



## 7 Key Theories of Design

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*DOI (link to publication from Publisher):*  
[10.54337/aau.dlm1](https://doi.org/10.54337/aau.dlm1)

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*Publication date:*  
2024

*Document Version*  
Også kaldet Forlagets PDF

[Link to publication from Aalborg University](#)

*Citation for published version (APA):*  
Laursen, L. N., Tollestrup, C., & Vesti, H. N. (2024). *7 Key Theories of Design*. Aalborg University Open Publishing. <https://doi.org/10.54337/aau.dlm1>

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**7 Key Theories of  
Design by Linda  
Nhu Laursen,  
Christian Tollestrup  
and Helle Vesti is a  
lecture note from  
the Design Lab  
Materials series  
for students at  
Aalborg University.**

7 Key Theories of Design  
Lecture Note

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This publication is no. 1 in the series Design Lab Materials

1. Edition  
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Series editors: Linda Nhu Laursen, Christian Tollestrup and Helle Vesti

ISBN: 978-87-85239-09-9  
ISSN: 2794-8226  
DOI: 10.54337/aau.dlm1

Published by:  
Aalborg University Open Publishing  
Kroghstræde 1-3 | DK-9220 Aalborg Øst  
aauopen@aaau.dk | www.open.aau.dk



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This book is dedicated to **Professor Marianne Stockholm**, we feel deep gratitude for your legacy and it is a privilege to continue your work.



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# Content.

Intro	7
The 7 key theories	11
1. Wicked problems	13
2. Co-evolution of problem and solution	19
3. Framing	25
4. Abductive reasoning	29
5. Reflection in- and on-action	37
6. Visual representations	43
7. Situating	49
Outro	55
References	58

**We are often asked which key theories constitute the AAU industrial design education. However, we find it rather unsatisfying not to be able to account for this in a simplified manner.**

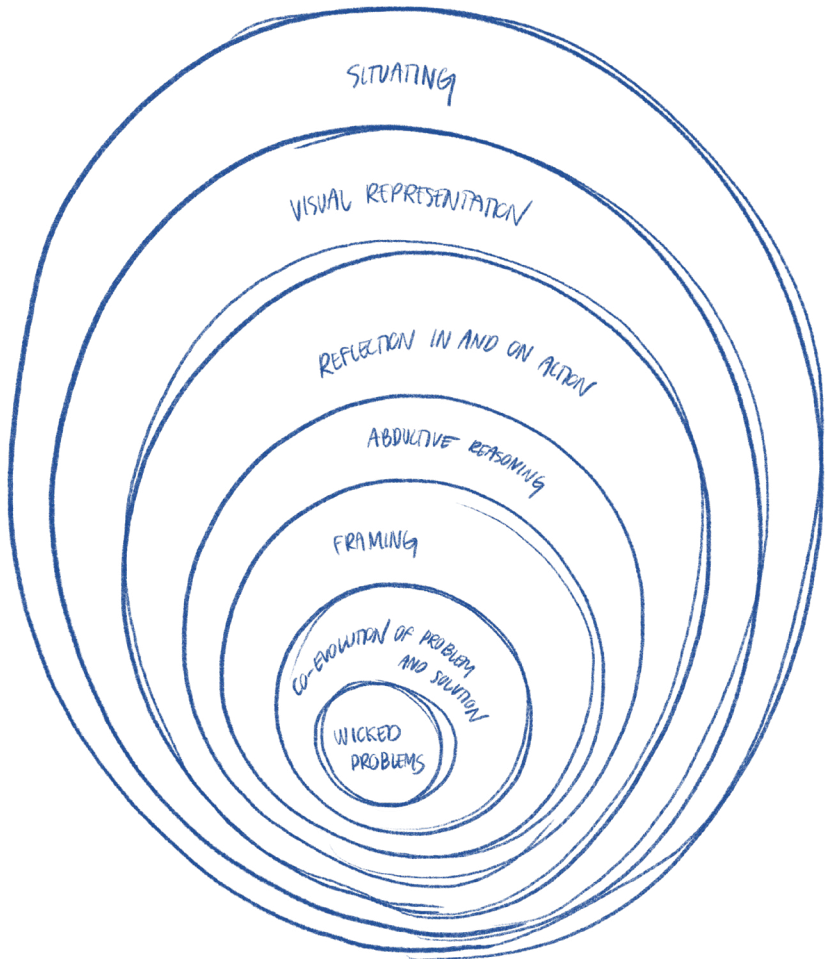
# Intro.

Design students from Aalborg are not educated within any distinctive design-related domain, discipline, or branch, nor are they taught not defined measures or acted in the interest of inducing product or artifact specialization. This is because the apparent focus of the AAU Design educational tradition **extends beyond domains, categories, tools, and techniques.**

Within industrial design practice, each new customer comes with new tasks and product categories, user types, behaviours, technologies, etc. Integrating the knowledge necessary for that particular situation, may include statics, ergonomics, material properties, production and manufacturing methods, technologies, sustainability, product-service systems, supply chains, company competences, market positioning, and so on. In other words, considering the demand for specialist knowledge varies greatly depending on the projects. This unpredictability, where knowledge is included depending on the situation at hand, means it is necessary for the design students to develop a broad palette of knowledge and professional terms so that the student can understand and work to integrate many related fields. As our industrial designers jump out and across the domain specific boxes, a question is raised, what is their focus and core expertise?

The most constant factor in the process will therefore be the methodological approach. The unpredictability has required that students learn to navigate the uncertain and ambiguous structure of the design process and has become a cornerstone of the industrial design at Aalborg University education's curriculum. For this particular purpose, a completely new reporting format was developed; beyond explaining the proposal and the product itself, a new type of report openly and honestly explained the design process behind the proposal, including dilemmas, failed trials, theory, and method application. Accounting for the co-evolution of the problem and the solution, as well as giving insight into the reflection-in and on-action. In this manner, one could follow the abductions and framing, co-evolution of the problem and the solution, reflections and reasoning about goals, problems, and approaches, as well as the method application in the specific project. The examination of a project showed that enormous resources were used to demonstrate a methodological understanding and reflection.





## The 7 key theories.

The content of this book has been long underway. Since 2001, where two of the authors started their journey at Aalborg University; Christian Tollestrup as a Ph.D. scholar, and Linda Nhu Laursen as a design student. Both of us were part of the very forming years of the Industrial Design education at Aalborg University. From day one it was very clear, that the design education in Aalborg was completely different from a classic design education, but it took us decades to understand *why*. Today after educating and researching design for decades, we are finally ready to decipher the magic. We humbly build on the founder of the education Professor Marianne Stockholm's work and stand on the shoulders of giants such as Schön, Suchman, Cross etc. as we try to make the theoretical foundation of design explicit – at least the version taught at the AAU design education.

Our experience is that most designers love visuals and many are lazy readers. So, for our readers, design professionals and design students, we promised to keep this book as short and concise as possible.

”

The framing for this book was ‘it is like a bouillon cube’, keeping all the flavour, depth, richness, and complexity of design theory, but in a short, simple, concise, and condensed format.

We have carefully curated and selected the 7 most important theoretical concepts in design theory, together they constitute the paradigm of design at Aalborg University. We bring an overview of these fundamental theories and provide a coherent and concise explanation of how they are interdependent. This unfolds the relativity of design, as each element constitutes a part of design that is not visible but influences, and is influenced by, the other elements. These invisible elements are essential and powerful – in fact, we see them as strong theoretical concepts that come to life as **the forces of design**.

Through several years of research, we have gotten it narrowed down to 7 distinct key theories: 1) wicked problems, 2) co-evolution of problem and solution, 3) framing, 4) abductive reasoning, 5) reflection in- and on-action, 6) visual representations, 7) situating – which is the magic we teach our designers.

**1**

**Wicked problems.**

# Wicked problems.

Design problems are generally classified as either “ill-defined”/ “ill-structured” (Reitman, 1964; Eastman, 1969; Newell, 1969; Simon, 1973), or “wicked” (Churchman, 1967; Rittel and Webber, 1973; Buchanan, 1992). **Ill-defined/Ill-structured problems** are characterized by fuzzy, ambiguous initial requirements and having not completely specified goals. They have an unknown number of solutions and no pre-constructed algorithms nor operators to generate such solutions (Casakin, 2010; Simon, 1973). On the contrary, for **well-defined problems** it is possible to apply an appropriate algorithm for generating a finite number of solutions. Because of this, well-defined problems are referred to as “routine-” or “sum problems” (e.g., recalling/applying familiar solutions), while ill-defined problems are referred to as “non-routine” (e.g., producing unknown and creative solutions via productive thinking). (Casakin, 2010; Gero and Maher, 1993)

The terms “ill-defined”/ “ill-structured” and “wicked” may seem hard to differentiate because of their somewhat, similar meanings. However, wicked problems are a particular form of ill-defined problems with a high level of complexity and shifting values (Kpamma et. al. 2017).

They constitute incomplete, changing, contradictory and interdependent information, which is difficult to gather (Buchanan 1992). The adjective ‘wicked’ is supposed to describe the mischievous and even evil quality of these problems, where proposed ‘solutions’ often turn out to be worse than the symptoms of the problem (Churchman, 1967; (in) Lönngren and Poeck, 2021). An analogy of this could be “the tip of the iceberg”: the one in line of sight which turns out is but a smaller symptom of a larger and more deeply rooted problem. The mischievous quality also becomes clear during attempts to solve the smaller problem since this may result in making matters worse.

According to the concept of Designerly thinking, wicked problems are understood as complex, indeterminate and ill-defined, and are characterized by incomplete, changing, contradictory and interdependent information, which can be challenging to gather (Buchanan 1992). Moreover, the works of Rittel and Webber (1973), Buchanan (1992), Lawson (2006) and Cross (2006) point to ‘wicked problems’ as being central to designers’ conceptions of reality.

The opposite of a **wicked problem** is a **tame problem** which Coyne (2005) compares to factoring a quadratic equation or traversing a maze. Given its seemingly untamable nature, a wicked problem evolves into different directions while also shifting in values. In distinguishing wicked from tame problems, Rittel and Webber have identified ten features characteristic of wicked problems (fig. 1).

### **10 features characteristic of wicked problems by Rittel and Webber (1973):**

- 1 No definitive formulation of the problem
- 2 No stopping rule for the problem
- 3 Solutions to the problem are not true or false, but good or bad
- 4 There is no immediate and no ultimate test of the solution to the problem
- 5 Every solution to the problem is a "one-short" operation
- 6 Problems do not have an inexhaustively describable set of potential solutions
- 7 Every problem is essentially unique
- 8 Every problem is a symptom of another problem
- 9 The existence of a discrepancy representing a wicked problem can be explained
- 10 The planner has no right to be wrong

**Figure 1:** Ten features characteristic of wicked problems formulated by Rittel and Webber (1973). Source: (Kpamma et. al., 2017)

Several scholars have studied which cognitive strategies are frequently applied by respectively expert and novice designers in dealing with ill-defined or wicked problems (Ahmed, 2007; Ball et. al. 1997; Casakin & Levy, 2020; Cross, 2006; Kim, 2019; Self, 2017; Oygür & Ulkebas, 2021; Visser, 2009; Viswanathan & Linsey, 2013). Such research has proven that the use of metaphors, analogical reasoning, visual analogies, and visual displays, effectively aids the process of working with conceptual ideation in ill-defined problem-scenarios (Casakin, 2005; 2010; Casakin & Goldschmidt, 2000).

Due to their ambiguous and fuzzy nature, wicked problems are never definitively solved and can potentially lead to an infinite number of ways to proceed towards satisfactory problem resolution. According to Rittel and Webber solutions to wicked problems also **change over time** (Rittel and Webber, 1973). Because wicked problems tend to act like dynamic systems of interconnected parts (e.g., partial problems and solutions) the designer is mostly dealing with unpredictable consequences of design choices/actions and need to explore different outcomes to progress (Zimring and Craig, 2001).

Therefore, solving wicked problems demands a level of acceptance of relativity and the unpredictable nature of design problems. These turn designing into an **indeterministic process** which is difficult to model and even more difficult

to prescribe (Goldschmidt, 1997). As Wicked problems are never really solved, and there is no stable problem definition, the “problem-solving process” is an explorative, convergent, and fluid process in which partial problems and solutions are explored in between the problem and solution space; design proposals will be developed in iterations while the designer gain a deeper understanding of how the two spaces interact and **co-evolve** (Dorst & Cross 2001).

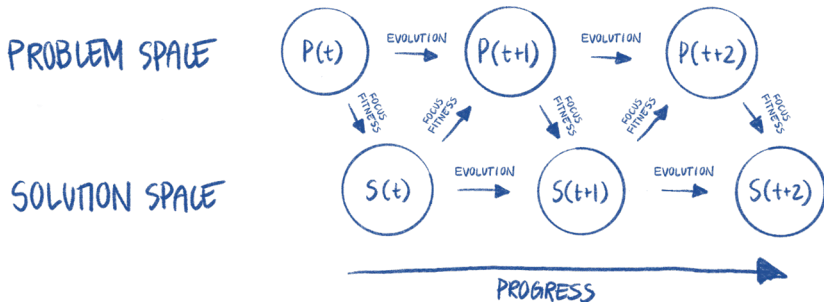
**2**

**Co-evolution of  
problem and  
solution.**

# Co-evolution of problem and solution.

Over the last thirty years, **design creativity** has often been described as a process of problem-solution “**co-evolution**” (Crilly, 2021). The notion of co-evolution has been widely adopted as a useful descriptor of one of the key aspects of Designerly thinking (Dorst and Cross, 2001; Dorst, 2019). Rather than solving a given problem in a linear manner and through consecutive steps, co-evolution involves exploration of both problem and solution space with the goal of developing an understanding of both, until a good match is found.

Co-evolutionary design, as introduced in Maher (1994), is an approach to design problem solving in which the requirements and solutions of design evolve separately and affect each other. Maher’s (1994) proposal was to develop an algorithm that would permit design exploration through the co-evolution of designs and design requirements. This proposal was later illustrated in a diagrammatic representation as the “co-evolution model” envisioned by Maher (see fig. 2). The model has since been widely reproduced and modified into new editions.



**Figure 2:** Variation of Maher’s (1994) and Maher and Wu (2006) co-evolution model. Model adapted in terms of terminology (algorithm, genotype, fitness function) and semantic expression to fit to design-context. Instead of having the horizontal movement (below the model) indicate “time” as the original model has, to illustrate that all spaces interact in the same time spectrum, we find that progress is a more meaningful variable in the context of design.

The phenomenon of exploration as illustrated in figure 2 has the following characteristics:

- There are two distinct search spaces: Problem Space and Design Space.
- These state spaces interact over a time spectrum.
- Horizontal movement is an evolutionary process such that:
  - Problem space  $P(t)$  evolves to  $P(t+1)$ ,  $P(t+2)$ , and so on;
  - Solution space  $S(t)$  evolves to  $S(t+1)$ ,  $S(t+2)$ , and so on.
- Diagonal movement is a search process where goals lead to a solution.

This can be **Problem leads to Solution** (downward arrow) or **Solution refocuses the Problem** (upward arrow). (Maher, 1996, p. 7)

In 1996 Maher and Poon talked of how designers “play around with ideas to get more understanding about the problem rather than focus on finding a solution”. They go on to develop what they call a “co-evolution” model of design.

Whereas Maher’s work in the 1990s had primarily described co-evolution as a means by which computers could perform creative design work, Dorst and Cross (2001) provided a detailed description of human designers creatively engaging in problem-solution co-evolution thus bringing the aspect of human creativity (Crilly, 2021). Through their protocol study, Dorst and Cross (2001) found evidence supporting that creative design processes follow Maher’s model of co-evolution. Engaging in design exploration via co-evolution on a more regular basis requires a high level of skill and experience. Because of this, researchers who have studied the problem-solving processes of expert designers have also found that experts often engage in the process of co-evolution (Lawson and Dorst, 2013; Dorst, 2019).

System thinking is a principle in human-centred design which can prove to be effective when engaging in the process of co-evolution. **Thinking in systems enables the designer to explore complex interactions, loops, and links** (Senge, 1997) in both problem and solution space as well as in between them. **By asserting how elements are interconnected and positioned from one another, the designer creates a holistic mental representation of the problem.** This way, the de-

signer perceives both design spaces in their entirety while also being able to identify the parts that make up the whole. Furthermore, the designer can assess which **priorities and criteria** (formulated in the design brief by clients/stakeholders/users) fit with one another to form links between them.

During a co-evolutionary design process, partial models of the problem and solution are constructed side-by-side. In this process, the designers are making solution conjectures (combining sub-solutions) and decomposing the problem into subproblems. The most crucial factor in this process is where partial models are mapped onto each other by the articulation of a concept. This is often regarded as a “**creative leap**”, “**flash of insight**” or, what Cross (1997) refers to as “**bridging**” (Maher and Tang, 2003; Dorst & Cross, 2001).

The driving force of progression in the co-evolution model is a continuous **framing and reframing** (Schön and Wiggins, 1992) of the problem space. The progression in the solution space is mainly ideation and solution-conjectures which sometimes lead to what Schön called “surprises”. Surprises are problems that occur when e.g., prototypes are built in real size; for example, the oven was assessed to be too hot to be put in a camper, no one could stand the heat when trying it out inside the camper – however, no issues were observed when using it outside of the van (e.g., in a normal sized house or outdoor kitchen).

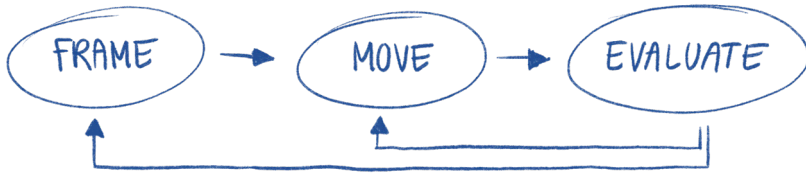
Such a situation or unexpected “surprise” may force a halt in the evolution of an idea, and demand that an iteration is initiated to reframe the entire line of problem evolutions (P(t)) to before the stage of testing occurred (maybe even further back). **Problem framing** (and reframing) is part of the “Schönian” epistemology called **reflective practice** (Schön, 1983).

**3**

**Framing.**

# Framing.

“Framing” is a term commonly used within design literature for the creation of a (novel) standpoint from which a problematic situation can be tackled (Dorst, 2015). **Problem framing** refers to a specific way of “seeing” a problem situation (Schön, 1983) including the articulation of constraints, types of goals, and task instructions (Silk et. al., 2021) while **problem reframing** refers to changing one’s current frame by taking on a new position from which to observe a problem situation and in this way re-shaping (reframing) one’s point of view. Thus, frames support problem scoping and rescoping in design processes. Framing is a widely applied strategy in situations of problem-solving which supports the process of articulating and defining constraints, performing “moves” toward a solution, and the “evaluation” of these moves, which might lead to new moves or the seeking of a new frame altogether (Schön, 1983; Lawson and Dorst, 2013).



**Figure 3:** Illustration of “the Schönian frame-move-evaluate model of designing” Schön (1983). From: Lawson and Dorst (2013) p. 35.

Schön (1988) suggested that:

”

In order to formulate a design problem to be solved, the designer must frame a problematic design situation: set its boundaries, select particular things and relations for attention, and impose on the situation a coherence that guides subsequent moves.

(Schön, 1988, p. 182)

As Schön mentions, framing can impose coherence on the subsequent moves in the design process which are clearly seen in the co-evolution process. Within a co-evolving context of problem and solution spaces, the dynamics of problem framing, and reframing is often seen as the key creative step that allows an original solution to be produced e.g., the designer takes on a fresh perspective and seek an understanding of the problem in hopes of finding the true core of the problem, or the “problem behind the problem” from the information provided by the client/stakeholder/end-user. Moreover, the shift between framing

and reframing is one of the main driving forces behind the dynamics of the co-evolution model by enabling a continuous exploration of problem-solution pairs to reach the aspired end-value (Paton and Dorst, 2011).

In continuation of the concepts introduced so far, e.g., wicked/ill-defined problems, co-evolution, and framing work independently, we now investigate why these concepts are key to understanding design thinking as a paradigm. Understanding how these concepts coexist and interact, individually as well as collectively, is imperative for understanding how the overall process of design reasoning and its highly complex nature.

Collectively these concepts circulate in the process of what is known as design reasoning. Reasoning is not unique to design, however, the type of reasoning called **abduction** is defining of design in both theory and practice.

**4**

# **Abductive reasoning.**

# Abductive reasoning.

**Reasoning in design** has been theorized from the perspective of logics and the terms of deductive, inductive, and abductive reasoning (Dorst, 2011; Roozenburg, 1993). Reasoning is first and mostly defined as a cognitive activity that dictates how people respond to situations in all aspects of their lives. All design-related activities rely on the reasoning processes of designers. Therefore, understanding the role that reasoning plays in design is critical to understand how design takes place (Cramer-Petersen and Ahmed-Kristensen, 2015).

Different types of reasoning exist within the scientific world. However, the types of reasoning that define (and thus differentiate) the three constitutional paradigms natural sciences, social sciences, and science of the artificial (Simon, 1969), are known as **deduction**, **induction**, and **abduction**. The latter have all been introduced by pragmatist and philosopher Charles Sanders Peirce (1839-1914). In the Peircean logical system the nature of knowledge and reality relate to each of

these concepts – the logic of abduction and deduction contribute to our conceptual understanding of a **phenomenon**, while the logic of induction adds quantitative details to our **conceptual knowledge**. (Cross, 2006; Kennedy and Thornberg, 2018).

## Deduction

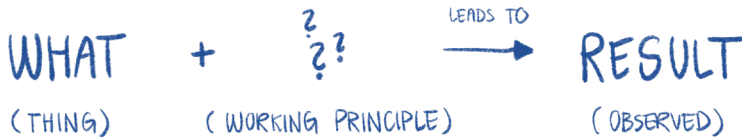
Deduction (fig. 4) is generally defined as the formation of a conclusion based on **generally accepted statements or facts**. Deductive reasoning is drawing logical consequences from premises; the conclusion is true given the premises are true also. For instance: All A's are B's and some A's are C's. Therefore some B's are C's. Moreover, deduction cannot lead to new knowledge because the conclusion has already been embedded in the premise (Merriam-Webster, 2022; Yu, 1994).



**Figure 4:** Equation for deduction; the only unknown is the result which is found by two known variables to the right of the arrow. This type of equation is the simplest since solving the equation does not require any rearranging of variables to arrive at a result. Model adopted from Dorst (2011).

## Induction

Induction (fig. 5) is a method of reasoning involving an element of **probability**. It means forming a generalization based on what is known or observed. An example could be that “all the children in my daughter’s class can jump, therefore my daughter can also jump”. As such, induction is based on generality and law of large numbers.



**Figure 5:** Equation for induction; the only unknown is the working principle. Model adopted from Dorst (2011).

## Abduction

Abduction, is defined as a **syllogism**<sup>1</sup> in which the major premise is evident but the minor premise and therefore the conclusion only probable.” Basically, it involves forming a conclusion from the information that is known. A familiar example of abduction is a detective’s identification of a criminal by piecing together evidence at a crime scene. Abductive reasoning is used within sciences dealing with the artificial (e.g., design), however, other areas such as criminology and law rely heavily on abductive reasoning as well.

<sup>1</sup>A deductive scheme of a formal argument consisting of a major and a minor premise and a conclusion (as in “every virtue is laudable; kindness is a virtue; therefore, kindness is laudable”) (Yu, 1994).

For **deduction, the goal** is to refine the hypothesis based upon other plausible premises while for induction it is empirical substantiation. For abduction, being the type of reasoning used within the design profession, the goal is to explore data, find a pattern, and suggest a **plausible** hypothesis. In this way, they each represent an epistemological view; **Positivism (deduction)**, **subjectivism (induction)**, and **constructivism (abduction)**.

Designers often apply solution-focused strategies along with abductive/appositional or productive styles of thinking to explore and resolve the ill-defined, and sometimes wicked problems which they continuously encounter in their line of work (Cross, 2006).

Deduction proves that something **must be**, and Induction shows that something is operative Abduction merely suggests that something **may be**. **Abduction** and **deduction** both deal with the conceptual understanding of a phenomena while induction is the quantitative verification. At the stage of abduction, the goal is to explore the data, find out a pattern, and suggest a plausible hypothesis with the use of proper categories; deduction is to build a logical and testable hypothesis based upon other plausible premises; and induction is the approximation towards the truth to fix our beliefs (phenomena that exist in the world) abductive reasoning suggests and aspire to create something new (things that do not yet exist

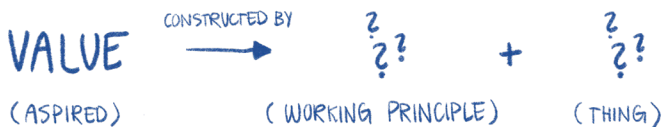
in the world) having to work mostly at an abstract level and in a fluid process towards assembling/shaping/modelling “things” (objects, systems, or services) that can provide the aspired value. The output is neither measured in values of **true nor false** as results in the sense of binary logic, but **good or bad** which adds the element of relativity (see fig. 1, in characteristics of wicked problems).

Abductive reasoning has two possible “equations” (fig. 6); In well-defined problems/design briefs, designers often only need to identify the “what” which is the thing (object, system, or service) that will provide the aspired value, while ill-defined, or wicked problems have more unknown variables and therefore greater complexity to the design task. Such complexity often calls for more extensive solution space.

### ABDUCTION 1



### ABDUCTION 2



**Figure 6:** Two possible equations of abduction. Model adopted from Dorst (2011).

Abductive reasoning work with a reversed logic from deductive and inductive reasoning. In this manner, abductive reasoning is **solution-oriented** as well as **explorative** while, in contrast to abduction, deduction/induction is **problem-oriented as well as definitive**.

It is only through suggestion (actions) and then reflection that the “validity” is evaluated because it is imagined (new) and wicked (complex/ill-defined) and therefore cannot be foreseen by algorithms.



**5**

**Reflection in-  
and on-action.**

# Reflection in- and on-action.

Reflective practice is the ability to reflect on one's actions which enables engagement in a process of continuous learning as well as building the reasoning that lay behind and supports the designer's proposal (solution proposal) (Schön, 1983).

The reflective practice model is one of the most widely cited theories in expertise studies. Its significance lies in its response to the fundamental proposition that socially embedded problems are complex, ill-defined, and unique, and cannot be resolved with the rationalistic methods suited to well-structured problems where objectives are clearly defined. Schön's model of thinking critically through self-reflection provides a framework that arguably enables individuals to respond to unpredictability, which is common to ill-defined problems. (Fook et. al., 2000)

The reflective practice model adopted two categories of reflection to illustrate the differing ways that reflective practice influences learning and expertise development both during (**reflection-in-action**) and after (**reflection-on-action**) practice (Schön 1983; 1987). Both concepts describe a deliberate thought process within a problem-solving process that focuses on past actions, known as reflection, which is generally triggered whenever an individual recognizes abnormalities in a current situation that call for careful consideration (Eraut, 1994). However, the two varieties are distinguished by their relation to the overall temporal structure of the reflecting individual's engagement with a design problem.

## **Reflection-in-action**

Reflection-in-action, also known as 'knowing-in-action', refers to undertaking reflection simultaneously with the undertaking of one's practice (Schön 1983; 1987). The process requires thinking about past experiences while engaged in the current task in order to develop new knowledge that can be appropriate to the situation at hand as well as future situations. This process draws on tacit knowledge construction, during which actions, judgements, and recognition of patterns coincide on a non-conscious level. According to Schön (1983; 1987), the objective of

reflection-in-action is to enable individuals to adapt to situations of uncertainty, through becoming conscious of their knowledge constructing activities during their routine process.

To Schön, reflection-in-action is:

”

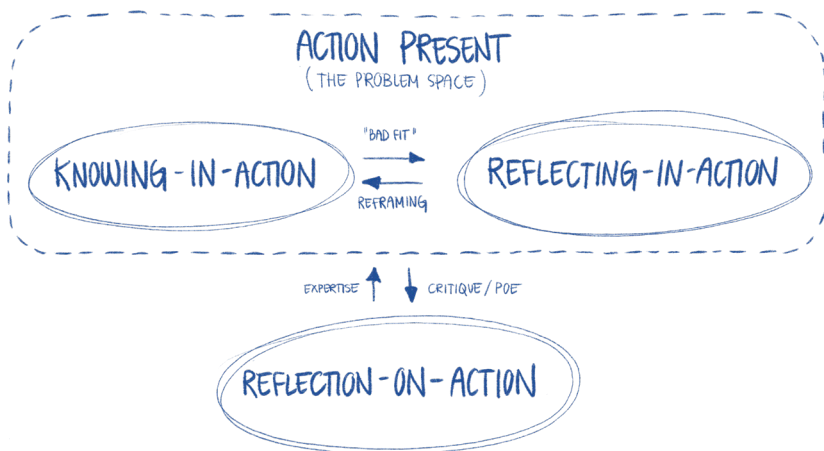
doing and thinking are complementary. Doing extends thinking in the tests, moves, and probes of experimental action, and reflection feeds on doing and its results. Each feeds the other, and each sets boundaries for the other.

(Schön, 1983, p. 280)

## Reflection-on-action

Reflection-on-action, by contrast, seeks to make sense of activities after their completion. Eraut (1994) describes reflection-on-action as a form of deliberation or serious consideration of past actions, where individuals relate theoretical knowledge to recent experience in order to develop their expertise. The process involves self-awareness and critical evaluations of the individual's responses to the situation (Finlay 2008). However, there is also a process-oriented reflection-on-action where the designer conducts a meta-analysis of how choices of methodology worked in retrospect. By doing this, the designer can assess knowledge and experience gains from actions.

From Schön's perspective, experts are those who apply both methods of reflection, by drawing on practical experiences and theoretical knowledge both to think on their feet and to refine their practice (Finlay 2008). One thing is to apply methods of reflection to learn from one's actions, but there is too a dimension in reflection-on-action that focuses on reflection on applied methods. The designer then asks, "which experiences were gained and how were they gained from a methodological perspective?" Adding this meta-perspective on methodology enables the designer to reflect on the process as well as progress. E.g., make status of one's available methodological toolbox and how the use of these makes a difference in the outcome seen in hindsight. This way, the designer realizes if the available methods are enough or if new methods should be applied.



**Figure 7:** Schön's Reflective Practice (Malinin, 2018).

Another approach within the key literature of designerly thinking is called “**Modal shift**” (Cross 2006). A **modal shift is a direct effect of reflection in- and on-action**. During modal shift, designers rapidly switch their attention between different tasks and different activities. For instance, they might focus on the overall project and then on a smaller detail of the project, like a “zooming in and out”- function. Applying modal shift during a process of co-evolution would enable the designer to observe all that inhabits the problem- and solution space by zooming in (partial problems and solution, sub-problems, and solution-conjectures), while zooming out would provide them with a perspective of the model as seen in figure 2, which is the view of an overall progress and co-evolving pattern between the two spaces. Another type of modal shift could be rapid shifts between analysis, synthesis, and evaluation, which is an approach found to heighten the quality of the eventual solution (Cross 2006). The designer moves into another phase (from having entered the modal shift) when the next course of action has been decided e.g., when the designer have decided on what to do- or create next and with what tool or type of design representation.

**6**

**Visual  
Representations.**

# Visual Representations.

The designer's main objective is to **extract, visualize** and **reshape the clients aspired values, priorities,** and **criteria into a potential solution** (Cross, 2006; Lawson and Dorst, 2013) by the means of representations. The term refers to any shape, form, or object which is capable of mediating an idea. Such an idea may be a highly concrete (building model in scale) or, it may be a less concrete, even abstract idea (a concept of circular economy). It may also be capable of expressing emotions (Ge et. al., 2021).

Representations enable designers to externalize their creative thoughts. They start writing, drawing, modelling, computing - whatever media they find suitable. As ideas can be concrete, abstract, or even both simultaneously, so can their

representations. Likewise, representations can take shape and evolve over time and in iterations.

Because of ill-defined problems, designers need to hold on to something not yet known; the future product, as seen from the point of view of design, and the future instrument of work, as seen from the point of view of use. In this respect, various kinds of representations play an important role. (Bodker, 1998). Research suggests that the process of sketching is a fundamental element of design thinking and is thought to be critical to generating concepts (Yang, 2009). It is a multi-purposeful tool for designers to mediate, discuss and reflect upon propositions in all stages of the development process.

To demonstrate how representations work, we could use the sketch as an example. **Sketching** is somewhat different from any other type of drawings employed by designers (Herbert, 1993; Fraser and Hemni, 1993) because designers create them not just to record an idea, but to help generate it. This process has been (quite famously) described as “the designer having a conversation with the drawing” (Schön, 1983). Others have suggested that designers are able to see more information in such sketches than was invested in their making. Thus, designers appear to see visual clues in their sketches that trigger mental images which in turn may suggest ideas for the current design (Menezes and Lawson, 2006). Sketches are

also useful for communicating ideas to others and initiating co-reflections. Goldschmidt (1991) has elaborated on the dialectics of sketching through representations:

”

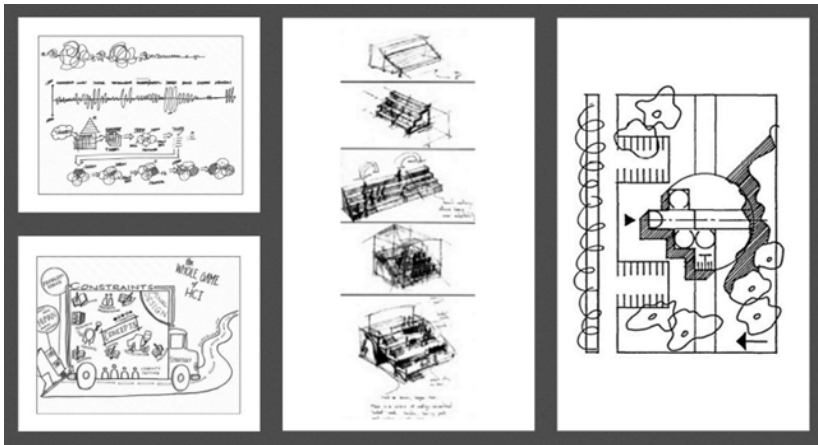
The dialectics of sketching is the oscillation of arguments which brings about gradual transformation of images, ending when the designer judges that sufficient coherence has been achieved.

(Goldschmidt, 1991, p. 123)

Design representations are therefore tools for internal and external communication and reflection, e.g., the internal dialogue with the sketch (Schön, 1983) and external communication and reflection with other designers, design teams, stakeholders and/or users. According to Mogensen & Trigg (1992). Representations may also be descriptions guided by one description method or another, prototypes, mock-ups, scenarios, and pieces of paper in an organizational game. Such representations provide a common basis for discussing what is going to be produced or computed, as well as how, and why. In some situations, the actual tangibility of these representations (that they can be inspected, pointed at, etc.) is important for the design situation, as pointed out by Mogensen and Trigg. Representations reflect the expectations and experience of their creators. They serve a purpose as

part of the overall design activity and in relation to the future use of the product.

Representations are not only strong tools of mediation and reflection (internal and external) they also grant designers the ability to explore the design process from multiple angles by taking advantage of the many possible dimensions and point of views, in which their explorative formation of ideas and concepts can take place. Exploring representations in multiple dimensions (through sketches, models, prototypes etc.) allows the designer to observe blind spots (another way of capturing what Schön (1983) called “surprises”) that was not visible in the initial representation. In this manner, design representations are deeply connected to the part of design that is situated.



**Figure 8:** Different types of sketches and design situations: Top left made by design practitioner (business plan proposition). Bottom left is made by student in HCI (a game proposition). The middle sketch shows five-stages of complexity while the right sketch is an example of a visual display. (Gray and Siegel, 2014; Self et. al., 2013; Goldschmidt, 1991)

**7**

**Situating.**

# Situating.

”

Thomas Gladwin (1964) has written a brilliant article contrasting the method by which the Trukese navigate the open sea, with that by which Europeans navigate. He points out that the European navigator begins with a plan – a course – which he has charted according to certain universal principles, and he carries out his voyage by relating his every move to that plan. His efforts throughout his voyage is directed to remaining ‘on course.’ If unexpected events occur, he must first alter the plan, then respond accordingly. The Trukese navigator begins with an objective rather than a plan. He sets off toward the objective and responds by the wind, the waves, the tide and current, the fauna, the stars, the clouds, the sound of the water on the side of the boat, and he steers accordingly. His effort is directed to doing whatever is necessary to reach the objective. If asked, he can point to his objective at any moment, but he cannot describe his course.

(Gerald Berreman 1966)

**Figure 9:** *Above is presented an analogy of situated actions explained via the difference between navigation and wayfinding. (Suchman, 1987)*

Though the term “situated” share some similarities with the verb “located”, situated is a bit more specific since it most often refers to an environment rather than just a geographic location.

To say that design is situated is to highlight the interactions and interdependencies between designers, designs, design methods, and the use situation with its actors, activities, structures, particulars, and broader context (Ataizi, 2012). Situated design is about recognizing the various environmental factors that products (services, or systems) go through at different stages in the co-evolving process, and how designers must implement knowledge from such transitions while also implementing situated actions and reflective practice.

For now, not one, agreed-upon authoritative definition of **situatedness** exists. Rather, different researchers have defined and used the concept in related but different ways, such as situated knowledges, situated practice, situated learning, and situating contexts. (Simonsen et. al., 2014)

Suchman (1987) is a sociologist whose core interest has been studying people who utilize their circumstances to achieve intelligent action. Suchman argues that effective actions emerge from circumstances - the plan is either a resource (when it is produced before the action) that plays an orienting role or is produced afterward, a re-

construction that aims to act as an object of reflection.

According to Beguin and Clot (2004) the saying that action emerges from circumstances means, that first, action is dependent on circumstances (e.g., indexicality<sup>2</sup>) and second, acting defines the context of action (e.g., reflexivity) (Beguin and Clot, 2004) which indicates a co-dependent force between context and actions. Any driving force is relative to the situation.

Working with the relativity-factors of **situatedness** grants the designer with possibilities to test how many different scenarios and interchanging situations will affect the needs of the client or stakeholders. The designer looks at what type of value can be promoted through testing different solution proposals in each setting, and test which solutions have the highest adaptability in the eyes of clients/stakeholders – in other words, the designer ultimately aim for **appropriateness**. Working situated is therefore about being able to simultaneously apply adaptive thinking and weigh one's design choices to favor appropriateness with the client and in relation to the situation.





# Outro.

In this book, we have presented 7 design key theories, which are the essence of what designers are trained in – at least, at AAU Industrial Design. The aim might have been too ambitious, to simply bring an overview of the powerful forces and fundamental theories of designing at AAU. The approach that these 7 design theories encompass, sets forward a particular paradigm for the design that is used at AAU. The connection and complex relation between these forces are, however, a topic of whole other study. For now, we just want to round off with three distinct points, which characterize the design approach at AAU:

## **An approach that is focused on action and reflection**

The co-evolution and reflective practice underscore the processual perspective on design, with framing and reframing providing direction in the process. The progression is made by proposing intermediate and selected parts of the solution

(abductive reasoning) through representations (models, sketches, visualizations). Abductive reasoning through representations is crucial to push forward the focus on modal shifts. Representations represent understandings of the problem and solution, that situate the activity in a co-evolutionary process. As such it is an approach of action and reflection, that happens forwards, but somehow is learned backward.

## **Navigating situated problems in situated processes**

Wicked problems are contextual and since problem and solution co-evolute, then so is the proposed solution. The next step in the co-evolution process is dependent on the output of the previous step and what has been learned about the relation between problem and solution (reflection-in-action). So, the next action will consider modal shift (reflection-on-action), the framing (re-framing), the resources available (time, competencies), and stage of co-evolution as the main contextual processual aspect of which the action is situated.

With the problem context constantly shifting between projects due to the variation, i.e., from e-scooters, furniture, and sound systems to toys, there is very little to no transfer of contex-

tual knowledge and solution principles from one project to another. The focus is therefore understanding how to navigate the co-evolution, by rehearsing a continuous and explicit reflective practice. Actively using framing and reframing as a foundation for proposing (abductive reasoning) solutions through representations. All this with a high degree of awareness of how the next action is situated in the process (progress of co-evolution and modal shift) and how it is situated in the problem-solution context.

## **An approach which has an intrinsic aim for new concepts**

Lastly, wickedness drives towards radicality. It indirectly implies a more radical and conceptual approach to forming new products. Forces a situatedness in the problem-solution space and relation - as a minimum the understanding of problems as wicked opens for a systemic perspective that facilitates and encourages a reframing of any presented problem and therefore points towards new concepts.

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the 1990s, the incidence of dengue fever has increased in many tropical and subtropical regions, including Hong Kong [1].

There are four species of dengue virus, *D. mosquito*, *D. sgtii*, *D. sgtens* and *D. sgti*. *D. mosquito* is the most common and is the cause of dengue fever in Hong Kong. The virus is transmitted by the bite of an infected mosquito. The incubation period is 3–14 days, with a mean of 5–7 days. The disease is characterized by a high fever, headache, muscle and joint pain, and a skin rash. In severe cases, dengue fever can lead to dengue haemorrhagic fever (DHF) and dengue shock syndrome (DSS), which can be fatal.

In Hong Kong, dengue fever is a notifiable disease. The first case was reported in 1968. Since then, there have been several outbreaks, with the most recent occurring in 1999. In 1999, there were 10 000 cases of dengue fever in Hong Kong, with 10 deaths. The outbreak was caused by the introduction of the virus from Singapore by a tourist.

The purpose of this study was to determine the seroprevalence of dengue virus in Hong Kong. The study was conducted in 1999, during the dengue fever outbreak. The study was conducted in a community-based setting, using a random sampling method. The study was conducted in the New Territories, which is one of the three main regions of Hong Kong.

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