2.4 and 3.4.6, indicate that there is room for improvement of accessibility and reparability.

Saidani (2023) mentions various reasons why products are getting more difficult to repair: e.g. physical restrictions; unavailability of parts, unavailability of repair manuals, or unavailability of tools; issues that concern safety, time and costs; issues that concern intellectual property and patents; or the discouragement of unofficial repair (Federal_Trade_Commission, 2021; Jaeger-Erben, Frick, & Hipp, 2021; Saidani, Kim, & Kim, 2023).

The repair of a product, as the opposite of buying a new product, also comprises an element of resistance (see 6.2.4.1), noticeable, for example, in the activities of the right-to-repair movement. The right-to-repair movement 'believe(s) products should last longer, and therefore when broken, they should be repaired. This requires products to be designed for repair as well as support for repairers of all kinds' (Ganapini, 2023). The movement addressed a call to the EU (Ganapini, 2023), asking for legislation concerning products' lifetime extension and the prevention of electronic waste. The 'right to repair' initiative, says the European Commission, 'will promote sustainable consumption throughout a product's lifecycle, making it easier and cheaper for consumers to repair defective goods, reducing waste and boosting the repair sector' (European-Commission, 2023b).

These policies, together with circular economy-related laws, seem to help products become more repairable, for purposes of product life extension (Saidani, Kim, & Kim, 2023). There is much work to be done though, when comparing, for example, the repairability indices of the Fairphone 4 and the iPhone 12 (score of 92/100 vs 60/100, respectively), according to the repairability index 2022 (Repairability-Index, 2022; Saidani, Kim, & Kim, 2023)

Platform for repair of products; the case of the 'Repair café'

Because of the new (renewed) interest in craft and DIY, combined with an increased level of (sustainability) awareness, a large number of repairing and reuse practices has appeared. One such example is Repair Café (Figure 69), an initiative that facilitates the repair of 'old' electronic devices. The Repair Café practice is relevant because it represents a culture of repairing it yourself (with some help) instead of buying a new item.

The ability and opportunity to repair a product are important when pursuing a sustainable product life cycle (Masclet, Mazudie, & Boujut, 2023). However, today's consumer culture does not always stimulate the repair of broken items, as indicated in Sections 3.3.5.1 and 6.2.4.4. The Repair café organization notes on their website that lots of people don't know they can repair things themselves. The organization aims to teach people to approach products differently, to appreciate their value, and important ways to use and manage products sustainably.

The option to repair is also something to consider while designing, through designing for reparability, anticipating longevity and taking into consideration modularity and ease-of-disassembly.

Figure 69: Repair Café (Wikimedia commons)

6.2.4.5 World view: Classical vs Romantic world view

According to Pirsig (1974), author of *Zen and the Art of Motorcycle Maintenance*, there are two kinds of understanding of things around us: the *classical* understanding (underlying form, reason, laws, underlying thought, behaviour) and the *romantic* understanding (immediate appearance, feeling, intuition). Interpreted in terms of product design, one is either interested in the underlying construction and raison d'être of something, or one sees only its surface appearance and how that feels. DIY promotes the *classical* understanding: being interested in what a device, machine or product is about, how it is constructed and built, and – very important – how to maintain, mend or repair it.

6.2.5 Learning

Not surprisingly, DIY activity facilitates learning (Peppler & Bender, 2013). Pedagogy, in a way, an important element of DIY: through learning, DIY can help increase people's skills, knowledge and awareness. And as a result it provides confidence, self-sufficiency and empowerment (Manzini, 2003). Referring to DIY in general, and to the maker movement in specific, Dougherty (2016), founder of Make Magazine mentioned in Section 2.2.2.2 that the activity of creating is in itself a form of learning, and Salvia (2016a) mentioned in Section 6.2.1 the learning aspect as one of the specific purposes of digital DIY. The phrase 'learning by doing' (Gibbs, 1988) fits very well with DIY activity, because people learn a lot from making mistakes and doing a better job the next time, which are typical DIY activity aspects.

The concept of *knowing-through-making*, as described by Mäkelä (2007) affirms the inherent causal relationship between making and learning from it. 'Knowlegde-making', is how Critchley (2023) calls it. Critchley (2023), while reflecting on the DIY construction ('infrastructuring') of a skatepark in Dulwich (London), accurately describes how also DIT (doing it together) supports learning by means of the fruitful collaboration between experienced and less experienced skateboarders. Community learning was also discussed in Section 5, in the context of Fablabs.

6.2.6 DIY as necessity vs DIY as lifestyle display

With the history of DIY in mind, Paul Atkinson (2006) mentions four types of DIY: Proactive DIY (self-directed, creative design input), Reactive DIY (kits, templates or patterns, involving the assembly of predetermined components), Essential DIY (necessity) and Lifestyle DIY (choice rather than need). 'DIY as a necessity' refers to a situation in which a person would not have the resources to buy an item, but instead he/she has or had to make it him-/herself. DIY has a distinctive meaning depending on the resources available. People in poorer conditions would sooner repair or create their own tools, needs, and housing , than richer people would, simply because they lack the money to buy a replacement (Figure 70). The distinction is, however, not always clear or black-and-white.

Table 8 displays a distinction between the reasons for DIY activity along the vertical axis and the distinction between proactive and reactive DIY activity along the horizontal axis. In addition to Atkinson's four types, this table also comprises an extra category between essential DIY and DIY by choice, being 'moral reasons for DIY', to accommodate DIY activities by people who deliberately choose to DIY for reasons of resistance, performed on principle. Figure 71 and Figure 72 illustrate two distinct types of DIY activities. Figure 71 shows the self-fabrication of an adjustable dumbbell set, assembled using machine gears, while Figure 72 presents a 'well-designed' set of 'Hanging Wine Bottle Pendants', showcasing re-active DIY by choice.

Figure 70: Rocinha Favela in Rio de Janeiro: DIY housing (Chensiyuan, Creative Commons)

DIY making/maintenance		
	pro-active	***re-active***
fun	for joy, hobbyism, community of likeminded, (hacking), (car tuning), inward, personally rewarding, sometimes complex, personal additions to hobby area	hobbyism, communities of shared interest, e.g. tin soldiers, games, etc. also carkits, helped by kits, suppliers
style	self-directed creative design input, lifestyle, not complex, outward directed, pastime, identity, from scratch (e.g. all kinds of projects, furniture, skateboard, clothes, projects)	facilitated, 'assemblage', following trend, lifestyle, trend, pastime, fun, identity, hobby, handcraft, making activities, mediated through the agency of kits, templates, patterns, aestetics
moral reasons	performed on principle, for reasons of resistance or sustainability (e.g. fanzines, hacking, repair, non consumerist behaviour)	efficient use of replacable and modular parts (e.g. Fair phone)
essential/ need	activities carried out as an economic necessity (DIY made clothes, housing, toys, tools, food)	making clothes from patterns, recipes, and mending (repair), home maintenance often involving the following of instructional advice from manuals (e.g. fallout shelters)

reason for DIY activity

creativeness of DIY activity

Table 8: Categorization of DIY types, along the axes of 'reasons for DIY activity' and 'creativeness of DIY activity' (partly adapted from Atkinson (2006) and Keinonen (2009))

Figure 71: Self-fabricated dumbbell set (Still from Metropolis, Human, 2023)

Figure 72: DIY project 'Hanging Wine Bottle Pendants' (YouTube), which also fits the definition of 'hacking'

6.2.7 DIY and cultural differences

People's behaviour depends on their cultural background or the country they come from and the habits and traditions they are used to. In some societies, people tend to decorate themselves (henna, tattoos) for reasons varying from simple aesthetics or pictorials to religion, worshipping ancestors, and other symbolism. The same applies to the clothes people wear and the products and items they use, as well as to certain vehicles people use. The decorations people apply to such vehicles (see Figures 73 and Figure 74) relate to people's context, motives, religion, artistic culture, superstition, tradition, and to the extensive use and purpose of those vehicles. See the examples shown in Figure 73 and Figure 74a, b, c, and d.

Figure 74b shows the age-old practice of the decoration of so-called Jingle trucks. The practice appears related to Sufism. The decoration of trucks, experts say, is a way to obtain 'religious merit,' similar to the Sufi practice of embellishing a shrine or religious site. By adorning their trucks, owners ensure that the vehicle will protect the driver and avoid breakdowns. Drivers often perceive their trucks as companions deserving gratitude, expressed through decoration (Ali, 2023). Ali cites expert Durriya Kazi: 'If a truck is more decorated and well-designed, more people will hire it, and business will grow', highlighting the commercial motivations behind this practice as well (Ali, 2023, p. 2). Figures 74c and 74d tell the story of the brightly coloured and decorated trucks that drive in India. Eckstein (2024) indicates that drivers of these trucks spend many hours on the road and can be away for weeks at a time. He notices that

the trucks serve ‘as a second home and they take great pride in them’ (Eckstein, 2024). The colourful decorations and shrines have all kinds of meanings and origins, such as policital, religous, and (folk-) artistic. They symbolism of the decorations also functions as an expression of individualism and as a request for luck on the road.

Figure 73: Customized Japanese ‘Dekotora’ truck (Kanon Serizawa. Image license: CC BY-NC-ND 2.0.)

Figure 74a: Customized Haitian ‘Tap-tap’ bus (Pinterest)

Figure 74b: Customized, ‘tricked up’ Pakistani ‘Jingle’ truck (Photo: Blackdotcooperative)

Figure 74c: Indian decorated truck (Dan Eckstein, CNN)

Figure 74d: Truck cabin decorated with vinyl and stickers in Sirhind, Punjab (Kaleena Sales, Centred)

A comparison: DIY and food

Interesting cultural differences also occur when the DIY production of food is concerned. In some less-populated areas (for example in some areas of Greece and Italy), food is cooked slowly and with a lot of attention to self-grown ingredients. Such a food culture represents a close relationship between using (eating) and the fabrication (growing, cooking) of one's food and meals. Meals from freshly grown and natural resources are amongst the most healthy meals in the world (Salah, 2014), whereas so-called 'processed' food is considered unhealthy, accompanied by a distant relationship between the consumer and the grower/maker. In recent times, people have become better aware of what good food is and what it is not. However, globally, many human diseases and casualties are still a result of eating unhealthy food and bad eating patterns.

This example attempts to explain the concept of DIY product design better, specifically concerning the relationship one could have with (and care for, see Section 5.3) what is being used or consumed.

6.3 A short (and incomplete) history of DIY

Western Do-It-Yourself in historical perspective

To be able to define the phenomenon of DIY accurately, it is very helpful, even necessary, to consider past periods of intensified DIY activity. The various DIY time periods all have taken place in a specific context, or era, in which there was apparently an unusually strong 'need' for DIY activity.

6.3.1 A DIY timeline

Section 6.3.1 concerns a condensed and limited timeline of some remarkable DIY periods and phenomena. Table 9 and the subsequent paragraphs attempt to elaborate on some of them.

Table 9: An incomplete DIY timeline

Timeline and (periods of) increased DIY activity			
Timeline	**Era/ phenomenon**	**Subject**	**Reference**
-1700	Pre-industrial times; Sector A society, agriculture, subsistence economy	'Economy' within 'oikia', see Sections 1.2 and 3.1	(Achterhuis, 2010; Cipolla, 2008; Shammas, 2008; Toffler, 1990)
1842	Mary Gascoigne: Handbook of Turning	the art of woodturning using a lathe	(Science-Museum, 2020)
~1850	'Early DIY'; Industrially-induced bifurcation of work and leisure	needlework, amateur upholstery and making curtains, later: sewing machine	(Edwards, 2006)
~1877	Sewing machine craze (lowering of prices)	Sewing machine	(Gordon, 2007)
1906 - 1920	Early DIY home improvement	Readi-cut homes	(Armstrong, 2008)
2nd half of nineteenth century	Victorian/Edwardian times	DIY toys	(Atkinson, 2006) (Science-Museum, 2020), (Calvert, 1982)
1908 -	The Ideal Homes Exhibition	necessity	(Atkinson, 2006)
1930s	W. P. Matthew's books and BBC radio, the first 'media handyman' broadcasts during the 1930s	necessity	(Atkinson, 2006)
1902/08 -	Popular Mechanics, Mechanix illustrated	DIY information, addressed also to rural areas: farms: tools, techniques, etc.	(Whittaker, 1952)
1920 -	Radio hobbyists		(Instructables.com)
1920s and 1930s	women's magazines	transfers, patterns, coupons, step-by-step instructions, home craft features	(Hackney, 2006)
1934	Perriand	Modular houses, available to the workman	(Roux, 2022)
1944	Slöjdföreningen	Involve users and organizations in the teaching of dwelling knowledge and interior decoration	(Göransdotter, 2020)
1950 -	Modern/ post-War DIY	Housing, necessity, after WWII, popular DIY through media	(Atkinson, 2006; Goldstein, 1998)
1967 - 1973	Scandinavian 'Socially responsible design'	'Make us more useful to society', a call from The Scandinavian Design Students Organization (SDO)	(Lie, 2016)

1968 – 1972 (- 1998)	'The Whole Earth Catalog' (subtitled Access to Tools)	Counterculture magazine, focus on self-sufficiency, ecology, alternative education, DIY and holism	(Binkley, 2003)
1970s	Workshops in the basement (U.S.)		(Anderson, 2012)
-Early 1970s	Zines	DIY Magazines	(Triggs, 2006)
1979 -	This Old House (Bucknell)	Popular DIY show on TV (later: magazine and online): home improvement	
1980s	Desk Top Publishing	digital design tools to the public	(Lupton, 2006)
1980	DIY movement	see DIY Ethic (6.2.4.1)	(McKay, 1998)
1980s	Desk Top Publishing: first desktop laser printer (HP) in 1984, Aldus (Adobe) PageMaker (1985)	'Publishing' at home	(Bear, 2019)
1990	Martha Stewart Living	Magazine including DIY instructions	(Lupton, 2006)
1995	Open source	'Free' software	
1990s	Computer hobbyists		(Instructables.com)
2001	Web 2.0	User-generated content; internet as an interactive platform	(Castells, 2010)
2000s	User-generated content	Wikipedia (2001), YouTube (2005)	(Castells, 2010)
Present		See Section 5: Declining models, changes, and developments	

6.3.2 In the beginning

Pre-industrial

DIY practices predate recent history, as human survival often relied on the ability to repair and repurpose tools and materials.

Roughly put, during the agricultural era (Toffler's First Wave society, which ran from around 8000 BC to around 1650 to 1750), land was the basis of all people's lives, which was organized around the central village. It was characterized by a simple division of labour, a decentralized economy: people produced most of what they needed themselves. Society was essentially a Sector A society: 'producing for your own use' (Toffler, 1990), see Figure 75.

Food was produced and consumed, people made candles, soap, and clothes, and kept livestock. It was only occasionally that surpluses were sold to others, most of the time barter complemented the subsistence economy.

Fablab founder Gershenfeld, from MIT, says: 'The industrial age was only an in-between age: people made products individually before and after the industrial era' (Kieft, 2014). DIY was also the predominant way things were produced in pre-industrial subsistence economies, before the emergence of industrial society (Achterhuis, 2011; Edwards, 2006).

This approach (building, modifying or repairing things without the direct aid of experts or professionals) was the predominant production setting of pre-industrial subsistence economies and has been replaced by industrial manufacturing in industrialized economies (Bonvoisin, Galla, & Prendeville, 2017)

In pre-industrial times, as part of communities, people developed and created tools as means to provide themselves with food and clothes (Achterhuis, 2010). Things were made for oneself and one's own close family (Figure 75). The so-called 'distance' between the people who made a tool or object and the people who would use it was very short: if not made by oneself, people knew very well by whom and how it was made; thus, how it should be repaired.

As was indicated in Section 3.1, the industrial society, which is built on a Sector B economy, was preceded by an endless history of the human species characterized by its Sector A economy (see Section 1.2): low task division and people were capable of creating and mending their own necessities.

At the end of pre-industrial society, Sector A (self-sufficient) communities changed into an industrial civilization (mainly Sector B: making for someone else) (Toffler, 1990). Over the course of the recent centuries, the meaning of 'consumption' changed due to the advance of capitalism, by the spread of markets, purchasing and choice (Trentmann, 2016).

Figure 75: pre-industrial household production: a military tailor and his family, around 1863, East End of London (Mary Evans Picture Library)

6.3.3 Mechanick Exercises 1896

Moxon's *Mechanick Exercises* (1896) is considered the oldest of all DIY manuals. It described how to cast metal, draw, join wood, etc. Moxon (Wallis, J, Pepys et al., 1978, p. 11) wrote: '…many Gentlemen in this Nation of good Rank and high Quality are conversant in Handy-Works', and '… to what purpose would Geometry serve, were it not to teach Handicrafts?' See Figure 76.

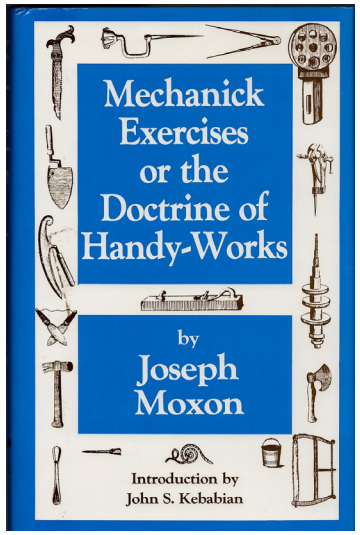


Figure 76: *Mechanick Exercises,* by Moxon (1896)

6.3.4 Early DIY (eighteenth and nineteenth centuries)

'Soft DIY, or 'decorative DIY'

According to Edwards, DIY originated 'in the eighteenth century, [when] many creative domestic handicrafts were the prerogative of the upper-class women who were not employed and whose role was to organize the running of the family home' (Edwards, 2006, p. 17). There was a need to give the women's idle hands something to do, according to Edwards. Later, in the nineteenth century, when there was an 'industrially induced bifurcation of work and leisure' (Gelber, 1999, p. 4), women took up *en masse* decorating their homes as a hobby. 'The ideology of the workplace infiltrated the home in the form of productive leisure' (1999, pp. 2, 20). It was the young woman's task to make the home beautiful by doing needlework, amateur upholstery and making curtains. Later, in the 1850s, there was recognition of women's ability to express inventiveness and creativity (Anon., 1856). The DIY works done by nineteenth-century women represented the individual through self-expression and creativity, and it increased the DIY woman's status (Figure 77). Some practices even broke down gender barriers; fret-sawing in particular was a part-time activity. Fret-sawing introduced woodworking to many women, while at the same time it was a true male hobby. Williams' work *Fret-Sawing for Pleasure and Profit* (2019), originally from 1877, specifically addressed both men and women (Gelber, 1999).

6.3.5 Berlin wool work canvasses (1850)

Berlin work or Berlin wool work was a hobby for Victorian ladies to spend their free time. The activity did not require much creativity and was rather simple since readymade printed template charts were provided. These charts, together with the invention of chemical textile dyes in around 1850, made this hobby

Figure 77: Ladies' early DIY (The Quilting Party, 1894, Granger Collection)

Figure 78: Berlin wool Men's slippers ca 1860, The McCord Museum (Maija, 2022)

accessible and rewarding (Maija, 2022). Figure 78 illustrates a result of Berlin wool DIY activity.

6.3.6 Self-made toys

Starting around 1800, there was an emergence of awareness and insight that 'childhood was a time for play' (Onion, 2018). Before that, according to Onion referring to Calvert (1984), 'neither playing games nor possessing toys was considered inherently childish by definition'. Whereas elite children, as noticed by Calvert (Calvert, 1982) from painted portraits, played with toys since the late 1700s, this was not the case for poorer people: 'in the first half of the nineteenth

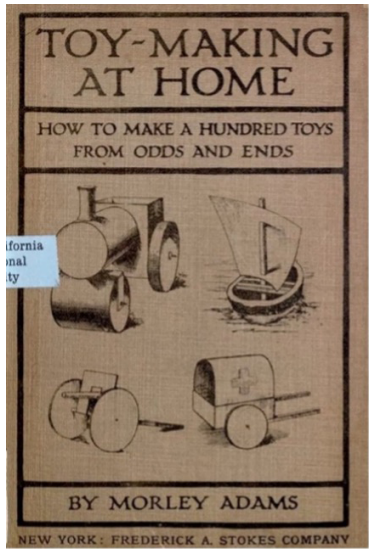


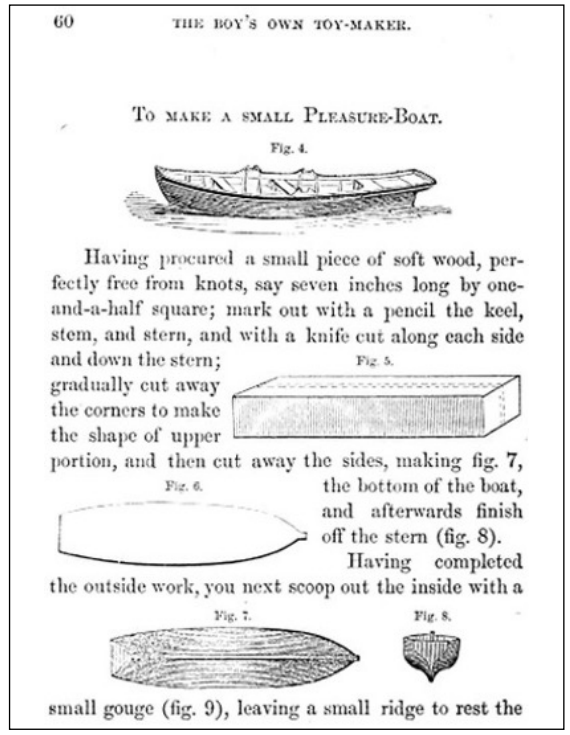
Figure 79: the book *'Toy Making at Home' by Morley Adams,* around 1900

century, American homes—especially the poorer ones—were still relatively barren of playthings' (2018). Due to the population increase in the nineteenth century (i.e. lots of extra children) and to the fact that toys were expensive, families made toys at home; it was DIY as a necessity (Science-Museum, 2020). Onion even refers to many nineteenth and twentieth century books that advise and help children to make their own toys at home (Figure 79).

In *Practical Education*, Edgeworth (1835, p. 29) promoted giving children supplies such as 'card, pasteboard, substantial but not sharp-pointed scissors, wire, gum and wax' in case children were too small to use hazardous tools such as saws. These tools were to be used to create scale models of furniture, architectural elements, and simple machines.

Apart from DIY as a necessity, there was a clear effect of pride of authorship involved. In describing her childhood in the 1820s and 1830s, Larcom (1889, p. 29) describes her 'rag children', self-made dolls, as 'absurd creatures of my own invention, limbless and destitute of features, except as now and then one of my older sisters would, upon my earnest petition, outline a face for one of them, with pen and ink'. Larcom loved these 'absurd creatures' 'far better than did the London doll that lay in waxen state in an upper drawer'.

The gender divide between boys and girls is clearly visible when comparing, for example, (1) The Boy's Own Toy-Maker (Landells, 1881) and (2) The Girl's Own Toy-Maker and Book of Creation (Landells & Landells, 1860). Boys were required to prepare and practice making 'essential' survival objects like huts and boats, which was called 'knowledge of common things' (Landells, 1881), see Figure 80, whereas girls were supported to learn and make items such as pincushions, doll's clothes, doll houses and baskets, thereby developing their aesthetic awareness and preparing for their future task of decorating their own homes when married: 'Nothing is more becoming than to see a home neatly and tastefully embellished by the handiwork of its inmates,' according to Landells (1860, p. vi) (see Figure 81).


60 THE BOY'S OWN TOY-MAKER.

TO MAKE A SMALL PLEASURE-BOAT.

Fig. 4.

Having procured a small piece of soft wood, perfectly free from knots, say seven inches long by one-and-a-half square; mark out with a pencil the keel, stem, and stern, and with a knife cut along each side and down the stern; Fig. 5. gradually cut away the corners to make the shape of upper portion, and then cut away the sides, making fig. 7, Fig. 6. the bottom of the boat, and afterwards finish off the stern (fig. 8). Having completed the outside work, you next scoop out the inside with a Fig. 7. Fig. 8. small gouge (fig. 9), leaving a small ridge to rest the

Figure 81: A page from *The Boy's Own Toymaker* (1881)

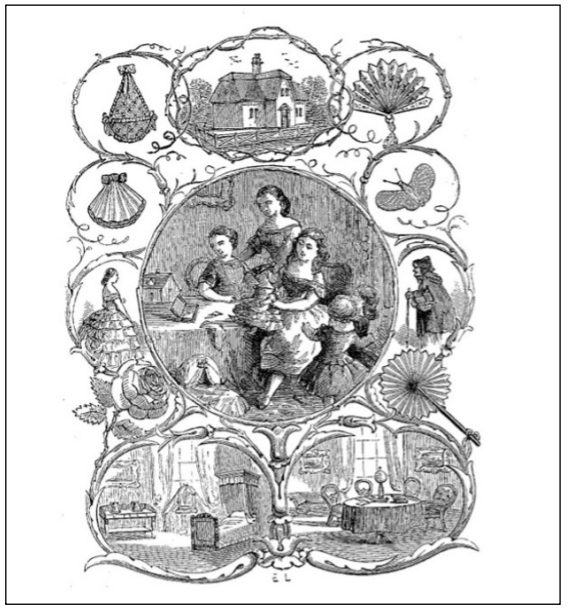


Figure 80: Cover page of T*he Girl's Own Toymaker and Book of Recreation* by Landells and Landells (1860)

6.3.7 Twentieth century Readi-Cut homes (from early 1900s)

Based on the idea of pre-cut, pre-fitted boats for consumers from a Michigan (U.S.) company, the Sovereign brothers started to sell kits for boats, homes,

and garages in 1906. 'Anyone who can drive a nail can put together an Aladdin House', they stated, 'We supply the entire house for you to fit and nail together in a few days' (Broman, 2010). See Figure 83. A few years later they named those pre-cut houses 'Readi-Cut', and started to offer small cottages, farm outbuildings (barns and henhouses) and, later, interior furnishings such as cabinetry, from 1915. They soon successfully extended to large-scale houses of all styles. Many other companies (such as Radford Architectural Company, Sears, and other Michigan firms, Liberty, Sterling) would compete with Aladdin in the Do-It-Yourself housing market in the twentieth century (Broman, 2010).

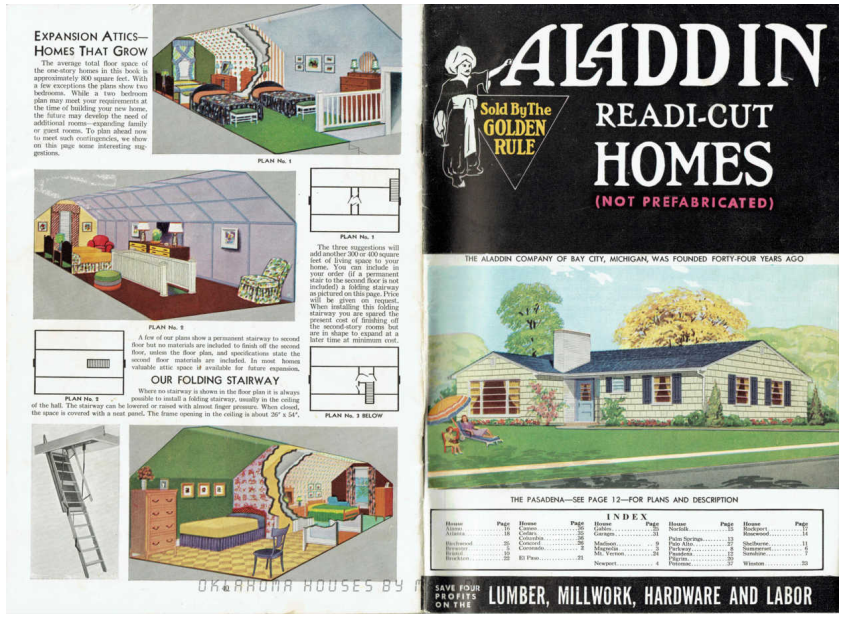


Figure 83: Readi-Cut home from Aladdin Company (1949-50) (Shoemaker, 2017)

6.3.8 Radio hobbyists 1920

An early example of modern era DIY amateur communities was established among radio hobbyists in the 1920s (Figure 84). People bought and made so-called 'crystal sets' and learned Morse's telegraphic code. This involved winding copper wire coils and stringing antenna wire. There were radio magazines, which were read by many early amateur radio operators. Ham (amateur operators) radio communication would continue until the 1950s.

6.3.9 Housing and furniture DIY projects 1930s

Brigham's Box Furniture

In 1909, Louise Brigham published a how-to manual *Box Furniture* (Figure 85). By advertising and providing instructions and examples that illustrated how to make furniture from recycled materials, the book would have fitted perfectly in today's context. Her mission was to 'render humble materials into beautiful and useful objects for the home' (Weinberg, 2009). Her instructional book involved, for example, bean boxes and canned fruit boxes to be used for the design and making of cupboards, desks, chairs, and music stands.

Figure 84: Radio amateur and Radio station 3ADT with Westinghouse RC (right), 1923 (Koster, 2019)

Box Furniture aimed for and conveyed simplicity, repurposing, sustainability avant la lettre, affordability, use of simple materials, modular design, participation, and utility. Although a progressive-era activist, artist and social worker, her work should not be interpreted as art education. Brigham's mission rather concerned 'vocational training' (Weinberg, 2009).

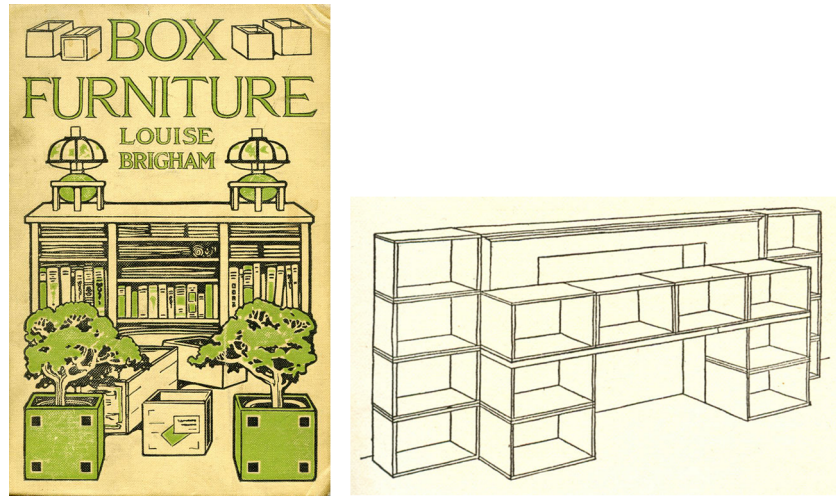


Figure 85: Box Furniture by Louise Brigham (1909)

Perriand's DIY holiday home

The first part of the twentieth century showed some interesting design efforts that concerned DIY facilitation. Charlotte Perriand, architect, student and then partner and competitor of Le Corbusier, created holiday houses for the recreating individual to assemble him or herself. Perriand called it 'La Maison au bord de l'eau' (Figure 86). Charlotte Perriand was very dedicated to creating tiny living spaces; her designs eliminated anything unnecessary, according to Perriand's daughter Pernette. 'Charlotte designed for the workers, not for the bourgeoisie' she says (Roux, 2022). This easily constructible holiday house is

an 'apotheosis of Modernist principles' (Roux, 2022), referring to its functional and affordable character and its exposed structure.

The principles and aims applied in Perriand's modular holiday house, and the dedication to the creation of small living spaces, align with the principles expressed in today's 'tiny houses' philosophy: e.g., self-sufficiency, life brought back to its essence, fewer material possessions, making conscious decisions (anonymous, 2020b).

Figure 86: Charlotte Perriand: DIY holiday home (1934)

6.3.10 1920s and 1930s crisis years

These were the years of economic crises, which made DIY efforts necessary to 'keep up appearances' while people's incomes decreased drastically (Science-Museum, 2020). Atkinson refers here to activities such as home maintenance, done by people themselves rather than by a professional, as a consequence of insufficient income or unavailability of professional labour: 'economic necessity' (Atkinson, 2006).

W.P. Matthew was known as the 'Television, Radio and Newspaper Handyman'. He was the author of more than 20 books and presenter of DIY programmes in the 1930s and 1940s, when a large number of new houses were built in Great Britain. During the 1930s, he presented '*Your House in Order*' on the radio. Matthew promoted products and DIY activities (Winfield-Chislett, 2023).

6.3.11 Slöjdföreningen

In Sweden, the *Hemmens Forskningsinstitut* (HFI, the Home Research Institute) and the *Svenska slöjdföreningen* (SSF, The Swedish Arts and Crafts Association) suggested designing differently by including users, iterative processes and prototyping (Göransdotter, 2020). Around 1943, while aiming for a kind of 'designing democracy', through the involvement of a wide range of Swedish national organizations such as the Temperance Movement, various educational associations, women's organizations, youth movements, unions, and the consumer cooperation, the SSF wanted to establish a home reform project that concerned educating people in dwelling knowledge, housework and interior decoration (Göransdotter, 2020). Figure 87 showcases two covers the *Slöjdföreningen tidskrift* (from 1905 and 1945).

Figure 87: *Slöjdföreningen tidskrift*

6.3.12 Modern DIY (from 1950s)

'hard DIY'

While American men were involved in World War II, many women started to work in factories helping the military equipment industry produce artillery, battle ships, planes, trucks, guns, ammunition, etc. (anonymous, 2021; Spring, 2017). These women (Figure 88) were recruited by the USA government, which, for example, published posters portraying 'Rosie the Riveter', who became an American icon (Figure 89). The war industry had a big impact on the demand for, and use of, professional power tools. The demand for drills, i.e. from Black & Decker, increased even more because the 'Rosies', the women working in

Figure 88: Women working in factories during World War II, with power tools, still from (anonymous, 2021)

the factory, started smuggling the drills home for their husbands' personal use (anonymous, 2021). Black & Decker concluded that people desired to have power tools around the house, for domestic tasks, for repair, and e.g., to build their own shed. It marked the beginning of widespread development, sales, and use of power tools for the common man, catering to the consumer market. This necessitated making them cheaper and easier to handle to meet the requirements for household use. In 1946, the company Black & Decker introduced the Home utility line, the world's first popularly priced drills and accessories, such as drill bits, for the Do-it-Yourself market (encyclopedia, 2024). In 1961, Black & Decker introduced the cordless drill (Figure 91).

With the Second World War came the call for so-called 'self-reliance'. Government institutions promoted DIY activity; 'Dig For Victory' (Figure 90), 'Make Do and Mend' and 'Grow Your Own Food' were all slogans that appeared during and after the War (Science-Museum, 2020).

Figure 89: USA government recruitment poster for women to work in the war industry: 'Rosie the riveter' (USA library of Congress).

Figure 90: Figure 91: Poster calling for self-reliance, 1939-1946 (Science-Museum, 2020)

'Modern Do-It-Yourself' refers to the 1950s and 60s, when the DIY era came of age (Atkinson, 2006; Goldstein, 1998). World War II ended, which led to much work needing to be done; in the U.S., there was no skilled labour available nor was there money to pay for professional help (Atkinson, 2006). People's lives changed radically after World War II: working weeks became shorter, which resulted in more time for family and leisure, homeownership increased, loans were better and holidays longer.

Along with the power tools came paint emulsion, paint rollers, plywood, glues and other tools and materials. All of this enabled laypersons to start constructing and repairing things themselves, aided by the abundant availability of manuals, toolkits, and magazines. People learned and applied manual skills as leisure and practiced these skills to improve their homes (Goldstein, 2003). This DIY era concerned projects inside and around the house, and it meant the birth of today's widely spread DIY stores.

Figure 91: Black & Decker ad concerning cordless power tools (since 1961) (anonymous, 2021)

'The twentieth century phenomenon of DIY came of age with the middle class families of the 1950s and 1960s', says Goldstein (2003). She indicates that for many home-owners DIY was a way to realize the American dream of an affordable and modern home (1998). 'DIY resonated as a quintessential expression of that dream, especially as it was defined by the dominant values of the 1950s: domesticity, leisure, independence, see Figure 92 (Goldstein, 1998, p. 37)'.

Figure 92: DIY activity using consumer power tools, in a context of family values and domesticity (anonymous, 2021)

Modern DIY, or 'hard' DIY, as successors of the early DIY ('soft' DIY) (see Section 6.3.4), also provided means and tools to be creative. However, there were differences between 'pro-active' DIY, which contained self-directed creative design input, and 'reactive' DIY, characterized by the aid of kits, patterns and the assembly of pre-determined components (Atkinson, 2006). Sections 6.2.6, 7.3, and 7.5.4.1 address this distinction.

6.3.13 Post-war DIY (1960s)

As mentioned above, during the 1950s and 1960s, 'the growing interest in DIY coincided with increases in disposable income, greater leisure time, and improvements in lifestyle. It marks a confluence of a variety of historical factors: changing social and cultural conditions, developments in manufacturing technology, the importance of newspaper and magazine publishing — and even television celebrity', says Jackson (2006). He states that DIY is a representative of people's increased economic and social autonomy in the second half of the twentieth century. Some other important characteristics related to modern DIY activities are described below.

DIY activity can be seen as a democratization of the work process, allowing decision-making and freedom from supervision (Atkinson, 2006). The enjoyment of (1) making and (2) using one and the same product (for example, a

DIY dinghy boat) come together by doing it yourself (Jackson, 2006).

As mentioned above, DIY's popularity grew to enormous dimensions when magazines (Figure 93) and TV shows (Figure 94) entered the scene: these helped to motivate, to lower the threshold and to make DIY easier by providing clear instructions, examples and templates. In fact, this mediating function of the various instructional media seems to be an important factor in its popularity.

Figure 93: Popular Mechanics 1951 (Popular Mechanics) (De Decker, 2007)

Figure 94: Barry Bucknell in Do-It-Yourself, for British TV in the Fifties and early Sixties (Photo: Evening News/ Rex features).

TV shows, DIY magazines and books

Mr. Fixit is an example of DIY television; it is the name of an instructional television series which broadcasted on Canadian CBC Television from 1955 to 1965. Other similar TV shows included *The DIY Network, This Old House* and *Do It-Yourself* (later *Bucknell's House*).

DIY activity was immensely supported through DIY magazines that shared instructions, example stories and patterns. One such magazine was the *Whole Earth Catalogue* (1968-1972) (Dougherty, 2016), which represented the '60s counterculture and promoted access to and use of DIY tools from electronics to pickaxes and chainsaws (Lupton, 2014). Other examples include *Do-it-yourself magazine* (Figure 95), *Practical Householder* (Figure 96), *Hobbies Weekly, VTG Magazine, Home Journal, Shelf Enthusiast*, and the long running *Popular Mechanics* and *Mechanix Illustrated*.

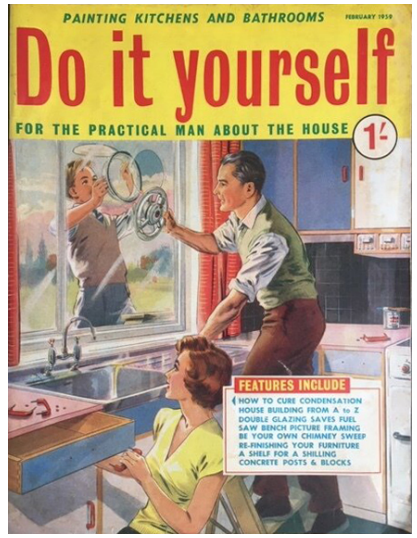


Figure 95: *Do it-yourself*: for the practical man about the house (1959) (Magman, 2022)

Figure 96: Instructions for how to build a table lamp, published in *The Practical Householder* August 1961 (Practical Householder)

6.3.14 Scandinavian design and criticism

'More than anywhere else in the world, designers in Scandinavia have instigated and nurtured a democratic approach to design that seeks a social ideal and the enhancement of the quality of life through appropriate and affordable products and technology', according to Fiell (2013). 'The Scandinavian peoples have traditionally relied on design ingenuity for their very survival and have become adept at skilfully handling the limited material resources available […] (2013, p. 12). Scandinavian design has throughout the ages concentrated on the production of tools, weapons and domestic implements, guided by craftmanship and essentialist principles. Both the concepts of *Slöjdföreningen* (Section 6.3.11) and *Skönhet för alla* (beauty for all) formed the foundation for the Scandinavian 'modernist' and 'democratic' approach to design (Fiell & Fiell, 2013). Swedish design history has always emphasized elements such as democratization, social and moral responsibility, 'close connection', functional and social design, all closely related to the (most of the time) socialistic and

social democratic character of the country itself (Fiell & Fiell, 2013).

According to many scholars, Scandinavia is also where participatory design originated. 'The participatory design movements in Scandinavia have their roots in post-war political movements striving for industrial democracy including forms of co-determination by unions and "shopfloor" workers in decision making and efforts to improve the quality of working life, in the broad context of democratization of society' (Gregory, 2003, p. 64). Sundblad (2011) specifically delineates Kirsten Nygaard's pioneering participatory design project in 1972, in partnership with the Norwegian Iron and Metal Workers Union (NJMF), which marked the commencement of engaging people and local unions in a computer systems research and development initiative, empowering these stakeholders with active involvement.

Norwegian critical design discourse in the early 1960s aligned with consumer activism, demanding product longevity and opposing so-called 'faddishness (fashion items)'. Inside and outside the design community, topics such as our natural environment, resource management and environmentalism received much attention. Briefly put, the criticism questioned what 'design for the real world' would entail (Fallan, 2011). Design and designers were named 'immoral minions of capitalism' and 'catalysers of consumption', Fallan (2011, p. 30) describes.

In 1962, designers were characterized as 'fadmongers' by the Norwegian botany professor Fægri, who wanted to defend the duped consumer (Fallan, 2011). Fægri and Papanek collaborated on an environmental regeneration project with students in 1969. Fægri, in 1962, published an article in *Farmand business magazine* with the title: '*The Designer - the 11th Plague*' (Fægri, 1962). The reason for his frustration and criticism was the discontinuation in 1960 of the production of a specific Porsgrund Porselænsfabrik oven-to-table set designed in 1955. Fægri primarily addressed the designers and the crux of his criticism was that the designers were 'self-asserting, egocentric, and cunning opportunists, turning everything they laid their hands on into ephemeral fashion products, while also being utterly servile to and uncritical of the manufacturers' immoral and irresponsible perpetual novelty pursuit', as Fallan (2011, p. 32) describes.

6.3.15 1980s DIY movement

The music scene serves as a representative example of what the British DIY movement or DIY culture was about and stood for in the 1980s: a 'counterculture'. Societal protests found their way through music, supported by the availability of MIDI equipment that made recording and producing easy (Kymäläinen, 2015; McKay, 1998). Earlier, the so-called Skiffle craze in the 1950s (using any nearby object as an instrument) also linked low-skilled music-making to protesting. For example, it was associated with the rise of the Nuclear Disarmament campaign. According to folk singer Ian Campbell, cited by McKay (1998, p. 21): 'DIY music [was] accompanying extra-parliamentary politics'. Comparing the DIY culture and NVDA (non-violent direct action) activism, McKay (1998, p. 16) says: 'Direct action implies acting yourself [...] having the initiative to decide for yourself what is right [...] fighting for control of your own life […] taking responsibility for your own actions on your own terms'. He cites a DIY activist who says: 'In the eighties, a lot of people who were hacked off with the way we were living, or were just plain bored, got off their arses and did something about it [...] DIY culture was born when people got together and realized that the only way forward was to do things for themselves [...] Ingenuity and imagination are the key ingredients' (McKay, 1998, p. 2). See also Section 6.2.4.1: DIY Ethic.

6.3.16 Further phenomena

At this point, this brief historic DIY overview starts to overlap with recent DIY activity and practices, which were explained in Sections 5.3, 5.2, 5.3, 5.4.1, and 5.4.2.

6.4 The overall value: DIY and the sustainability domains

6.4.1 Introduction: sustainability as starting point

The starting points and described problem statement of this thesis were outlined in Section 3 (Industrial design background and criticism) and Section 4.3 (Summary: the problem statement): 'How to improve the relationship between the user and the product, in order to (re-) establish a sustainable situation.'

The analysis sections of this thesis have uncovered that the major problem of 'our' unsustainable behaviour (both industry's and consumers') is caused by the (industrially induced) harm to the relationship between people and the items they use and purchase.

Today's culture of consumption, instigated by industrialization, has (had) very severe effects on sustainability (Ehrenfeld, 2008) because our natural environment suffers a lot from the consequences of traditional mass production and from the consumption, use and disposal of consumer products. What's more, passive consumption conflicts with people's aspirations and needs (Press, 2007).

In order to re-establish a valuable relationship, the concept of DIY was suggested. Section 6 discussed the concept and definition of DIY and has added a historical perspective. This paragraph measures the DIY concept along the domains of sustainability as they were defined in Section 4.1. It will help to validate the suitability of the DIY concept as an answer to the stated sustainability problem.

DIY, representing the bottom-up, opposite direction when compared to the traditional industrial structures, seems to bring forth a sustainable form of product design, creation, and usage. And it not only does this with regard to the environment; sustainability will be approached in a broad sense and is considered to concern both the human and natural domain. Through analysis of both literature and recent developments, this thesis attempts to validate the assumption that DIY, as a true type of Do-it-yourself- as a practice and philosophy, answers today's urge for approaching product design and development in a sustainable way.

The question of whether DIY has a positive impact on sustainability will be addressed by assessing current and past DIY practices from a sustainability point of view; what consequences/ implications does the phenomenon of DIY have from a human, natural and ethical perspective?

6.4.2 The 1st domain: DIY and the Human domain

Human needs, attributes of 'Being'

6.4.2.1 Sustainability: *'Human Being'*

DIY enables people to express their intentions, capabilities, and self-identity (Atkinson, 2006; Shove, Watson, & Ingram, 2005; Wolf & McQuitty, 2011). According to Schreier (2006), as a result, people benefit from functional advantages, from the uniqueness of the outcome, from enjoyment of the process and from the 'pride of authorship'. DIY enables people to reveal their identity and create exactly the product they desire (Von Hippel, 2005), and it provides a sense of democratization (Atkinson, 2006). DIY answers users' needs in terms of Maslow's Pyramid hierarchy: the level of self-actualization, corresponding to Csikszentmihalyi who states that 'man is also homo Faber, the maker and user of objects, his 'self' to a large extent a reflection of things with which he interacts' (Csikszentmihalyi, 1981).

Maines and Tanenbaum refer to the concept of 'hedonizing technologies' when focusing on the pleasures of production, privileging these pleasures over the value of the item itself (Maines, 2009; J. G. Tanenbaum, A. M. Williams, A. Desjardins et al., 2013). In a DIY context, these pleasures of production (the activity of making, doing) closely relate to what Schreier (2006) calls 'the enjoyment of the DIY process'.

Because of the attention given to the product, DIY activity enhances awareness and product attachment and imbues a product with meaning (Csikszentmihalyi & Halton, 1981; Mugge, 2007; R. Mugge, J. P. L. Schoormans, & H. N. J. Schifferstein, 2009; Seldis, 2017). As referred to in Section 6.2.2, DIY also increases people's self-sufficiency, autonomy, freedom, awareness, and a sense of democracy. Accordingly, the concept of DIY brings people closer to Maslow's attributes 'Being' (Helne & Hirvilammi, 2016; Maslow, 1998), and to Max-Neef's aspects of *human needs* (see Section 4.2.1, and Table 1 and Table 2). 'The activity of DIY and making encourages engagement with content, critical thinking, problem-solving and collaboration while sparking curiosity' (Salvia, Bruno, & Canina, 2016b, p. 2080).

The most important (and obvious) aspect of DIY is that it allows people to be designers (Edwards, 2006; Max-Neef, 1992; Prahalad & Ramaswamy, 2004; Press, 2007). DIY answers people's needs and desires and supports their 'Selves' by letting them address their psychic energy in a product or task: human 'Being' as an important aspect of sustainability (Figure 2). The product gets 'charged' (Csikszentmihalyi, 1981). By charging a product through investing attention, '…people expect from it satisfaction and even a certain inner growth' (Friedmann, 1961, p. 108). When observing a case of DIY from the 1960s, for example, the interior decoration of a home with the help of paint emulsion (Figure 97) and paint rollers (Atkinson, 2006), compared to a DIY project done in 2011 (for example, creating a 3D printed jewellery hanger based on a self-made CAD file), it is the same set of motivational factors that is of importance. When it concerns DIY, it appears that people are driven by their motivation to participate in the process (exert creativity) and by the result: the individual and personal outcome (striving for status, revealing identity) (Schreier, 2006).

As introduced in Section 5.3.2, creativity is what makes the human species unique (Csikszentmihalyi, 1998; Sennett, 2008). People have always wanted to express their creativity, says Atkinson (2006), and executing the design process by yourself answers people's need for a sense of control in general (Ruskin, 1853; Thompson & Schlehofer, 2008). According to Wehr

Figure 97: DIY interior decoration in the 1960s (Halcyon)

(2013), people closely relate DIY to self-reliance and control (Science-Museum, 2020; Wehr, 2013). Control provides assurance about future outcomes; control helps to avoid effects of helplessness. People have an innate need to control resources. 'Personal control is about the judgment that one has the ability, resources, or opportunities to take action to increase the likelihood of obtaining positive outcomes or avoiding negative ones' (Thompson & Schlehofer, 2008). These aspects answer the need of people to have control over their work without being supervised (Atkinson, 2006). The sense of control DIY offers is closely related to that of democracy. Similarly, counteracting Rogers' traditional model of diffusion of innovations (Rogers, 1962) (Figure 34), DIY concerns a bottom-up hierarchy of user involvement, collaboration and facilitation.

In the past, DIY has facilitated, through newly established self-publishing options, the propagation of specific subcultural views. Additionally, DIY has

historically helped to level classes, as it helped break gender barriers (Section 6.3.4), by permitting the working classes to engage in leisure activities from which they were previously excluded (Atkinson, 2006). Similar to Nieuwenhuys' observation (1969) that was mentioned in Section 4.2.1.1, Georges Friedmann wrote in his *The Anatomy of Work* that people are employing their leisure time in diverse ways in an attempt to realize the potentialities left unused by their jobs. Friedmann saw that people started to fulfil their cultural and recreative needs by, for example, constructing and decorating their homes and making boats themselves.

DIY provides the means for people to teach themselves all kinds of skills. This increases people's assertiveness, activeness, self-confidence, and self-respect. According to Atkinson (2006), DIY can enhance people's notion of themselves as designers rather than as passive consumers. One of the effects of DIY is that people learn from the process and practice their creative skills again and again, encouraging people to constantly develop themselves. But most importantly, people improve their own 'selves' by actively engaging (pursuing their individual requirements) in the creation of an object or performing a task, as interpreted from Csikszentmihalyi (1981).

As we've learned earlier in this thesis, the *'Human Being'* assumes a specific role in this world. The distinction between human beings and other animals (or life in general) is characterized by a number of facets, among which the ability to use tools, to cook, to care (Bryson, 2009), to make fire and talk about fiction (Harari, 2014), and to be creative (Csikszentmihalyi, 1998). The development of the 'Self', or the development of *'Human Being'* , represents one of the pillars of the *Tao of Sustainability*, as defined by Ehrenfeld (2008). According to Ehrenfeld, the concept of Being (Heidegger's Dasein: human beings as conscious, connected and inseparable from the world, as referred to in Section 4.1) should be a starting point when striving for sustainability. The altered supplier-consumer relationship, instigated by the upcoming practice of DIY, promises to have a positive impact on humans and the world they live in. DIY promises to support a sustainable relationship between things and people, respectively between people and nature (Bianchini & Maffei, 2013; Salvia, 2013), and hence supports Being.

6.4.2.2 DIY, and harmony, duality

Ehrenfeld (2008) refers to the Tao (Tze, 1972) when he refers to the balance between Human, Nature and Ethics. In terms of Tao, any strict separation should be avoided. Tao's unity can be seen as a duality of two dynamic parts of a whole: non-separate, not opposing, but complementing each other and exchangeable. One requires the other, not in a static equilibrium way, but dynamically, in harmony (Stikker, 1986). The Yin Yang symbol specifically excludes any sharp boundaries, as Figure 98 shows.

Interpreting this could help with reaching the unity and harmony needed for a fair relationship between making and using, between the producer and the user, between people and nature (Section 4.3).

6.4.2.3 Self-reliance

In his book *Democratizing Innovation*, Von Hippel refers to innovating lead users who are ahead of the majority and therefore can help producers significantly in their NPD (new product development) process. For example, 'in the kite surfing industry, the collective

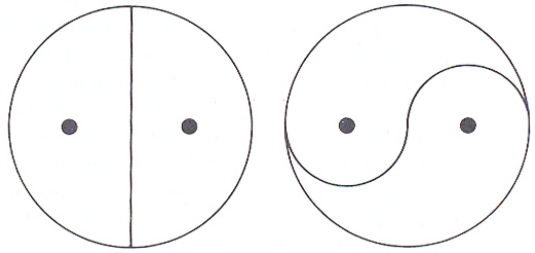


Figure 98: Yin Yang: one requires the other (Stikker, 1986): Western (dividing, on the left) vs Taoist (harmony, on the right)

product-design and testing work of a user innovation community has clearly become superior in both quality and quantity relative to the levels of in-house development effort that manufacturers of kite surfing equipment can justify' (Von Hippel, 2005, p. 14). Although this case clearly showed the benefits of user design, users will not always be capable of doing the highly skilled work as described by Von Hippel. The level of participation strongly relates to the product itself and the user involved.

Mike Press explains: 'In the old days […] consumers were just people who consumed the products of a corporate power and vision. Innovation was clearly a top-down thing'. 'Today', he says, 'we are all bloggers, creators of our own culture on YouTube, open software participants, and contributors to product innovation' (Press, 2007). He mentions that, after having nominated a *real* 'Person of the Year' ever since 1928, *Time Magazine* nominated 'You' in 2006. *Time Magazine* writes: 'The World Wide Web became a tool for bringing together the small contributions of millions of people and making them matter' (Grossman, 2006).

6.4.2.4 Experience

When considering the value of DIY to people, it seems wise to also judge along the definitions of 'experience'.

The experience of DIY as an activity, answering many of the *human needs* as defined by Maslow and Max-Neef (Maslow, 1943; Max-Neef, 1992), promises to align rather well with Desmet's and Hekkert's definition of 'product experience' (2007). As discussed in Section 2.3.5, they distinguish three levels of product experience: (1) aesthetic experience, (2) experience of meaning and (3) emotional experience.

In fact, DIY could help elevate the product experience at all three levels:

(1) Frank and Schreier (2004) affirm the beauty of self-designed products, according to their findings that laypersons appreciate the results of their DIY activity more than the standard product.

(2) DIY provides more opportunity to impose your own personality than an off-the-shelf product would do, since DIY by definition charges a self-designed object with (symbolic) meaning. By charging a product through investing attention, '…people expect from it satisfaction and even a certain inner growth', says Friedmann (1961, p. 108). Or, as Csikszentmihalyi (1981, p. 190) has stat-

ed: 'When an object is imbued with qualities of the self, it expresses the being of that person, whether in written words or a chair that was crafted or a photograph.'

(3) Referring to Mugge (2009), who states that 'For the formation of a strong emotional bond with a product, the consumer should personalise the object through an effortful process', and who also describes how such a bond results in better care for a product, it seems plausible to conclude that DIY associates with a higher bonding and the tendency of people to take good care of the result. Interestingly, 'care' is what Ehrenfeld calls 'the heart of sustainability' (Ehrenfeld, 2008).

In relation to the above, Marchand and Walker (2008) have found that communities practising self-production and repair were motivated by the rewards they received concerning a longer-lasting relationships with those self-made items.

6.4.2.5 Product fit, personalization

Apart from all the psychological benefits and benefits relating to sustainability, there is still the direct advantage of a DIY result: it answers one's individual product design requirements. At least, that is what DIY promises and offers: deciding for yourself what the design will be, considering aesthetics, making, functionality and its general purpose. DIY can bypass the requirement of satisfying a wide and heterogeneous audience and it can bypass any conditions that concern brand alignment issues. The layperson designing for him or herself is the only stakeholder. Examples of DIY projects fulfilling aesthetic goals are numerous, see Figure 99.

Figure 100 shows a self-designed and self-built house, a project in which the layperson designer was able to reflect both his aesthetic wishes (fitting in the environment) and his function wishes (living in it).

Figure 101 shows a still of a video that concerns instructions for the DIY building of a forest shed. There are many of these DIY instructional videos.

Figure 99: leaf prints on boiled eggs after boiling with onion skin (25 Must Do DIY Projects, 2015)

Figure 100: Self-design house (Hytte Ustaoset, Norway, by Jon Danielsen Aarhus, 2017)

Figure 101: DIY building a forest shed (DUYbuild97, 2023)

6.4.3 The 2nd domain: DIY and the ethical domain

The ethical component of sustainability, which could be regarded to be the overarching component, concerns people's accountability for their actions, 'the act of avoiding harm knowingly', according to Ehrenfeld (2008). Ehrenfeld puts forward that modern technological life has made it difficult for people to know the consequences of their actions, because of displacement in time and space. As a consequence, it has become problematic to feel and be responsible.

To be able to conclude whether DIY represents a sensible and desirable scenario, whether it represents a practice that should be supported or not, DIY is to be valued from different angles. One is the viewpoint of labour division, strongly related to industrialization, to which DIY is assumed to be the opposite. The division of labour - according to many authors - resulted in so-called alienation between the maker and the product, whereas any form of DIY activity – by definition - represents an integration of tasks; the end user will pull tasks to-

wards himself: 'de-alienation', either vertically speaking (see Section 3.3.3.2) or horizontally (Sector A (Toffler, 1990)). 'The consumer engages in de-alienation, by use and by customization to their own needs' (Julier, 2007, p. 60).

Many authors, when considering product design, emphasize the importance of the relationship between product and user (Verbeek, 2000). In essence, as Clive Dilnot (2009) has put it, design is about relations. 'What design designs are the relations between things and persons and things and nature' (Dilnot, 2009, p. 183). French sociologist Bruno Latour approaches things as matters of concern: '…how many participants are gathered in a thing that make it exist and maintain its existence' (Latour, 2004, p. 246). From the user's perspective, the ultimate way to charge a product with attention would be to design and create it yourself.

DIY encourages people to constantly develop themselves. Most importantly, it helps people to improve their own 'Selves', by actively engaging (pursuing their individual requirements) in the creation of an object or performing a task, according to Csikszentmihalyi (1981).

Eric Fromm poses that 'the basic passions of man are not rooted in his instinctive needs, but in the specific conditions of human existence, in the need to find a new relatedness to man and nature after having lost the primary relatedness of the pre-human stage', as cited by Csikszentmihalyi (1981). When people create their own goods, they're forced to take care of their resources; they need to connect to their environment. DIY stands for de-massification (Toffler, 1990) and – as mentioned before – brings back together people's actions and the consequences of these actions.

According to the above, DIY product design seems a reasonable scenario to achieve a better connection (1) between human and the product and (2) between human and nature.

6.4.3.1 Democratizing Design/ Self-determination

DIY's democratizing effects apply to the ladies who did home decoration and crafts themselves in the nineteenth century. Although the women's domestic works were seen as good 'housewifery' (Edwards, 2006) or as a sign of 'femininity' (Gelber, 1999), the activities were also a means of self-expression and provided self-respect. 'No well-bred gentleman would scrutinize or inquire into the exact shape or purpose of any article a lady might be engaged upon' (Anon., 1853), cited by Gelber (1999, p. 162). Along with people's social motivations, DIY answered to certain ideological, craft-related ideas. In 1956, Editor of *The Practical Householder* Camm wrote: 'Do-it-yourself is an expression of the ingenuity, enterprise and self-reliance of the individual, […]', cited by Edwards (2006). In her paper '*The Democratization of Fashion*', Walsh (1979) writes about how patterns democratized clothing in the nineteenth century, giving ordinary people access to fashionable clothing.

Modern DIY (1950>) in many ways means a democratization of the work-process (Atkinson, 2006). People are their own boss when they organize and do their home maintenance projects. Doing the work oneself, instead of hiring a professional, is off course a kind of democratization on its own.

Some use the term 'democracy' in a different sense, different from its relatedness to the involvement of people (Section 4.2.2.3). The title of IKEA's '*Democratic Design Manifesto*' seems to promise that they consider people's direct design input. However the company refers to five other so-called democratic principles of which it says these form the heart and soul of IKEA: form, function, quality, sustainability, and low prices (Engman, 1995).

6.4.3.2 Product attachment

The more the user can change and decide, the higher the feeling of accomplishment and product appreciation. Becoming attached to a product or object that is self-made is easier than with industrially produced ones (Belk, 1988; Mugge, 2007; Pierce, Kostova, & Dirks, 2003). According to Pierce, 'The most obvious and perhaps the most powerful means by which an individual invests him/herself into an object is to create it' (Pierce, Kostova, & Dirks, 2003, p. 93). Accordingly, Norton (2012) notes that 'labour leads to love' (only if a task is completed), referring to the increase of emotional product attachment when consumers make something themselves, by hand. As discussed in Section 2.3.7, Mugge (2007) distinguishes self-expression, group affiliation, memories and pleasure as the four most important factors that influence attachment to products. It is not a surprise that she states that customization of a product brings a high level of attachment. This aligns with Schreier who states that the most extensive DIY activity results in the strongest user-product attachment, even willingness to pay (Schreier, 2006).

6.4.3.3 Appropriate Technology

Initiated as a critique of the dominant policies which focused on maximizing economic growth, 'appropriate technology' is a term and movement that relates to production and technology that is small-scale, affordable by locals, decentralized, energy-efficient, environmentally sound and locally autonomous (Hazeltine & Bull, 1998).

The definition directly signifies its ethical aspect: utilizing technology that is appropriate, not too much, not too little, people-centred and labour–intensive. Stemming from the context of the energy crisis in the 1970s and also relating to economic development in non-developed countries, today it refers to utilizing the simplest technology that would still achieve a certain purpose, a consideration mostly in order to address social or environmental issues. Appropriate technology was originally named 'intermediate technology' by the economist Ernst Schumacher in his work *Small Is Beautiful* (Schumacher, 2010).

One of the origins of the tendency to electrically power all domestic appliances stems from the idea of abundant energy availability, starting in the age of the Industrial Revolution. Later, in the U.S., the use of electricity as such was even promoted (around the 1960s) to support sales and the economy. 'Don't let work kill the housewife, let electricity do it for you!', according to commercial sales pitches in the 1950s (Lean, 2017)'. 'Our domestic "needs" are culturally constructed', says Greenfield (2013). Rising expectations, he states, have often led to a rise in energy use. He argues that, in order to reduce energy use, 'change must be more than technological: it must be cultural too.' Although in a different time and context, today's governments again extensively promote the use of electricity as a solution for everything, even in terms of sustainability. It seems plausible though to not search for the solution in finding new energy sources, but rather to adapt patterns of energy usage.

'Appropriate technology' thinking is in a way also closely related to the criticism that is called 'alienation' (Section 3.4.6). Similar to de-alienation, utilizing appropriate technology could support a better connection between people and the things they use or operate. In this thesis, the concept of DIY is associated with laypersons designing and making their own product.

Interestingly, this DIY concept also applies to the relationship between user and product in a use situation, i.e. the principles of self-sufficiency and DIY not only apply to the product design process, but also to the interaction and usage. This considers the human-product relationship, awareness of the relation between action and consequences, and the support of human creativity and involvement. The principle applies to the accessibility and transparency of a product. In this case, DIY and self-sufficiency mean: see and understand what a product entails, what happens, how it functions, how it is made, have the option to manipulate, change, improve and repair. In that sense, automation, smartness, internet of things, and digitization in general, can – apart from their positive assets – cause an increased distance between user and object due to a lack of accessibility, transparency, and hence involvement.

'Appropriate Technology' is still a very valid concept of criticism, since today there seems to be an urge to increase the smartness of physical products (digital interactions, automated driving, Internet of Things), whereas this will inevitably result in a decrease of awareness, control, involvement, and access. Interestingly, vinyl records are more popular than they have been in the last 30 years, which represents a trend of returning to mechanical and transparent mechanisms, opposing digitization. Modern examples that might help plead the case for appropriate technology, as they illustrate the unnecessary use of electricity, include wayfinding (Google maps vs paper maps), using a leaf blower vs using a broom, riding a bicycle using battery power vs using human power, or craft making vs 3D printing, etc. This criticism concerns aspects as pedagogy and awareness, emphasizing the relationship between user and product. Voting machines form an example; the user has no insight into the machine's functioning or malfunctioning. Digital and electronic technology in these cases is not transparent to users when it concerns their functioning. According to former Dutch Minister of Education, Culture and Science (OC&W) Dijkgraaf, we've become dependent on technology and he poses the questions of whether we still know what is going on and whether we can trust it (Berg, 2022). Accordingly, Ehrenfeld noted in Section 4.2.2.1 that technologic advancements, globalization, and labour division, i.e. displacement in time and space, hinder people's awareness of the consequences of their actions.

In short, Appropriate Technology (Hazeltine & Bull, 1998) concerns:

- Small scale
- Decentralization
- Labour intensive
- Energy efficient
- Environmentally sound
- Locally controlled

6.4.3.4 The appearance and form of a product as such: honesty, transparency

The size and form of products are mostly proportioned based on an architecture of components in close balance with aspects and elements of usability and user-product interaction: an 'honest' assembly and design. To make a product accessible and understandable, the user (and maker) should be able to grasp it, the form of it, the construction of it, the working principle, and the assembly.

Dutch journalist, essayist, and writer Hofland reflects on the difference between (1) machines (products) of which all mechanisms and movements are visible: publicly exposed machinery and components, is how he names it, and (2) 'dressed' machines, or even 'dressed-up' machines: products housed within a casing for the sake of safety, aerodynamics or fashion and commercial display. The first category is associated with bare and visible movement of components, and the noise and the accompanying smoke, which Hofland calls 'the music of the movement' (Hofland, 2002, pp. 10-11), which one could interpret as the 'poiesis' of the bare machine. In his book *Machines in Bikini,* W.F. Hermans (1977), an eminent Dutch writer, criticizes the imbalance between products and the housings in which they have been forced. He refers to automobiles that have started to look like puddings, electric razors like pieces of soap, flat-irons and lady shavers like goldfish and singing birds, and airplanes as if they would never have to land. 'The miracles of technology are being encapsulated by apathetic uniformity', he writes. W.F. Hermans explains that, as a result, consumers have started to care less, skip maintenance, and have less respect for products.

As digitization of products has fostered a design tendency of miniaturization and of a sometimes symbolic appearance, the working principles of a product become less visible to the end user. For that reason, it is important that designers make the invisible functions visible (Bonsiepe, 2006), in order to give 'visual' access to the items people use. 'Honesty' and 'appropriate technology' clearly refer to having a better and honest connection (relationship, see Section 2.3.3) with products, as part of the world around us. In a way, a famous example of such 'honesty' is in the Fairphone (since 2013), see Figure 102. Its manufacturer has focused, using a modular approach, on the replaceability of their components, hence allowing a longer product life and a better user involvement. Fairphone focuses on fair sourcing of materials and fair production, and the modular set up facilitates easy repair, upgrades and recycling.

Figure 102: Fairphone 5

6.4.3.5 Wear and tear, or building a relationship

A product's value to anyone can increase because of the traces of the product's use by the owner. Musician Brian Eno (Weightman & McDonagh, 2003) notes in an interview how traces of use help convey a product's life and the relationship people have had with it. He explains how it supports the user-product connection. Referring to these traces, he believes that people have a taste for things that do not have a 'one-reading-only' surface, but show they are 'alive'.

Kintsugi, Kintsukuroi, golden repair

The Japanese art of *Kintsugi* concerns the repair of broken ceramics with gold or silver *maki-e* lacquer. Traces of these repairs contribute to the beauty of the object, according to the Japanese. One distinguishes *hibi* (all fragments are assembled), *kake no kintsugi rei* (one or more fragments are lacking, see Figure 103) and *yobitsugi* (using a similar fragment of something else). Related to *Wabi Sabi* philosophy, it appreciates beauty through imperfection and perishableness (Smith, 2015). Kintsugi emphasizes the cracks in a ceramic object, which helps to uncover part of its history (Kwan, 2012). *Kintsugi*, as many repair practices

Figure 103: Example of *Kinstsugi* (The Ceramic School)

do, relates strongly to Kopytoff's *Biography of things* concept, as discussed in Section 2.3.3; the repaired object expresses specific traces which are there as a result of people's repair intervention. The concept of 'beauty through repair' also supports the avoidance of throwing away things that are broken.

6.4.4 The 3rd domain: DIY and the natural domain

The world around us

As mentioned above, designing and making your own objects and tools brings about a product that ultimately answers one's individual wishes. As a result, people will need fewer attempts of trial and error before they find the item they require. Ultimately, it will lead to a situation of less consumption. Higher involvement increases people's consciousness of the materials and resources

used (Csikszentmihalyi, 1981) because they have to (more or less) acquire their supplies themselves. This is even more the case when the end user searches for and purchases his or her own semi-manufactured goods or raw materials. Both motivational categories that characterize DIY, human cultivation by doing a project for oneself and 'the pride of authorship' (Schreier, 2006) as a result of the DIY process (see 6.3, Sustainability: *'Human Being'*), increase the attachment a person feels towards his creation. The closer human-product relationship enhances the user's care for the product, thereby the product's durability (Verbeek, 2000). DIY allows people to not only choose colours or apply aesthetics but to push a product's design towards efficient material use, sustainable material selection, etc.

Studying makers of cigar box guitars, Atkinson (2020) notes that these self-made objects are built almost exclusively by recycling, re-using and repurposing. This DIY activity consequently results in (1) a longer life of these otherwise 'redundant' component parts and (2) these endeavours often create strong emotional bonds between the instruments and their makers. The latter stimulates the life extension of the objects even more, through a longer period of use, reconfigurations, modifications and – over time – the makers' improved skills. These conclusions seem to clearly provide answers to the problem of 'Throwawayism', an intrinsic element of consumerism, referred to by Cooper (2005) as well, discussed in Sections 2.3.7 and 3.5.

As true types of DIY, assembling and maintaining your own belongings has a very positive effect on sustainability and nature. The activities give rise to better care, due to striving for quality (Pirsig, 1974), and a longer life for the object. DIY brings forth barter and re-use; people tend to search for cheaper and more sustainable solutions rather than just 'buy a new one'.

DIY as a practice and as a philosophy represents, in organizational terms, a move towards horizontal as well as vertical integration (Mintzberg, 1983); people do a greater part for themselves and do the managing or execution by themselves (see also Section 6.2.4). The 'organizational' integration (in contrast to the division of labour) brings about a better involvement of the maker, a higher spirit, and lets the maker be the 'owner' of the task.

6.4.5 Limitations of the DIY concept

Although DIY as a concept promises to (re-)establish the user-product relationship (the connection between making and using), it is important to also consider the potential negative effects of DIY activity.

As described above, DIY can be attributed great value from the perspective of the sustainability domains, such as those used by Ehrenfeld. It is important to note that the phenomenon of sustainability, from these perspectives, is approached with a long-term view: how sustainability can ultimately be achieved within the ethical domain, the human domain, and the nature domain. Involving people, the awareness process, and the intended improvement in understanding and responsibility for the consequences of human actions, as well as the positive impact this can have on nature and human well-being, require long-term commitment.

That in itself is already a limitation. However, there are also short-term limitations to consider. Section 7.5.6 discusses, in general, factors (dimensions) that should be addressed before and during the consideration of DIY. The complexity of tasks could serve as a threshold for DIY activity, as mentioned by Dellaert and Stremersch (2005) in Section 7.5.6.7. Repairing

or assembling electrical components can - when it comes to DIY - pose hazardous situations, as noted by Bakırlıoğlu (2017)in Section 7.5.6.9: the safety dimension of DIY. These and other 'boundaries' of DIY (see Section 7.5.6) require a balance in the division of tasks between the facilitator and the executor (the layperson) of a DIY project.

When reflecting on its sustainability, DIY trial and error can lead to inefficient use of resources. It is important to note that DIY - being inherently focused on single-piece production - does not benefit from scale advantages that could promote efficient material use. Additionally, the layperson may lack the professional knowledge to select the best and most environmentally friendly materials. This trial-and-error approach can also lead to increased waste: DIY activities may result in an excess of temporary prototypes (for example, due to creative exploration). As Mota (2011) notes, 'Digital fabrication tools can turn out to be either a much more sustainable form of production or generators of an enormous amount of additional refuse'.

6.5 Learning from the past: returning factors that drove DIY

A brief analysis: factors that stimulated the intention to Do-it-yourself

In order to find out what drove DIY activity and what DIY could teach us, and to create a new frame of reference, it's important to depict DIY's factors of the past. These factors seem to play an important part in today's circumstances as well. A series of categories of stimuli can be listed, each referring to a wide range of sub-factors. Eras of increased DIY were generally stimulated through:

- the specific context of a certain timeframe
- technology advancements (manufacturing and information)
- human (innate) motivation
- mediation/facilitation

These factors will be discussed in the following paragraphs.

6.5.1 1st Factor: Contextual factors

Design is a reflection of society

Apart from technological factors, factors that concern *human needs* and behaviour, and the mediation as an agent to achieve participation, different periods in history always have their specific character; they form specific contexts. Those factors have been discussed in the previous sections (Section 6.2 and Section 6.3). They concerned, for example, the social shift that introduced so-called 'Early DIY' (bifurcation of work and leisure), the eras of necessity DIY in the early 1900s, and the end of the Second World War indicating the need for DIY home maintenance and care for the nuclear family (Figure 104).

The post-World War II years and this nuclear family concept also showed a culture of rebuilding and re-establishing both society and the economy. People initiated hobbies such as DIY construction of houses and sheds.

Figure 104: Investing in the nuclear family through DIY activity (no source found)

Another example was the so-called automation that created the urge to spend creativity and energy that was left unused by people's jobs on hobbies and leisure (Huppes, 1985). Fear of war during the Cold War period led to the promotion of fall-out shelters and self-help activity. Criticism, social activism, and protests were among the motivations for a DIY culture in the 1970s and '80s (see 6.2.4.1).

Generally, and logically, in times of crisis, people turn to taking care of themselves through self-sufficient solutions, mending, repairing and DIY making, and by growing food. This is why, during the financial crisis around 2008, people in Greece living on islands and growing their own crops had better lives and were better prepared and equipped than people from the city. The definition of DIY also covers self-made weapons and vehicles such as tanks in war regions. Figure 105 shows examples of military vehicles, assembled from parts originally belonging to different vehicles and wrecks.

Figure 105: Improvised military vehicle, Kobane, Syria, 2015 (Secchi, 2017)

It seems important to stress that DIY in industrially developed countries means a counter direction to mainstream industrial economy, whereas DIY in non-industrialized societies is mainstream: mending, repairing, improvising, making for and taking care of oneself. See also Section 6.2.5 and Section 6.2.7.

6.5.2 2nd Factor: Enabling technology (manufacturing and information)

6.5.2.1 Tools for manufacture

Periods of increased DIY activity are characterized by the fact that they're preceded by specific technological advancements. These technological developments were of crucial value and facilitated - and still facilitate - the act of *doing it yourself*. More specifically, technological advancements resulted in the availability of tools, kits, and information, to the general public. Examples of these tools include the sewing machine of the nineteenth century, consumer power tools such as drills since the 1950s, and computers today. The term 'kits' refers to the availability and publishing of patterns in the nineteenth century, the DIY boat kits (for example, the Dinghy (Jackson, 2006)) in the 1960s, and today's user-friendly CAD and product-configurators. 'Information' refers to the distribution of DIY magazines in the early DIY period and in the 1960s, TV shows and today's internet forums.

In the past, the increasing levels of the division of labour occurred together with increasing levels of technology. Interestingly though, each recent rise of user participation that describes the opposite of a division of labour has also been preceded by new technological advancements. 'Technologies have had, and continue to have, a democratizing effect on design, []', according to Beegan (2008).

In 1851, the first home-use sewing machine (by Singer) was introduced. It was hand-cranked and then foot-powered. The sewing machines spread rapidly throughout the U.S.; women saved enormous amounts of time compared to doing the work by hand. Especially after 1877, when prices of the machines dropped spectacularly, almost every American woman was sewing with the machine (Gordon, 2007). Mechanization decreased the time women needed for plain sewing (practical needlework) and allowed them to spend more of their leisure time expressing the 'womanly arts' by doing fancywork (artistic and decorative items) (Gelber, 1999). In the 1920s, though, the number of women sewing at home had radically decreased because of industrial production methods and social and demographic shifts (Gordon, 2007).

Likewise, one of the most important factors that brought about the rise of the DIY movement in the 1940s and 1950s was the availability of consumer power tools, which was extensively referred to in Section 6.3.12 (see Figure 106). Tools and materials were made available for the non-professional (Johnson, 1967). Atkinson (2006, p. 9) refers to a 1954 article in *Time magazine*, titled *The Shoulder Trade*, which reported about the 'range of new tools and materials fuelling the DIY boom'. These tools included, for example, easy-to-use ready-glued wallpapers, rollers with a reservoir, and paint emulsion.

The arrival of the photocopier did the same for the creation of amateur magazines since 1956 (Triggs, 2006). And as the next step in this sequence, Information Technology –as stated above – has in many ways encouraged user participation. Referring to DIY in the 1950s and 1960s, Atkinson summarizes: 'The level of work necessary to build a fallout shelter would

have been far greater without the use of power tools, and the production of a dinghy at home would have been almost impossible without developments in materials such as plywood, resins, and glues. […] the easier reproduction and dissemination of fanzines, with the associated lack of censorship from editors, publishers or retailers, was only achieved through the large scale take-up of photocopiers' (Atkinson, 2006, p. 7).

Figure 106: Dremel sander (three tools in one) ad from around 1949 (Goldstein)

The Internet caused the tremendous rise of user-generated content and online user participation in general, as can be concluded from the popularity of forums such as Flickr, YouTube, Wikipedia, etc. Note that the word *Web 2.0*, which means the 'web as platform' and implies participation by users, was only introduced in 2002.

As they have done in the past, technological advancements today seem to first help professionals to take up more complex or efficient projects before they become available in the form of consumer tools that help the end user to DIY.

6.5.2.2 (tool)kits for DIY in the past

'Part of the sustained growth of DIY as a leisure activity from the 1960s onwards may be attributable to a gradual de-skilling of the process involved, reducing much of DIY to a case of self-assembly and finishing' (Atkinson, 2006, p. 5). As a comparison, in 1935, described DIY cases were works such as electrical work, wood turning or making a radio. Since then, people have received more and more assistance and less skill was needed. DIY turned into activities

based on semi-finished products, easy-to-use (tool-) kits and manuals: from pro-active to re-active DIY.

A toolkit can be defined as an aid to enable non-specialist users to design producible custom products that exactly meet their needs (Von Hippel, 2005). Toolkits, in the sense of helping the user participate in the process of design and development, have been around since the first home-based DIY period. Those were, for example, the patterns (since approximately 1860) that together with the emergence of the sewing machine and availability of fabrics caused the home-based sewing craze in that period (Gordon, 2007), see Figure 107 and Figure 108. Later, people used toolkits to build pre-determined constructions, boats, or model-aircraft (Jackson, 2006). The bike stool project shown in Figure 109 is available on *Instructables.com*. Figure 110 shows an example of the many DIY 'how-to' videos that are available on Youtube, concerning hobby projects and repair instructions of all kind. Knowing that the user's willingness to participate can be helped a lot by providing toolkits, the designer could facilitate the process of user-participation by creating the toolkits to help the user start a DIY project.

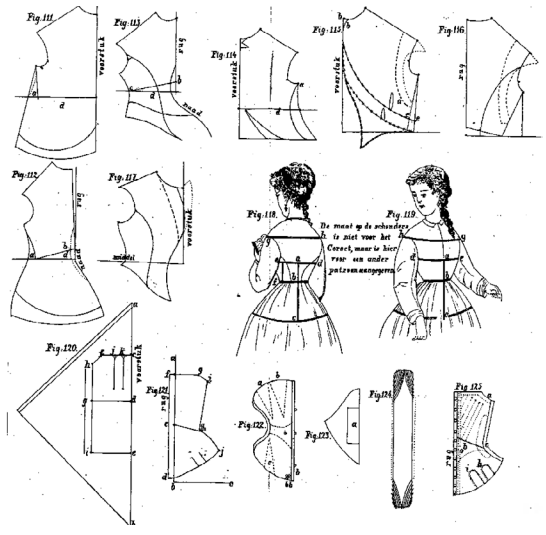


Figure 107: Mid-nineteenth century sewing patterns (Bender & Saskia, 2022)

6.5.2.3 Information

Both in the past and today, DIY activity depended on the availability of information: the availability of visual and textual support (patterns and example projects). Whereas, in the old days, there were magazines and ladies meetings and later even TV shows to promote and motivate people to DIY, today nearly everything can be found on the internet. Remarkably, DIY magazines (paper, webpages and digital platforms) are still here today.

Information appears to be a necessity and catalyst for the 'democratization' of design, both in the past and today. Specifically, the enormous increase of information availability helped and continues to help with spreading and sharing

Figure 108: Roebuck catalogue promoting 'home sewing' and selling fabrics (1926), The Winterthur Library: Printed Book and Periodical Collection and Gordon (2007)

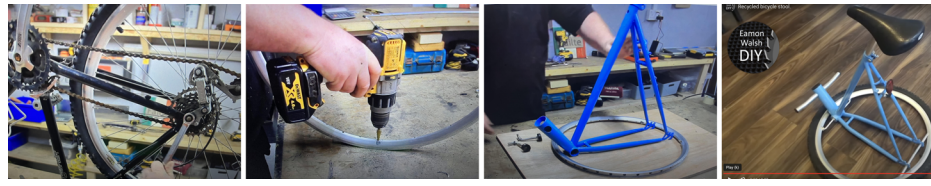


Figure 109: Bikestool project transforming a bicycle into a stool (*Instructables*, 2024)

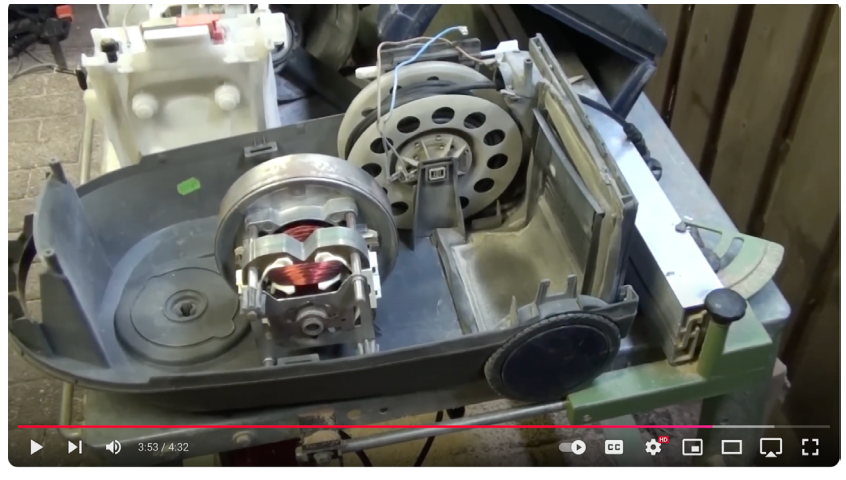


Figure 110: Video sill of repair instructions for a vacuum cleaner (Youtube, 2024)

('how-to') information with others, with other members of specific communities, with peers.

Press (2007) writes about the internet letting us all be like Von Hippel's lead users (Von Hippel, 2005), meaning that all people can be active innovators creating their own products. 'Over the past few decades, new materials and sharing mechanisms have led to a wider adoption of DIY culture', says Kuznetsov (2010b).

Digital technologies (S. Fox, 2013; Hoftijzer, 2011a) have connected people from all over the world and have brought production closer to consumption (distributed systems and scale-free local production) (Anderson, 2010; Salvia, Bruno, & Canina, 2016a), as discussed in Sections 5.4.2.1, 5.4.2.3, 5.5. DIY communities that focus on handicraft, everyday home improvement, citizen journalism, guerrilla gardening, solving of social problems or amateur astronomy, share projects through their networks. Laypersons use platforms such as *YouTube, eBay, Facebook, Flickr* and *Wikipedia,* and how to contribute and collaborate online (Kymäläinen, 2015). In 2012, reflecting on what he called the 'sharing online' shift, Anderson (2012, p. 13) stated: '[…] DIY'ers, once working alone, suddenly start working together'. Online platforms serve as communities for layperson enthusiasts to make, collaborate and share their work, and to comment, recommend or tag. Examples of such communities are *Instructables, Dorkbot, Ravelry, Etsy, Spoonflower, Crafster* and *Adafruit.*

6.5.3 3rd Factor: People's motivation to DIY

6.5.3.1 Motivation elements: a model of factors

DIY, in the past and in the present, has always been driven by the presence of at least two major factors. One is the facilitating technology that makes participation possible; the second factor is even more prominent: human motivation (Atkinson, 2006; Hoftijzer, 2008; Press, 2007).

In literature, motivation is often characterized by factors such as ability, opportunity, intention, and beliefs. Various models intend to relate the factors that influence a person's motivation to each other, starting from people's inner motives and leading to specific behaviour. Thøgersen (1995) has depicted these factors in a concrete MOA model that focuses on the three elements of Motivation, Opportunities and Ability, whereas Gatersleben (1998) and Vlek (2000) have constructed a rather complex and more complete NOA model, emphasizing Needs: an approach that considers people's needs and well-being. The HOAM model (Figure 111) incorporates the factors that influence DIY activity (context, technology, human motivation, and mediation). The model combines existing systems and adds 'mediation' as a factor that could help ignite the combined elements of opportunities, ability, and intention (Section 6.5.4).

Referring to Section 5.3.2 that discussed people's tendency to be creative, extensive division of labour (Mintzberg, 1983) was in fact very demotivating because of the repetition of the tasks to be done (Huppes, 1985; Marx & Engels, 1844; Mintzberg, 1983). DIY provides a sense of democratization; they experience the feeling of being their own boss (Atkinson, 2006) and of having control. And of course, DIY answers users' needs in terms of Maslow's Pyramid hierarchy: the level of self-actualization (which includes creativity and problem solving). It is Maslow's range of attributes of Being and Manfred Max-Neef's system of (human) needs (both discussed in Section 6.4.2.1) that specifically include many of the characteristics of

DIY: participation, leisure, creation, identity and freedom (Max-Neef, 1992).

Through their study in 2010, Kuznetsov and Paulos (2010a) concluded a range of motivations for people to work on DIY projects within the realm of specific DIY platforms, such as Instructables. These are depicted in Figure 112.

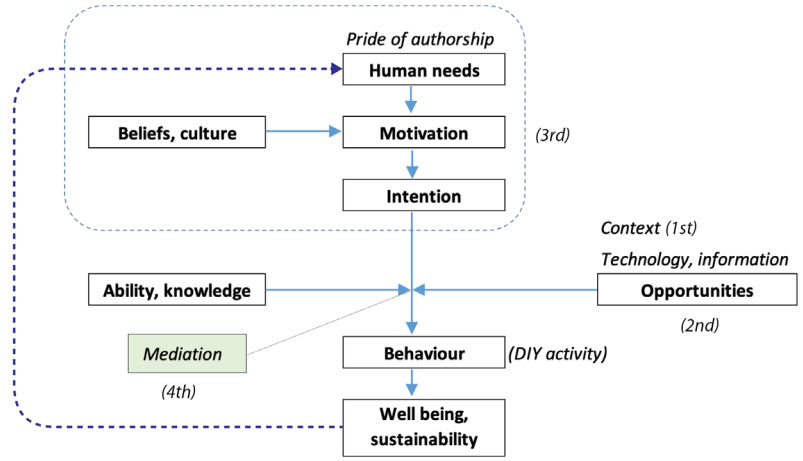


Figure 111: HOAM: *'Human Being'* , Opportunities, Ability and Mediation model, adapted from Thøgersen (1995) and Gatersleben (1998)

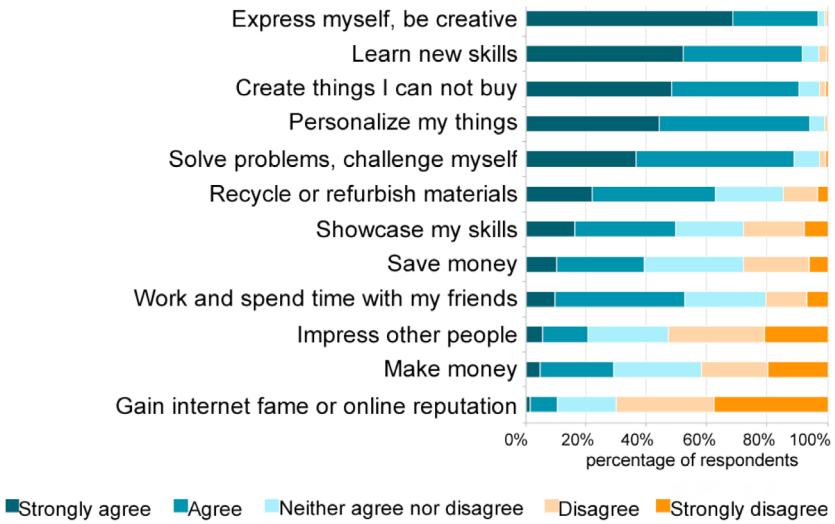


Figure 112: Motivations for working on DIY projects (Kuznetsov & Paulos, 2010a)

6.5.3.2 Reasons to DIY

As referred to earlier in this thesis, Schreier (2006) and Franke (2010b) name four elements that stimulate the activity of customization: (1) the functional benefit: a closer fit between the needs of the layperson and the product characteristics, (2) the perceived uniqueness, (3) the process benefit (hedonic and experiential needs), and (4) the pride of authorship, related to people's 'Self' (Schreier, 2006). The resulting 'psychological ownership' leads to a higher willingness to pay, as Franke (2010b) states. Kudus (2016) confirms this effect in a

study comparing participants' perceived value between a 3D-printed, personalized design and a standard design product. The participants were not trained designers; however, they were interested in personalizing a 3D object using additive manufacturing and 3D printing tools. Below, the motivational aspects of process enjoyment, pride of authorship and people's Self are discussed.

The enjoyment of the process (hedonic and experiential)

Schreier's 'joy of the customization process' (Schreier, 2006) relates to the activity of going through the stages of a design process. When aiming to support DIY activity as much as possible, aspects such as joy, happiness, and flow, while executing the task and going through the process, come into play. Csikszentmihalyi (1990) refers to studies that have suggested eight major components that establish the 'phenomenology of enjoyment'. When reflecting on how 'flow' feels, in the most positive sense, people mention at least one of these eight aspects, he describes: (1) people approach tasks they have a chance of completing, (2) people must be able to concentrate on what they are doing, (3) the task has clear goals, (4) the task provides immediate feedback, (5) people are deeply though effortlessly involved, the task removes from awareness the worries and frustrations of everyday life, (6) people have a sense of control over their actions, (7) people's concern for the self disappears, but the sense of self emerges stronger, and (8) people experience a loss of sense of time duration.

In addition, Csikszentmihalyi describes that optimal experiences require the investment of 'psychic energy' (attention) and require that the activity could not be done without skills. Without the right skills, he says, an activity is simply meaningless, not challenging. 'Competition is enjoyable only when it is a means to perfect one's skills', according to Csikszentmihalyi (1990, p. 50). Figure 113 visualizes how the state of flow (the flow channel) is related to both challenge and skills.

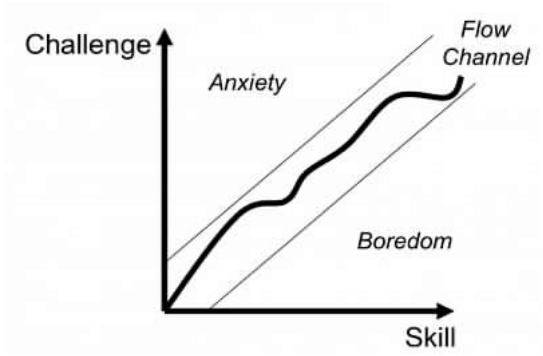


Figure 113: Flow, anxiety and boredom, Csikszentmihalyi: The psychology of optimal experience (Csikszentmihalyi, 1990, graph by Maymin)

Pride of authorship

Pride of authorship concerns the 'output-oriented' benefit of 'having done it' oneself, says Schreier (2006). Pride in general concerns an emotional response to the evaluation of your own competence (Harter, 1985). Pride is associated with achievement and with a positive outcome as a result of one's own efforts

(Lea & Webley, 1997). Some clear examples of people's enthusiasm and of a certain extension of their 'selves' were discussed in previous paragraphs. Upper-class women in the late nineteenth century increased their status among family and guests by decorating their home interiors. Modern DIYers (since the 1950s) willingly showed (and show) the results of their efforts concerning home improvement (Goldstein, 2003). And Brown states that self-built homes contribute to telling the life story of the maker (Brown, 2005).

People's Self

Apart from the positive aspects of the process enjoyment and the pride people gain from the result thereof, DIY activity results in a variety of positive mental effects concerning the development of people's 'Self'. The effects concern, for example, participation, control and sense of democracy, elements referred to by Maslow (1998) and Max-Neef (2022).

In addition to Belk (1988), Csikszentmihalyi (1981) and Verbeek (2015) who discuss the objects and tools in particular forming an extension of people's self, (in Section 2.3.3 and Section 2.3.7), it is worth mentioning Sartre here who also argues that objects are incorporated into a person's 'extended self'. Sartre (2015) wrote that one of the three ways through which an object becomes part of one's self is the 'creation' of an object. 'The creator retains an identity in the object for as long as it retains a mark or some other association with the person who brought it into existence' (Belk, 1988, p. 150). The other two ways are: the appropriation or control of an object for our own personal use, and through knowing the object. Papanek adds to this view: 'design is the most powerful tool yet given man with which to shape his products, his environments, and, by extension, himself' (1985, p. 102). 'At the core of design is an ontological and anthropological act – making as the making of self - which is also a meditation on and a realization of being', according to Dilnot (2009, p. 187).

The above affirms that DIY, hence investing psychic energy into an object, indeed helps improving people's relationship with that product.

6.5.4 4th Factor: Mediation: assistance, support, guidance

Assistance, the intermediary

As a conclusion from past appearances of DIY, mentorship and guidance is a proven principle, as was noted by Atkinson (2006), for example, who refers to the emergence of DIY magazines as the accelerators of DIY in the 1950s (see Section 6.3.13), and by Jackson who refers to DIY kits as 'an easy way into home hobbies' (Jackson, 2006, p. 64). He found that: 'In post-war Britain support and information for DIY activity came from increased access to new forms of mass media such as television and magazines' (Jackson, 2006, p. 59).

The many examples of Section 5 and Section 6.3 have indicated the importance of guidance and facilitation through projects, kits and instructions. Typically, DIY magazines dealt with things such as guidance, tutorials, examples, patterns and pre-designed kits. In many cases, a DIY project is – in accordance with the abbreviation - executed fully autonomously. In many other cases though, people have been motivated externally to do a project (motivated by somebody else, through magazines, DIY shows on TV, scrolling the internet, etc.), have been informed how to do it, and are helped/assisted during the execution of the DIY project. This 'guidance', as one might call it, has a technological component, as was extensively referred to in the previous paragraphs. And it has a human component: the person or designer who

created and provided the relevant information and the (tool)kit, and who has helped the end user in performing the DIY task.

The actual interaction between layperson and facilitating designer comes down to a learning situation: the exchange of information and knowledge. Parts of this interaction can obviously be managed digitally. Some other important exchange aspects might be taken care of in a physical and personal way, they might require interventions by the designer, as these actions and reactions should anticipate 'open' design decisions (n.b. different from standardized configuration platforms, characterized by automation and 'fixed' solution spaces (Korneeva, Hönigsberg, & Piller, 2021; Piller, 2004). Design-for-DIY specifically seeks a closer connection between designer and layperson, hence between product and layperson.

Generally, the success of a DIY design project depends on the options (opportunities, technology), the 'willingness' (motivation) of people, and the capacity/capabilities (ability) (see Section 6.5.3.1, Figure 111). Especially the factor of the layperson's capability refers to the differences between the various end users (or participants/ laypersons). It is clear that (the impact of) motivational factors are different for every individual. In order to challenge a person when providing a specific task (i.e. a DIY task), the complexity/effort level of that task should be a tiny bit higher than what would be considered comfortable (Csikszentmihalyi, 1990; Norman, 2004). By doing so, the person becomes interested, not overwhelmed, challenged, and he or she learns from it (to go further the next time).

Historical analysis reveals that DIY was truly adopted by a broad audience only after people were stimulated and facilitated to do so: DIY kits helped the DIY diffusion; patterns were published and distributed in the nineteenth century and DIY magazines and even television shows in the 1960s (Jackson, 2006) spread the DIY message. Facilitation, mediation between the prosumer (Tapscott, 1996; Toffler, 1990), the task and the object were of high importance to the acceptance of DIY. Paul Atkinson (2006) concludes that modern DIY's sustained growth since the 1960s may well be attributable to the decrease in the complexity of the DIY tasks, 'to a gradual de-skilling of the processes involved' (Atkinson, 2006, p. 5). Gelber (1999, p. 262), elaborating on post-World War II DIY, noted: 'The kit package severely limited hobbyists' creativity but greatly facilitated their productivity.'

Although this study argues that, theoretically, people have an innate desire to express their creativity - a view supported by numerous scholars (Csikszentmihalyi, 1998; Max-Neef, 1992; Sennett, 2008) - and aims to inspire laypeople to engage in DIY activities through facilitation and mediation, individuals' intrinsic interest in DIY activities undoubtedly varies.

6.6 Conclusions and insights

The factors mentioned in Section 6provide historical confirmation and grounding for the suggestion to support and even facilitate DIY activities.

The phenomenon of DIY has now been viewed from a historical perspective, both in relation to the broad field of industrial design and production and in relation to past periods of Do-it-yourself activity. The historical analysis of industrial design (and its context) in general and of DIY (literature research) in particular have helped to relate present observations to matters from the past.

By extrapolating patterns that occur when comparing past and present, it is possible to anticipate matters in the future. Figure 114 and Figure 115 provide a clear comparison of the past 1950 DIY age and today's opportunities.

Section 6 revealed the true concept of DIY: what's it all about. In short, DIY is in many ways the opposite of the traditional structures of both industrial production and consumption. The most important aspect of DIY activity is the fact that production and consumption have been merged in the activity of a single individual (Edwards, 2006): the layperson.

The previously mentioned historical events have illustrated DIY practices and phenomena in the past and the structural circumstances and consequences. Section 6 has helped to derive the underlying drivers (factors) of DIY activity. The significance of the concept of DIY has been discussed in relation to people's intentions, their ambitions and to sustainability, and has been viewed from the various stakeholders' perspectives. Altogether, Section 6 serves as a reference for the subsequent sections, starting with Section 7: 'An intervention: facilitating DIY activity'. Having analysed the human motives, and anticipating the ongoing technological developments, it is tenable to encourage and stimulate the practice of Do-It-Yourself. Do-It-Yourself meets people's demands in many ways. However, it is important to keep in mind the limitations of the DIY concept as discussed in Section 6.4.5.

Anticipating the conclusion that it's worth pursuing DIY activity, it seems obvious to look at what could be done to support the DIY practice. Considering the fact that the field of 'industrial design' serves as context in this thesis, the designer plays a particularly important part in the subsequent sections.

N.B. The activity of DIY suggests an alternative to a problematic system - a production and consumption-focused system that inherently contributes to a significant part of the issue at hand, namely the damaged human-product relationship (Section 4). Phenomena and measures such as reuse, repair (discussed in Sections 6.2.4.3 and 6.2.4.4), refurbishment, disposal, and return behaviour are worth supporting and may serve as critical elements in the system critique represented by DIY. However, focusing solely on mitigating the negative consequences of industrial society, without addressing the industrial system as a whole, may limit the effectiveness of these measures in tackling the broader problem.

Figure 114: Left: DIY on the cover of *Time magazine* 1954, Right: Time magazine 2006: 'You' as Person of the Year; These two covers tend to illustrate that computer technology (i.e. the power it provides to the end-user) metaphorically resembles the democratizing power of the 1954's physical power tools.

Figure 115: DIY in the past and in today's context: (*Time magazine* 1954, Wired magazine 2011); these two covers tend to illustrate the similarities between the eras: people having reasons to make and design things themselves (Sections 5.3 and 6.5.3)

Nine Perdeck, image used with permission

Section 7. Facilitating DIY activity

7.1 Introduction

The work in this thesis considers the practice and field of industrial design together as a prefabricated (invented) construct. It is approached from a critical point of view, as was also clarified in Section 2 and 3. Methodologically, after an analysis of today's situation and of the past (Section 4 and 5), Section 6 (specifically Section 6.3) described how the concept of DIY could help achieve the goals as described in Section 1.6, and why and how the concept of DIY seems to provide an answer to the stated problem as described in Section 4.3.

This section (Section 7) considers the 'design vision' of a near-future scenario. The vision is established as an answer to the challenges mentioned above and it anticipates the stated opportunities (Section 5).

The vision concerns 'the support of a layperson's DIY activity, to be facilitated by a designer'.

7.2 Brief summary: Why support DIY?

The beneficial characteristics of the concept of DIY, as discussed in Section 6.3, form the basis of the vision of this section.

As referred to earlier in this thesis, John F. Ehrenfeld states that people need to take care of their own Being (Ehrenfeld, 2008; Maslow, 1943; Max-Neef, 1992) in order to be able to re-establish people's 6.2.4.3 with nature (Section 1.3, Section 4.1, Section 6.4). Ehrenfeld's findings serve as an important part of the reasoning for Do-It-Yourself, in which Do-It-Yourself represents the design and making-activity executed by the individual layperson him or herself. DIY would ultimately enable the layperson to be in control of, and have a say about, his or her own needs and solution-bringing objects (again). DIY could be associated with a matter of necessity, with a true alternative for consumerism, or with lifestyle display.

DIY would bring a better product fit (Schreier, 2006), as people would individually (made with scale-free production tools) decide about dimensions, aesthetics and functionality, which would help people develop and increase their knowledge, skills, self-esteem, self-sufficiency and the opportunities to express themselves (Atkinson, 2006), bringing joy with the design process and pride of authorship (Schreier) at the end. Conclusively, bringing people and the tools or objects they use or surround themselves with closer would help re-establish the relationship between them. Past and recent works have extensively advocated the importance of this correlation, for democratizing and sustainability reasons (from a human point of view), and for commercial reasons (from a sales point of view).

Referring to the positive consequences DIY would have for the natural environment, DIY implies (closely related to the above-stated) an even more direct and intensive relationship and attachment (Csikszentmihalyi, 1981; Mugge, 2007)) with the object or tool to be designed or made than normally would be the case. In the case of DIY, the user involvement would not only concern the finished product, but it would concern the full process of its conception (or at least parts of it), which would result in a better knowledge and consciousness of one's actions and decisions, an increase of people's care for a product, their intention to repair, re-use, a longer product lifecycle, hence less use of natural resources and less waste

to throw away (Hoftijzer, 2012; Royakkers, Van de Poel, & Pieters, 2014). The user-product interaction goes far beyond only using, having or cherishing it; DIY equals a conjunction of both producing and consuming (Edwards, 2006). In terms of interaction in a philosophical sense, in additional to Verbeek's definition (Verbeek, 2015), DIY refers to both the physical and mental extension of a person's aspirations: self-designed and self-made tools as an expression of personal identity. Apart from offering a learning experience, DIY also provides the maker with better insights concerning the origin of a product and the product's life span.

DIY answers to Ehrenfeld's broad definition of sustainability, i.e. comprising the ethical, human and natural domains (Ehrenfeld, 2008). DIY contributes to the provision of individual and social empowerment (Manzini, 2003), it serves as a 'window of opportunities' to foster sustainability through, for example, personal growth, community empowerment and waste reduction (Salvia, 2013), it represents a democratic design process (Atkinson, 2006; Hoftijzer, 2009b), and the DIY approach is referred to by Bianchini and Maffei (2013) as beneficial to the environment.

From a historical point of view, magazines, DIY kits and even TV shows stirred up the DIY craze of the 1960s to big proportions (Johnson, 1976), as discussed in Section 6.5.2 and Section 6.5.4. In those days, the diffusion of DIY was helped by the deliberate encouragement and facilitation of DIY activities. Facilitation and mediation between (1) the 'prosumer' (Tapscott, 1996; Toffler, 1990)) and (2) the task and object were of high importance to the acceptance of DIY. As was mentioned in Section 6.5.2, Paul Atkinson (2006) concludes that 'modern DIY's sustained growth since the 1960s may well be attributable to the decrease of the complexity of the DIY tasks, to a gradual de-skilling of the processes involved' (Atkinson, 2006, p. 5). From various points of view, the support of DIY activity (designing and making by yourself; merging of maker and user), representing the opposite of the separation between making and using, promises to offer an alternative or a solution to the problem. After all, DIY represents Sector A economy and is the exact opposite of what mass production portrays (see Section 1.2).

7.3 The Paradox: the persisting threshold

Today's DIY practices vary to a wide extent, from rather light product customization (reactive DIY), to fully autonomous DIY (proactive DIY) (Beegan & Atkinson, 2008; Keinonen, 2009). Most of these practices tend to democratize the process of design to some extent (Leadbeater, 2004; Troxler, 2011a; Von Hippel, 2005).

The essence of DIY is in the accessibility of design activity to laypersons. Although, despite recent predictions and increased opportunities for DIY, involvement by the layperson is not a given. Most people who engage in DIY projects and maker spaces are either professionals or well-skilled hobbyists, not laypersons. There are lots of tools and spaces available, but there seems to be a mismatch between (1) the large amounts of tools and equipment available for DIY activity and (2) the lack of design knowledge, urge, skills and understanding by the layperson to create DIY products. The mismatch is presumably caused by three factors: (1) for most people, consumption is habitual and common sense (Baudrillard, 1998; Duong & Frank, 2017). (2) The industrial context has made people incapable (and unaware) of making or mending things by themselves, i.e. 'de-skilling' (Brugger & Gehrke, 2018). Sennett refer to this as 'the declining of the skills society' (Sennett, 2011). (3) The complexity and inaccessibility of products (Masclet, Mazudie, & Boujut, 2023) (see Section 6.2.4.4).

In line with the notion of our consumer society, of people's habit and sometimes addiction to consuming (Baudrillard, 1998; Boradkar, 2010; Julier, 2007; Sterling, 2016), Powell (2009) points out that 'the choice and selection of leisure activities, of which DIY was once a considered option, is identified as subject to heightened competition, with preference given to those that supply an immediate sense of gratification.' She refers to time compression and television formats. 'As a consequence of this', she says, 'the "cash-rich time-poor" increasingly turn to tradesmen to realize their visions of domestic transformation, more interested in the outcome than process' (Powell, 2009, p. 89).

This accentuates the need for an inspirational method and approach that makes DIY more accessible to the layperson, by guiding and facilitating design for Do-It-Yourself through professional designers. The concept of Design-for-DIY requires a complete shift of people's mindset. Letting people do parts of a product design project for themselves is – as was discussed in Section 3 – in contrast to existing structures and requires a flexible way of thinking (Piller, 2011); DIY is – in relation to the area of industrial design - a disruptive phenomenon. The full acceptance of DIY and of facilitating that (design-for-DIY) could best be seen as part of a broader change in society, in which present structures will change likewise (see also Section 5.2).

Online configurators or easy-to-use customization toolkits do allow people to make choices, however these decisions are mostly of a very superficial kind: picking colours and/or selecting from a range of predefined configurations/geometries within the strict boundaries of a fixed solution space. Such configurators do not adequately bring democratization or new skills or knowledge, nor do they address people's creativity, which is a crucial element of *'Human Being'* (hence an important aspect for this study) (Maslow, 1998; Max-Neef, 1992).

7.3.1 Status quo, the persistence of 'old-thinking'

New practices and structures seem to promise a clear change to our social and economic environment; they have instigated a mindset of endless democratization possibilities among authors (Anderson, 2012; Hatch, 2013; Romeijn & Meerman, 2010). Although many of the near-future views are valid, considering the observations made and the future perspectives envisioned, the status quo is persistent. New and disruptive initiatives seem to be absorbed (neutralized) by 'old-thinking' patterns and by traditional institutions and economic systems of mass production that focus on efficiency and profit (see Section 4.1.1, 3.3.1, 5.2.1).

Technological tools have become too complex (or not taught), whereas, historically, consuming is made too easy. It concerns conservatism, conformism, the differences of perspective and interests between the powers-that-be (and persisting economic models), and new opportunities in general.

Uber applies many of the sharing economy 'principles': they take underutilized assets, remove intermediaries and processes, offer flexibility, and give people access, but it is not a business based on sharing, says Botsman (2010). Uber requires a lot of dedication and investment from their drivers but pays them poorly and offers no certainty. Rachel Botsman says the term 'sharing economy' (collaborative economy) is getting diluted and confused. In *What's mine is yours*, she clarifies the contradiction between 'altruistic sharing' (open source culture) and 'making a profit': selling, renting and leasing (commercial transactions) (Botsman & Rogers, 2010).

7.4 A redefined problem definition: How to support DIY?

In order to provide a concrete answer to the original problem statement (Sections 4.3 and 6.4), to overcome the original threshold (Section 7.3) and to overcome the powers of 'old' thinking and 'old' structures (Section 7.3.1), a scenario is required in which the concept of DIY will be actively supported and facilitated. The original problem definition as described in Section 4.3 concerned: 'How to improve the relationship between the user and the product, in order to (re-) establish a sustainable situation?' This stage (Section 7) of the thesis, after having chosen to further elaborate on the concept of DIY as a means to (1) improve the relationship between the user and the product and (2) (re-) establish a sustainable situation, allows the rewriting of the problem statement towards a rather concrete question: 'How to support DIY?' This accentuates the need for a method and approach that makes DIY more accessible to the layperson by guiding and facilitating design for Do-It-Yourself.

Section 7.5 will consider the concretization of the scenario of 'DIY facilitation', presented as a (near) future vision, by regarding the questions 'how?' (Section 7.5.1), 'who?' (Section 7.5.4) and 'what?' (Section 7.5.5).

7.5 Towards a vision

The preceding sections addressed the fact that DIY could very well affect and bring changes to the field of industrial design, pushed by both democratizing technology advancements and people's motivation to participate. The concept of DIY promises to provide some clear solutions to Ehrenfeld's domains of sustainability: nature, human and ethics. The vision will for that reason consider the support of DIY, to provide access to the 'means' for designing and making oneself, to help, enable, empower, facilitate, teach the layperson to design, and make his/her own decisions and choices, and express his/her creativity. This and the following paragraphs address the question 'How to facilitate DIY'?

7.5.1 How to support DIY?

7.5.1.1 Learning from the past: facilitation

Here, the designer comes on stage. As the designer – by definition – fulfils the task of the intermediary between demand and supply (Sparke, 1987), he (or she) is the person to create the suitable and inspiring environment for DIY. Designing and making your own product will arguably not be limited by the 'fixed solution space' provided by one supplier. Each case will be quite different from the other because each case of 'new DIY' will be highly dependent on the user's considerations and on the characteristics of the product (or type) involved.

As facilitation was the crux at that time, it will presumably be crucial in today's circumstances as well. It will help address a larger audience than only hobbyists. For a DIY project, this would mean that a DIY project should be suitably designed, in accordance with the ability level of the person 'consuming' the DIY kit (Csikszentmihalyi, 1990).

7.5.1.2 Mediating DIY

To help people (laypersons) design and make things for themselves requires a mediation approach between laypersons and the tools, skills and knowledge they need to achieve their

goal, i.e. to DIY (see also Section 6.5.4 and Section 7.2). A certain mentorship is required, which includes teaching, guiding, to – ultimately - achieve the self-sufficiency of the layperson. Pedagogic principles apply to such a scenario, among which Tao's principle that support should only be offered if a pupil requests it (Huang & Lynch, 1996).

The historical cases discussed in, for example, Sections 6.3 and 6.5.4 resonate with pedagogy insights that stress the positive impact of mentoring on both engagement and learning (Adams & Lenton, 2017). Further, sources that associate with crafts and DIY indicate DIY's relationship with values and practices concerning, for example, mentorship and community-building (Garber, 2013).

7.5.2 A Design-for-DIY intervention

As can be derived from studies of DIY history, in any previous era of DIY it was always the designer who facilitated the DIY process. Either by designing and creating the easy-to-use consumer machinery (tools), designing software, providing tutorials, manuals (Figure 116 shows an example), and kits, or facilitating the DIY activity by offering assistance through magazines and blogs; the end user/prosumer was always helped and motivated to do (design or make) it himself. As discussed in 6.2.1, mediation seems, as was the case in the 1960s, to be crucial in order to reach the majority of people.

This supports the view that designers should encourage the DIY practice; that they should assist, facilitate, and motivate people to design and make their objects and products themselves. The next paragraphs motivate this statement.

'The designer must be conscious of his social and moral responsibility' says Papanek (1985, p. 102). With (amongst others) Victor Papanek (1970) in mind (who appeals to the responsibility of the designer (engineer), anticipating the described 'democratic' shift would be a responsible act for the designer to do. In his book *Sustainability by Design* (2008), John F. Ehrenfeld states that a sustainable approach of design should put the concept of 'Being' at the heart of the discussion, confirming his view that sustainability is an existential problem. The concept of DIY provides some clear solutions to Ehrenfeld's areas of interest: nature, human and ethics, as I have extensively addressed in Section 6.4. The objective of a design-for-DIY approach is to help, enable, empower, and facilitate the layperson to design and make his/her own decisions and choices, to have access to the 'means' for designing and making of his/her own goods.

In many cases, the talents and skills of a designer are utilized in a commercial manner, whereas society requires a lot more: visionary entrepreneurs, innovative (not in a commercial way) thinkers, searching for new and disruptive ways to structure the world and how to sustainably interact with each other and the products and services around us.

Being educated as he or she is, one could say it is his/her responsibility to utilize and apply/employ his/her knowledge to the benefit of society. In many cases, it is the industry that employs the designer after he or she has graduated. The design company's or producing company's turnover is what counts, not thinking about the best way to serve people or society.

It is the designer's responsibility to take care of the sustainable aspects of a product, says Royakkers (Royakkers, Van de Poel, & Pieters, 2014) and to design relevant products that truly answer the demands of the end user (Chapman, 2005; Papanek, 1985), just as we expect

a doctor to provide complete service and be a servant to a nation's healthcare, to serve the health of his or her patients. 'The designer's responsibility must [even] go far beyond these considerations', Papanek (1985, p. 55) says, 'His social and moral judgement must be brought into play long "before" he begins to design, since he has to make a judgement, an *a priori* judgement at that, as to whether the products he is asked to design or redesign merit his attention at all.'

7.5.3 The role of the designer, the role of design: enabling the layperson

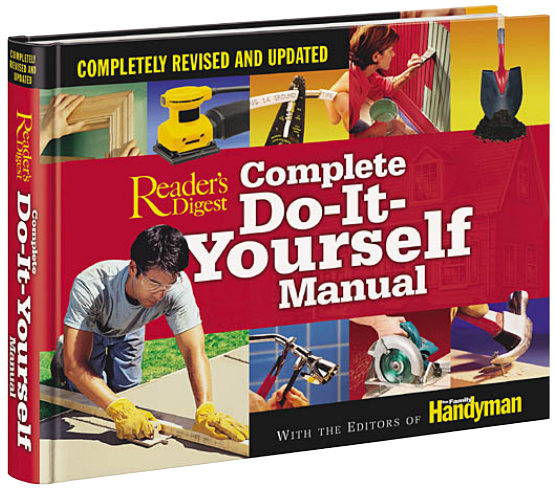


Figure 116: *Reader's Digest 'Complete Do-It-Yourself manual'*

Given the imperfect human-product relationship and design's role therein, as noted above, the professional designer has a moral responsibility to try to solve this. 'The responsibility for the relationship between industry and culture falls […] on the shoulders of design', stated design historian Penny Sparke (1987, p. 5). Schumacher (2010) and Myerson (2016) suggest that designers need to reverse their thinking and concentrate on 'scaling down': adopting a mindset of participation, designing for people and aiming for engagement. As highlighted by Ehrenfeld (Ehrenfeld, 2019, p. 83), '[…] we need a shift from a view of ourselves first from one of Having to one of Being, and second from one of Needing to one of Caring'. Manzini (2012) suggests that professional designers can no longer maintain their 'monopoly on design', similar to Atkinson (2008) and Van Abel (2011) who state that design should not remain an exclusive activity.

Similarly, De Vere (2023, p. 1) advocates that 'design practice is moving from a model where the designer is at the subjective centre of design decision making, involved primarily in artifact creation, to that where the designer is both an activist and facilitator contributing critical know-how to the design of socio-technical systems'. De Mul (2011, p. 38) sees the designer of the future as a meta-designer, 'shaping environments in which unskilled users can design their own objects'.

In line with Papanek's (1985, p. 15) statement (Section 7.5.2) that the 'genuine

needs of men have often been neglected by the designer', this thesis proposes a Design-for-DIY scenario in which the designer takes responsibility and facilitates the layperson's DIY activity. More concretely, designers are envisioned to support laypersons either as collaborators or as facilitators (Sanders & Stappers, 2008). Figure 117 shows an abstract representation.

Following on from, for example, the historical insight that the success of DIY in the past may have been 'attributable to a gradual de-skilling of the processes involved' (Atkinson, 2006, p. 5), designers in this study's scenario play both a facilitating and guiding role, in which the relative contribution to the collaborative task (with the layperson) is variable.

As part of his study concerning human-centred design approaches, Keinonen (2009) mapped the very helpful *Design Contribution Square*, in which he also indicates the position of DIY (Figure 118).

It shows the ways in which the professional designer's contribution (preparing and facilitating) may relate to the layperson's contribution. This thesis focuses on the left area of Figure 118 and on the support of the top left segment: DIY design.

Important elements of the envisioned Design-for-DIY scenario are the increase of the layperson's level of design skills and knowledge and supporting the layperson to take an active role. This study distinguishes (1) the long term (visionary) goal of total autonomy and self-sufficiency (top level in Figure 118) for the layperson, and (2) a realistic attempt to reach people who would normally not engage in DIY (lower levels). The thesis primarily focusses on the latter, as a first step.

7.5.3.1 The designer's job as facilitator

In a design-for-DIY situation, the job of the facilitating designer greatly depends on the organization or structure he or she is positioned in. Although this thesis will not specifically focus on the financial/monetary feasibility or model that would suit the Design-for-DIY concept, one could imagine the facilitating designer to be an entrepreneur or an artist, or a not commercially motivated or funded designer who shares his or her knowledge as part of the community, offering a platform and suitable DIY projects. Alternatively, he or she could be a representative of a company (a brand, agency, or service) that offers products partly to be designed and made by a layperson. In such an included service scenario, he or she could be the representative of a workshop facility or the representative of a supplier company (for example, a DIY store) that offers raw materials or semi-fabricated products.

In all the above cases, the designer's facilitating role includes the notion that he or she is the intermediary between the tools and materials to design and create on the one hand and the 'designing' layperson on the other.

Given that design-for-DIY scenarios vary, the extent to which design guidance is offered may depend on the layperson's demands, as well as the social relationship between designer and layperson. For example, design guidance may vary from (1) close mentoring, (2) offering a toolkit at a distance and/or (3) cultivating collaboration and learning among peers. From a designer's perspective, the motivation for design guidance may have a social, entrepreneurial, commercial or educational character.

In the context of the DIY scenario, a designer's role can range across a spectrum from that of

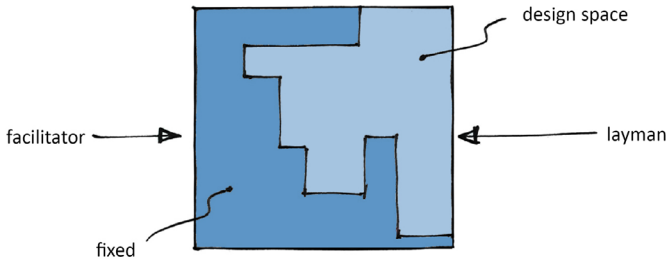


Figure 117: Abstract representation of the facilitation of DIY design

an artist to a user-assisting specialist. The designer-as-an-artist has always been there, and the artistic aspect of a product or purchase will most likely maintain its significance, although the openness of the DIY developments will uncover loads of layperson creativity. Referring to the second category, the assisting or facilitating role of the designer will vary from a guide that operates very near to an existing brand or solution, such as NikeID, offering a very fixed and narrow solution space for the end user, to an inspirer who operates as a non-corporate

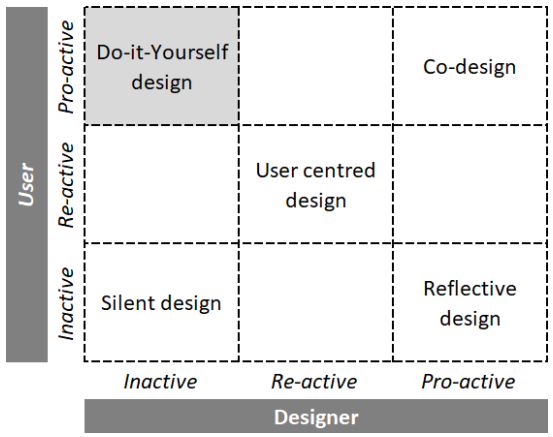


Figure 118: Matrix of design activity, reinterpreted from Keinonen (2009)

expert who sees it as his task to facilitate and inform people. Many of both kinds of platforms existing and are running, as are many initiatives that pursue goals in between these two.

The DIY scenario might have an effect on the traditional design profession, although history seems to indicate that the design profession was not negatively affected in times of previous increased DIY activity. On the contrary, the DIY craze in the 1950s and 1960s helped establish a new phenomenon, named the DIY industry, which still exists and thrives today. This, for example, brought about the need and the design of consumer power tools and the emergence and growth of DIY stores. When considering the field of graphic design, and desktop publishing (DTP) in particular, Lupton (2006) notes that, although DTP in the 1980s provided 'digital design tools' to the general public, and although 'some designers worried that secretaries equipped with Times Roman and Microsoft Word would obliterate the design profession, the field of graphic design got bigger rather than smaller' (Lupton, 2006, p. 19).

Most importantly, this thesis (Section 7.5) suggests an alternative service to be provided by designers, i.e. facilitation of DIY projects, it emphatically does *not* suggest a scenario in which the design profession will be taken over by laypersons. Nota bene, Salvia and Cooper (2016) note that design could and should be a catalyst for sustainable DIY practices, which seems to validate the assumption that the need for design and designers will increase or change, not disappear.

The facilitation approach aligns with a process and also includes specific articulation of roles and role-division between designers and (DIY) laypersons, and it addresses the assumed participation thresholds people might experience (Section 7.3.1).

Taking Design-for-DIY as a starting point, the actual DIY facilitation could concern various aspects of a design process. The facilitation of DIY product design requires efforts at several levels and in various stages of the process. Examples include providing inspiration, being the designer of the initial (pre-)design, being the creator of the DIY platform, being the creator of the DIY toolkit, providing guidance during the execution of the layperson's DIY project, facilitating and consulting. The designer's facilitating role includes that he/she is the intermediary/medium between the tools and materials to design and create on the one side, and the 'designing' end-user on the other; the designer provides the means to make and assert one's creativity (closing the gap).

It is important to depict the various concrete tasks - for the facilitating designer - that need to be considered. The envisioned mediating role will encompass a variety of tasks: tasks related to the creation of a DIY toolkit (for interaction), a communication platform, running a preliminary design project and assistance during the layman's DIY activity.

In the next section, a preliminary range of facilitation steps will be discussed, all part of the broad definition of design-for-DIY.

7.5.3.2 The designer's capability

A typical position for a junior (industrial) product designer is to be one of the creative and communication partners in a team of designers, engineers, a project manager, and client. A senior designer progresses towards a project manager position, which is responsible for a project's process, the team, the client relationship, and the outcome including feasibility, representativeness (aesthetics, functionality) and client satisfaction (etc.).

The 'industrial' designer, as a responsible professional, traditionally filling the gap between a user's demand and a company's offer, would be the appropriate person to bridge the gap between what is technically possible and what a layperson can manage. The product designer is trained with knowledge and skills to think of solutions and ideas, to design and explore these solutions in search of a physical or service product, and to ultimately make the product or object work. A product designer is educated to shape the world around us, which implies some responsibility.

The common knowledge of an industrial designer refers to the areas typically included in a product design process, from strategy and analysis to implementation. In particular, skills such as analysis, communication, collaboration and empathy are some of the key assets of a designer (Invision, 2019; Pal, 2018).

Design-for-DIY, or 'facilitating the layperson to design by him-/herself', is proposed to be

the task of the product designer, corresponding with the anticipated changes in the design field. These capabilities, together with designer's moral responsibilities, make him or her quite suitable for taking up the facilitation of DIY.

The designer has a good sense of the needs, the process, the various aspects, and the disciplines, and has a broad view, not a specialist such as an engineer, scientist, or craftsman (artisan) only. He or she integrates the various tasks and is capable of making decisions for his or her surroundings and taking responsibility for them.

7.5.3.3 Professional quality

Being a designer typically involves a commitment to quality, safety, and artistry in both product design and the processes they oversee. Such ownership and responsibility are essential aspects of the Design-for-DIY approach. Depending on the specific DIY project, in each DIY project, a balance in task division is needed between (1) the designer's pursuit of quality and accountability for that quality, and (2) the creative freedom afforded to the layperson who is enabled to DIY. As referred to in Section 7.5.3.1, this balance may vary in each case and lies somewhere on the spectrum between a fully designer-led process and a project entirely managed by the layperson. Section 7.5.6 further elaborates on this balance between the designer and the layperson.

7.5.3.4 A central and visionary role

This study considers a broader vision and philosophy that argues for a central and larger role of the designer in the complex network of industry, manufacture, design, suppliers, retail, distribution, and consumption. Whereas design in many cases serves (is strictly paid by) the producer of a mass-manufactured product, the envisioned scenario (based on societal and technological changes and an anticipating vision) includes a central and connecting role for the (mostly highly educated and skilled) designer.

7.5.4 The 'indirect' target: the layperson

Indirectly but no less importantly, this study is aimed at the layperson. In fact, the layperson plays a central role in this story. Whereas the traditional relationship between the designer and the consumer is mostly indirect, a Design-for-DIY scenario can be characterized by a modern mentor-apprentice relationship between the designer and the layperson. The Design-for-DIY scenario aims to provide room for the layperson's individual needs and wants, to provide reasonable design space and well-balanced design guidance.

The designer in this case invites and enables the layperson to take part in a design project and to express his or her creativity. The designer's role changes here from a directive and deciding authority to a rather guiding facilitator.

7.5.4.1 Autonomous DIY vs guided DIY: who is the layperson?

The vision of this study (Sections 7.5) supports the increase of the layperson's level of design skills and knowledge, and to stimulate that layperson in taking an active role. Measured along the proficiency levels of, for example, Sanders (2006a) or Dreyfuss (1980), this means that the layperson would move up from the level of adaptors or makers to the level of creators: in short, from the level of using strict instructions to the level of designing intuitively and autonomously.

This study distinguishes (1) the long-term (visionary) goal of total autonomy and self-sufficiency (top level in Figure 118) for the layperson, in line with the definition of sustainability and well-being, and (2) a realistic attempt to reach people who would normally not engage in DIY (lower levels).

Each layperson is different from the other. These differences, concerning making and designing, may consider the extent to which they have experience in DIY, have the knowledge (of materials, of products), have gained skills and are specifically interested. Atkinson (2006) and Keinonen (2009) both refer to a distinction between pro-active, re-active and in-active design activity. Aligned to these categorizations, and to Sanders' levels of creativity (2006b), Hermans' 'lay designer continuum' (Figure 119 and Figure 120) indicates a spectrum from reactive to pro-active lay-designer activity (DIY activity) (Hermans, 2015).

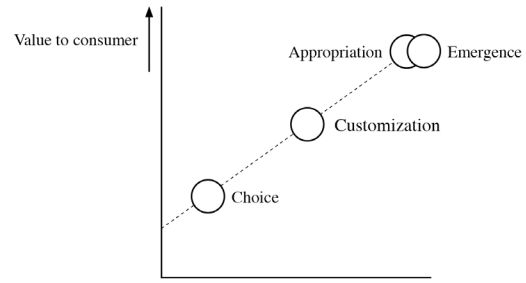


Figure 119: Tactics mediating consumer and designer in post-industrial design (Hermans, 2014)

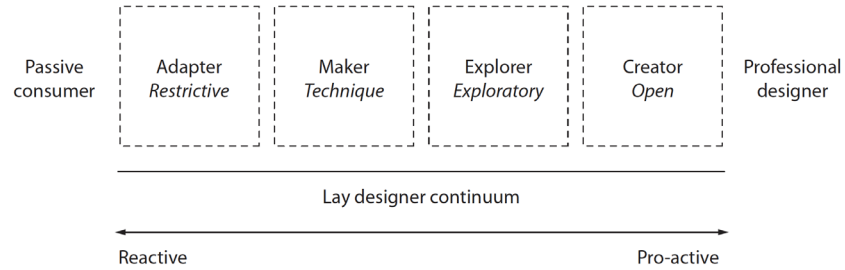


Figure 120: Lay designer continuum (Hermans, 2015

Figure 121 shows both extremes of (1) mass production and (2) fully autonomous DIY activity. This thesis concentrates on the left side of the graph: facilitating Do-It-Yourself activity, or how to convert the Sector B (distant, bottom right corner) relationship into a Sector A (DIY) relationship (top left corner) (see Section 1.2).

The design-for-DIY framework should support and facilitate learning and improvement. Offering the service and facilitation is part of the balance and variation needed to help both novices and more experienced laypersons. Laypersons should have the option to either make use of certain services and support or

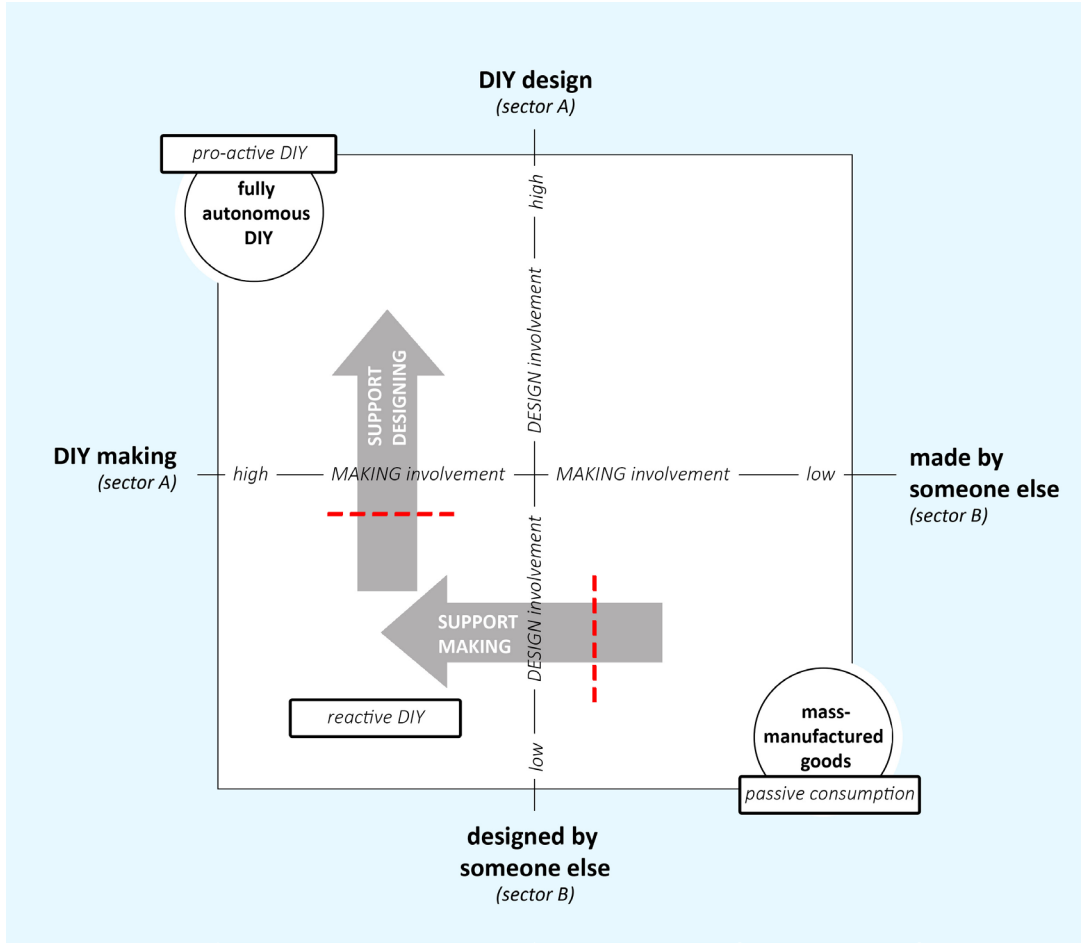


Figure 121: Layperson involvement in making and designing. Mass manufacturing vs DIY. Figure 121 also refers to Boradkar's Mass Production – Mass customerization Map (Boradkar, 2010), p. 121). Mass customization and Do-It-Yourself (DIY) on the axes of (1) making involvement and (2) design involvement.

not. This flexible character of a DIY design project expectedly helps to (1) reach a wide audience, (2) allow people to decide on the level of required support by themselves and (3) challenge/help people to train themselves in striving for a higher level of self-sufficiency. This requires strategies that cater to the diverse needs of different laypeople, making projects accessible to a varied audience. This element of DIY facilitation will be addressed in Section 8.

To reach a certain awareness and involve the not-obvious layperson, facilitation should be carried out carefully. Toolkits and facilitation are needed to not intimidate people or demand a level they can't reach. The goal is awareness, experience and improving skills by providing a framework for Design-for-DIY.

Referring to for example Figure 120 and Figure 121, the study addresses people with limited DIY skills. The most interesting area for this study, in Figure 121, is the area in the top left corner. In this figure, support activity could help the layperson move from the 'inactive' creativity level to the 'reactive' level (horizontal), and subsequently from a reactive position to a pro-active situation (vertical). This two-step approach aligns in the graph with the activities of designing and making, respectively.

Collaboration, peers

The DIY facilitation scenario explicitly underpins the importance of learning (see Section 6.2.5) and collaboration (see also Section 5.4.1.2); it encourages people to support and learn from each other. For example, the 'Otelo' international network of open technology labs initiated in Austria in 2009 (Hollinetz, 2015) serves as a clear example of the value of community collaboration, as is also the case for the Fablab network and for the case of a DIY Skatepark in Dulwich (London) (Section 6.2.5), a case described by Critchley (2023).

7.5.5 Scope: What to offer?

What to offer? What would be a method or tool to help the layperson design?

7.5.5.1 The envisioned Designing for DIY scenario

After having concluded, in the previous paragraphs, that the facilitation of DIY is needed to support the layperson's DIY endeavours and that it is the designer who should facilitate, the next question would regard the means to achieve this facilitation scenario.

Today's connected and rapidly changing world might provide in new ways of trading, new economics of local currency and sharing, giving room to 'post-industrial' practices as Design-for-DIY. A facilitation scenario for DIY promises to be a great fit as historical comparison with eras of 'soft' (1850s) and 'hard' DIY (since the 1950s) proves (Atkinson, 2006; Goldstein, 1998; Hoftijzer, 2009c). It is the designer's responsibility/task to help facilitate the end user to make his/her own decisions and design his or her own tools and objects. Today's designer should and can play an important and inspiring role in the democratization of design. As the traditional spider in the web of product development, the designer is the person to bridge the gap between technology and the end user, between what's offered and DIY. In order to do so, manuals, tutorials and assistance are needed. The designer should function as a motivator and catalyst of DIY activity.

Design-for-DIY does not, as would be required if evaluated as a traditional business, focus on financial profit, nor on a profitable business model, but it primarily focuses on solving the rather important issues as have been discussed: *'Human Being'* , ethics, and the natural environment. Design-for-DIY would concern both the outcome and – very important - the activity/ process of doing and learning. When implementing Design-for-DIY in today's business structure, a comparison could be made with the successful rise of the DIY concept of the 1950s and '60s: a fully grown business emerged from it. As discussed in Section 7.5.5.2, the so-called 'modern DIY' craze since the 1950s and '60s led to an enormous growth of the number of DIY stores and of the DIY industry. The DIY industry is defined as an industry that does not only supply the professional workman, but, more importantly, also directly supplies to the end user. The DIY industry involves raw materials, semi-finished products, consumer tools and support, platforms, and media. In that sense, DIY can be considered as creative or interpretative consumption (Edwards, 2006). Today's support of DIY might require a similar kind of large-scale support. Both ideology and practical considerations are integrated into the concept that should provide the means for the layperson to really make use of the new technological and highly 'connected' context: accessible and lots of information, easy communication, and affordable tools.

7.5.5.2 What to DIY?

What do we most want to engage with?

Csikszentmihalyi's study of the special meaning certain objects have for people, of what people cherish, reveals what people would like to engage in and form a relationship with (Csikszentmihalyi, 1981). The categories that scored the highest were the ones that people could easily form a connection with. The items were 'charged' with attention. Respondents' answers to Csikszentmihalyi included many family associations and relatedness through self-making and made-by-relatives. Concerning the first category, Csikszentmihalyi (1981, p. 61) concludes that furniture was in many cases seen as 'the embodiment of a personal accomplishment, or an ideal they strive to achieve', as furniture was often made by those men themselves.

He cites one of the respondents who made his own desk:

'I made it. It's very simple, actually, it's just a door. Actually, of the things that I've made, the reason I'm fond of them is that I've made every effort to achieve simplicity. I have a passion for building things as compulsively as possible and as economical of design as possible. My wife and I are junkers and garbage freaks, we like to make use of things other people don't use or throw away, that are free' (Csikszentmihalyi & Rochberg-Halton, 1981, p. 61).

Under the category of 'visual art', he specifically names paintings made by children or other family members. One respondent answered:

'Because my granddaughters made them. They are their handwork. Their Dad framed it for them […] They know I appreciate it' (Csikszentmihalyi, 1981, p. 66).

Through summarizing various studies (Ellis, 1985; Prelinger, 1959), Belk found the following categories of objects that people consider as extended self: (1) body, (2) internal processes, (3) ideas, and (4) experiences, and (5) those persons, places, and things to which one feels attached (Belk, 1988).

Perdeck's Figure 122 focuses on the physical proximity of the object. When defining suitable product categories for DIY, it seems plausible to consider these levels of connectedness and nearness (Perdeck, 2015).

From near to further away, these levels concern:

1. On the body: E.g. personal accessories worn on the body: jewellery, ear plugs, clothes, footwear, glasses, apparel, backpack

2. Personal equipment: E.g. appliances, phone, tablet, tools, objects with personal value, things that express personal identity, taste or style, art, car tuning, guitar, tennis racket, books, apps, and libraries

3. In the home: Anything physically close and precious: home decoration, furniture, desk, chair, cabinet, record player, photographs, books, plants.

4. The home: This category concerns home maintenance and styling activities, including gardening.

Salvia, studying Re-DIY, says he focused on domestic products (and furniture) because they

Figure 122: Levels of proximity (Perdeck, 2015)

tend to fall in a product category that is expected to be achievable for a layperson to become involved in, and because it represents a category that laypersons most probably like to engage with (Salvia, 2015). An additional argument for him to focus on domestic products is that these products account for around 60% of landfill waste in the UK (WRAP, 2012).

Although mass-customization truly differs from DIY, it seems interesting to consider popular mass customizaton categories as a reference. The common categories of mass-customization practices, and the category sizes, are listed in Figure 123, according to (Piller, 2024), see also Section 5.4.2.2. Most categories concern items and surroundings that are emotionally close the person, things that express personal achievement (gardening, maintenance projects, repair, electrical projects) and offer safety and comfort.

Category of configurators	Amount per June 2022
House and garden	245
Accessories	168
Apparel	163
Motor vehicles	155
Sportwear and equipment	115
Food and packaging	105
Paper and books	79
Kids and babies	58
2d Printing platforms	56
Electronics	55
Industrial Goods	41
Footwear	39
Games and music	39
Uncategorized	32
Office and merchandise	24
Beauty and health	23
Pet supplies	21

Figure 123: Configurator-database categories of mass customization configurators/ platforms and the number of occurrences (Piller, 2024)

7.5.5.3 Focusing on physical products

Considering the ambition is to re-establish the relationship between people and products through the support of DIY, the developmental scenario should preferably address the DIY of 'physical' products. After all, that would support laypersons to learn and experience material behaviour and the use of tools to manipulate and would help them learn through making by hand: physical DIY is connected to the material world.

Additionally, this aligns with the so-called 'handmade effect,' as described by Fuchs (2015), referenced in Section 3.7. As digital technologies will likely ease the use of tools and encourage passive laypersons to become active without the need for years of craft learning, a balance is needed: facilitation through easy-to-use new technologies.

7.5.6 Project suitability dimensions

The factors that have an effect on the suitability of a DIY project

In addition to the product categories named in the previous paragraph, this paragraph will provide an indication of the 'boundaries of DIY': dimensions that (partly) decide whether a product category would be suitable for DIY or not. Similar to traditional 'designer to client and consumer' design processes, DIY projects and Design-for-DIY projects also need to consider things such as goals, design space, design freedom and project requirements. Product design boundaries and requirements may concern the use of the final product, its context, its technical or material components, safety requirements, etc.

Dimensions, boundaries

These below-mentioned DIY boundaries should be considered part of the list of requirements concerning the project's product: which products would be suitable to have people design and make for themselves? What factors are of importance? The same boundaries could be seen as factors that help decide how to manage the division between facilitator and layperson. In a sense, the boundaries are requirements that apply to Design-for-DIY.

Based on previous sections and literature , a range of DIY suitability dimensions (Figure 124) was defined (Hoftijzer, 2009d), addressing factors that are decisive when deciding or assessing DIY conditions. Some of the boundaries are absolute, others are dynamic and flexible. The dimensions are a preliminary abstract representation of the design freedom and boundaries that users will encounter. The dimensions help assess and enhance people's expected DIY willingness in a certain situation.

7.5.6.1 Effort

The layperson's willingness to DIY partly depends on the effort (strain and number of actions) it takes to perform the action of participating. The DIY project should therefore be inviting and challenging, for example, a toolkit should facilitate a process that is clear and easy to perform, and the depth/ level of participation should suit the user (Csikszentmihalyi, 1998). Mugge (2009) distinguishes (1) mental effort (referring to the distribution of design effort and control between designer and layperson), and (2) physical effort (who is the actual maker). In order to help a wide range of people or to ensure that a platform has an audience, the DIY process should be designed and presented at various levels. In order to attract people, it is important to keep the effort low and offer various approaches and levels. Dellaert and Stremersch (2005) refer to the balance (and paradox) when considering that a satisfactory customization offer is positively affected by a high extent of mass customization, and negatively affected by configurator complexity.

Figure 124: Dimensions and boundaries of DIY

7.5.6.2 Choice

Creating your own design might be of less value to the user when there are a lot of existing (satisfying) product options to choose from. When the number of alternatives is small and unsatisfying, designing your own solution then becomes a great option to discern or outshine: design to fulfil your own requirements, to create something unique. Apart from the pleasure of the DIY activity, the choice to DIY or not depends on the potential relationship people could build with the product (depending on the category).

7.5.6.3 Social behaviour

Often, the act of purchasing products is associated with social behaviour and social structures or relationships. People behave and purchase conforming to certain social 'rules', their behaviour sometimes heavily depends on what others do; people follow their examples (influencers). Reputation is the driving force that separates trendsetters from trend followers (Marseille, 2009).

Choices are never objective, according to Csikszentmihalyi (1981); everything a human being feels or sees is transformed through the context of one's culture: marketing and media in this case. Consequently, social structures and social behaviour may block someone from DIY and instead encourage him or her to buy the same item as others. People are herd animals after all.

Products associated with social behaviour are perhaps less fit for DIY, unless

the DIY activity itself would be the popular topic to share and advocate.

7.5.6.4 Shopping experience

When compared, a real-time searching and shopping experience (and all related rituals) is very different from an online customizing experience or a DIY making experience. Shopping offers the advantage of easily choosing from the options on the shelf and taking it home immediately, whereas DIY activity requires lots of effort, patience, and time before the product one desires is actually ready for use. Products for which people would rather go shopping because of the explicit experience of shopping are for those people less suitable for DIY. This paragraph, which revisits the contradiction between (active) DIY and (passive) consumption behaviour, should also be connected to what is referred to as 'addictive' consumption behaviour, as described in Section 3.4.3.1.

7.5.6.5 Art and Design (author driven design)

If a product is characterized by the fact that it was designed by a famous designer or brand (see Section 2.2.3.1) and people have specifically sought it out for that reason, then people will probably not have the desire to adjust it to their needs or create it themselves. They'd prefer to have and keep it original, valuing the fact that a specific author or designer has created it. In fact, the exchange value of such a 'designer item' would drop if one would customize it (Figure 125).

Figure 125: Chaise Longue (Perriand)

Additionally, in most cases, the author of an iconic design will not be pleased if his or her creation is subject to adaptation by the layperson. Examples in the architecture, fashion and industrial design branches confirm this.

In some cases, a 'fixed' design includes the option to choose the colour or materials applied. The colour range will mostly be limited in those cases, in order to preserve the designer's intention, retain the uniformity of a series of products (furniture, automobiles (Volvo, Rolls Royce), or stay close to a brand's identity yet offer variation. This dimension addresses the differentiation and balance between 'author-driven design' (emphasizing the interests and the authorship of the designer) and 'market-driven design' (answering market demands), referred to in Section 2.2.3.1.

7.5.6.6 Capability

Is the user capable of participating in a product design process? The answer to this question depends on who is involved. There's a difference between people with regard to their knowledge and skills for design and operating design tools (sketching, making, 3D Cad), with regard to operating a web application that should guide them through the customizing process, concerning their perception of digitally visualized content, also concerning their spatial awareness, technical insight, and creativity. Accordingly, the different groups of users will require different levels of participation, different for each product or group. Offering various levels of DIY projects will help to enable and facilitate different people to choose what depth of participation suits them best. Norman (2004) refers to Csikszentmihalyi when describing that the job offered should preferably correspond to the capability level of the user involved, 'pushing slightly above a person's capabilities' (see Section 6.5.3 and Section 6.5.4).

7.5.6.7 Complexity

The chance of a successful and valuable practice or implementation of a DIY project partly depends on the complexity of and the access to the product involved (which also concerns the complexity of the configurator or the toolkit). In the case of a product or toolkit that has a rather complex architecture, the DIY offer should either concern the less complex components of a product (for example, the body components) or a rather simple structure by itself. Dellaert and Stremersch (2005) considering mass customization, indicate that the complexity of the mass customization offer (extent of mass customization) has a negative effect on the configuration utility. This is likely also true for the case of a DIY project.

7.5.6.8 Commodity

Products can be placed on a scale from undifferentiated (referred to as commodities) to highly differentiated. Commoditized products in this sense are purely functional products without any attempt to differentiate from competitors. Examples include raw products, milk, copper, a light bulb, a ballpoint pen, a hinge, a socket, etc. (equivalent no matter who produces it). The product exists, and people have it, but no one wants to, nor should, spend time personalizing it. Presumably, people will not have the desire to DIY or customize such an undifferentiated product. In terms of Arthur Eger's evolutionary product phases (Eger, 2007), a commoditized product did not pass all phases of product differentiation and will for that reason not be subject to the final evolutionary stages of individualization and awareness (also see Section 5.2.2.4).

7.5.6.9 Safety, hazardous elements

Obviously, the DIY layperson should be prohibited from access to any design decision that concerns hazardous components of a product, or that could cause dangerous situations (see Figure 126). DIY should in that case be limited up to a certain (safe) level. At the same time, since most components are openly available through the internet, even parts required for the assembly of a weapon, it will be increasingly difficult to prevent people from making whatever they desire to make. Bakırlıoğlu (2017) refers to a product's components that, from

a safety perspective, require management, maintenance, and repair by a professional: 'The safety of people dealing with electrical parts (i.e., assembling and disassembling, using, maintaining, repairing, and reusing) is an important concern […]'.

Figure 126: DIY design of a chainsaw?

7.5.6.10 Brand paradox

'A brand is not the name of a product. It is the vision that drives the creation of products and services under that name', says Kapferer (2008, p. 171). Mostly, product branding is done with great care and consistency, aiming for appreciation and loyalty from the user. This is why people who buy a branded product generally demand the original unadjusted product that answers to the brand image. Customization should for that reason be limited. From a company's perspective, enabling people to participate in the design and development process of a product is a delicate issue. If people have the opportunity to customize the original product, they could deconstruct a carefully designed brand identity or promise. Therefore, in the case of a branded product, the width and depth of the options to choose from (which is the level of customization, the share designed by the user) depends on what adaptations and DIY input are allowed by that specific brand.

All adjustments people can apply should always suit the brand image; they should be in line with what the brand stands for. However, a brand that has no particular identity, other than being a trustworthy platform that delivers qualitative T-shirts (Spreadshirt.com), has no trouble permitting people to design whatever they want on their custom T-shirt. The DIY graphic design that is printed on a physical Spreadshirt T-shirt does not affect the brand image, as Spreadshirt's brand name is not present on the item (acts as a 'capacity-based' brand). A brand with a strong, strict, and visible identity ('product-based' brand) would have many more problems if it did the same. This is why brands that offer customizing services will have to very strictly assess whether a layperson's design of, for example, a beer bottle label does not infringe on the brand image.

7.6 Conclusion: a vision of Design-for-DIY

The foregoing sections seem to justify the encouragement and facilitation of DIY. They conclude that there is a need to support Toffler's 'Sector A': making for oneself, bringing together 'making' and 'using' in one person. Designers should take responsibility and educate, encourage, and provide opportunities to people to design and make things for themselves (Do-It-Yourself), to become skilled, connected and aware of what it takes to manufacture the things they use. Such a Design-for-DIY scenario would change things positively: (1) Design-for-DIY would help the designer to better serve the end user, and (2) it would create better circumstances for the layperson to fulfil his or her needs, both literally and referring to the fundamental *human needs*, that include creation, autonomy, imagination and freedom (Max-Neef, 1992). It addresses people's inspirations and motivations; it offers a closer human-product relationship; it has positive effects on sustainability (Ehrenfeld, 2008), on *'Human Being'*, and (3) it provides answers to the consequences of industrialization.

After having explored DIY's definition, contexts, background, and relevance, it was possible to define a vision of how to anticipate. The vision (below) originated from the identification of the inconsistency between today's system of passive consumption and the essential characteristics of human 'Being'. The vision and the approach consider the support of Do-It-Yourself product design to facilitate and teach non-designers to increase their skills and knowledge and to democratize design.

This vision entails the designer's task or responsibility to support and facilitate people with DIY, aiming for the improvement of the human-product relationship.

The design engineer should – up to a sufficient level – provide the opportunity to people to design and make products by/ for themselves; the designer's task is to Design-for-DIY.

Design-for-DIY represents a special case of a product design process. Design-for-DIY refers to the envisioned scenario in which professional designers are there to provide the means that enable laypersons to design and make for themselves. The means comprise either the platform, toolkits, templates, tools, information, inspiration, preliminary designs, or the (physical) workshop environment. In terms of process steps, Design-for-DIY requires taking an important range of extra process steps into consideration.

7.6.1 A new system compared to old structures

In this thesis one could detect a reasoning structure according to the so-called 'levels' of Design Management (Best, 2006; Borja de Mozota, 2003; Kootstra, 2006): the strategic (vision), the organizational (tactical) and subsequently the operational (project) level. The facilitation of DIY, or Design-for-DIY, refers to a design narrative that comprises a shift of task divisions and activities (a system change).

7.6.1.1 The strategic level of Design-for-DIY: why?

The phenomenon of DIY product design itself could very well be regarded with the help of the abstract '*Vision in Design*' (*ViP*) model (Hekkert & Dijk, 2014), which gives room to address or assign both past and future context factors, in a search for the definition of a future scenario. This model could help position the old (Toffler's Second Wave) situation and a potential new scenario. Referring to the adapted *ViP* model of Figure 127, the so-called 'old'

context (left area of the graph) shows the industrial system whereas the right side of the graph shows the potential new context of a 'democratized' scenario. The transition, made visible through Figure 127 in the consecutive segments, arguing for a change from top-down (industrial context, left side of the graph) to bottom-up, (democratization, right side of the graph) aligns with the thesis' vision (Section 7.5) that concersn: 'Design-for-DIY'.

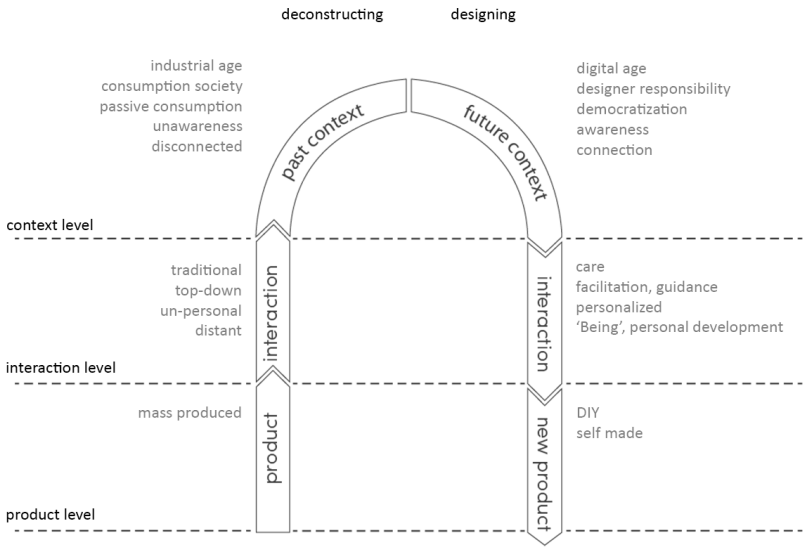


Figure 127: Graph of the *ViP (Vision in Product Design*) method (Hekkert and Dijk, 2014), in relation to the established vision

7.6.1.2 The organizational level of Design-for-DIY: how? (level of tactics)

Design-for-DIY requires a different vision, different starting points, and a different structure, and it also means different (extra) design process steps, in order to prepare, facilitate and offer a DIY project to the layperson comprising a design space, a kit, instructions and a DIY environment. Therefore, from an organizational perspective, the Design-for-DIY scenario involves an entirely new process description; it should include all the steps from preparation to execution.

Many considerations should be taken into account, of which elementary is the search for the right distinction of (1) the fixed elements to be decided and established by the professional designer and (2) the layperson's design space.

Additional to the design space Design-for-DIY offers to the layperson, it specifies a new job for the professional designer: he or she would serve as an agent for DIY.

7.6.1.3 The operational level of Design-for-DIY: what?

The tasks to be executed by the professional designer require a lot of expertise and design skills: preparing, designing the DIY kit, facilitating, etc. Tasks that go beyond the traditional industrial design process. This means that, when designing for DIY, the designer's job increases in size: he or she should not only bear in mind the requirements and the product design synthesis, but also consider the design environment and design toolkit for the layperson, plus all related Design-for-DIY requirements, divided under DIY product requirements, DIY process requirements and facilitation requirements.

The operational level also considers the layperson's design activity; after all, that DIY activity is the most essential element of the Design-for-DIY concept.

7.7 The need for a method; a framework for Design-for-DIY

The search for a better relationship between people and the products they use, given the potential of DIY, the changing role of designers (Salvia & Cooper, 2016; Sanders & Stappers, 2008) and the designers' responsibility, was the reason to suggest and develop a method, a framework, to help professional designers support DIY activity.

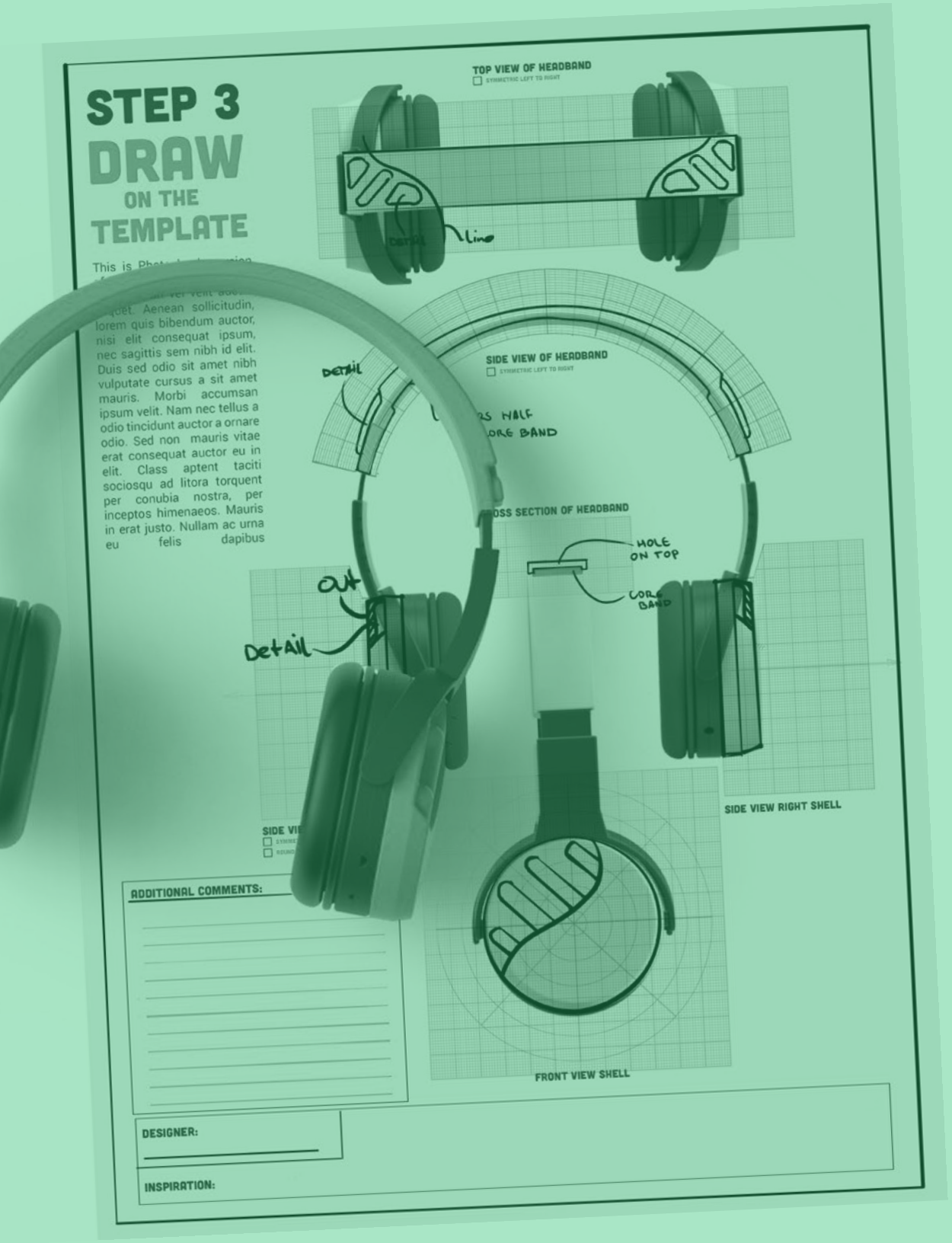
The Design-for-DIY scenario should preferably address DIY of 'physical' products, which would support laypersons to experience materials' qualities and manufacturability (Salvia, Bruno, & Canina, 2016a).

The thesis will subsequently attend to 'Design for Do-It-Yourself'; an approach to facilitate and Design-for-DIY, the requirements that come with it, the design dimensions and boundaries, the corresponding role and tasks of the designer, how to facilitate and teach a varying audience, and the difference between a conventional product design process and the facilitation of DIY product design.

In order to sketch a scenario of Design-for-DIY, for supporting both designers and laypersons, which will include the findings of the previous sections and help implement aspects of the stated vision, it is necessary to describe what such an approach would look like. The perspective chosen for such a process description is that of the facilitating designer, as he/she is the person who is, according to the vision as stated in Section 7.6, envisioned to be capable and responsible for the task of supporting DIY activity.

The scenario proposed designates the designer as the facilitator, the creator of DIY projects. The Design-for-DIY framework would benefit and help the designer in establishing and designing DIY projects. The introduction of a Design-for-DIY framework in this research might help close the 'gap'. By suggesting the building of a bridge between designers and laypersons, the aim is (1) to prompt designers to take responsibility and to take a facilitating and teaching role, and (2) help laypersons to gain confidence (through learning), be self-sufficient and proactive, enjoy the process of designing and making, and be proud of what they achieve through DIY activity.

The framework should represent the Design-for-DIY process. It should serve as a template for the designer, preferably function as a repository of Design-for-DIY knowledge for the designer who uses it and function as a generic tool for setting up multiple DIY projects, either very different or similar. The framework should also help teach laypersons and encourage them to design and make, and in so doing encompass the act of designing and making as a fluid activity.



Design for DIY study result (De Waard, 2014)

Section 8. Design-for-DIY studies: exploration of the Design-for-DIY process

Gaining insights into Design-for-DIY, through a series of Design-for-DIY studies

8.1 Introduction

The previous sections have collectively produced knowledge and insights that helped establish the vision of Design-for-DIY (Section 7) and the ambition to develop a Design-for-DIY framework (Section 7.7). To investigate what the concept of Design-for-DIY could entail practically, given the aims of Section 7 and the insights from previous sections, this section conducts a series of explorative Design-for-DIY studies.

A series of four Design-for-DIY studies were run, to gain knowledge of the Design-for-DIY process and to search for a basic fundament of a so-called Design-for-DIY framework. The studies were executed by students in the context of their graduation project (Table 10). The graduation projects were supervised by the author who provided a range of goals and starting points as a basis for the studies.

The graduate students had relative freedom in choosing a specific product for their Design-for-DIY studies, provided each project fit within the predefined research scope ('a common base', see Section 8.2) and contributed to the development of a Design-for-DIY framework, under the guidance of the thesis author. In relation to the overall research scope of this thesis, the studies of this Section functioned as exploratory studies, aimed at investigating potential steps of a Design-for-DIY trajectory.

The studies focused on the design steps a designer should perform to facilitate a layperson's DIY activity and provide a DIY project to laypersons. The studies were exploratory in nature and designed and executed to help bring to the surface issues to take into account when designing for DIY. They also helped to discern whether the notion of a generic process and framework capturing the various approaches taken and design challenges addressed would be feasible.

8.2 Method

The goal of all four studies was to enable and support laypersons' DIY activity through the development of specific DIY projects for them to engage in. While designing the specific DIY projects, the studies explored and analysed the design process that would help achieve this.

In exploring commonalities among the various Design-for-DIY processes used in the different studies, and with the eventual aim in mind to create a Design-for-DIY framework, each study focused on a distinct product and context. The products that were chosen as project themes specifically allowed for the distinction of design tasks between designer and layperson. The studies were also distinctive in their use of materials and toolkits for the laypersons. This aspect will be discussed in the subsequent sections.

Each of the studies presented here focuses on the design steps a designer can perform to facilitate a layperson's DIY activity. To establish and share a common base and definition of

Design-for-DIY, a number of potential tasks for a designer facilitating a DIY project were identified from previous sections (0, 7.5.1.1, 7.5.1.2, 7.5.4.1) and literature (Adams & Lenton, 2017; Anderson, 2010; Franke & Piller, 2004; Keinonen, 2009; Kuznetsov & Paulos, 2010b; Schreier, 2006) prior to the studies, and these tasks were included in the Design-for-DIY studies themselves.

• Facilitate the DIY process and activity by creating a toolkit for specific techniques (Atkinson, 2006; Franke & Piller, 2004; Gordon, 2007; Jackson, 2006; Schreier, 2006; Von Hippel, 2005).

• Reflect on and refine the DIY process and the resulting toolkit.

• Create a DIY environment, including physical or online materials and informaion (Anderson, 2010; Gelber, 1999; Kuznetsov & Paulos, 2010b; Salvia, Bruno, & Canina, 2016a; Triggs, 2006).

• Decide how tasks are divided between the designer and the layperson (Atkinson, 2006; Hermans, 2015; Kalyuga, 2007; Keinonen, 2009).

• Establish a means to maintain guidance during the DIY design process (Adams & Lenton, 2017; Garber, 2013).

The four studies were initiated and run with these elements as staring points. Figure 128 is a copy of Figure 8, emphasizing and indicating the dual goals of the studies in this section: (1) executing the task of Design-for-DIY, and (2) analysing the process required for it. The 'designer' column, showing the activity and results of designing-for-DIY, along with the 'researcher' column, indicating the reflection and deduction of the process used, illustrate the - explorative - research-through-design approach.

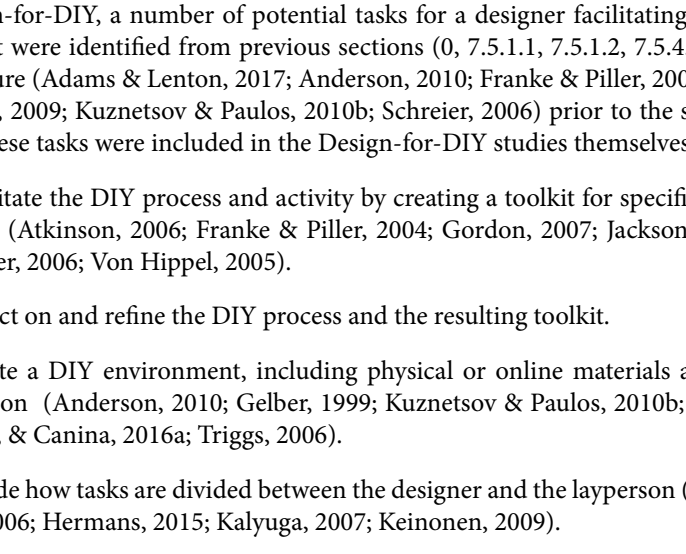


Figure 128: Design-for-DIY, considering three levels of Design-for-DIY (see also Figure 8)

The studies, along with their outcomes and processes, served as validation and input for the subsequent development of a generic Design-for-DIY framework.

Given the goal of conducting these studies, even though they have an explorative character, a small range of research questions served as the basis. These are listed in Section 8.2.1.

8.2.1 Studies' general research questions

1. What does the division of tasks between designer and layperson in this project look like?

2. How did the project allow design freedom for the layperson?

3. Is the notion of a generic framework capturing the various approaches taken and design challenges addressed feasible?

8.3 Brief description of the Design-for-DIY studies

Whereas the 're-establishment' of the human-product relationship can be considered as the overall goal and anticipated result of the research presented in this thesis, the four studies focused on elements of this overall goal, i.e. how to serve and involve people with varying levels of knowledge and skills (Section 8.4).

Table 10: Design -for-DIY studies

case	method	data	facilitators	participants laypersons	partipants design students
1. 'DfDIY' of a coffee maker	research through design	observation of process and results, and interviews	1 to 3	17	
2. 'DfDIY' of a desk lamp	idem	observation of process and results, and interviews	1	7	
3. 'DfDIY' of headphones	idem	observation of process and results	1	8	4
4. 'DfDIY' re-using plastics	idem	observation of process and results	1	2	

Participants in the coffee maker study (#1) were asked to choose and assemble their own coffee maker from many different second-hand jars, cans, lids, and rings available. The specific question addressed by study #1 (coffee makers) was: 'How can different complexity levels of DIY participation be offered to laypersons in designing products from second-hand product parts and materials?'

The desk lamp study (#2) concerned a tangible 'deformable' form that enabled the participants to explore form in a 3D design space and then translate their designs into a producible form. Study #2 addressed the question: 'How to capture and transfer the 'design intent' of the layman designer to enable the 3D fabrication of a self-designed desk lamp?'

The Design-for-DIY study of headphones (#3) focused on offering an accessible and attainable toolkit template for the layperson to design with to create a personalized wearable design using ready-made hardware components. In Design-for-DIY study #3, the question was: 'How can a designer enable a creative space for drawing and designing a personalized headphones set?'

The specific study called 'Reusing plastics at Scrap' (#4) focused on the design of tools for assembling parts and materials from 'Scrap' and providing instruction sheets to facilitate DIY activity by laypersons. Design-for-DIY study #4 focused on the question: 'How to organize and enable a DIY project based on the circular reuse of materials. The project involved Scrap Rotterdam, a company that sells industry waste materials.

The data and interpretation as presented primarily originate from the students' work, conducted under the supervision of the author. Each of the studies below describes its most relevant key findings. The data that support the findings of this study are available in the repository (R1).

8.4 DIY design of a coffee maker (#1)

8.4.1 Description

The 'DIY design of a coffee maker' study (Perdeck, 2015) (see repository R1-a) focused on how to facilitate laypersons with different skill levels. The goal was also to evaluate the laypersons' design behaviour, the interaction between facilitator and laymen, between laymen among each other and the suitability of the offered DIY kit. A physical platform was created to offer a DIY experience and the opportunity to learn and develop skills and knowledge of designing and making. The project focused in particular on the creation of DIY instruction, on a DIY environment, and on the activity of DIY design. The platform (including projects) was suggested to: offer a qualitative and enjoyable leisure time; enable people to express independence and personality through design; improve design and DIY skills; and gain awareness about materials and production techniques. The designer researcher conceptualized the various elements of both the workshop space and the specific project. The physical workshop environment included various distinctive areas: the 'see' area (a bar), a 'think' area (an information corner) and a 'make' space (a workshop), together named the '*Maakplaats*' (English: 'Maker space'). The 'see' area was e.g. inspired by scholars as Wolf and McQuitty (2011) and Mostert van der Sar, Mulder, Remijn et al (2013). The 'think' area was inspired by e.g. Wakkary and Maestri (2008) and De Miranda (2009). The 'make' area by Kuznetsov and Paulos (2010b).

8.4.2 Procedure, stimuli

A test was performed to evaluate the platform, the instructions, and how these dealt with a variety of layperson skill levels. The design researcher created various DIY design projects and examples (see Figure 131) to be offered to 17 participants. The projects were presented via project-specific instruction sheets and were carried out in a real-life workshop, by laypersons with various skill levels. Participants were invited to perform the DIY tasks, facilitated by a designer. Evaluation of the Design-for-DIY offer was done through observation and analysis of participants' behaviour, interaction, processes run, and the resulting coffee maker designs. While testing the DIY platform, participants were helped by instruction sheets that provided project 'how-to' information. The participating laypersons were asked to choose and assemble their own coffee maker from the many different second-hand jars, cans, lids, and rings (made of glass, ceramics, stainless steel, aluminium, and rubber) that were displayed in the physical environment (Figure 129 and Figure 130). Using second-hand components complements DIY activities well, as they highlight reuse and repairability options often lacking in new, less repairable products.

8.4.3 Key findings

• Several unexperienced participants expressed pride and surprise after completion of the coffeemaker.

• The experience level of the laypersons was found to be directly related to the degree of required support and information. Beginners required practical support, telling them what to do, whereas the more experienced participants were eager to know more about the specific product. Participants indicated their DIY ability themselves.

Figure 129: Stimuli, components available for the DIY workshop (Perdeck, 2015)

• To offer each layman a project that would suit his or her personal experience level, the project needed to offer different levels of complexity. This was done by (1) offering the same project with adjusted guidance sheets and by (2) offering different coffee maker projects. The second scenario appeared the most suitable, as this approach distinguishes the projects in a clearer way.

• The experienced participants indicated that they would have wanted to be able to move to a higher and deeper level of design. The participants noted that they would have liked to be facilitated towards determining the project's level of complexity by themselves, in order to fit their personal skills and knowledge level and to increase their level of motivation.

• The process stages to go through should be better clarified to the layperson before starting to design. However, the stages should not be strictly separated.

Figure 130: The Design-for-DIY materials and environment (Perdeck, 2015)

The separate workshop areas of 'see', 'think' and 'make' (Figure 136) should be more integrated, with a less strict sequence.

• During the DIY activities, especially for the rather 'novice' laymen, the use of xamples (Figure 131) appeared to be inspirational and motivating.

Figure 131: Examples (pre-design) made by the facilitating designer (Perdeck, 2015)

Figure 132: coffee makers made by participants: a French press, a drip coffee set, and a French press, respectively (Perdeck, 2015)

• Participants felt proud and pleasantly surprised with their results (Figure 132). People even said that the coffeemaker they made was better than the one they had at home.

8.4.4 Key findings that concern the process structure

The coffee maker project discerned the tasks for the designer: (1) managing the '*Maakplaats*' (Figure 133) workshop environment, (2) creating the project instructions (of various sorts and levels) and (3) helping the layperson while DIY-ing. The major elements of the Design-for-DIY process that were undertaken in order to establish the 'live' platform and the range of projects on offer, concerned a '*Maakplaats*' workshop environment, the various available DIY services complementing that workshop environment: courses, community/ online network, materials, information, tools and techniques, and the various DIY needs (advice, knowledge, space). Figure 136 depicts the circular DIY process run by laypersons in this project. It highlights the different stages for

the layperson to run through within the workshop environment: see, inform, think, choose, make, use, and sharing information. The model shows a circular character, which indicates that it supports iteration and learning by the layperson.

In relation to the research questions (see Section 8.2.1),

1. In this project, the division of tasks assigned (1) the designer to set up the workshop environment ('*Maakplaats*'), either physical or digital (Figure 134), supply materials and tools, create and distribute DIY instructions ('*Mijn Ding*', Figure 135), and provide guidance to laypersons. Meanwhile, (2) laypersons engaged with the workshop environment under the designer's guidance. The user tests indicated that the setup was feasible, although some modifications were suggested.

2. The project provided design freedom to the layperson in several ways: (1) laypersons could assess their own skill level and choose the complexity of the project they wished to undertake; (2) while performing the DIY tasks, they were free to select from the available materials; and (3) they could assemble these materials as they preferred, in alignment with the working mechanism of the coffee makers.

3. The project's structure and approach appear to be generalizable, though the provided tools and stimuli will need to be tailored to fit the specific nature of each project.

Figure 133: '*Maakplaats*' and its service environment (Perdeck, 2015)

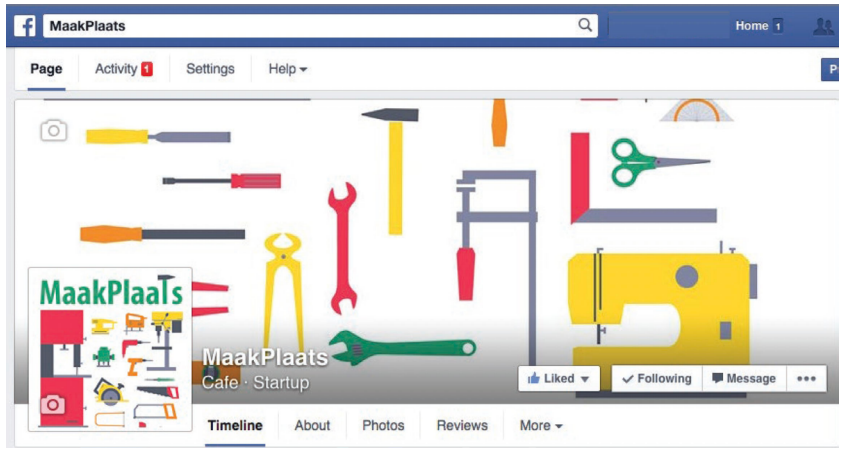


Figure 134: *Maakplaats* website to reach the DIY community (Perdeck, 2015)

Figure 135: Instruction sheets called '*Mijn Ding*' (Perdeck, 2015)

8.4.5 Limitations and recommendations

Since this project involves the design and proposed implementation of a physical workshop space ('Maakplaats'), further financial research and analysis of suitable real estate is recommended for this specific case study.

Various results and conclusions from this study allow to state that the design-for-DIY approach in his project is also suitable in case of Design-for-DIY concerning other products. In fact, the variety of coffee makers in this project is an indication that this DIY process is suitable for a variety of projects.

8.5 DIY design of a desk lamp (#2)

8.5.1 Description

The study focused on testing and evaluating a specific technique for the manipulation of forms, thereby capturing and transferring a layperson's 'design intent' in respect of a desk lamp.

A pre-design, a specific toolkit, and the design of a platform (as part of the full Design-for-DIY process) helped establish the desired DIY interaction and a specific design communication system. As one of the project's starting points, Keinonen's Design Contribution Square (Figure 118) is taken as a basis to argue for a DIY situation in which the layperson (the user) should be considered to be in a proactive position (Keinonen, 2009; Sypesteyn, 2014).

A design kit was designed based on the starting points: guidance (design space and activities), complementation (resources, materials, tools) and expansion (varying the complexity/number of decisions to be taken).

8.5.2 Procedure, stimuli

The toolkit offered a specific temporary 'prototype' ribbon to the layman, which enabled him or her to physically manipulate that ribbon into a certain three-dimensional curved form (Figure 137). Subsequently, the layman was asked to document the prototype result him-/herself, according to a strict photograph-protocol. The kit included a specific procedure instruction to follow. The sequence of lamp design DIY steps for the layman ran from the inspiration phase to adjusting the final 3D printed outcome. The entire envisioned DIY design procedure, visualized partly in Figure 139, includes: (1) inspiration, (2) ordering the kit, (3) receiving physical kit, (4) ideation, (5) making the preliminary sculpture, (6) preparing documentation, (7) 3D scanning, (8) following photograph protocol, (9) uploading pictures, (10) receiving final 3D printed result and (11) adjusting.

The professional designer, who is the creator of the pre-design and the supplier of the toolkit and the environment (website), takes the uploaded photographs as a starting point for the making of a corresponding CAD model and the large-

Figure 137: Stimuli provided to the participants: the preliminary ribbon and base (Sypesteyn, 2014).

ly 3D printed end product (Figure 138).

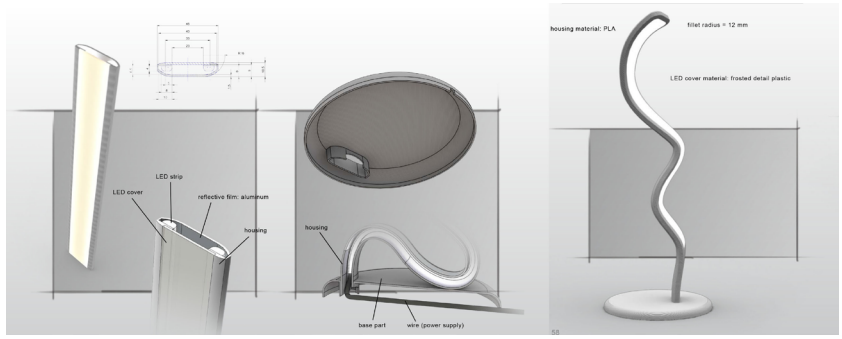


Figure 138: Structure and elements and preliminary design of the Sculptur desk lamp (Sypesteyn, 2014)

By offering the designed kit to a group of participants who were to execute this procedure, its suitability, quality, and shortcomings were evaluated. The tests were executed by seven layperson participants. Each of them was instructed to produce and document a physical model of the' Sculptur' desk lamp by using the website platform for guidance and instructions (see Figure 139 and Figure 140). All participants were asked to fill out a questionnaire to have them indicate their experience of using the 'Sculptur' toolkit. While performing the main

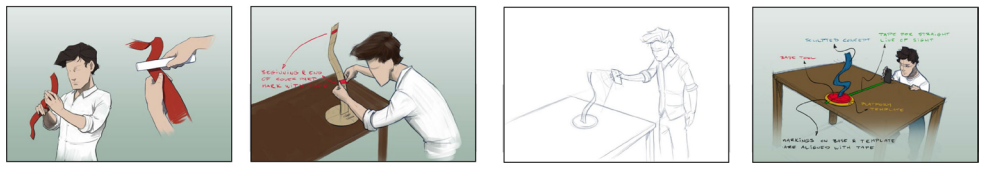


Figure 139: The envisioned DIY design process (Sypesteyn, 2014)

tasks of the user tests - manipulating/forming and documenting the desired ribbon shape - the materials used included the preliminary ribbon, a pen, tape, paper, and a camera. The exact questionnaire questions can be retrieved in the repository (R1-b). The tests and questionnaires were qualitative in nature. They focused on potential problematic aspects of the intended interaction and of the physical tools.

8.5.3 Key findings

• Participants indicated they would have appreciated knowing more about the DIY design stage they were in. This might have increased the sense of involvement and control.

• The project was well received by participants; participants did not require any additional instructions.

• The questionnaire answers seem to show relatedness between (1) the design ownership people felt, and (2) the match of the CAD model (made by the designer) with the original layperson's design intent. The discrepancy between expectation and CAD model , one participant said, originated from colour differences between mock-up and final model. Considering the inexperienced level of laypersons, such correspondences should be taken care of more.

• The tests have also led to the awareness that the design documentation procedure, concerning the use of camera to freeze the ribbon design, might need more accuracy (consider a suitable lens and CAD render settings).

• Five (of seven) participants indicated that the perceived time spent on the DIY design steps was longer than the actual time that it took. An indication of time or duration might be beneficial to the DIY kit and platform, to provide a sense of ease of use and control to the layperson in the DIY process. The exact questionnaire answers can be retrieved in the repository (R1-b).

The availability of video instructions as part of the website environment, instead of lengthy textual explanations, might also be a suitable solution for this, as participants indicated.

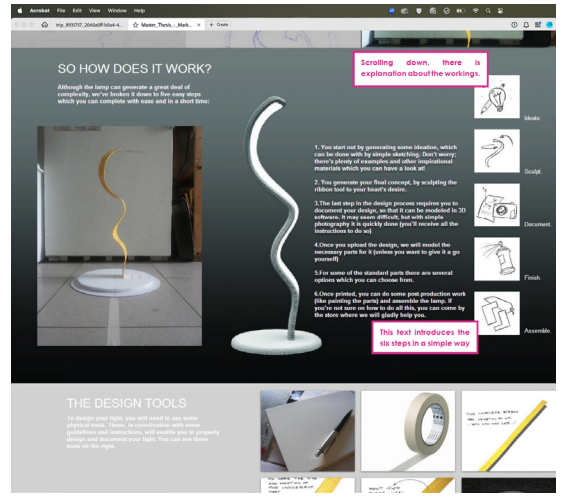


Figure 140: Sculptur website (Sypesteyn, 2014)

8.5.4 Key findings that concern the process structure

The project design concerned a toolkit that allowed the layperson to manipulate a tangible ribbon of which the form was subsequently communicated to the designer. This project focused on the provision of design space to the layperson in correlation with the decisions taken by the designer. The design space for the layperson appeared to depend on the boundaries that were defined in the early stages. It is an indication of the importance of appropriately considering this division of responsibility and design freedom between the two parties.

In relation to the research questions (see Section 8.2.1),

1. In this project, the division of tasks assigned the designer to develop the Sculptur desk lamp DIY project, including creating the instructions and procedures, documenting the results, handling the 3D modelling, and facilitating the entire process from start to finish. Meanwhile, laypersons engaged in designing their own Sculptur desk lamp, including ideation, shaping the form and documenting the process according to specific procedures.

2. Participants had the design freedom to shape the form of the Sculptur desk

lamp by manipulating a provided preliminary ribbon into an original and personal design. While the manipulation was primarily decorative, it included several decisions for the layperson to make: the overall path trajectory (the silhouette), the end fillet radius, the housing colour, the height and fillet radius of the base, and the position and dimensions of the LED cover. Depending on their preferences, laypersons could choose from one of three complexity levels for the DIY kit. The test focused only on level 1, which involved designing the silhouette.

3. The specific procedure for manually shaping and documenting the silhouette form provides a novel DIY approach. The project's structure and methodology appear to be generalizable; however, the provided tools and stimuli will need to be tailored to fit the specific nature of each project.

8.5.5 Limitations and recommendations

While the project carefully considered guiding the layperson and providing support through the kit, the focus on expanding people's knowledge remained at a moderate level. Additional studies could address that aspect more.

The number of participants is too small to draw any decisive conclusions from the tests. However, the tests were helpful in indicating problematic elements of the kit and of the envisioned interaction.

The implemented process steps in this project appear to be suitable and feasible for projects involving other products, especially when considering the conclusive outcomes mentioned above.

8.6 DIY design of a set of headphones (#3)

8.6.1 Description

Headphones were the subject of De Waard's project, because of the fashionable and technically manageable character of the product (De Waard, 2014). Young trend-sensitive people were the target audience. This project dealt with the likelihood that people might prefer to buy a branded set of headphones, instead of their own creation. Referring to Franke , Karim de Waard anticipated a high perceived value, depending on the preference fit, the process enjoyment and the process effort (Franke, Schreier, & Kaiser, 2010a). Another important aspect of the project was the modular architecture, which was required to be able to assemble both the fixed base of the product and the DIY-designed parts.

The DIY area, the design space, comes down to the headphone shells and the headband sleeve, the most eye-catching elements. The headphones predesign was the basis for the kit that was to be offered and distributed through an online platform. In constructing the toolkit, the opportunity was taken to not only provide preference fit and enjoyment of the process but specific attention was paid to the DIY interaction medium: to the layperson's effort of drawing his or her design, as a true designer.

The Design-for-DIY study focused on finding the right balance in tasks between the designer and layman so as to enable the layperson to maximize creativity via a structured visual design space, while not having to worry about the electronics and assembly issues. De Waard included an in-between 'redesign' step to find out whether a final designer's fine-tuning step would be appreciated.

To enable the layperson to design his or her own personalized headphone set and to communicate the design intention, a 2-dimensional drawing template, including a fixed and open design space, was provided (Figure 147). The project distinguished (a) the base structure of the product that was to be predefined and even presumed to be mass manufactured, and (b) the (unique) elements of the product, which are to be modified by the layperson.

8.6.2 Procedure, stimuli

For this Design-for-DIY case study, the designed procedure and accompanying toolkit were tested by eight non-design participants and four design students (for comparison) (Figure 142).

Anticipating the eventual use of the established toolkit, the procedure to follow by the participants contained (Figure 141):

- Step 1: find inspiration from existing pictures, atmospheres, contexts.
- Step 2: design by exploring and sketching, with the inspirational pictures in mind, start using template.
- Step 3: communicate your design through a final sketch on the provided template.
- Step 4: redesign, adjust if needed, based on revision of the preliminary 3D model.
- Step 5: print: if satisfied with the result-before-printing, have the designer print it.

The process carried out by the participants was observed, and they were asked to complete a survey after step 4 (see Figure 141). The survey focused on their evaluation of the design outcomes following the translation, by the designing facilitator, into a 3D CAD model and render. The exact survey questions can be retrieved in the repository (R1-c).

8.6.3 Key findings

- The availability of examples of finished templates and the 3D model results helped the participants to get started. Indicating that these example template drawings weren't particularly 'beautiful', helped lowering the design threshold for the inexperienced participants.
- After running the DIY process, the participants indicated they felt reasonably pleased with the end result, and that they felt capable of transferring their thoughts on paper.
- The re-interpretation (by the facilitating designer) of a layperson's design resulted in a better fit between the resulting model and laypersons' expectations. According to the laypersons who were interviewed, the interpreted design 'looked better' than their own design; it was valued higher. Considering the 'interpreted' design, participants felt that they had had less influence on the design, though (Figure 143). The layperson participants indicated that they were willing to pay more for the re-interpreted design (Figure 144). The exact questionnaire answers can be retrieved in the repository (R1-c).

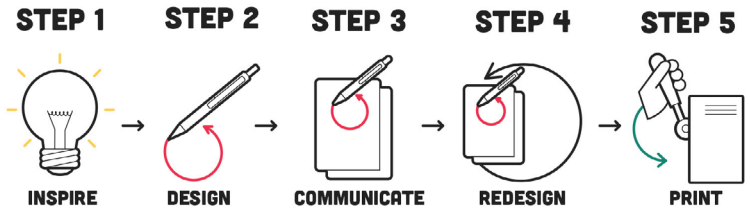


Figure 141: Steps to follow (De Waard, 2014)

• Participants were all able to communicate their design through drawing (Figure 146). Whereas laypersons in many cases strictly copied the lines, rims and volumes provided by inspirational theme-pictures, in comparison the design students translated the provided inspiration theme into a rather abstract interpretation of the theme.

• Furthermore, the design students sketched and visualized some extra 3D views helping them to clarify their design intentions, while laypersons strictly drew 2D lines on the template as suggested. This led to the insight that, when designing for DIY, the project and the DIY kit should be suited to and aligned with the expected or anticipated skill level of the layperson.

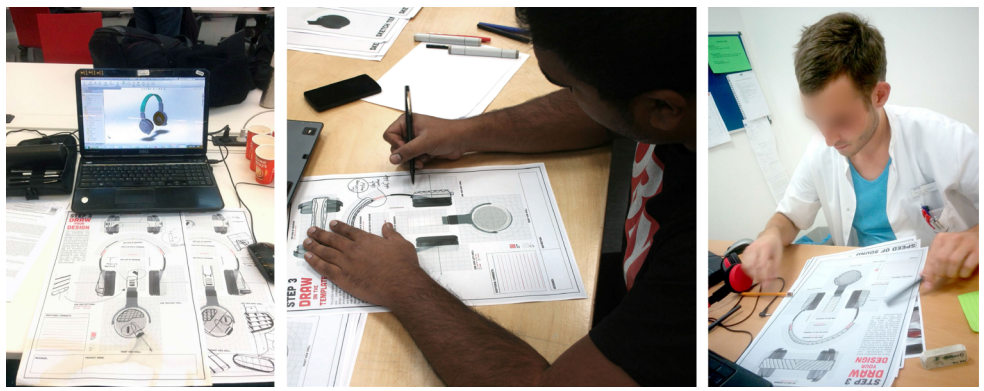


Figure 142: Pictures of user test (De Waard, 2014)

8.6.4 Key findings that concern the process structure

The headphones project implemented a very clear task division between designer and layperson; similarly, it made a clear distinction between fixed elements (pre-fabricated) and the elements that were open for DIY design and manipulation. Figure 148 indicates the stages of the DIY project, of which some are executed by the layperson (steps 1-2-3), and some by the designer (steps 4-5). The model sets out the activities required from the designer, in addition to the preparation of the entire DIY theme and flow, and of the templates that are part of steps 2 and 3. A very interesting aspect of this project – regarding the process structure - is the transfer of the layperson's design to the designer who added a final interpretation before 3D printing it.

In relation to the research questions (see Section 8.2.1),

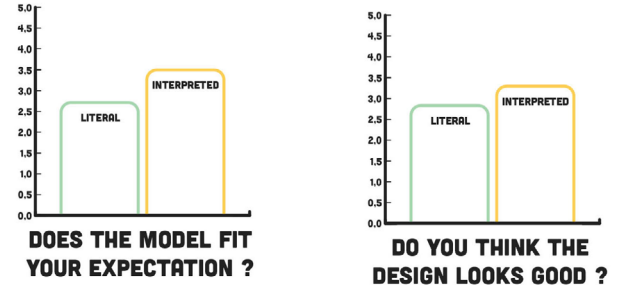


Figure 143: Appreciation of the literal versus the interpreted design model (De Waard, 2014)

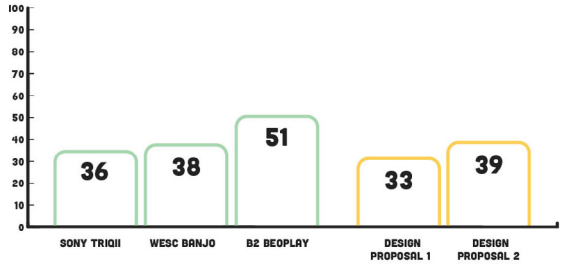


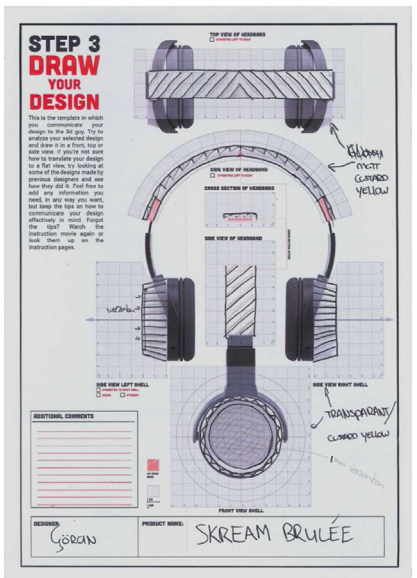
Figure 144: Willingness to pay (De Waard, 2014)

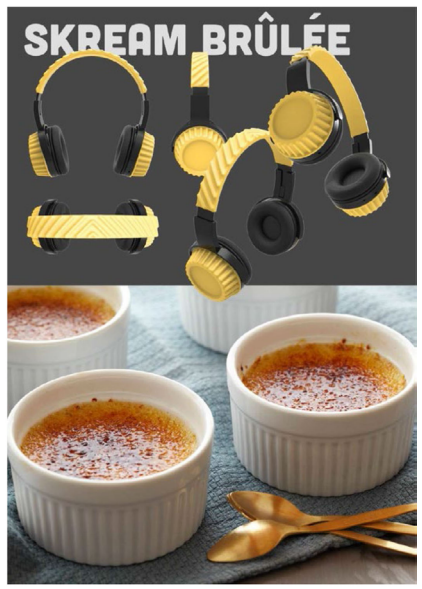
1. This project made a clear distinction between the so-called 'fixed elements' of a pair of headphones and the design space available to the layperson—namely, the elements open for DIY design and manipulation. The layperson's input in the DIY design process was facilitated through a paper template, allowing them to sketch their design in 2D.

2. The design freedom offered to the laypersons centred on the (sketched) 2D design of both the headband and the shells, using the provided template. On a scale of 1 to 5, the eight non-designer participants reported an average perceived influence of 4, indicating a relatively positive perception. However, the small group size of participants does not allow for definitive conclusions to be drawn from these results. Further data from this study can be retrieved in the repository (R1-c).

3. The use of a 2D template proved to be an effective way to distinguish between fixed elements and the DIY space, and to facilitate the layperson's input in the

design process. This approach appears to be generalizable and applicable to a wide range of products. Findings from this study also suggest that the suitability of the template is influenced by the user's level of design competence.






First proposal

De volgende vragen gaan over de eerste van de twee voorstellen. Probeer de vragen te beantwoorden met het ontwerp dat je in voor je had toen je hem tekenden in gedachte.


1. 1. Klopt het uiteindelijk ontwerp met de verwachting die je had na het invullen van de template? *

Markeer slechts één ovaal.

	1	2	3	4	5	
Het is veel slechter dan ik verwacht had.						Het is veel beter dan ik verwacht had.

Figures 146 and 147: DIY design: drawing the design intentions using the provided template (kit), based on inspiration theme (right, bottom). and final result of the 'SKREAM' BRULEE design (De Waard, 2014)

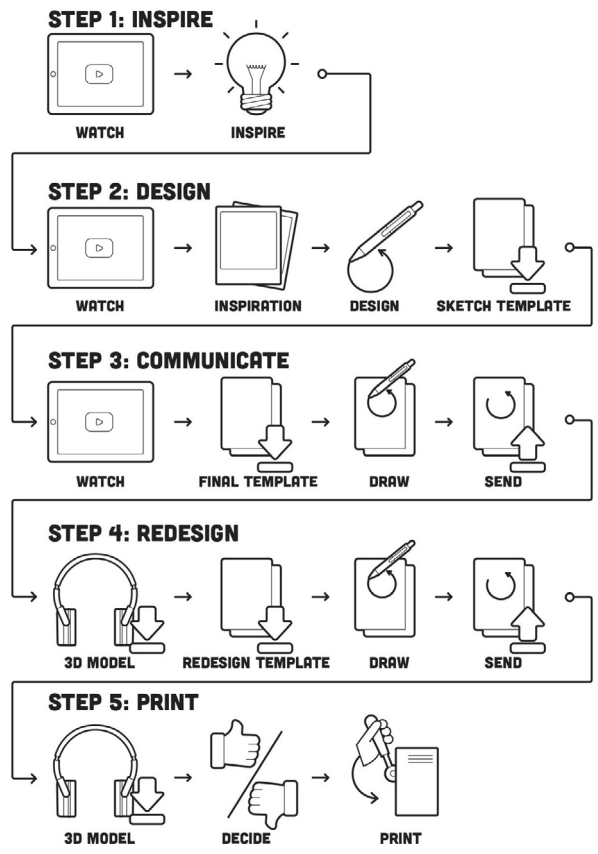


Figure 148: The Design-for-DIY and the DIY process (De Waard, 2014)

8.6.5 Limitations and recommendations

As the tests in this study concerned twelve participants, it is hard to draw any concrete conclusions. However, the tests and survey results provided clear indications of aspects that could be improved.

Among these recommendations are the consideration of the product category, to either provide less design freedom in case of a product that is so much associated with brands or choose for a different product category. In general, there is a remaining need for finding the correct balance between designer input and layperson input.

This project's implemented process steps seem to be suitable and feasible for projects that concern other products. Figure 148 shows a generalizable process structure.

8.7 The 'Scrap' case: DIY design from (plastics) reusage: 'Upcycle it yourself' (#4)

8.7.1 Description

Scrap is an organization that sells redundant plastic manufacturing waste and components. In this project, DIY design and making was supported by setting up and improving a physical workshop environment (Lopez Pradas, 2013).

The project proposes to add a range of specific elements to the warehouse of Scrap. These were the services (1) of a physical workstation, the design and embodiment of a series of cutting and welding tools, so-called tooltips, (2) a facilitating designer and (3) a series of product-specific DIY instructions, as part of a DIY kit, for laypersons to work with. Figure 149 shows an overview of the envisioned DIY environment.

8.7.2 Procedure, stimuli

The design of the DIY kit mostly focused on tutorials and the accompanying tools needed for assembling plastic 'Scrap' materials (Figure 150). Additionally, the study concerned the providing of instruction sheets to facilitate DIY activity by laypersons. A key goal of the project was to explore how a plastic-scrap selling warehouse called Scrap could be positioned as a DIY community-building platform, to increase the involvement of laypersons in DIY design work. To

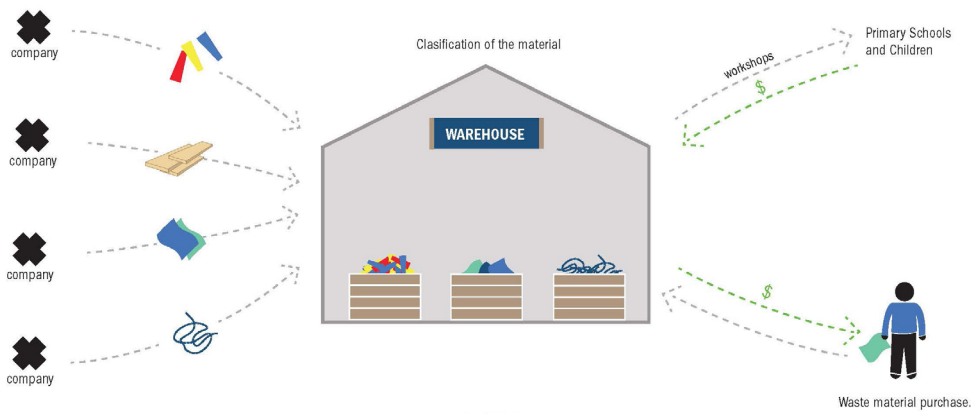


Figure 3: SCRAP structure.

support DIY instructions, a range of sample product designs were created using industrial waste materials from a participating plastic scrap yard. The samples were created using the new tools. Several test runs were conducted to define and evaluate key features of the sample designs, instructions, projects, and tools (Figure 151 and Figure 152).

Figure 149: Elements of the envisioned Scrap DIY environment (Lopez Pradas, 2013)

8.7.3 Key findings

• An analysis of the feedback from participants indicated that templates or patterns can facilitate DIY design. Results conclusively showed that for a Design-for-DIY framework, DIY supporting elements should be considered. For example, pictures of the procedure and display of materials, and tools for manipulation.

• Given the continuously changing stock of Scrap's reusage materials, it proved to be important to suggest projects that suited the available materials. Projects should include a degree of flexibility in terms of material characteristics, including the properties and forms of the proposed or provided materials and object-parts.

• For this reason, the offered projects and instruction sheets (Figure 153) should vary and depend on the availability of specific scrap materials.

• Learnings from the material manipulation tests resulted in some interesting design clues for the DIY platform to be established. Generally, supporting the layperson in manipulating or assembling different (random) plastic parts

requires a well-structured material flow and distribution, distinguishing and knowing about the various specific types of materials, and communication

Figure 150: tool tips for welding Scrap plastics (Lopez Pradas, 2013)

Figure 151: Participants creating example designs and instructions (Lopez Pradas, 2013)

thereof. Such a structure is needed for safety, and for environmental and DIY design reasons.

8.7.4 Key findings that concern the process structure

The Scrap case concerned an organizational extension to the Scrap warehouse: towards a platform for DIY activity. Practically, the additions to Scrap's offer (in Figure 154) concerned a tangible workstation that offers toolkits, instructions and the design of a dedicated welding tool. It also specifically enables the manipulation of the 'traditional' Scrap materials: industrial unused waste plastics, including the design of a dedicated welding tool. Participants' creation and documentation of design projects helped establish instructions for the future laypersons.

The Scrap case is rather unique, in that it concerns the addition of DIY tools and elements to an existing warehouse.

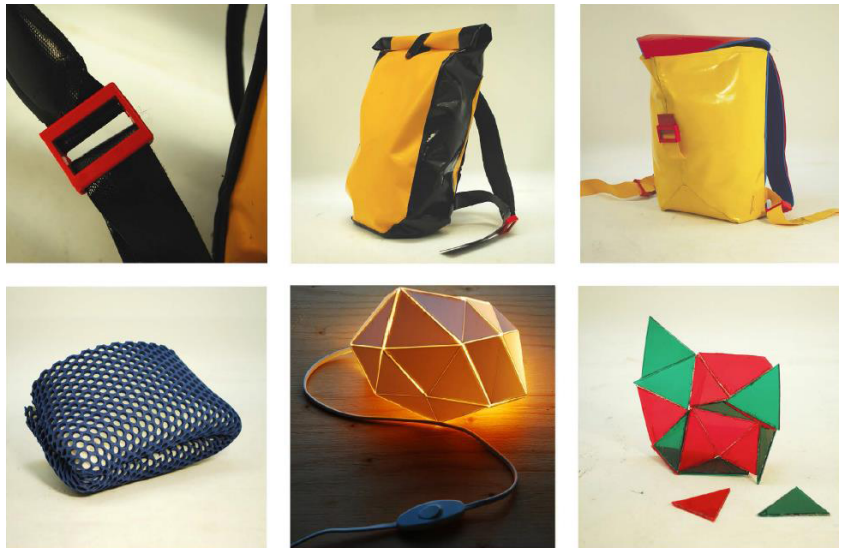


Figure 152: Preliminary results to serve as example projects (Lopez Pradas, 2013)

Figure 153: Scrap instruction sheets (Lopez Pradas, 2013)

In relation to the research questions (see Section 8.2.1),

1. The designer's facilitative role involved setting up new services to be offered by Scrap. In addition to creating Scrap-specific DIY projects and corresponding instructions, the designer facilitated access to specialized tools for manipulating plastic spare parts, such as welding equipment. This setup allows laypeople to express their creativity by working on DIY projects guided by the provided instructions, which are tailored to the materials available at the Scrap

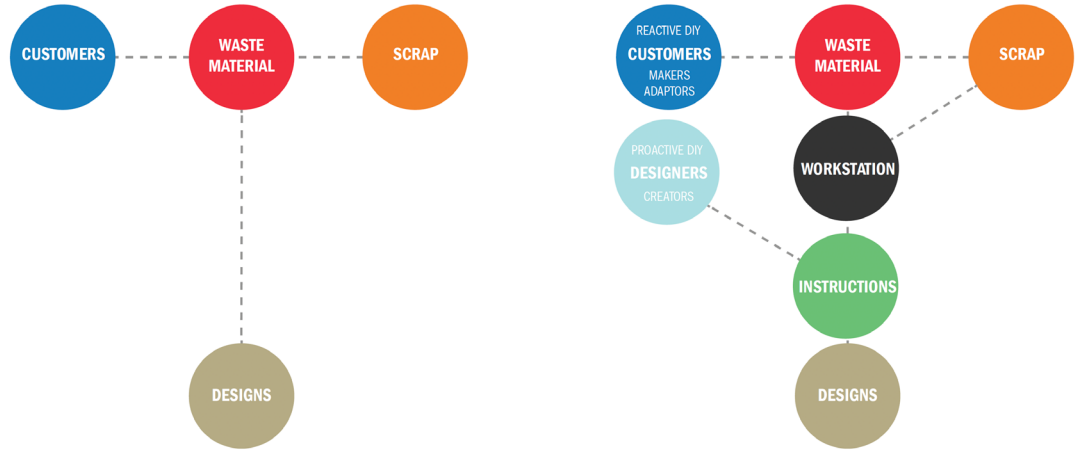


Figure 154: The additional services of Scrap (Lopez Pradas, Hoftijzer, & Keyson, 2013)

warehouse. As an outcome of this study, it is recommended to tailor Scrap's DIY project instructions to the materials available at any given time.

2. The Scrap warehouse project resulted in the design of tools, instructions and guidance for the layperson when undertaking a DIY project. These additional services helped increase and improve DIY facilitation at Scrap. Such a structure, however, likely compromises actual design freedom for people with design experience.

3. The project was unique in that it involved adding services and tools to an existing setup. The concept of providing these services around a specific material supply appeared to be a valuable design intervention and feasible for similar contexts and platforms.

8.7.5 Limitations and recommendations

The study focused on designing a new setup for the Scrap warehouse. The tests conducted primarily evaluated and optimized the newly designed tools (e.g., welding tools) rather than performing an extensive user test. Conducting a comprehensive user test would be a recommended next step for the Scrap warehouse. Further data from this study can be retrieved in the repository (R1-d).

8.8 Overall conclusions of the Design-for-DIY studies

The process models developed as part of the studies were designed to structure and assist the designers in facilitating laypersons. They helped to map the development steps taken by the facilitator and supported the identification of common aspects of the Design-for-DIY process: who took which steps, and which elements were needed.

The projects, the processes and the results have established a clearer view of what Design-for-DIY is about. These insights and models (Sections 8.4, 8.5, 8.6, 8.7) serve as valuable and relevant information in search of a suitable, preferably generic, Design-for-DIY framework. In addition to the findings derived

from the individual studies, the following are overarching conclusions that address the research questions outlined in Section 8.2.1:

To facilitate DIY activity, all four projects successfully included instructional media and a specific kit (also all four studies) that distinguished fixed elements from the free design space available to the layperson concerned. In line with conclusions drawn from DIY practices in history (Atkinson, 2006; Bonvoisin, Galla, & Prendeville, 2017; Goldstein, 1998; Hollinetz, 2015), the studies highlighted the importance of collaboration, templates and tools for manipulation, adjusted to the layperson's level.

In all cases, it appeared appropriate for the designer (student) (1) to prepare the project by considering the product design degrees of freedom, (2) to decide on the division between the tasks for the designer respectively the DIY tasks for the layperson, (3) to establish a toolkit (template) and environment (materials, tools), (4) to design and provide instructions, and (5) to provide guidance.

The division of tasks between designer and layperson was in each case a very help helpful and necessary step to take. The pre-design and preparatory stages helped distinguish the task division between the designer and the layperson. Decisions were made based on the laypersons' capabilities, their knowledge, and the complexity and adaptability of the product components. To reach their intended audiences, all the cases effectively included a DIY platform environment to enable laypersons to enrol in the DIY project and obtain the necessary support materials. All four studies had to consider the varying layperson's skills and level of experience, which was done by distinguishing means of facilitation, accommodation and support.

As a general conclusion following the studies, the DIY projects appeared to be possible, feasible and doable. The Design-for-DIY processes were reasonably similar; they showed resembling patterns of tasks and steps, which implies that it is feasible to derive a generic Design-for-DIY framework from them. The studies illustrated ways to construct DIY projects for non-designers. They refer to a situation in which the professional designer is the creator, manager and supplier of the DIY environment and the facilitator of the DIY activity by the layperson. While executing their projects, the researchers anticipated the changing role of a designer and the designing role of the layperson.

8.8.1 Discussion, limitations

Given that the studies outlined in this section were conducted to explore an additional layer of DIY design facilitation beyond a traditional design process, they focused on the design and development of the envisioned platforms, toolkits, tools, and potential DIY projects and instructions. While all studies included an evaluation of the resulting Design-for-DIY services, they were primarily exploratory in nature. As indicated, the small group size of participants in the project evaluations does not allow for definitive conclusions to be drawn from the results. As mentioned in Section 8.8, the studies served as inspiration and provided a preliminary synthesis for developing a generic Design-for-DIY framework structure and model.

8.8.2 Framework usage scenario

Typically, design methods focus on design for end users rather than facilitating the end user to design things for him-/herself. The facilitation of DIY however, or Design-for-DIY, forms a scenario that comprises a shift of task divisions and activities.

The envisioned use of a Design-for-DIY framework designates the designer as the facilitator (see Section 7.5.3), the creator of DIY projects, and the layperson as the executer of a DIY project (Figure 155). The studies helped to map the development steps to be taken by the professional designer, which supported the identification of numerous common aspects of the Design-for-DIY process, the Design-for-DIY scenario. Given the study conclusions and the concluded tasks and task division, a preliminary range of steps was assembled, see Table 11. The steps of Table 11 form the basis of the Design-for-DIY framework that is developed and defined further in PART III.

A Design-for-DIY scenario can be characterized as a modern mentor-apprentice relationship between designer and layperson, which – as was referred to in Section 7.5.1.2 - has a positive impact on both engagement and learning (Adams & Lenton, 2017). The designer's role thus changes from being a directive, decisive authority to that of a facilitator. In order to anticipate the variety of projects and the variety of layperson's profiles, and considering the professional designer's preferences, the Design-for-DIY framework should be flexible; designers should be allowed to consider the elements they need and skip those parts they do not need. After setting up and delivering a DIY project (step 11 in Table 11), a designer could decide to let it be used autonomously by laypersons

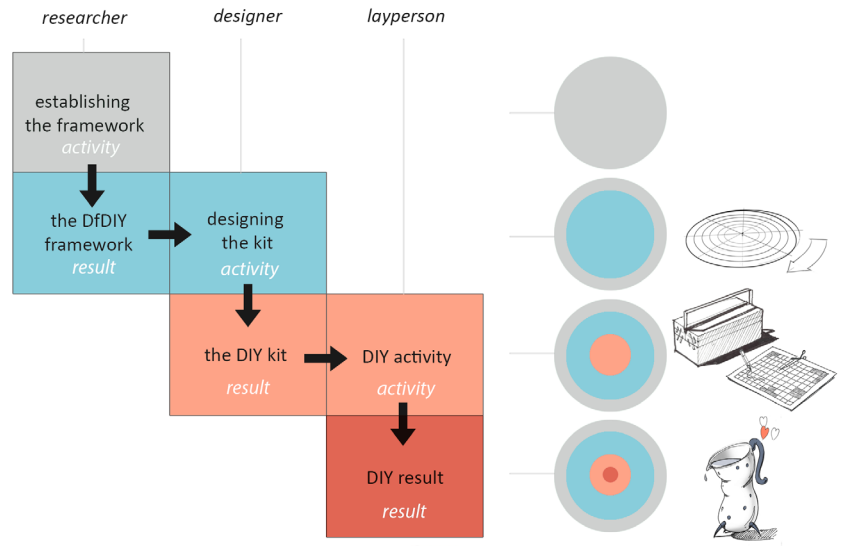


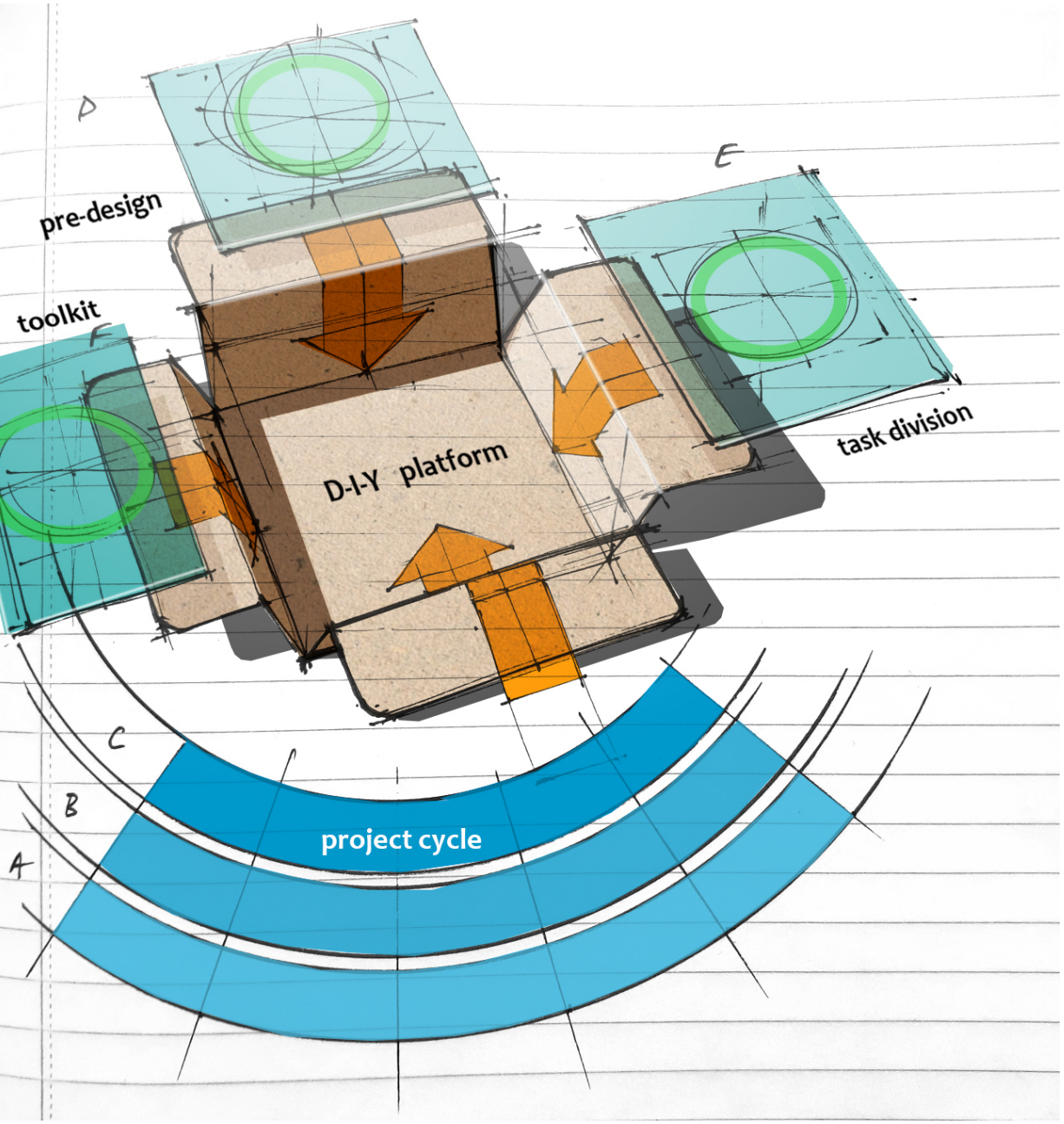
Figure 155: The designer's task of Design-for-DIY (designing the kit, blue), and the layperson's activity of DIY design (orange)

or choose a collaborative approach. Such a decision depends on the anticipated autonomy level of the targeted laypersons. Once a project is available, multiple laypersons can start that DIY project, using the provided guidance and tem-

plates. It is a plausible scenario to launch the project and support the community (for example, through collaboration between laypersons as mentors) to take it further (see also Sections 5.4.1.2, 6.5.3, 6.2.5).

Table 11: Process steps, taken from the Design-for-DIY studies

	Usage scenario Design for DIY framework
	From a designer perspective
1	Decide about establishing a DIY project for laypersons
2	Considering (and discuss) a design case: the product type
3	Preliminary design of a product
4	Considering the task division: designer/ layperson
5	Considering and preparing the support materials for the layperson
6	Considering, preparing and designing the kit and 'interface' for the layperson
7	Establishing, designing instructions and manuals, course elements
8	Considering and establishing the DIY platform/ environment
9	Considering and preparing other services and to offer
10	Anticipating and preparing the in loco support to offer
11	Assembling all elements of the DIY project on offer
12	Inviting/ sharing the project with laypersons
13	Introducing the DIY environment and projects
14	Providing knowledge/ course elements
15	Guiding/ supporting/ advising the layperson while he/she is doing DIY
16	(Co-designing and/ or post design)
17	(Helping to) manufacture
18	Concluding a project together with the layperson
19	Support further development, follow up

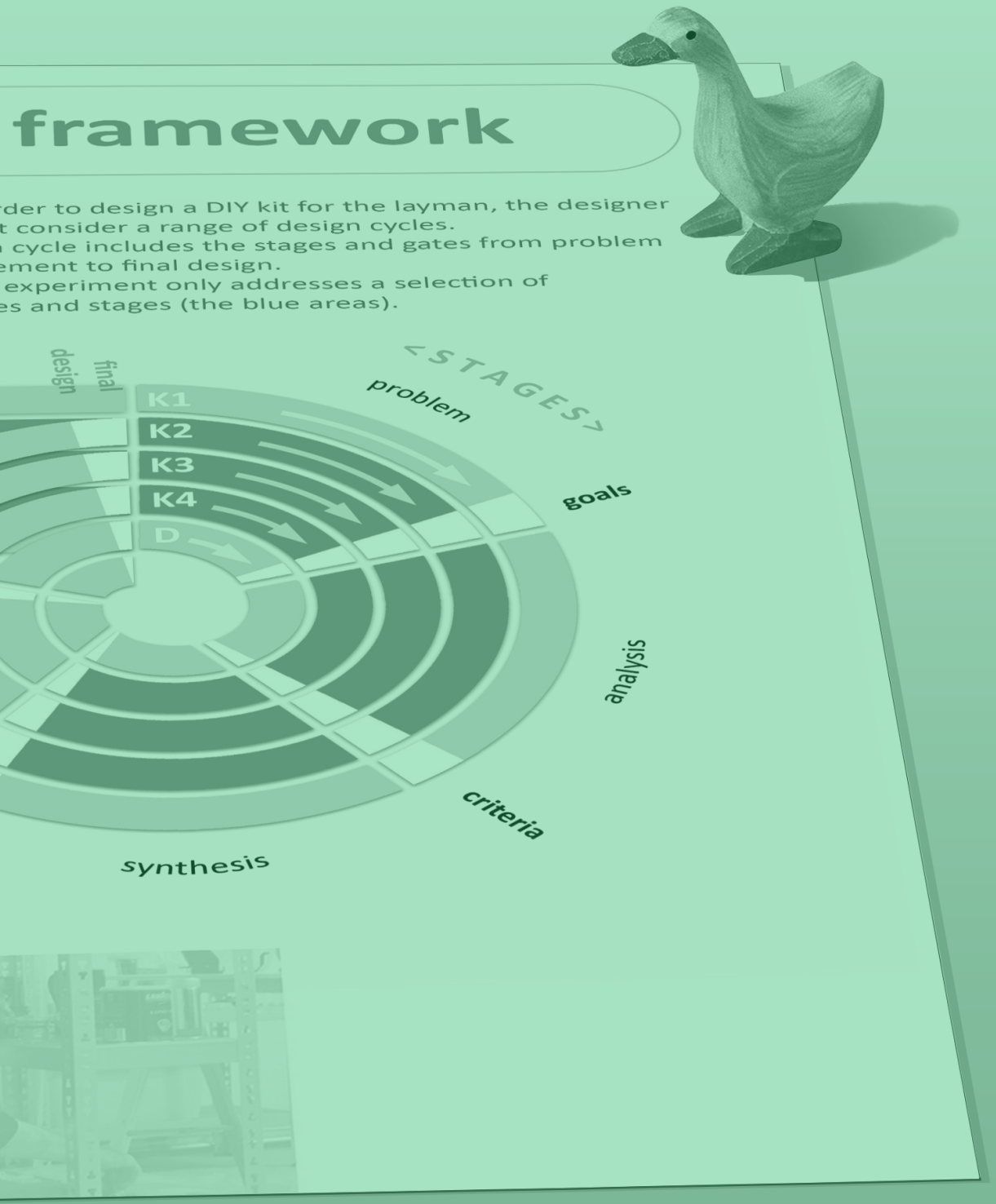


Preliminary visualization of facilitation of DIY

PART III - Framework

After having done all the preliminary steps, Section 9 will concern the construction of a Design-for-DIY framework: a model to help designers establish DIY projects. Section 10 will help to assess the quality of the framework and provide suggestions for improvement.

'Taking all the above into account, the question arises as to how, and in which ways have these various facets of DIY activity acted as a democratizing agency. This has occurred in a number of ways: giving people independence and self-reliance, freedom from professional help, encouraging the wider dissemination and adoption of modernist design principles, providing an opportunity to create more personal meaning in their own environments or selfidentity, and opening up previously gendered or class-bound activities to all' (Atkinson, 2006, p. 5).



Stimulus (Design-for-DIY gameboard) used for experiments

Section 9. The Design-for-DIY framework

9.1 Introduction design frameworks

This section discusses how the concluded process parts representing the Design-for-DIY process help establish a method to be utilized by the designer who intends to offer DIY projects to the layperson. The method should serve as an all-encompassing 'framework' that involves all the steps a designer should take to prepare, offer and facilitate laypersons' DIY activity: a so-called Design-for-DIY framework.

The following paragraphs concern the goals, structure and contents of the proposed spiral-shaped Design-for-DIY framework.

The challenge of such a framework is to provide clear and unambiguous information and knowledge about the process steps to consider when designing for DIY (facilitating DIY activity) and to offer enough freedom and flexibility to the designer so that he/she feels comfortable in choosing his or her own path and style.

9.1.1 Existing design frameworks

As the scope of this research is to establish a Design-for-DIY framework, this paragraph explores existing design frameworks and design models, in order to learn from them or refer to them in case that is appropriate. Considering its usage scenario, in establishing a Design-for-DIY framework we could learn both from existing generic design models (this section) and from the models developed in the range of Design-for-DIY studies (Section 8).

Taxonomy of design and development models

In design, frameworks and process models have multiple purposes, of which the most common seems to be an abstract representation of the design process.

According to Pugh (1991), a design model or framework serves as 'the designer's toolkit'. Wynn and Clarkson (2018) distinguish design process models along two perpendicular axes: (1) the type dimension (abstraction level) and (2) the scope dimension, from a micro- to a macro level. Their taxonomy indicates that the purpose of a framework may vary from, for example, 'prescriptive guidelines for the design and problem solving activity' to 'understanding how meso-level process flows relate to the design's progression' (Wynn & Clarkson, 2018, pp. 166-172).

Prescriptive vs descriptive

According to Roozenburg (1991), models of engineering design processes are characterized by a sequence of project stages (from concept of detailing), whereas the models of architectural/industrial design 'emphasize the cycle of cognitive processes' to be performed by the designer ('productive-deductive-inductive thinking') (Roozenburg & Cross, 1991). The first they name prescriptive, the latter descriptive.

Linear process models

Al Murani (2019) indicates the similarities between some known and some less known linear design process models by comparing them in one overview: Table 12. Smulders and Valkenburg's 'integrated model for the product development process' (Buijs & Valkenburg, 1996) would also fit in this table, as would Muller's Fish trap model (Muller, 2001) and, in essence, all of today's 'design thinking' models that concern the stages Empathise-Define-Ideate-Prototype-Implement align with these models. The models also align with IDEO's process model: Inspiration-Ideation-Implementation. These models are not similar, all have their own merits, but what ties them is their procedural character, of operational project level. SDN (Weisser, 2022) and Oleksiuk (2018) have described service design process models with very similar stages and appearance. Engineering design models of Pahl and Beitz (2013) and French (1985) also align with the stages discussed above, however the discipline and level of detail is different.

Models	Stages						
Human-centred design framework model	Inspiration			Ideation	Implementation		
Hass-Plattner Institute model	Emphasize		Define	Ideate	Prototype	Test	
4D model	Discover		Define	Develop			Deliver
Design Innovation Process	Sense intent	Know context	Know people	Frame insights	Explore concepts	Frame solutions	Realize offerings

Table 12: Comparison of linear design process models: Al-Murani (2019): HCD model; Hasso Plattner model; *Double Diamond* model (Moll, 2024); Design Innovation Process model.

Reflective models and cyclic models

Schön's (1984) reflective practitioner model including the stages Plan-Act-Evaluate-Rethink could also be positioned in this same Table 12. Schön however referred to designing as a process of solving a unique problem (reflection-in-action), not as a generic step-by-step process.

Roozenburg & Eekels' (1998) basic design cycle also fits in Table 12, although this model – similar to Schön's model, emphasizes its circular, thus reflective, intention. Besides, Roozenburg & Eekels' model is characterized by its gates in between the stages. Design models such as ViP (Hekkert & Dijk, 2014) and SID (Tromp, 2013) tend to choose a wider perspective, look at design from a higher abstraction level. ViP concerns the returning stages of context, interaction and consequently the product. ViP and SID (Phenomenon-social statement-behaviour- strategy-design proposal) both take societal changes into account, which makes them of a rather abstract and even organizational or strategic level.

Evans proposed a spiral-shaped design process model to 'highlight the iterative nature of the design process' (Evans, 1959; Vossen, Kleppe, & Randi, 2013; Wynn & Clarkson, 2018). Evans argues that a design project cannot be run through by following a sequential process alone. He suggests a procedure of iteration, reflection and refining, a spiral shape. The character of Evans' model is actually quite similar to what Cross proposed as a 'type' model, an almost 'consensus' model for both design/architecture and engineering purposes (Roozenburg & Cross, 1991).

9.1.2 Design-for-DIY process models

There are many DIY projects available. Varying from simple to complex, today's DIY projects are shared through multiple platforms (for example, Instructables) with large repositories of DIY projects (instructions, tutorials, films, examples and tips). However, a description or procedure of how such projects were established it is mostly lacking.

Fablab (Bo-Kristensen, 2018) has depicted its 'designing the design process' model in their Fablab manual and they approach it from an educational perspective (Figure 156). The model clearly distinguishes the phases of 'setting learning goals', arranging design materials, which prepares for the facilitation of DIY activities (comprising the stages of (1) research (brief and field study), (2) creation (ideation and fabrication) and (3) staging (argumentation and reflection). The model is a rather abstract and circular representation of what Fablab aims to offer through their platform and workshops (Gershenfeld, 2012), in which it clearly distinguishes the tasks of the designer and the layperson.

Kymalainen's (2015) 'framework for co-creating DIY service concepts' distinguishes the pre-co-design phase, the co-design phase and the post-co-design phase. The relevance of Kymalainen's model for the Design-for-DIY research is the fact that it separates the different tasks within the 'system' of Design-for-DIY: it comprises a preparation phase, followed by phases in which the actual involvement of the layperson is facilitated.

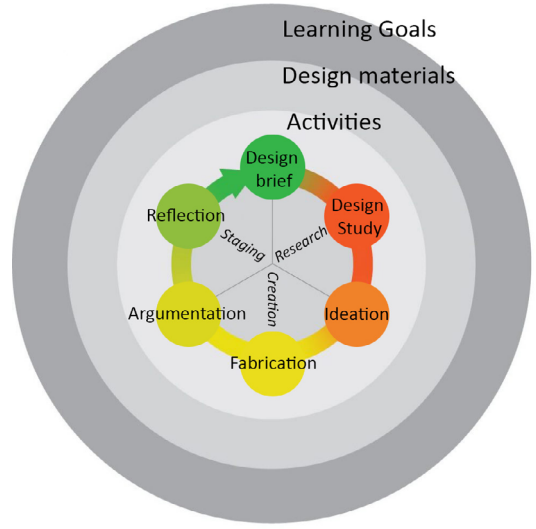


Figure 156: Fablab: 'designing the design process' (Bo-Kristensen, 2018)

Ellen Lupton shared her view on DIY graphic design (Lupton, 2006) in her book *D.I.Y. Design it Yourself*, in which she considers DIY creation and publishing. Her visualization shown in Figure 157 is not a strict process model for facilitating DIY activity, but in a way, it is: it tells the designer what to consider

when constructing a DIY project and it tells laypersons what to try and do when DIY-ing. DIY project platform Camellia Café (2022), in Table 14, shows a sequence of generic steps and elements that would help laypersons run a DIY project, and – in case support is needed – that would help a designer set up and facilitate a project for that layperson.

9.2 Reasoning and setup of a Design-for-DIY framework

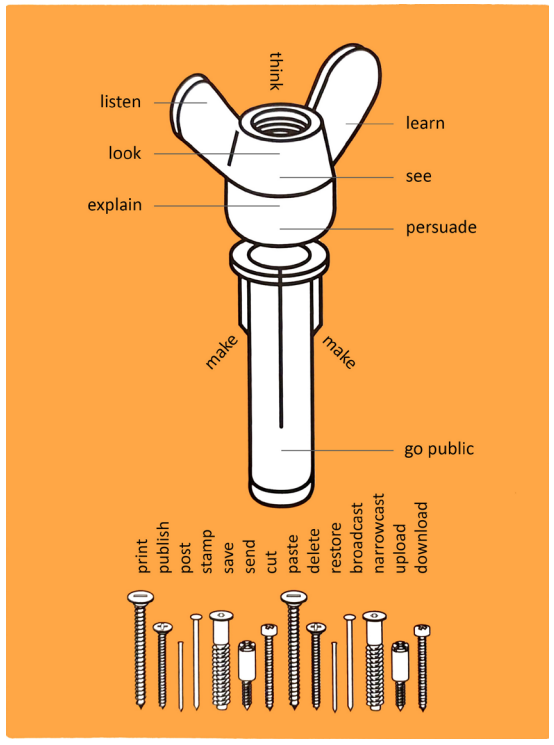


Figure 157: Ellen Lupton's abstract visualization of the DIY graphic design process (Lupton, 2006)

The knowledge gained in this research serves as input for the construction of the Design-for-DIY framework, a means to help the designer set up DIY projects.

In addition to the aforementioned challenges, the Design-for-DIY framework should address both the professional designer tasks and the steps to be taken by the layperson. First the professional designer performs various design iterations in constructing and preparing the actual DIY project to offer, followed by the layperson who is invited to assert his/her creativity and involvement and perform DIY activity.

All the above has led to the insight that Design-for-DIY requires a novel Design-for-DIY process model. The model should preferably include a small range of design cycles to represent the different design tasks (for example, preparing the DIY toolkit) and the iterations that are part of these tasks (for example, the

synthesis of a toolkit).

In addition to the consideration of relevant cyclic frameworks from literature (Bo-Kristensen, 2018; Vossen, Kleppe, & Randi, 2013) and from the Design-for-DIY studies, this advocates a multi-level approach. Both literature (Pep-

Table 14: Camellia Café DIY process stages for the layperson (https://www.camellia.xin/main.html)]

	Ask	Think	Solve
Design	Your need functions	Statics or move Feasible	Optimize functions
Build	Feasible Easy Economical	Mechanism, automation, ... Build, disassemble, maintain, ... Cheaper but qualified	"A beard well lathered is half shaved" Never always build, pause to think
Overcome	Small Medium Big	Think by yourself Search in Website Sometimes give up the old idea is good for new success	Use many ways to answers Give up the unfeasible idea
Test	Does it fullfill your purpose? Does it look elegant? Does it operate easily or robust? Is it easy to disassemble or maintain?	All or only some Most people like it For Most people it is easy to use Disassembling and maintaining is very important	Don't hurry to be happy when you're finished After server test you will have great achievement

pler & Bender, 2013) and the Design-for-DIY studies indicate the pedagogic character of Design-for-DIY and the importance of supporting creativity, both elements associated with circular and spiral shapes and structures that represent designers' cognitive processes (Roozenburg & Cross, 1991; Schön, 1984) (Evans, 1959; Vossen, Kleppe, & Randi, 2013).

9.2.1 Goals of the framework

The Design-for-DIY framework (to be offered to designers) was proposed to support DIY activity by laypersons. Indirectly, the Design-for-DIY framework will help establishing some of the starting points of DIY activity, of which some are:

- The framework should help designers make laypersons aware of their skills and creativity.
- The framework should help improving the relationship between laypersons and the items they use and make: decrease alienation, increase user-product attachment.
- The framework should make both designers and laypersons aware of the implications, consequences, background and options of production and making.
- The concept of Design-for-DIY and the accompanying framework should offer a sustainable alternative for product design and development.

The development of the Design-for-DIY framework needs to consider a range of requirements. Although the framework design will be based on a wider

range of aspects described in this thesis, the list below offers an overview.

9.2.1.1 A tool for the facilitating designer

• The Design-for-DIY framework should offer knowledge of the DIY process and of previous DIY and Design-for-DIY project examples.

• It should describe and provide clear steps to take.

• It should offer suggestions and approaches towards facilitating DIY design.

• It should help him/her initiate a Design-for-DIY project, prepare it, facilitate and assist DIY activity.

• It should support the designer as regards different levels of DIY skills.

• It should be flexible, as the final implementation will differ each time, the designer and the layperson audience change each time, and the circumstances and project will be different each time.

• The Design-for-DIY framework should function as a reference and guide for designers when creating a 'DIY project' for laypersons.

• The framework should be clear and complete to the designer.

• The framework should help create an inviting DIY environment, including physical or online materials and information.

• It should help decide how tasks are divided between the designer and the layperson.

• The framework should help the designer to take responsibility and facilitate laypersons, be a mentor.

• The framework should aim to serve as an alternative model for product development, in which design space and freedom for the layperson are integrated.

• The Design-for-DIY framework should be published, distributed and offered to designers who want to engage in offering DIY projects to laypersons.

9.2.2 Reasoning for the structure of the Design-for-DIY framework

Key elements from the gained knowledge have served as starting points for the shape and structure or the framework.

(1) The Design-for-DIY scenario and the Design-for-DIY studies have taught us that the entire process is represented by a 'sequential' range of distinctive design tasks to be executed one after the other, and that each of those tasks can be seen as a process in itself. In addition to the consideration of example frameworks from literature (Bo-Kristensen, 2018; Vossen, Kleppe, & Randi, 2013) and from the Design-for-DIY studies, this calls for a multi-level approach.

(2) Both literature (Peppler & Bender, 2013) and the Design-for-DIY studies (Section 8) indicate the pedagogic character of DIY and of Design-for-DIY. Another key element of DIY and of Design-for-DIY is the support of creativity and iteration. Both these elements of pedagogy and iteration tend, in literature design process models and in the Design-for-DIY studies (Section 8), to be associated with circular (Bo-Kristensen, 2018; Gibbs, 1988; Roozenburg & Cross, 1991; Roozenburg & Eekels, 1998; Schön, 1984) and even spiral shapes and structures (Evans, 1959; Vossen, Kleppe, & Randi, 2013), shapes that emphasize the repetitive, flexible and non-linear character of the process, giving room to the designer's cognitive processes (Roozenburg & Cross, 1991).

This is why Design-for-DIY requires a novel process model and why it will have a cyclic character, in fact a spiral shape describing the sequence of steps from the outside to the inside. Such a structure allows the framework to describe a process model inside a process model: different levels with a design process to run at each level.

All the findings together in this study have contributed to the development of a multi-cyclic Design-for-DIY framework, preliminarily depicted in Section 9.2.3 and Figure 159, comprising two dimensions: (1) the dimension of design levels or cycles (tasks, functions) to perform (Section 9.2.4) and (2) the analytical and iterative design stages that are part of each cycle (Section 9.2.5). Figure 158 illustrates the reasoning of the structure of the Design-for-DIY framework.

9.2.3 Two dimensions

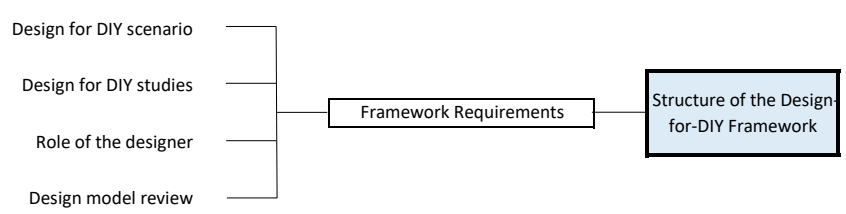


Figure 158: Knowledge and requirements for the setup of the Design-for-DIY framework

As a basis, the spiral-shaped process depiction (Figure 159) is structured along two dimensions: one radial and one circular, representing:

(1) Radial, from the outside to the inside, the subsequent major design cycles (preliminarily, the 'pre-design' cycle, the 'design kit' design cycle, the 'platform' design cycle and the DIY cycle), are positioned.

(2) Circular, the various (standard) design stages of each cycle are structured. These 'Design-for-DIY segments' (or cells) of the model are defined by the coordinates of a combination of a specific cycle and specific stage. The fact that cycles become smaller towards the middle of the framework relates to the final DIY project that comes closer to the desired outcome, process and situation.

As the Design-for-DIY framework should serve the designer in designing DIY projects, it needs a structure that is clear, comfortably useful, easy to use, flexible and complete. The following paragraphs will address the format, the shape that accurately represents the 'Design-for-DIY process' to be run by the designer, while being comfortable to use.

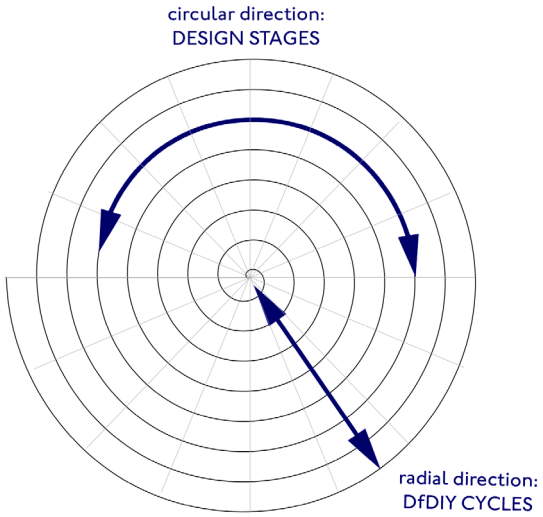


Figure 159: Clarification of the radial structured cycles and circular stages of each cycle, as two vectors of a preliminary Design-for-DIY framework

9.2.4 The radial dimension: the cycles of a Design-for-DIY framework

The proposed Design-for-DIY framework concerns a number of concentric cycles that represent the major design tasks to be done at different decision levels. The model aims to facilitate a dialogue between the designer and the layperson.

The concentric shape also reflects the iterative cyclical character of models for teaching and learning as documented by various scholars (Gibbs, 1988; Van Boeijen, Daalhuizen, & Zijlstra, 2020). The option of re-running a cycle resonates with the 'learning-by-doing' approach.

The multi-cycle model for Design-for-DIY also refers to David Kolb's and Donald Schön's models that depict the stages of learning (Kolb & Kolb, 2008; Schön, 1984). As described in previous sections (Section 6.4.3.2, Section 6.4.2, Section 7.5.3, Section 8), the learning aspect is specifically incorporated in the Design-for-DIY philosophy and Design-for-DIY framework.

Each cycle prepares for the next, in centripetal direction. The order in which successive cycles are positioned in the framework is considered fixed, however the designer is free to improvise and choose his or her preferred path.

Cycles of the framework

Cycle 1: The Project cycle helps to define the goals and contents. The layperson's interests, the product's suitability, accessibility, complexity and the dimension or boundaries of DIY (Section 7.5.6) all need to be considered, as was the case in the coffee-maker study (Section 8.4). In short, in the Project/Design Brief cycle the designer (and layperson) needs to address the project's purpose, target audience, reason for initiation and product category.

Cycle 2: The **pre-design** serves as a reference and draft product design for the project, as well as an example for the layperson, and it provisionally delineates the fixed areas and free design space they will have. This exploratory cycle thus serves as a first design step, in which a preliminary product design is established. Activities in the Pre-design cycle are geared towards anticipating DIY restrictions and options. The need for such a cycle was observed in case studies #2, #3 and #4 (Section 8).

Cycle 3: The **toolkit cycle**. The Design-for-DIY cases described above demonstrated a number of ways to assist the layperson in creatively designing a product, supported by a toolkit approach. The design of the toolkit, a fundamental element of all Design-for-DIY cases run, should include clear task allocation (to what extent is the layperson involved and for which aspects), specific tools and instructions, a specific design-space medium that supports relevant techniques. We hereby need to consider the layperson's level of skill and design intent, the expertise of the facilitating designer and the envisioned freedom of design. Flexibility and variation in the layperson's level of skill are important aspects to be considered within the Toolkit cycle.

Cycle 4: The **Platform cycle** brings together many of the key design-support elements a layperson may need when undertaking a DIY project. This design environment considers designer support, physical and digital materials for inspiration, examples, peer and community networks, potential suppliers of materials, etc. (Figure 160). Related to this, this cycle should include a post-design re-interpretation step, allowing the designer to contribute expertise in respect of manufacturing, safety, aesthetics and so on. Design-for-DIY studies #2 and #3 indicated the value of such a 'Post-design' step (Section 8). The Platform cycle should be inviting, attractive and accessible, as it also represents the project and even the facilitating designer or institution from the outside. The platform addresses the establishment of a collaborative environment and connection to communities and other platforms. A platform could or should also form the basis for multiple different projects, all made available through one specific portal: this platform.

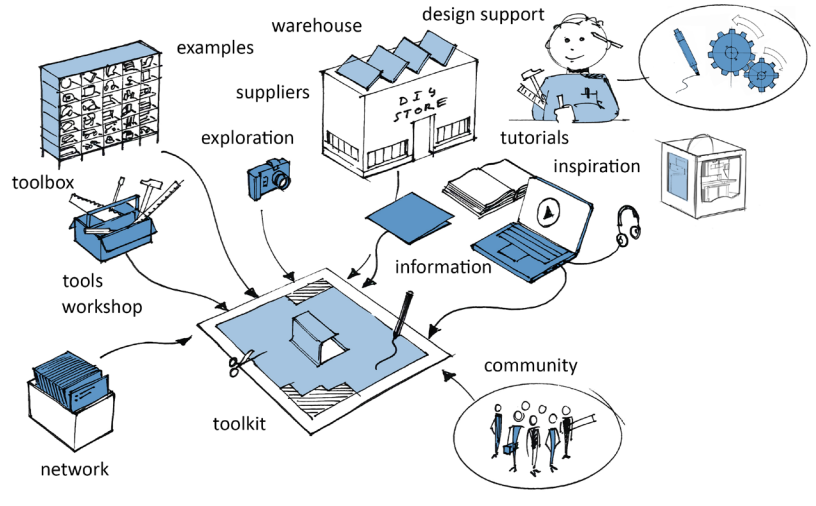


Figure 160: Optional elements of a Design-for-DIY Platform

Cycle 5: The **DIY Design cycle** is when the layperson is invited to perform their DIY task, guided to a greater or lesser extent by the facilitating designer, within the environment as it has been prepared and provided by the facilitating designer. The layperson here runs through a full design cycle using the guidance and support offered in the 'project'. This specific 5th cycle has an iterative character. Repeating it can help the layperson to apply lessons learnt from the previous iteration to improve their skills, to take up the challenge of increased complexity or to try implementing new insights in an alternative design direction.

9.2.5 Circular: Design process stages represented in each of the main cycles

When zooming in on each of these main cycles representing the activities a designer has to perform, it is clear that each of these cycles contains the range of design process stages well known in the field of product design. Roozenburg and Eekels' model called the *Basic Design cycle* (Roozenburg & Eekels, 1998; Van Boeijen, Daalhuizen, & Zijlstra, 2020), as well as The Design Council's *Double Diamond* model (Moll, 2024), could be the basis of the stages implemented in the Design-for-DIY framework. This means that, similar to common design practice, each of the cycles concern activities such as ideation, iteration, making choices, evaluating, etc. Table 15 shows the initial matrix comprising both the cycles (vertical) and the stages within these cycles (horizontal). The range of design process stages (from problem statement/strategy to use/evaluation) that are part of a standard product development model (process tree), such as depicted by Smulders and Valkenburg in their '*Integraal model voor het productontwikkelingsproces*' (Buijs & Valkenburg, 1996), or by Roozenburg and Eekels' model of '*De basiscyclus van het ontwerpen*' (Roozenburg & Eekels, 1998; Van Boeijen, Daalhuizen, & Zijlstra, 2020), or by Ullman's '*design cycle*' or Pahl and Beitz' *design method* (Eger, Bonnema, Lutters et al., 2006), apply to each of the Design-for-DIY cycles. These design process stages are circularly implemented in the model. The stages include both the activities (stages) (for example, 'evaluate'), and the process statuses gates (for example, 'criteria') in between.

Stages as part of the framework cycles

Each of the cycles in the Design-for-DIY framework (Figure 161) comprises a series of steps – alternating 'stages' (activities) and 'gates' (subsequent decision moments) in the product development model (process tree) as depicted by, for example, Roozenburg and Eekels (1998). These are outlined below.

Step 0 (stage): **Problem statement** (situation/ question).

Just as each design trajectory does, each cycle starts with describing the problem: 'which situation needs to be solved?' This first step of the range of stages and gates prepares him/her in defining the goals of this design cycle.

Step 1 (gate): The **goal** of this cycle (what to achieve?).

Following the problem statement, in this stage the framework suggests defining the goals of the specific cycle: 'which goals should be achieved?'

Step 2 (stage): **Analysis** of relevant factors (needs, context).

This stage suggests analysing the factors that are relevant to the problem statement, for example, the analysis of a product category, of current tools, of people's capabilities and wishes, of literature, etc. The analysis stage is, like all stages, different for each cycle.

Table 15: Initial elements of a Design-for-DIY framework

Initial segments of the Design for DIY framework					
	1	2	3	4	5
	Design Brief cycle	**Pre-design cycle**	**Toolkit cycle**	**Platform cycle**	**DIY cycle**
stage	problem statement	problem statement	problem statement	problem statement	problem statement
gate	Goal	Goal	Goal	Goal	Goal
stage	Analysis	Analysis	Analysis	Analysis	Analysis
gate	Criteria	Criteria	Criteria	Criteria	Criteria
stage	Synthesis	Synthesis	Synthesis	Synthesis	Synthesis
gate	Design Concepts	Design Concepts	Design Concepts	Design Concepts	Design Concepts
stage	Simulation	Simulation	Simulation	Simulation	Simulation
gate	Expected properties	Expected properties	Expected properties	Expected properties	Expected properties
stage	Assessment	Assessment	Assessment	Assessment	Assessment
gate	Final Design	Final Design	Final Design	Final Design	Final Design

Step 3 (gate): **Design criteri**a/ requirements/ boundaries.

The analysis will result in the description of design criteria, different for each cycle. In a later stage (stage 8) of this cycle, these criteria help assess the design results of this specific cycle.

Step 4 (stage): **Synthesis**, exploration (development).

In this stage, the framework suggests that the designer starts exploring ideas and creating solutions, either concerning the project (Cycle 1) or concerning the pre-design (Cycle 2), the toolkit (Cycle 3) or platform (Cycle 4)

Step 5 (gate): **Design concepts**.

In step 5, the framework suggests selecting one or a couple of the design results that were established in the synthesis stage. The depiction of a concept should be as concrete as possible.

Step 6 (stage): **Simulation**, testing, materialization, embodiment.

To be able to value and assess the selected design(s), the design(s) need to be tested by simulation of behaviour. It concerns, for example, the testing of prototypes through experiments.

Step 7 (gate): **Expected properties** of the design (predictions).

This gate suggests documenting the expected properties of the final product, derived from the simulation or test stage. The properties are required to assess the design in the next stage.

Step 8: (stage): **Assessment**/ evaluation.

This stage of the framework is about the assessment of the provisional outcome of this cycle and its expected properties, based on the criteria, which were defined in the earlier stage 'Design criteria'. This evaluation forms the basis for the decision whether to accept the design outcome of this cycle or not, and to either move to the next or redo the current cycle.

Step 9 (gate): **Final design**, value and decision.

This gate concerns the delivery of the final design of this cycle. In case of the platform cycle, the 'Final design' step represents the last step before the project can be offered to the layperson.

9.3 The Design-for-DIY framework

9.3.1 Segments of the framework in detail

The inward progressing (radial) cycles and the circular stages within each cycle together form a 2- dimensional model, depicted as a spiral. Such a model suits the various use requirements and purposes that were mentioned in Section 9.2.2.

The matrix as depicted in Table 16 clarifies the content of each segment of the Design-for-DIY framework. The matrix comprises both the cycles (vertical) and the stages within these cycles (horizontal). These cycles are represented in chronological order, each segmented in a series of steps per cycle. The matrix serves as a basis for the set-up of the spiral-shaped Design-for-DIY framework as depicted in Figure 161. Referring to this, cycles 1 to 4 represent the preparatory and facilitating tasks by the designer, while the fifth (the DIY cycle) is where the layperson actually undertakes the DIY project, guided by the designer.

Table 16: Design-for-DIY segments in the Design-for-DIY matrix

Cycles >	PRODUCT/ PROJECT cycle	PRE-DESIGN cycle	KIT cycle	PLATFORM cycle	DIY cycle
	actor: designer	actor: designer	actor: designer	actor: designer	actor: amateur
	on behalf of: amateur	on behalf of: amateur	on behalf of: amateur	on behalf of: amateur	on behalf of: design(ing)
	choosing product case as a vehicle	running preliminary design process	defining design tasks, design space, setting up dialogue, levels, learning, medium	choosing and designing the environment	execution of the DIY project/ validation of preparation stages/
Stages and gates V	**1.0**	**2.0**	**3.0**	**4.0**	**5.0**
Problem statement (S)	What project to offer?	The preliminary design of ..	How are tasks divided between facilitator and amateur? The design of the DIY kit (the interaction space/ canvas/ medium)	The design of the DIY environment/platform/ what environment for specific case?	The amateur should be guided and facilitated, in such a way it teaches him
1	**1.1**	**2.1**	**3.1**	**4.1**	**5.1**
Goals (derived from problem) (G)	(To be able to) Propose a suitable project	Running and documenting specific product design process for DIY purpose	Divide tasks and decide on DIY dimensions and levels, Propose a suitable template/ interaction medium that supports DIY activity	Propose platform and format for communication with laymen	The amateur runs (parts of) the design process himself/ Run DIY process, resulting in DIY product/ 'The design of...'
2	**1.2**	**2.2**	**3.2**	**4.2**	**5.2**
Analysis of factors (relevant to problem statement) (S)	Analyse suitablility of product and analyse context and DfDIY starting points (obtained from vision concerning products)	Analyse product design factors (life cycle) + pre-design factors (suitablility), process factors	Analyse stakeholders, layman capacity, preferences, task division, levels of skills and challenge, other examples of design kits, techniques, media, formats, templates	Analysis of various example platforms, what is need to guide/ support DIY activity?	Analysis of amateur behaviour/ is information lacking?/ which parts of the offered process to improve?
3	**1.3**	**2.3**	**3.3**	**4.3**	**5.3**
Design criteria/ boundaries (derived from analysis) (G)	Reqs / criteria concerning the suitability of a project: decide on DfDIY requirements	pre-product design reqs from DfDIY starting points and product life cycle. Criteria concerning pre-design and pre-design process	Reqs concerning task division/ dialogue, Reqs concerning the design of the kit	Reqs concerning the design of the environment	Criteria for assessment of DIY process success/ Suggesting personal criteria to chooce and decide on for implementing in unique outcome
4	**1.4**	**2.4**	**3.4**	**4.4**	**5.4**
Synthesis, exploration (framed by criteria) (S)	Explore potential DfDIY cases	Running draft process	Suggest which parts to provide, and which to ask from the amateur/ apply to pre-design sequence, Designing the protocol to follow, the design space to offer, template	Deciding upon the environment elements to offer	Execution of DIY design synthesis
5	**1.5**	**2.5**	**3.5**	**4.5**	**5.5**
Design Concepts (result from synthesis) (G)	Options for product cases	pre-design concepts	Proposal for task division, Concept kit for DIY	Platform concept(s)	Original DIY results
6	**1.6**	**2.6**	**3.6**	**4.6**	**5.6**
Simulation (materialisation, test, embodiment) (S)	Estimate consequences, arguing/ dry-run of next cycle	Simullation of Pre-design proposal	Simulation of task division scenario, Simulation of kit (use)	Simulation of platform (use)	Simulate DIY result concepts
7	**1.7**	**2.7**	**3.7**	**4.7**	**5.7**
Expected properties of design based on simulation results (G)	Properties of product/project in relation to DfDIY case.	Concrete and assessible depiction of (physical) pre-design and process	Description of the division of tasks between amateur and facilitator, Expected properties of the kit	Properties of the platform, concluded from simulation/ embodiment	Expected properties/ qualities of the DIY design result
8	**1.8**	**2.8**	**3.8**	**4.8**	**5.8**
Assessment/ evaluation (S)	Assessment of final definition of DIY case	Assessment of pre-design	Evaluation of task division proposal, Assessment/ evaluation of toolkit	Evaluation of the platform	Assessment evaluation based on criteria
9	**1.9**	**2.9**	**3.9**	**4.9**	**5.9**
Final design, value and decision based on evaluation (G)	Final definition of DIY case, or not	Decide on/ value the pre-design	Decide on the suitablility of the defined task division, Final DIY design kit, or not	Final design of the platform, or not	Final DIY design, or not

9.3.2 The Design-for-DIY framework

As was addressed in the previous sections, the Design-for-DIY framework is the result of thorough analysis of the components of such a design methodological model, and of the studies outlined in this thesis (Section 8). It has the shape of an inward running spiral (introduced in Figure 159). A final framework proposal was established after a process of iterative design stages, of which some iterative steps are depicted in Figure 161.

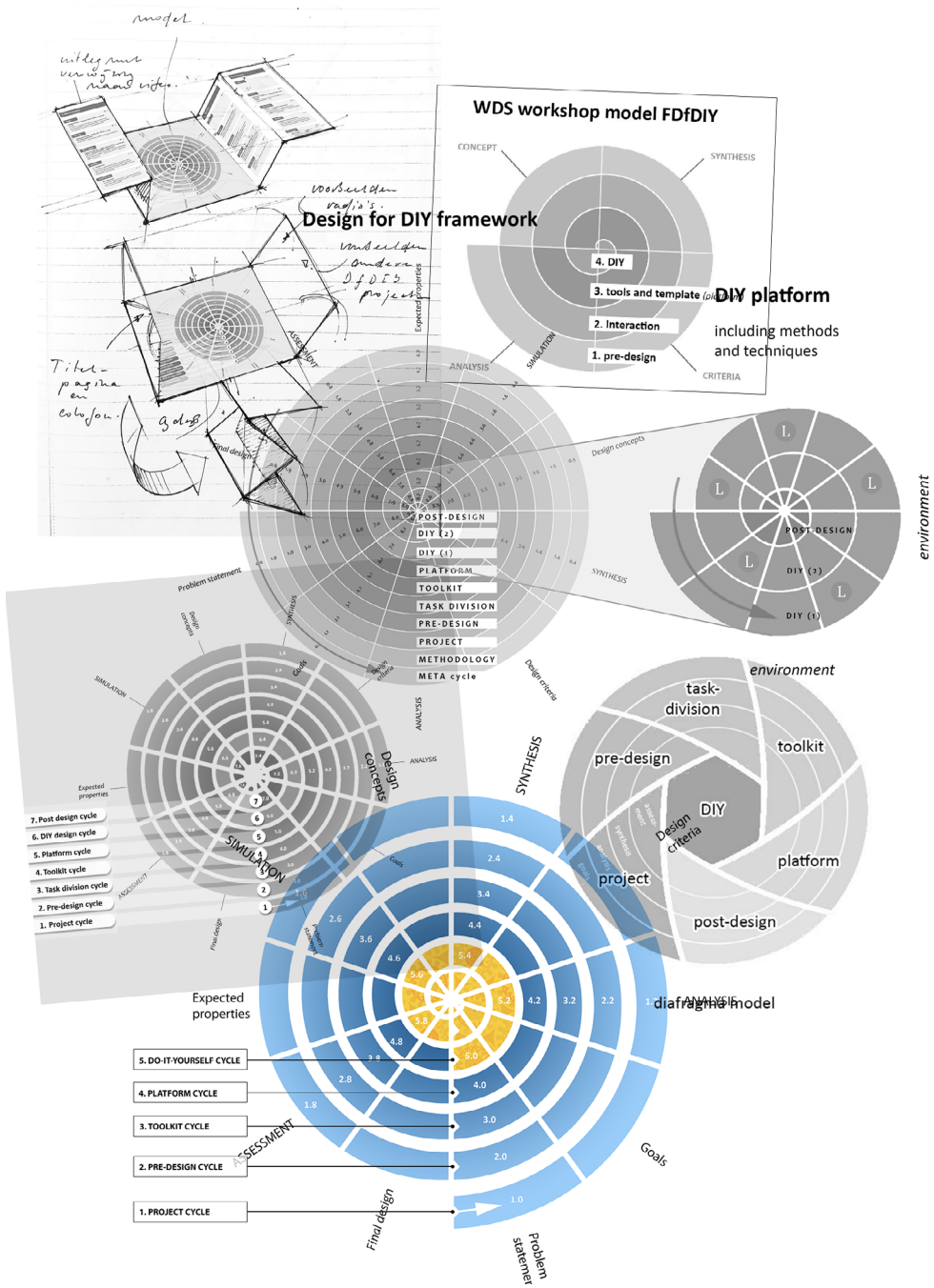


Figure 161: Iterative stages of the development of the framework

Each cycle of the resulting framework (in Figure 162) prepares for the next, in centripetal direction. The order in which successive cycles are positioned in the framework is considered fixed, however the designer is free to improvise and choose his or her preferred path. There are clear differences between the successive cycles, although some overlapping and integration are likely to occur.

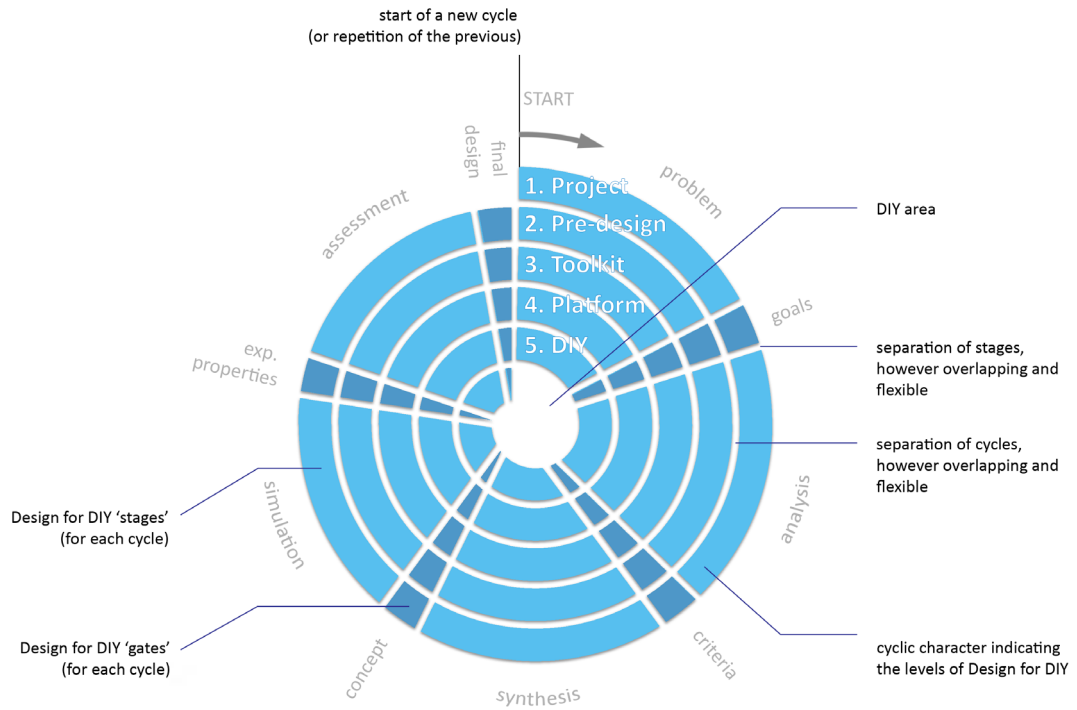


Figure 162: The proposed Design-for-DIY Framework, its cycles and stages

As explained, each of these cycles comprises a full and iterative Design-for-DIY sub-process, which can optionally be run repeatedly (in case further - lateral - iteration is required. The designer utilizing the Design-for-DIY framework is invited to start at the base: at the most outward process cycle: the 'project cycle' (1). Through the subsequent cycles of the pre-design- (2), toolkit- (3), and platform cycle (4), he or she reaches the point at which a DIY project is developed and is ready to share with laypersons: the DIY cycle (5) is ready to be shared (see Figure 162a for example scenarios when using the framework).

The scenario envisions a designer taking responsibility for running cycles 1 to 4, given their knowledge and experience. However, it goes without saying that such a framework encourages the involvement of laypersons throughout the entire process.

9.4 Use of the framework

For reasons of usability and accessibility, the visual Design-for-DIY framework - as a tool and method - needs to have a digital and interactive presence. The visual framework is available through its specific website (Figures 163a and

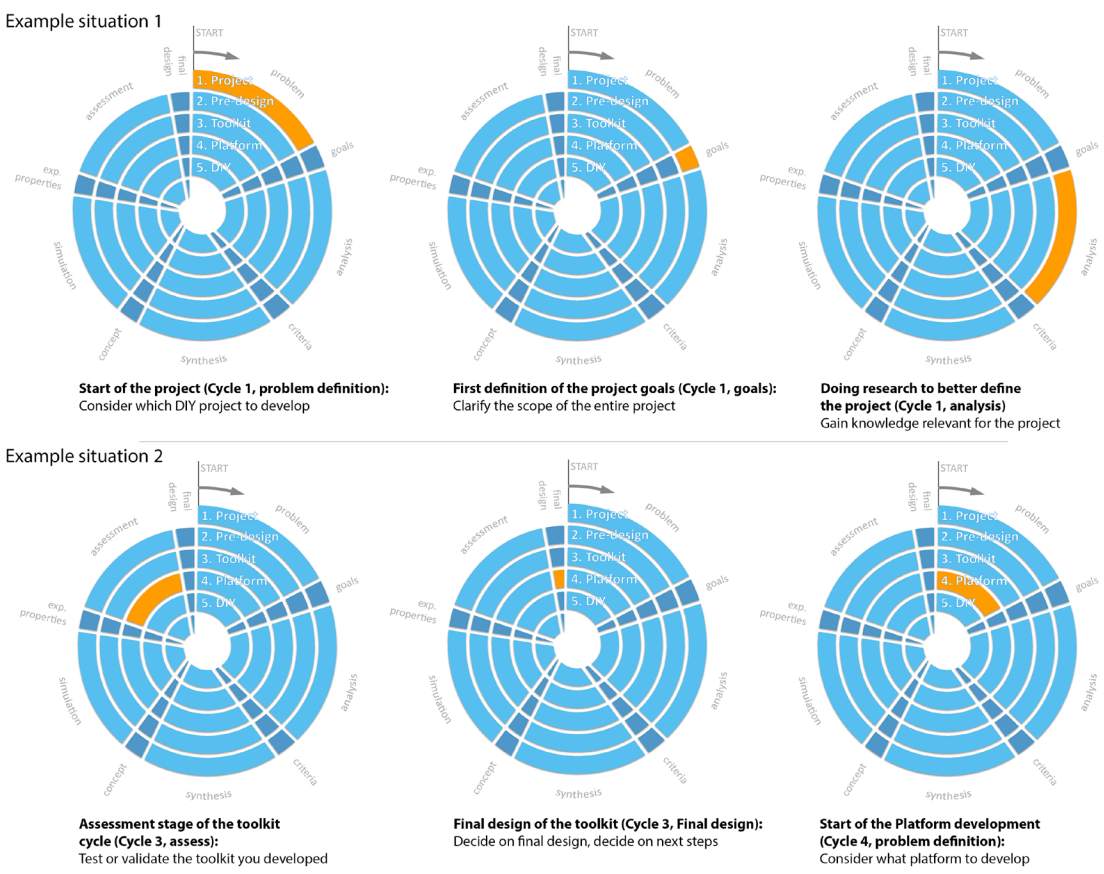


Figure 162a: The Design-for-DIY framework as a smartphone app

163b) and is also available as a tangible board game. The embodied framework offers in-depth information concerning the entire structure, concerning the Design-for-DIY process it represents. It offers the extensive opportunity to click and pick the items to learn more about them, which allows users of the framework (designers) to address and look up background and practical information, internal and external links and examples (either static or in short videos) concerning all cycles, stages and segments, and find advice about anything they need or require.

Hence, the framework's function is twofold: (1) offer the service of the framework's content and guidance to help designers in creating DIY projects for laypersons and (2) attract attention, provide information and help increase awareness and provide a hub for designers who are into designing for DIY.

9.4.1 Information, interaction

Figure 164 shows the availability of specific information in relation to a specific segment of the framework, to help the designer run the stages, and to help him or her to learn more about its options, project examples, etc.

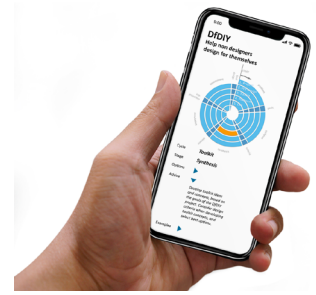
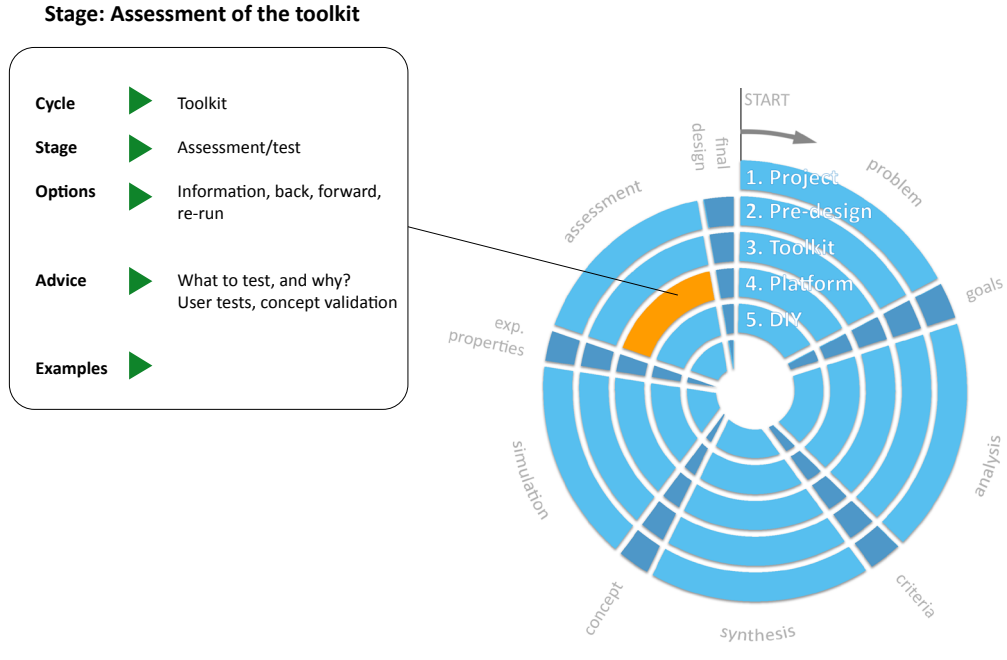


Figure 163a: The Design-for-DIY framework as a smartphone app

Figure 163b: The Design-for-DIY framework website

Figure 164: A depiction of the framework-in-use, providing information about the topic that was requested



Section 10. Experiments for the assessment of the Design-for-DIY Framework

10.1 Introduction

The previous sections (Section 6, Section 7 and Section 8) have collectively contributed to developing knowledge about a suitable Design-for-DIY process and its components, aligned to the proposed vision described in Section 7, aiming to establish a framework that supports designers in creating and facilitating DIY activities and projects. Those gained insights subsequently have resulted in the development of the Design-for-DIY framework illustrated in Section 9.

Following this synthesis, experiments were conducted to evaluate the Design-for-DIY framework as a method. Twelve designers were tasked with developing a DIY project for laypersons, using the framework as a reference. The research questions, procedures, results, and conclusions of the experiment are described below.

10.2 Goals of the experiments, experiment research questions

The goal of the experiments was to answer the Experiment Research Questions outlined below: to evaluate the quality of the Design-for-DIY framework by conducting a series of experiments and using questionnaires for both quantitative assessment and reflections on open-ended questions.

The research questions addressed in undertaking the Design-for-DIY experiments centred on the quality and usability of the Design-for-DIY framework as a method and tool to support the designer in establishing a DIY project for the layperson. The specific Experiment Research Questions (ERQ's) were as follows:

ERQ (1). Do designers judge the Design-for-DIY framework as complete?

ERQ (2). Is the Design-for-DIY framework clear?

ERQ (3). Is the Design-for-DIY instructional video clear?

ERQ (4). Do designers perceive the framework as providing sufficient freedom to design?

ERQ (5). Is the Design-for-DIY framework sufficiently accessible?

ERQ (6). To what extent does the Design-for-DIY framework differ from the designer's knowledge?

ERQ (7). Do designers understand the reasoning behind the Design-for-DIY framework?

ERQ (8). How can the Design-for-DIY concept (the vision of Design-for-DIY) and the Design-for-DIY framework be implemented?

The experiments were followed by a questionnaire, which in turn helped answer the above ERQs (Section 10.2). The results and conclusions from these experiments (answering the ERQs in Section 10.2) in turn help to answer the thesis's main and sub-research questions, specifically sub-research question D (Section 1.7.2).

10.3 Experiment setup and method

The experiments involved six runs (Table 19), labelled I to VI, each conducted by a different pair of collaborating designers. The designers included an industrial concept engineer, a UX designer, three product designers, a consultant/ teacher/designer, a product developer, a business relations manager/design coach, an information designer, a designer/researcher, an industrial designer, a design business owner, and a social designer/design educator. These designers were educated at TU Delft, Design Academy (Eindhoven), Haagse Hogeschool, Willem de Koning (Rotterdam), and the University of Twente (Enschede). In doing the experiments, each pair of designers was assigned the task of running a Design-for-DIY project' by using a set of tools for support: the Design-for-DIY framework (presented as a board game (Figure 167), sketching tools, paper, glue, tape and radio electronics (for indicating the size of the components, Figure 166). Figure 165 shows the exact agenda of one of the experiment days.

EXPERIMENTS DFDIY AUGUST 29ND	V	
OCHTEND SESSIES	**Comfort van**	**tot**
ontvangst	9:00	9:15
read instructions/ video	9:15	9:45
design process execution	9:45	11:00
BREAK	11:00	11:30
visualization of concept on A1 sheet	11:30	11:50
presentation of outcome	11:50	12:00
questionnaire	12:00	13:00

EXPERIMENTS DFDIY AUGUST 29ND	VI	
MIDDAG SESSIES	**Comfort van**	**tot**
ontvangst	13:30	13:45
read instructions/ video	13:45	14:15
design process execution	14:15	15:30
BREAK	15:30	16:00
visualization of concept on A1 sheet	16:00	16:20
presentation of outcome	16:20	16:30
questionnaire	16:30	17:30

Figure 165: Tasks and agenda regarding the experiments (reception; instructions; design-for-DIY execution)

A design brief that was provided to participants, which concerned an explanation of the scope, a reference to an introductory movie explaining the Design-for-DIY framework to use, concrete assignments, and additional practical information. The assignments were (quoted from the design brief, which is available in the repository (R2-a), as follows:

'You are asked to design a DIY-radio project:

(a) a radio-design that is (partly) open to be designed by a layman (amateur) ([] the pre-design)

(b) the DIY kit that should help the layman to design for him-/herself ([] the toolkit), and

(c) the overall support around the DIY project you think is necessary ([] the platform).'

For time management reasons, the experiments concentrated on cycles 2 to 4 of the framework (the pre-design cycle, the toolkit cycle, and the platform cycle), respectively on the stages from 'problem' to 'concept' within each cycle (see Figure 167). These represent the cycles and stages of the envisioned Design-for-DIY process that are most representative and relevant for the experiment.

The setting concerned a separate studio environment from which participant activity was observed and recorded. The designer pairs were supported in discussing the steps they would take. Each experiment, including the time needed to fill out the questionnaires, took about four hours to complete (Figure 165).

Figure 168 considers stills from the recordings of the Experiments I and II, illustrating the setting of the designated room for running the experiments, and the tools and materials provided to the designing participants.

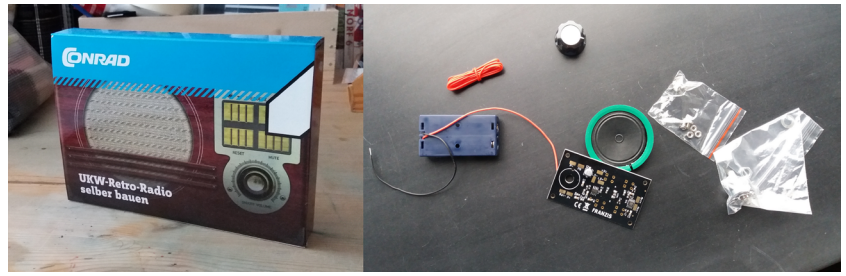


Figure 166: Components of the *Conrad 'selber bauen'* radio kit served as 'design-for-DIY starting point'

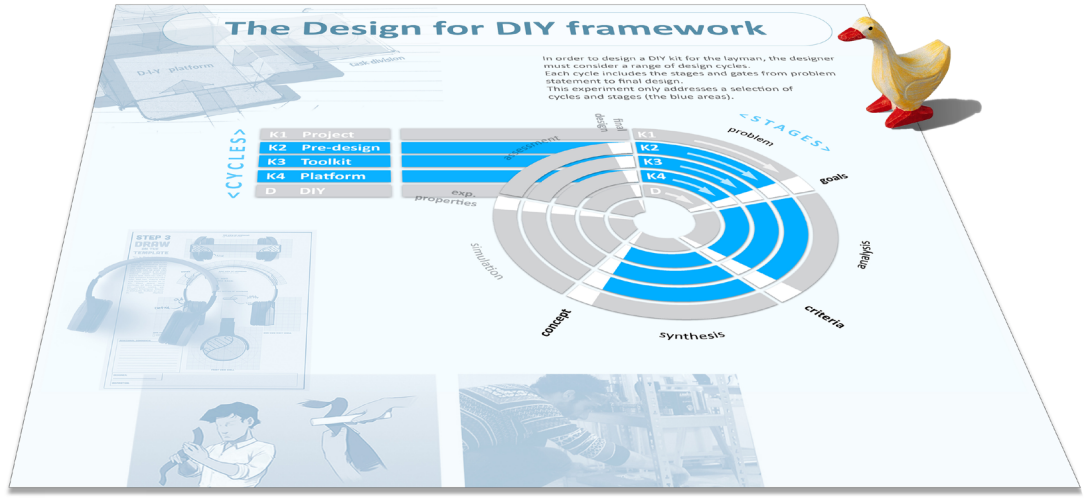


Figure 167: The provided gameboard of the Design-for-DIY framework, used for all experiments

DfDIY framework experiments			
(Design for DIY of radio)			
name	**method**	**data**	**participating designers**
experiment I	Research through design: generating knowledge through design activity; using stimuli	observation of process, and questionnaire answers (Likert scale), aiming for the development of generalizable knowledge	2
experiment II	idem	idem	2
experiment III	idem	idem	2
experiment IV	idem	idem	2
experiment V	idem	idem	2
experiment VI	idem	idem	2

Table 17: Design-for-DIY experiments: Design-for-DIY of a radio

Figure 168: Video stills of Experiment I and II, showing participants establishing a DIY project

Examples of resulting project designs

Figure 169a and 169b display portions of the resulting Design-for-DIY project designs from Experiments I and III. Although the experiments of Section 10 focused on the designers' reflections through questionnaire responses, the physical project outcomes helped confirm that the Experiment assignments were sufficiently clear. In some cases, the experiment duration appeared too short to allow for the development of a fully detailed DIY project.

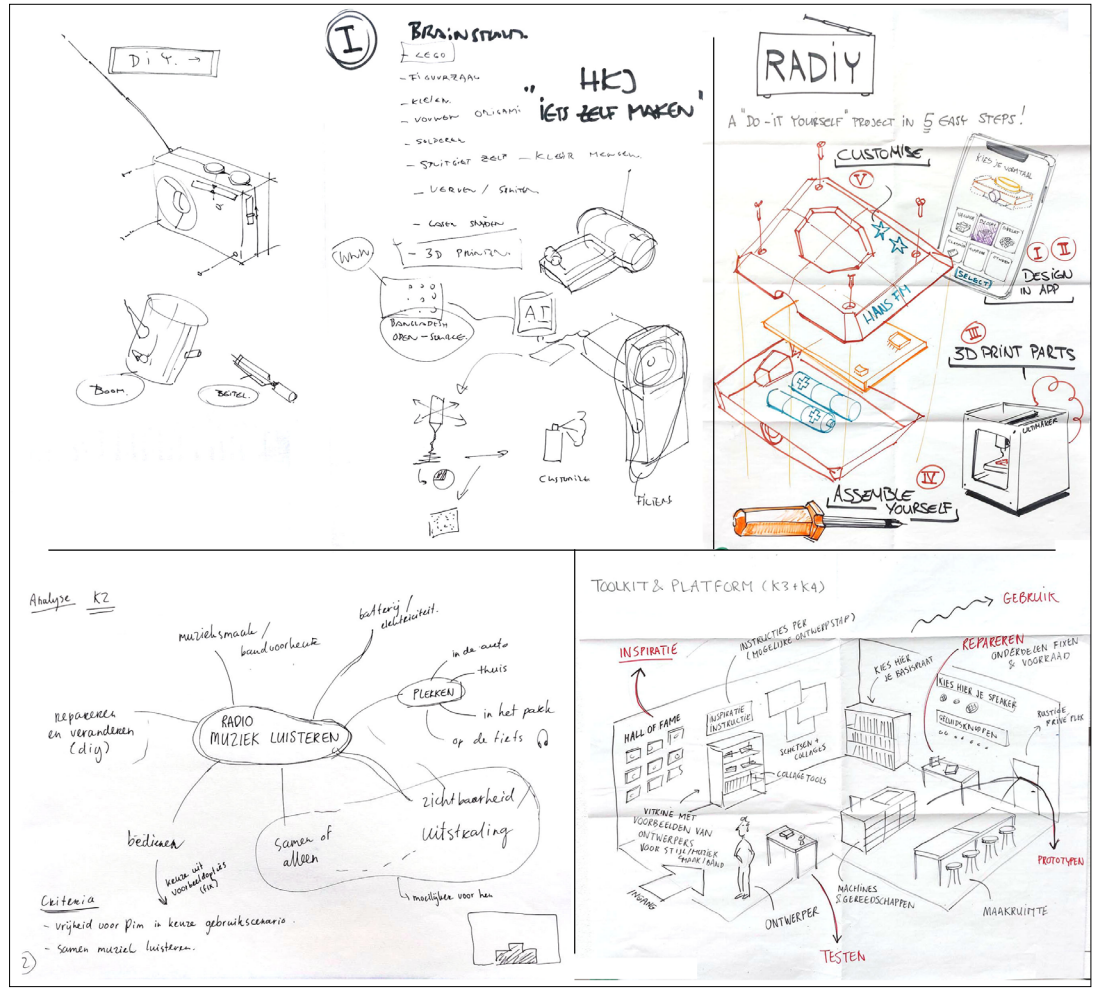


Figure 169a: Design-for-DIY process steps and design outcome of Experiment I.

Figure 169b: (bottom) Design-for-DIY design process step and design outcome of Experiment III.

10.3.1 Questionnaire questions

As part of the experiments, in order to have the participants reflect on their experience using the Design-for-DIY framework, all 12 participants were asked to fill out a questionnaire. The questions were as follows:

Questions about the (anticipated) result

1) How confident are you that the layman is capable to create his own radio with the kit you designed? [not – very confident]

a) In case you expect a need for additional support, what would that support be?

2a) For a potential layman, what would be the top 3 reasons to use the kit?

2b) For a potential layman, what would be the top 3 reasons NOT to use the kit?

About the process

3) To what extent did you consider a set of design criteria in conducting this assignment? [not at all – very much]

4) To what extent did you specifically address the division between the fixed part by the designer and the design space for the layman? [not at all – very much]

a) Please elaborate

5) To what extent was the process you ran complete? [not at all – very]

6) To what extent was the process you ran structured? [not at all – very]

7) To what extent was the process you ran elaborate? [not at all – very]

8) To what extent was the process you ran explorative? [not at all – very]

9) How would you rate the amount of design freedom you had when creating the kit? [not at all – a lot]

a) Please elaborate

10) To what extent did you feel comfortable to start designing? [not at all – very]

a) Please elaborate

Questions about the framework

11) To what extent did the framework match your way of designing? [not at all – a lot]

12) What are the most important similarities?

13) What are the most important differences?

14) To what degree did the framework add to your design knowledge? [not at all – a lot]

a) Please explain

15) Did the use of the framework influence your design freedom? [yes – no]

16) How do you feel about this? Please explain

17) What do you think about the amount of guidance the framework provides? [too little – too much]

a) Please elaborate

18) How would you rate the clarity of the framework? (unclear – very clear]

19) If necessary, what should be clarified?

20) How would you rate the completeness of the framework? [incomplete – very complete]

a) Please elaborate

21) How do you rate the amount of information given concerning the design stages of each cycle (problem statement, analysis etc.)? [too little – too much]

22) What do you think about the character of the framework? [uninspiring – very inspiring]

a) Please elaborate

23) Did you use the Design-for-DIY examples from the movie? Why (not)?

24) In case you did, which examples were helpful?

25) Which of the framework cycles was most helpful?

a) Please explain

26) How would you rate the cycle arrangement? (order of cycles) [inaccurate – very accurate]

27) In case of an illogical order, please elaborate

28) Please rate the clarity of the position of the predesign cycle in relation to the entire DfDIY framework. [unclear – very clear]

29) Please rate the clarity of the position of the toolkit cycle in relation to the entire DfDIY framework. [unclear – very clear]

30) Please rate the clarity of the position of the platform cycle in relation to the entire DfDIY framework. [unclear – very clear]

31) How would you rate the suitability of the followed process steps for other DfDIY cases? [not suitable – very suitable]

32) To what degree did the use of the framework increase your knowledge, considering Design-for-DIY? [not at all – a lot]

a) Please elaborate

33) How do you rate the clarity of the reasoning behind the framework (why the framework is developed)? [unclear – very clear]

34) Do you think the reasoning is valid?

35) What do you think about the suitability of a movie for explaining the framework? Please explain

36) How would you rate the clarity of the movie used in this experiment? unclear – very clear]

37) Please explain and consider the specific sections of the movie

38) Other thoughts about the movie

Question about Design-for-DIY

39) Generally, what would you consider to be a suitable way to share/spread the concept of Design-for-DIY?

40) What would you consider a suitable way to share DIY kits with potential laymen?

41) What would you consider a suitable way to support the implementation of DIY facilitation within the discipline of product design?

42) What would you consider factors that could block/hinder the implementation of DIY facilitation within the discipline of product design?

43) Which scenario(s) would you consider most plausible for a Design-for-DIY situation?

a) Please explain

The questionnaire results helped answer the experiment research questions (ERQs) listed in Section 10.2. These ERQs were helpful in answering the overall Research Questions (Section 1.7), and Research Question D in specific, of this thesis, in turn. The questionnaire was provided digitally (see repository (R2-b, R2-c, and R2-d), for the questionnaire form, the questions asked and the connection with the ERQ's).

10.4 Results and findings

The range of experiments and the questionnaires completed by the twelve participants generated ordinal data on a 7-point Likert scale (graded responses to closed questions) and written answers and recommendations (based on responses to open questions). The data measurements are presented below, in a Boxplot format (Figure 170) . The boxplot indicates the Minimum (which is the lowest score), the Q1 value (which is the 1st quartile; the bottom of the 'box', Median excluded); the Median value (line within the box); the Mean (average, the 'x'; Q3 (the 3rd quartile); the Maximum value, and the outlier points. The difference between the Q1 and the Q3 value defines the inter-quartile range (IQR), and indication of the spread and variability in the data set.

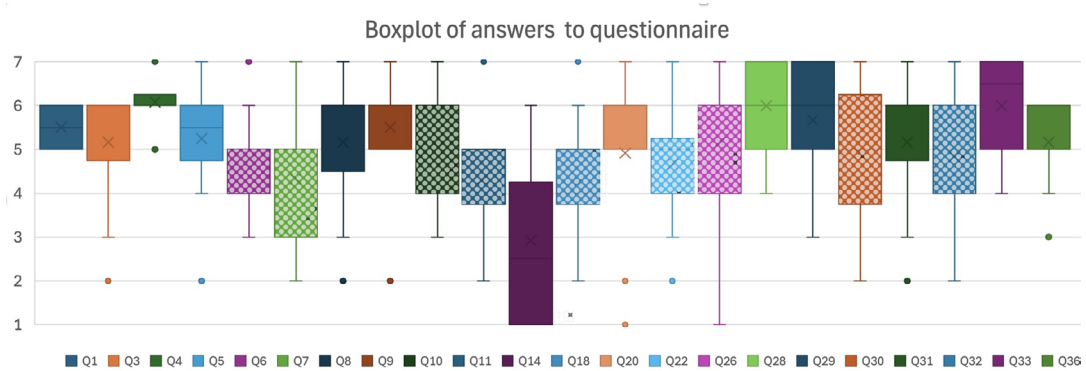


Figure 170: Boxplot representing the results of the questionnaire answers (the dotted 'boxes' are considered not significant (see Section 10.4.1.)

The data that support the findings of this study are available in the repository (R2-e).

10.4.1 Interpretation of the results

Although the experiment has a qualitative character and the dataset has a descriptive nature, the outcomes have been subjected to a significance test. This test assesses whether the resulting answers to the questionnaire questions provided a convincing outcome.

The choice of the most suitable significance test depends on whether the 7-point Likert scale data is interpreted as interval data (with equal spaces between data points) or as ordinal data (which is categorical). If the 7-point Likert scale data are interpreted as interval data, and the data set is normally distributed, then the one-sample T-test applies. If the data are interpreted as ordinal, the Mann-Whitney test suits better.

Although Likert data are sometimes treated as interval data in medical and psychological contexts, I chose to use the Mann-Whitney test because I cannot assume that the data are at an interval level. The data are rather at an ordinal level and are non-parametric since they represent categories and are discrete. However, I do recognize that there is some academic dispute around the interpretation of Likert data, whether to treat them as ordinal or interval data.

For the Mann-Whitney test, I compared two datasets, of which one concerned the dataset retrieved from the questionnaire answers, and the other data set consisting of the values of '4' as the 'expected' (hypothesized) neutral score. Technically, the test defines whether the real outcome and the expected outcome were statistically different from each other or not. It calculates whether the difference is significant or not. Starting from a 0-hypothesis that the two datasets are the same, the Mann-Whitney U-test defines whether to reject or accept the 0-hypothesis. 'Reject' in his case means that the difference is significant: that the data provided a convincing outcome (see the results in the repository (R2-e).The Mann-Whitney test has indicated that most data are to be called significant, though the answers to nine of the 22 questions (questions number 6, 7, 10, 11, 18, 22, 26, 30 and 32), do not provide evidence that the distribution of the data is significantly different from the expected outcome (having the neutral score of 4), as the Mann-Whitney test is concerned.

10.4.2 Results of the questionnaire

Both the statistical results and responses to the open-ended questions from the experiments are explained below. They are organized according to the research questions they address and help answer. The data that support the findings of this study are available in the repository (R2-f).

10.4.2.1 Answering Experiment Research Question (1)

Responses to questionnaire questions 1, 3, 5, and 20 (Section 10.3.1) collectively provided answers to ERQ (1): 'Do designers judge the Design-for-DIY framework as complete?' (Section 10.2).Results re. ERQ (1): The majority of participants (9 out of 12) confirmed they followed a complete process, scoring above the neutral point (Q5.) All 12 participants are confident that the layman will be able to create his or her own radio with the help of the DIY kit they created, scoring either a 5 or 6 (Q1). The participants mention that they expect an additional need for (1) support concerning the use of a 3D printer, of a soldering iron, electronics, machine specific support, (2) support by a professional designer offering guidance, supervision, design advice, instructions (Q1a). Ten of twelve participants indicate that the framework is relatively complete, scoring above the neutral point (Q20), which appears to provide evidence that the designers were sufficiently equipped. Participants indicated that they would appreciate more examples and explanation of Design-for-DIY cycles though. Out of 12 participants, 8 rated their consideration of design criteria as a 6 (on a 7 point scale) when reflecting on their design process (Q3). This suggests that the framework may not need to further emphasize the importance of using design criteria.

10.4.2.2 Answering Experiment Research Question (2)

Responses to questionnaire questions 4, 6, 18, 19, 25, 26, 27, 28, 29, 30, and 31 (Section 10.3.1) collectively provided answers to ERQ (2): 'Is the Design-for-DIY framework clear?' (Section 10.2).

Results re. ERQ (2): The attention to 'task division', given by the framework, appears to be sufficient: all claim to have implemented this DIY aspect (Q4). Participants used various ways to distinguish designers' tasks from laypersons' tasks. Some 'guided the layperson through the design process step-by-step', through a grid and choice options, and also offered total freedom, depending on the levels of expertise. Some implemented component

templates (through template sketches), and some deliberately considered boundaries as an addition to the facilitation of 3 levels of making and designing. All considered the distinction of predetermined choices versus free design space (Q4a).

Eight of twelve participants think the cycle arrangement was accurate (Q26). The participants seem to be comfortable with the proposed sequence of the cycles (see also Q28, Q29, Q30), as long as they can rearrange the cycles to their own preference and 'move freely through them as long as it helps' (Q27). According to participants, the framework helped them to plan by dividing the process into steps and timeframes. It also offered freedom and served as a checklist. The position of the Platform cycle in relation to the others seemed less clear to the participants. Participants responded in various ways, such as (1) indicating a desire for more examples illustrating the framework's cycles, and (2) expressing appreciation for the freedom it provides and the guidance it offers. 'I think the framework is as clear as it can be for a design process framework […] This framework also did not make us work exactly according to the stages and cycles, but it helped and guided us while designing', one participant indicated. (Q19). The pre-design cycle was considered the most helpful of the three cycles by participants (45.4%), followed by the toolkit cycle (36.4%). This preference was supported by comments such as: 'The toolkit cycle makes things concrete; that is where the most happens', and 'Dividing the pre-design into steps and tasks helped define how to approach the layperson' (Q25). Generally (9 of 12), participants were positive about the suitability of the followed process for other Design-for-DIY cases (Q31).

10.4.2.3 Answering Experiment Research Question (3)

Responses to questionnaire questions 23, 24, 35, 36, 37 and 38 (Section 10.3.1) collectively provided answers to ERQ (3): 'Is the Design-for-DIY instructional video clear?' (Section 10.2).

Results re. ERQ (3): The clarity of the instruction video is perceived as clear by 10 (of 12) participants (Q36). Of the twelve participants, six used the Design-for-DIY examples from the instructional video (Q23). Those who referenced the examples either mentioned all of them generally or referred specifically to elements like the graphic representation of the fixed versus open design space for laypersons, as well as the mock-up model and reference products (Q24). Reflecting on the effectiveness of using a video to explain the Design-for-DIY framework, nine participants expressed positive feedback. Additionally, participants suggested improvements, such as allowing control over the viewing pace, providing a concise set of key information, reducing the video length, and considering a more engaging format like animation to inspire further (Q35). Further reflections on the instructional video indicated that participants felt it would benefit from a more concise and compartmentalized format (Q37, Q38).

10.4.2.4 Answering Experiment Research Question (4)

Responses to questionnaire questions 7, 8, 9, 15, and 16 (Section 10.3.1) collectively provided answers to ERQ (4): 'Do designers perceive the framework as providing sufficient freedom to design?' (Section 10.2).

Results re. ERQ (4): Nine (of twelve) participants responded positively to the question whether the process they ran was explorative (Q8). Eleven participants gave a positive answer when asked if they experienced enough design freedom during the process (Q9). Eight out of twelve participants felt that the framework influenced their design freedom (Q15). Reflecting on their responses to Q15, participants were generally positive. For example, they noted that the framework provided 'structure that is helpful when creating DIY products', described it as 'just a method', and viewed it as 'more of a guideline rather than a limitation'. One participant added, 'Within the framework and project, I felt that I had enough design freedom to not feel restricted' (Q16).

10.4.2.5 Answering Experiment Research Question (5)

Responses to questionnaire questions 2, 10, 11, 12, 13, and 17 (Section 10.3.1) collectively provided answers to ERQ (5): 'Is the Design-for-DIY framework sufficiently accessible?' (Section 10.2).

Results re. ERQ (5): 8 of 12 participants feel comfortable to start designing (Q10) after watching the video and reading the assignment. The general concept of Design-for-DIY was said to be inspirational, but some participants said the stages as presented were not new. To anticipate differences between designers in terms of the support they require, a dropdown menu or a link to further information was mentioned as potential improvement. Visual attractiveness and opportunities for real-time feedback were also aspects mentioned as potential points for improvement of the framework's inspirational character. After using the framework, participants mentioned the following reasons for utilizing the Design-for-DIY framework: it is fun, it provides a positive experience, it provides pride, offers to opportunity to show [results] to others, usefulness, the learning of new skills, of opportunities and of production. DIY gives the opportunity to be a real designer, they state, 'to proudly enjoy a self-created artefact, to battle mass-consumption, to exert creativity, for social reasons, for reasons that concern the design and process of the self-designed radio in particular: the appearance fitted to your personal needs, the sound, learning about sound, access to a new (like-minded) social community. Also, the low-cost aspect, the self-sufficiency aspect (learn skills to fix your own things), expressing yourself through personalization, were mentioned (Q2a). Top-3 reasons they mentioned to not use the kid concerned: lack of (leisure) time, expensive project, too much effort compared to purchasing one (online), lack of expected quality (or guarantee), the concept of a radio is outdated, searching for ease-of-use, unnecessary, design freedom is limited, fragile object, afraid to fail, no interest in the challenge, no long-term expectations, negative associations with DIY (Q2b).

When asked about the similarities between their usual design methods and the Design-for-DIY framework procedure, participants highlighted aspects such as the iterative nature, the inclusion of both divergent and convergent process steps, the substages involved, and the concept of reversibility. One participant explained: 'The framework allows for that process [i.e., 'reversibility'] as the design of the fixed part still needs to be determined' (Q12). As for differences, participants noted, for example, that the 'platform cycle' typically falls outside the scope of their usual practice. Another difference involved the framework's seemingly strict order of cycles, whereas one participant preferred a more flexible approach, 'starting, for example, with synthesis to explore options and get a feel for it, then moving on to analysis'. Participants also mentioned the unknown outcome of a Design-for-DIY project, which contrasts with traditional design processes where the end result is usually clear and well-defined. One participant mentioned the involvement of the end user as a difference (Q13).

Reflecting on the amount of guidance the framework provides, participants were generally

positive: on a 7-point scale (from 'too little' to 'too much'), the most popular score was 4, which is also the median. When asked to elaborate on their responses, participants indicated, for example, that they expect experienced designers would use this model [the framework] intuitively. One participant remarked, 'It leaves enough freedom but still helps to divide the work into steps, so the balance feels just right to me'. Another participant commented, 'The division between cycles K2, K3, and K4 [pre-design, toolkit, and platform cycles] provided good guidance, although the stages within these cycles didn't feel new'. Yet another participant added, 'I think it is very interesting. It [the framework] provides lots of freedom while ensuring that all key aspects [design problems] are addressed'. Another participant indicated that more guidance would have been helpful, as the terminology was new to them (Q17).

10.4.2.6 Answering Experiment Research Question (6)

Responses to questionnaire questions 14, 21, 22, and 32 (Section 10.3.1) collectively provided answers to ERQ (6): 'To what extent does the Design-for-DIY framework differ from the designer's knowledge?' (Section 10.2).

Results re. ERQ (6): Answers to the question whether the framework added new knowledge to the participants were rather divided, though most participants considered the framework as not very new in relation to other models. The answers included comments such as: 'The framework resembles the design thinking/lean startup method I use on a daily basis.' Another participant noted, 'The different cycles—pre-design, toolkit, and platform—were new to me. One of the key insights is that defining and designing what is fixed and what constitutes the design space could be included on the poster of the framework'. Additionally, another response mentioned: 'Pre-design can be seen as framing, the toolkit as the design stage. The 'platform' is really new: how do we bring it to the user?' (Q14, Figure 170a)

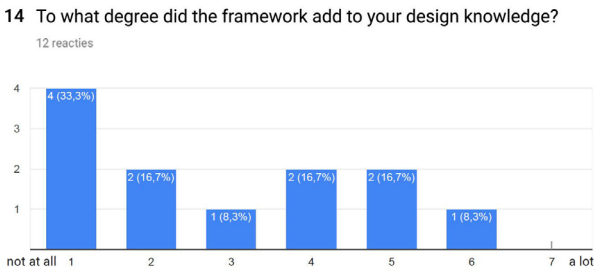


Figure 170a: Plotted answers to Q14

The amount of information provided by the framework regarding the design stages of each cycle was perceived as low to moderate (Q21). However, Seven of twelve participants confirmed that the use of the framework has increased their knowledge concerning Design-for-DIY (Q32). The framework makes them think about the steps, target group and creative tasks as part of a project. One participant specifically says he/she didn't know about Design-for-DIY before, though will implement it in the future (Q32). Many of the participants seemed

to share the view that designing an unfinished product (to be completed by the layperson) was an interesting and new concept. The framework sparked the participants' imagination, provoked thought and offered a process guide rather than providing a new and strict protocol.

Elaboration on the character of the framework, participants answered e.g. the following: 'Inspiring for sure, it seems simple but how useful is it in practice?', and 'There is never full iteration in all phases in my experience. This should somehow be acknowledged', and 'I find the visual presentation refreshing, and it also makes me curious. Because there are 5 steps, it is clear and organized. Additionally, since the same sequence of methods (problem, analysis, synthesis) is used within each step, it provides a very logical and consistent structure.' One participant answered: 'It is on the edge of comfortable. Because much is uncertain, something actually happens.' 'Once we started working with the framework, it inspired me to think about ways to encourage people to create their own products', another participant responded. Another said, 'The framework is inspirational, but the visualization of it is not.' (Q22) The numerical results for Q22 did not yield a significant outcome.

10.4.2.7 Answering Experiment Research Question (7)

Responses to questionnaire questions 33 and 34 (Section 10.3.1) collectively provided answers to ERQ (7): 'Do designers understand the reasoning behind the Design-for-DIY framework?' (Section 10.2).

Results re. ERQ (7): The reasoning behind the framework (why the framework is developed) appears clear for ten of twelve participants (Q33). '[…] the framework is a great step toward involving people more in creating their own living environment. Great!', is what one participant said when asked about the validity of the reasoning. Another reaction: 'Yes, because K3 and K4 are really essential areas to consider when you need to let people design for themselves.' Other reactions: 'Yes, I do think the framework addresses the part that comes before the actual design of a product', and 'Yes, indeed! However, it's really about finding the right balance to meet user-needs and competences and attract the intended customers'. Another reaction: 'Increasing awareness about production processes and repairing products, feeling more ownership, etc., was clear. As a designer, I would just find it interesting to explore this very broadly.' The answers to this question were largely positive, although some respondents interpreted it as concerning the framework's practicality, while others viewed it as related to the grounding of Design-of-DIY as a concept (Q34).

10.4.2.8 Answering Experiment Research Question (8)

Responses to questionnaire questions 39, 40, 41, 42, and 43 (Section 10.3.1) collectively provided answers to ERQ (8): 'How can the Design-for-DIY concept (the vision of Design-for-DIY) and the Design-for-DIY framework be implemented?' (Section 10.2).

Results re. ERQ (8): To spread the concept of Design-for-DIY, participants suggested sharing success stories and showcases, addressing communities through social media, schools, universities, using platforms and implementing Design-for-DIY in education. Some participants mentioned; 'also in hub stores for DIY designers like they exist nowadays like, Hutspot, Collectiv Rotterdam, Groos'. Some mentioned MOOCS (massive open online courses), master classes, boardgames, repair cafes (Q39).

In participants' view, suitable channels and methods for sharing DIY kits and supporting DIY activities could include traditional DIY stores (e.g., Gamma), DIY platforms, maker spaces, combinations with coffee shops, workshops, DIY shops, and training programs for companies and schools (implement at IDE). Participants indicated that DIY should fit naturally into people's daily routines. For example, 'Have a manufacturer sell a drum kit and invite people to design their own drumsticks' (Q40 and Q41).

Some of the barriers mentioned are related to consumption habits, to the lack of time, effort and design skills. Also, product warranty (in relation to safety) was mentioned as potential problematic aspect (Q42).

Based on a predefined set of options, the twelve participants indicated the following scenarios as the most plausible (multiple choices per participant were allowed (see Figure 171): 'companies offer DIY projects, providing their own workspace'; 'companies offer DIY projects, selling their own components'; 'companies offer DIY projects, selling their own tools'; and 'the designer as an additional service provider to a collaborative platform'. Options, other than provided: 'community building via 'bezorgde ouders', selling courses, provide education: teach children in making and technology. Government and educational programs (e.g. 'Technasia') could serve as a valuable messenger' (Q43).

10.4.3 Conclusions and limitations

The experiment results provided answers to the research questions outlined in Section 10.4.2. Conclusively, when reflecting on the framework model design, it seems reasonable to conclude that participants evaluated the Design-for-DIY framework as rather complete. Specifically, the framework offers design freedom, allows for exploration, and guides the designer in considering essential design criteria and the consecutive design cycles (pre-design, toolkit, and platform). The arrangement of these cycles within the framework is both accurate and flexible, and the instructional video is clear. Most participants felt comfortable starting their designs, and they were generally positive about the suitability of this process for other Design-for-DIY cases.

Another conclusion is that participants recognized many of the merits of Design-for-DIY and the use of the framework, such as fostering pride, skill development, low cost, and self-sufficiency. At the same time, they also acknowledged the barriers people might face, including the high effort required, lack of time, and limited skills.

The outcomes of the experiment allow the conclusion that a Design-for-DIY framework was created that can sufficiently help the designer to develop and establish a DIY project.

It seems reasonable to conclude that most participants were able to navigate the provided framework, moving forward and backward through the process steps as needed. The outcomes of the experimental research in Section 10 align with the thesis's ambition: establishing the Design-for-DIY framework and validating its intended purposes. When considering the trajectories run in the studies (Section 8), each of these projects' processes would fit in the Design-for-DIY framework of Figure 161, considering that the framework model is a representation of the process that the facilitating designer needs to run.

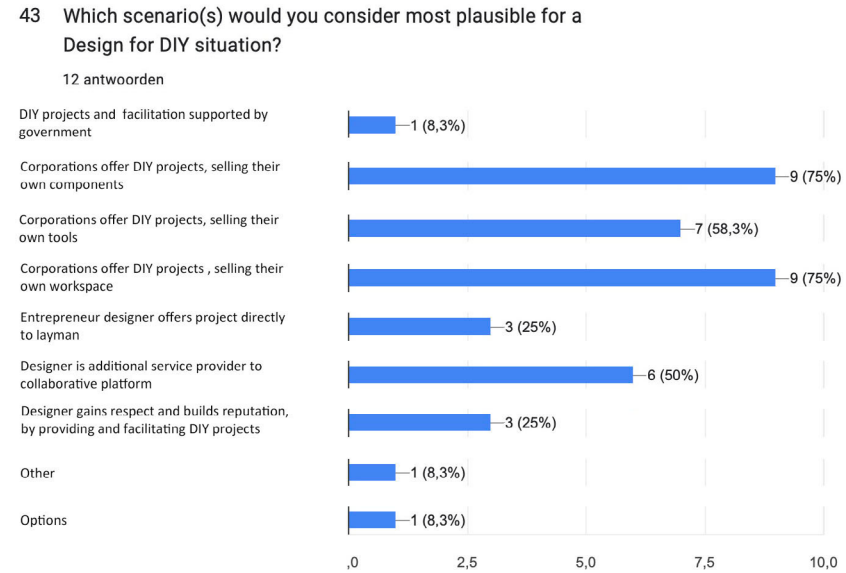


Figure 171: Answers to Q43

10.4.3.1 Suggestions to improve the framework

Next to the numerical findings from the experiments, many suggestions to improve the Design-for-DIY framework were provided by the participants in the 'open question' fields of the questionnaires. These provide valuable input for the framework's future improvement and further development and have resulted in a number of key insights.

Among other things, suggestions given by the participants concerned:

- Flexibility of the proposed framework structure: Although participants felt free to manoeuvre, it was suggested to communicate a more explicitly flexible path to follow.

- Alignment between the framework's information and the Design-for-DIY process: Suggestions included ensuring that information is readily available 'on-the-spot' to support the designer as needed.

- Format (media type) of guidance and information provided: Participants suggested offering a poster format and segmenting video instructions into shorter parts.

- Need for project examples: Given the innovative nature of the Design-for-DIY concept, examples of previous projects that align with the framework could help guide designers embarking on new DIY projects.

- Variability among individual designers, suggesting a need for a customizable framework: Differences in preferences among designers highlight the value of offering a user-tailored level of support, guidance, and freedom, indicating that both designers and laypersons may benefit from personalized support in Design-for-DIY.

10.4.3.2 Limitations

As indicated in Section10.4.1, the questionnaire outcomes were subjected to a test to assess the significance of the results—specifically, to determine whether the distribution of responses differed significantly from the expected neutral score of 4. The result, as indicated in Section 10.4.1, is that a small selection of questions should not be considered, according to the outcome of the Mann-Whitney test. (see repository R2-e).

Although most of the data are considered significant according to the Mann-Whitney test, they are based on a relatively small sample of designers testing the Design-for-DIY framework. Such a small sample size poses additional risks: it is less likely to represent the broader population, making it harder to generalize the outcomes, and it is more susceptible to outliers or extreme responses. Findings from a small sample may also be harder to replicate in follow-up studies. In short, Caution is advised when interpreting the results of the Design-for-DIY framework experiments.

Simultaneously, the open-ended questions in the questionnaire produced many interesting and relevant insights. These responses provided extensive positive feedback as well as suggestions for improvement, aligning well with the qualitative nature of the experiments.

Section II. Conclusions and discussion

This thesis aims to (1) share the research that was done and (2) bring this as a storyline that is as clear and accurate as possible, through thorough analysis of today's production-consumption split, through the indication of opportunities and factors to improve the user-product relationship, through the suggestion of a solution direction, namely Design-for-DIY, and through the partial validation of that concept. This final section is there to reflect on the initial goals and question of this thesis, to humbly discuss conclusions and implications of this research, and to look ahead by suggesting future research.

II.1 Reflection on this thesis and its outcome

This thesis addresses the various principles of product development, among which Ehrenfeld's three domains of sustainability: the ethical, the natural and the human domain (Ehrenfeld, 2008). Through analysing what has caused and what still causes the harmed relationship between users and the products they use; this thesis proposes a solution direction that addresses all of Ehrenfeld's three domains: Design-for-DIY. The scenario promises a better relationship by addressing people's true needs (Maslow, 1998; Max-Neef, 1992), passions (Campbell, 2005) and skills (Sennett, 2008), by considering ethics, i.e. connecting actions and their consequences and looking at aspects such as the extensions of ourselves (Blackburn, 2001; Manzini, 2006; Verbeek, 2015), and – in doing so – taking care of our natural environment, i.e. through better attachment (Csikszentmihalyi & Halton, 1981; R. Mugge, J. P. L. Schoormans, & H. N. J. Schifferstein, 2009), smaller scale (Myerson, 2016; Schumacher, 2010), local approaches, repair (Masclet, Mazudie, & Boujut, 2023) and better care. The thesis takes a critical approach, in the tradition of various authors I refer to in this thesis, and it aims to provide an answer to the observed problems and challenges, similar to e.g. Olsen, who advocates 'a fundamental symmetry between people and things, materiality and immateriality, natures and cultures […]' (Olsen, 2012, p. 161).

Ehrenfeld's model helps in the reasoning that a better and sustainable situation can be achieved through (1) intervention at the level of the user-product relationship or, even better, (2) intervention at the level of the system we live in: the industrial context. This would help to achieve not only a better user-product relationship, it would help to achieve a sustainable situation ethically, for people, and ultimately for nature (Ehrenfeld, 2008). The Design-for-DIY concept was proposed along these lines of thinking (Figure 32 and Figure 172).

The entire research and storyline as described and depicted in this thesis have led to numerous insights that go beyond the testing and validation of the Framework model only. The thesis represents in that sense not just the synthesis of a solution to a problem; it provides new combinations of knowledge areas leading to cross-disciplinary paths and proposals. These disciplines concern, for example, design history, design methodology, ethics, culture, technology, consumer behaviour, economy, business, social sciences and psychology. As a conclusion to this, looking back, it seems valid to state that all of these areas are connected, as should be the case when doing design.

II.2 Reflection on goals and research questions of this thesis

The objective of this study was introduced in Section 1.6. The objective has a broad definition:

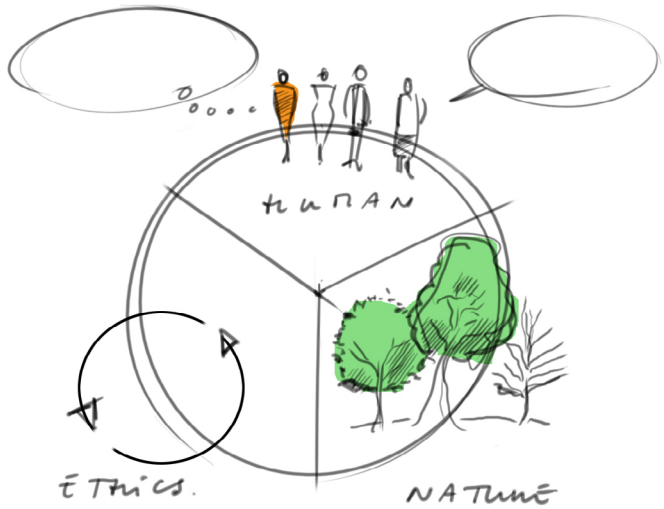


Figure 172: Effectuating sustainability by addressing the ethical, human and natural domain (freely adapted from Ehrenfeld (2008))

'To deduce and propose a design scenario that would help counter today's unsustainable user-product relationship.

When reflecting on the outcomes of this research, they seem to align with the ambition of the study: deducing and proposing a scenario that would help counter today's unsustainable user-product relationship. It does so by the provision of a scenario and method for the facilitation of DIY activity: Design-for-DIY. The Design-for-DIY framework, in which both the method and scenario were integrated, was developed, tested and assessed positively on many aspects.

The adjacent research questions (Section 1.7):

Main Research Question (Section 1.7.1):

How to establish/ re-establish a sustainable relationship between people and products?

This main Research Question was answered by addressing four research sub-questions throughout the thesis. These research sub-questions (Section 1.7.2):

A. 'Which key factors have caused today's troublesome relationship between people and products?'

(addressed in Section 2, Section 3, Section 4)

Section 2 and Section 4 have analysed both the industrial system in which we live and the negative consequences of that system on the relationship between people and the products they use. These negative consequences, plotted on Ehrenfeld's definition of sustainability (concerning the human, ethical and natural domains), have resulted in a clear description of the concretized problem statement at hand in Section 4.3. The concerns of this statement align with research sub-question no. 2 (Section 1.7).

B. 'How to democratize design?'

(addressed in Section 5)

Section 5 explored, as an answer to this research question, the opportunities that lie in the universal *human needs*, and that lie in the socio-sphere and Technosphere. With Ehrenfeld's model in mind, countering the threats of the industrial tradition (Sections 2 and 3), and cherishing the opportunities discussed in Section 4, Section 6 presents the concept of Do-it-yourself(DIY) as a solution direction. The concept of DIY, as is reasoned in Section 5, counters many of the industrialization characteristics and provides positive answers to the questions raised concerning the human, ethical and natural domains.

C. 'How should design anticipate? What would be the role of design?'

(addressed in Section 6, Section 7)

Aiming for an alternative approach that would lead to a better relationship between people and the products they use, a vision was presented in Section 7.6: 'The design engineer should – up to a sufficient level – provide the opportunity to people to design and make products by/ for themselves; the designer's task is to Design-for-DIY. This vision specifically assigns a facilitating task to the designer: he/she should take responsibility by enabling laypersons to design for himself.

D. 'What would be a suitable methodology and framework model for the implementation of the intervention?

(addressed in Section 8, Section 9, Section 10)

Following the description of the Design-for-DIY vision in Section 6, the subsequent Section 8, PART III, Section 9 and Section 10 concern the development of a dedicated Design-for-DIY framework: through exploration (Section 8), deduction (Section 9) and validation (Section 10). This Design-for-DIY framework forms the concretization of the envisioned scenario and provides the means for any designer to initiate and create DIY projects for laypersons. The framework serves as a guide, a source of information, and the designer is invited to employ the framework to the extent he or she prefers.

After deducing and analysing what seems to cause today's harmed relationship between products and people, a Design-for-DIY framework was developed. The validation of its purposes, i.e. the support of designers in facilitating laypersons to engage in DIY activity, promises to bring a sustainable relationship between laypersons and the products they use closer. The evaluation of the Design-for-DIY framework has led to insights that both concern confirmation of the Design-for-DIY framework approach, and to recommendations for improvement. These framework findings are discussed in both Sections 10.4.2 and 10.4.3.

11.3 Value to practice and theory

A design framework not only has an operational value, but (1) it also serves as an extension of the designer, similar to a tool or object being an extension of human beings (Pugh, 1991; Verbeek, 2015), enabling them to reach further, establish a better intervention and have better impact. In other words, the availability of the Design-for-DIY framework serves as an extension of the facilitating designer, reaching out to laypersons in order to involve and engage

them. (2) Participants of the experiments confirmed that using the framework made them aware of the DIY concept and of its relationship with sustainability. These elements also confirm the value of (establishing) a Design-for-DIY framework for design theory; the framework can serve as a basis for further knowledge development, supporting a wide variety of DIY and design and sustainability areas. Aligned with the above, the framework offers a way to think bottom-up, to think differently about the product-user relationship and to approach the field of design accordingly. Referring to previous sections that addressed the concept of DIY in a business context - specifically concerning the decoupling point and the decision of whether a company should outsource or produce something in-house (see Sections 5.4.2.6 and 6.2.3- it may be worthwhile to consider implementing the developed Design-for-DIY framework in a broader context. Given the purpose of the Design-for-DIY framework (to establish stronger relationships by facilitating interaction), the framework appears well-suited to foster collaboration and support relationships between diversity of stakeholders and interest groups. These relationships could have either a horizontal or vertical character. The concept may resonate with B-to-B scenarios, particularly in areas as task division, make-or-buy decisions, collaboration and negotiation. It could also relate to the broader concept of capacity building - an important element of e.g. the UN's Sustainable Development Goals (UN, 2024). Capacity building involves 'activities through which vested parties (such as individuals, organizations, communities, or nation-states) develop the ability to participate effectively in politics or other forms of collective action' (Banyan, 2024).

11.4 Impact and potential limitations

The thesis most of all is about what comes next, about learning from the past and implementing changes in the (near) future. It fits into a somewhat new domain within the field of industrial design (IDE): not representing a way to 'sustainably' mass-produce (which is 'end-of-the-pipe-problem-solving'), but it actually questions, criticizes and challenges the field of industrial design and mass production itself. It proposes measures that go beyond incremental changes (Hoftijzer, 2015) and aims to present a solution to the problem.

Since the topic of DIY as an alternative to unsustainable production and consumption patterns is fundamental and conceptual in its position and proposal, short-term feasibility (such as economic profitability) is not one of the requirements. This perspective is based on the notion that the underlying problem has its roots in the same context of short-term feasibility.

Although the context factors and problem description in this thesis are realistic, and the argumentation seems valid, the narrative requires a high-level shift in thinking; the scenario adheres to a severe change of today's culture of mass consumption and mass production and it anticipates a (near) future in which economic and monetary systems will not be the same as they are today.

Other challenges that the Design-for-DIY scenario will face concern people's habit and addiction to consumption, to cling to the patterns of the consumption society. As described in Section 6.2.4.2, not all people adhere to a 'DIY ethic' or see DIY as a practice of resistance. Nor do all people feel the importance to be self-sufficient or to consume less. Similarly, from the industrial point of view, the progressive concept of Design-for-DIY does not fit into traditional economic thinking, as was indicated in Sections 5.2.2.7 and 7.3.

In return, there are many reasons – of which some discussed in this thesis - why a Design-for-DIY scenario as described above is worth exploring, envisioning, and designing. The

Design-for-DIY approach has the potential to gain ground. The Design-for-DIY framework can help structure future DIY projects in such a manner that they respond to new developments and challenges and promote a more sustainable human-product relationship. While representing a reversal of the traditional industrial design thought process, the Design-for-DIY framework can serve as a support mechanism for designers to create DIY projects and empower laypersons to produce locally made products, aligned with a vision where people take an active and responsible role.

The Design-for-DIY concept also answers today's growing quest and focus on living sustainably, as people's 'climate change' awareness grows (Bristow, 2007): the trend concerns small-scale, local economy and repair (Section 6.2.4.4). The COVID-19 pandemic emphasized the need for solutions related to independence and DIY (Richterich, 2020). Also at a rather abstract level, Design-for-DIY aligns with today's growing need for social bonding (Roser, 2020), which it does through its call for collaboration (Section 7.5.4).

The process and result as they are presented in this thesis do not end here. On the contrary: the observed issues and the suggested solution direction, supporting people's awareness, self-sufficiency, hence sustainability in its essence, can serve as an alternative manner of structuring how things go. The work in this thesis supports the notion to stop considering the mass-production-, globalized and mass-consumption-based world we live in as a given.

This element addresses a dimension of the thesis that some might consider ideological or political: specifically, the focus on people's development, sustainability, and identifying the root causes of today's pressing issues. The stance of the thesis - supporting, for example, environmental care and the democratization of production - is presented as objective and not politically motivated (see also Section 5.2.2.7). By developing a future vision and crafting a scenario that encourages DIY activity, this study is grounded in research and reasoning from diverse sources and scholarship across both historical and contemporary fields. Additionally, the thesis considers and addresses opposing viewpoints.

11.5 Conclusions with regard to education

The exploration of how to Design-for-DIY helps to put together a near-future scenario of the designer's profession. Taking this in consideration, the question of how to Design-for-DIY is also a question that is of interest to design schools, both from a research and an educational point of view: anticipating and preparing the designer for a professional career in a field that is, and requires, changing (Hoftijzer, 2011b, 2015).

While many education programs prepare students for a future in a traditional user-supplier relationship context, one should anticipate recent developments and views. Hummels (2011) believes '[…] that education should reflect upon its own paradigms, and envision what types of designers society will need in the future. Open design is one of the reasons to look critically at current educational models.' Voûte indicates that design should align with changes concerning (1) 'inputs' (technologies), (2) 'outputs' (products, services), (3) the involvement of (facilitated) users and (4) the addressing of socio-cultural values and societal changes (Voûte, Stappers, Giaccardi et al., 2020).

The Design-for-DIY concept represents a valuable and relevant subject to IDE education, in multiple ways. Such as (1) the concept of Design-for-DIY addresses and elucidates the underlying problem of unsustainability in relation to how we produce and consume, (2) it

teaches students to consider people's true 'needs': to address democratization and facilitate self-sufficiency (for example, enable people to do things themselves, while taking into account attitude, confidence, and ability) and (3) it concerns the activation people's personal development and resilience (for example, design of a service).

The integration of Design-for-DIY, or DIY, into design education suits various formats, such as (1) a theoretical module focused on exploring and discussing the concept of DIY (e.g., its psychological dimension and DIY ethics), or (2) a design project module that addresses design methodology, practical implementation of Design-for-DIY projects, and the facilitation of laypersons.

II.6 Propositions that concern this thesis

(see also the separate inlay with the complete set of propositions)

1: By putting their knowledge and skills at the service of the industry, designers have hardly been able to fulfil the responsibility they carry for addressing real problems over the past decades. An independent and even activist role is desired here.

2: Once technology reaches a level of complexity that the user does not understand, alienation may occur, causing an unsustainable situation (because of lower involvement, poorer repairability). The designer should serve as a mediator between the user and the manufacturer by keeping or making technology manageable and understandable.

3: Studying and anticipating the human-product relationship should concern both (1) the user-product relationship, and (2) the maker-product relationship, which involves e.g. the notion that we are 'homo faber'. It would help uncover the biography of an object: its origin, its reason to be, its intention, its use, its context, its footprint, etc., which will help increase people's awareness, knowledge, involvement, and care for people's natural environment.

4: Whereas the general public fully recognizes the environmental and health-related benefits of growing your own food (small-scale) and DIY cooking, the same principles apply to DIY product creation. Both practices ultimately help avoiding harmful consequences of the industrial processing (manufacturing), and support the development of people's skills, awareness, and knowledge.

II.7 Future research

The study considers the observation of a problem, it associates this problem to the field of industrial design, followed by the suggestion of a solution direction, through proposing a scenario and methodology of Design-for-DIY. Follow-up research is proposed, as part of the Design-for-DIY methodology, to evaluate the designer-layperson interaction further. Further formal studies are needed in which designers offer DIY projects to be carried out by laypersons, to learn from the actual implementation of the Design-for-DIY framework. Results are expected to help draw conclusions concerning the interaction between designer and layperson and to better address the details of the Design-for-DIY framework.

As a next step, I consider the thought of utilizing the Design-for-DIY framework and designing projects for DIY very appealing. Such a study or project would include an active role of the layperson to learn from. 'How do laypersons experience the DIY project in which they participate, regarding attractiveness, openness, design space, design freedom, level flexibility, clarity and complexity?' This would include the implementation and evaluation of the proposed methodology and steps. As a recommendation, I suggest describing and utilizing evaluation criteria essential for assessing the impact of the intervention on factors such as user satisfaction, sustainability, and skill development. The Design-for-DIY framework could serve as a basis for ongoing assessment and feedback.

Additionally, future work should consider further development and detailing of the proposed Design-for-DIY framework. Based on the conducted experiments (Section 10) and further study, I suggest taking the next steps in concretizing the framework, cycle per cycle, segment per segment. Which actions and interactions take place in each of those segments? The Design-for-DIY framework could suggest implementing concrete learning elements in each DIY project-to-be.

Design-for-DIY will, similar to design in general, probably be influenced by – and can benefit from - artificial intelligence (AI). Visual AI, exemplified by e.g. Vizcom, Mid Journey, Stable Diffusion, and Dall-E, promises to revolutionize the creation of visual content. It is evident that ideation and further synthesis elements benefit from these new developments. However, it is important to bear in mind that the DIY concept emphasizes learning, crafting, and skill development. In other words, in the context of a Design-for-DIY scenario (and perhaps in many other scenarios), artificial intelligence could help achieve an easy result or provide inspiration, but it would not assist in developing people's skills, self-sufficiency, or their sense of 'self'.

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Short Curriculum Vitae

Date of birth: 19th of July 1973

Place of birth: Asten

Education

1985 – 1991: Norbertuscollege Roosendaal, The Netherlands, Gymnasium ß

1991 – 2000: Delft University of Technology, Industrial Design Engineering, Delft, The Netherlands

Professional

1992 - 2001 Freelance illustrator, graphic designer

1996 - 1998 Hoftijzer & Van Dooren Multipurpose V.o.F., design agency, Delft, The Netherlands

2001 - 2005 First bv (today: People Creating Value), design agency, Enschede, The Netherlands

2005 - 2006 Indes design & engineering, design agency, Enschede, The Netherlands

2006 - 2007 Goliath bv, board games and toys, Hattem/Zwolle, The Netherlands

2007 - 2012 University of Twente, Faculty of Industrial Design Engineering, Enschede, The Netherlands

2012 – today Delft University of Technology, Faculty of Industrial Design Engineering, Delft, The Netherlands

Additional

2005 – today Visiting lecturer at various institutions (among which Saxion University College, Enschede, The Netherlands; Beijing Jiao Tong University, Beijing, China; University of Antwerp, Belgium; Umea Institute of Design, Umea, Sweden)

2009 – 2011 Member of Faculty Council of 'Engineering Technology', University of Twente, Enschede, The Netherlands

2018 - today Chair of the 'Design Sketching' Special Interest Group (SIG) of the Design Society

2021 – 2022 Chair of the Board of Studies of the faculty of Industrial Design Engineering, Delft University of Technology

Recent profile at Delft University of Technology: https://www.tudelft.nl/io/over-io/personen/hoftijzer-jw

Recent research profile: https://research.tudelft.nl/en/persons/jw-hoftijzer/publications/

Recent profile (on Linkedin): http://nl.linkedin.com/in/janwillemhoftijzer

Papers and presentations

Multiple parts of thesis were previously published in magazines, journals, and conference proceedings, and were presented at various occasions and venues among which keynotes and design conferences.

Hoftijzer, J. W. (2008). Co-creation: het Nieuwe Doe-Het-Zelf? Product Magazine (5), 12-14. This article, focusing on the term 'co-creation', describes the similarities between (1) new signs and opportunities for user participation in product design and (2) the traditional (or historic) Do-It-Yourself phenomenon as referred to by, for example, Goldstein, Gelber, Jackson and Atkinson. It addresses the historically increasing distance between user and the maker of a product (Hoftijzer, 2008). The article is addressed in Section 2 and Section 6.3.

Hoftijzer, J. W. (2009a). The collaborative Design Lab: The future designer. Paper presented at the 5th World Mass Customization and Personalization Conference: Mass Matching - Customization, Configuration & Creativity, Helsinki, Finland. This paper concerns the description of an IOP/ IPCR research project proposal (The Netherlands), that attends to the matter of co-design, and the creation of a collaborative design laboratory. The paper announces the initial questions concerning: DIY factors, the development of a toolkit, task division and the designer's future role in general (Hoftijzer, 2009a). The paper is addressed in Section 2, Section 5,| Section 6.2.4, and Section 7.6.

Hoftijzer, J. W. (2009b). DIY and Co-creation: Representatives of a Democratizing Tendency. Design Principles and Practices, an International Journal 3(6), 69-81. Retrieved from http://www.Design-Journal.com. This paper attends to the concept of DIY that represents a convergence of design and consumption. It compares both today's practices of 'new DIY' and historic periods of 'soft' respectively 'hard DIY', and explains people's preference to do things themselves (Hoftijzer, 2009b). The paper is addressed in Sections 3, 5, 6 and 7.6., Section 7.6.

Hoftijzer, J. W. (2009d). The Implications of Do-It-Yourself. Paper presented at the International Conference on Integration of Design, Engineering and Management for innovation, Porto, Portugal. This paper discusses the factors that enable DIY activity, people's innate needs to express their creativity, the boundaries of DIY, and further the implications of DIY for human behaviour, sustainability, industry, consumers and people's self-reliance (Hoftijzer, 2009d). The paper is foremost addressed in Section 7.5.6.

Hoftijzer, J. W. (2011a). Design-for-DIY, Beyond the fixed solution space. Paper presented at the World Conference on Mass Customization, Personalization, and Co-Creation 2011: Bridging Mass Customization. This paper regards technology's mediating function when it concerns DIY in the past and DIY today: (1) through the availability of toolkits, (2) through scale-free manufacturing, (3) through the abundant availability of information, and (4) the digitization of products (Hoftijzer, 2011a). The paper is addressed in many of the Sections of the thesis.

Hoftijzer, J. W. (2011b). Design Management: Guiding the Design Process. Design Management: Towards a New Era of Innovation - 2011, Tsinghua-DMI International Design Management Symposium, Hong-Kong. This paper concerns DIY and customization as integrated part of design, design management, and design education. The paper refers specifically to the course module within the IDE University of Twente course of Design Management that concerned 'product customization' (Hoftijzer, 2011b).

Hoftijzer, J. W. (2012b). Sustainability by Do-It-Yourself product design, User design opposing mass consumption. Paper presented at the DRS 2012 conference, Chulalongkorn University Bangkok Thailand. This paper addresses Ehrenfeld's definition of sustainability (considering the human domain, the ethical domain and the natural domain) and Heidegger's Being, and measures DIY against the sustainability yardstick (Hoftijzer, 2012). The paper is addressed specifically in Sections 4.2 and 6.4, and its theme forms an elementary part of the reasoning for Design-for-DIY.

Hoftijzer, J. W. (2015, October 20th-22nd, 2015). Implementing 'Design for Do-It-Yourself' in design education. Paper presented at the 8th World Conference on Mass Customization, Personalization, and Co-Creation (MCPC 2015), Montreal. The starting points being (1) that DIY is worth facilitating, and (2) a Design-for-DIY framework should help designers to facilitate laypersons, and (3) how to implement Design-for-DIY in design education, this paper considers a series of studies done by graduating students of IDE. The studies were done to help develop a Design-for-DIY framework as a working method (Hoftijzer, 2015). The paper is primarily addressed in Section 8. The presentation held at that conference included a preliminary Design-for-DIY framework.

Hoftijzer, J. W. (2020b). Design-for-DIY: Democratizing design. The international Philosophy of Human-Technology Relations conference [PDF (PPT)]. Enschede, The Netherlands: PHTR. This online presentation considered the briefly summarized vision of the facilitation of DIY, and the reasoning for it (Hoftijzer, 2020). This vision is addressed in Section 7.6.

Hoftijzer, J. W. (2023a). Democratizing design: the development of a 'Design for Do-It-Yourself' Framework. conference paper. Cumulus the Global Association of Art and Design Education and Research, Antwerp. Taking the observed unsustainable relationship between people and the products they use as a starting point, this paper discusses – given the results of prior studies and existing design models - the design and summarized validation of a Design-for DIY framework. A range of experiments were done to test the proposed Design-for-DIY framework (Hoftijzer, 2023a). This paper is addressed in Section 1.2, Section 9 and Section 10.

Hoftijzer, J. W., & Keyson, D. V. (2023). A framework model for facilitating Do-It-Yourself design. Proceedings of the Design Society (Cambridge University Press), 3, 181-190. https://doi.org/DOI:10.1017/pds.2023.19. This paper concerns to the full storyline leading to the establishment of the Design-for-DIY framework, and focuses on the designer's role and the framework's usage scenario (Hoftijzer & Keyson, 2023). The contents of this paper are considered in Section 1.2, Section 5, Section 7, Section 6.4, Section 8.1, Section 7.5.3, Section

8.8.2, and in Section 9.

Hoftijzer, J. W. (2023b). Experiments and Evaluation of a Design-for-DIY Framework. E&PDE, Barcelona. This paper considered the experiments that were undertaken with 12 designers as participants, to test the Design-for-DIY framework, concerning its guidance, its clarity, suitability, completeness, effectiveness, the experiments' outcomes and conclusions (Hoftijzer, 2023b). The paper is regarded primarily in Section 10.

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Atkinson, P. (2011b). Orchestral manoeuvres in design. In B. VAN ABLE, EVERS, Lucas, KLAASSEN, Roel and TROXLER, Peter, (eds.) (Ed.), Open Design Now: Why Design Cannot Remain Exclusive (pp. 24-31). BIS Publishers.

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