THE DESIGN THINKING PLAYBOOK

MINDFUL DIGITAL TRANSFORMATION OF TEAMS, PRODUCTS, SERVICES, BUSINESSES AND ECOSYSTEMS

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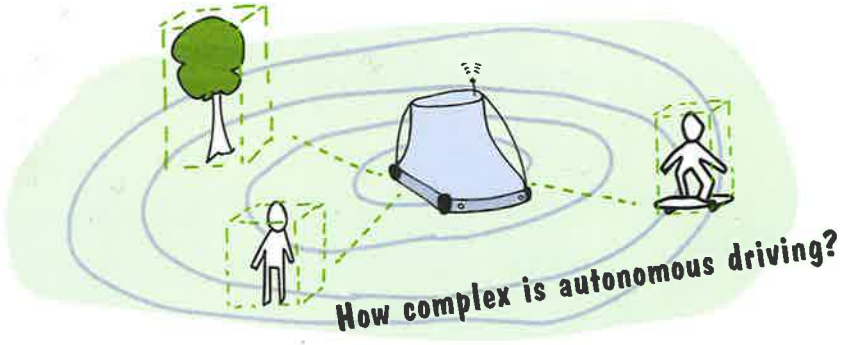
3.1 Why systems thinking helps to understand complexity

We begin our chapter on designing the future with systems thinking, although the approach and the mindset are at least as old as the design thinking paradigm. We are firmly convinced, though, that the basic conditions and interaction of systems must be taken into account more and more when we develop our future products, services, and business ecosystems. The use of a converging mindset of systems thinking and design thinking will be pivotal in many areas.

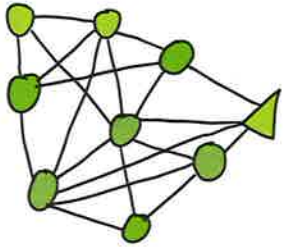
The last time Peter dealt with systems engineering was during his time as a student at Munich Technical University. He can recall quite well a discussion during a lecture in the context of the *Challenger* explosion on January 28, 1986. It was determined at the time that the system had not been adapted to safety needs, and this was why the terrible disaster occurred. Peter often thinks about the disaster. How complex are things when a self-driving car is on the road? How many systems must interact with one another?



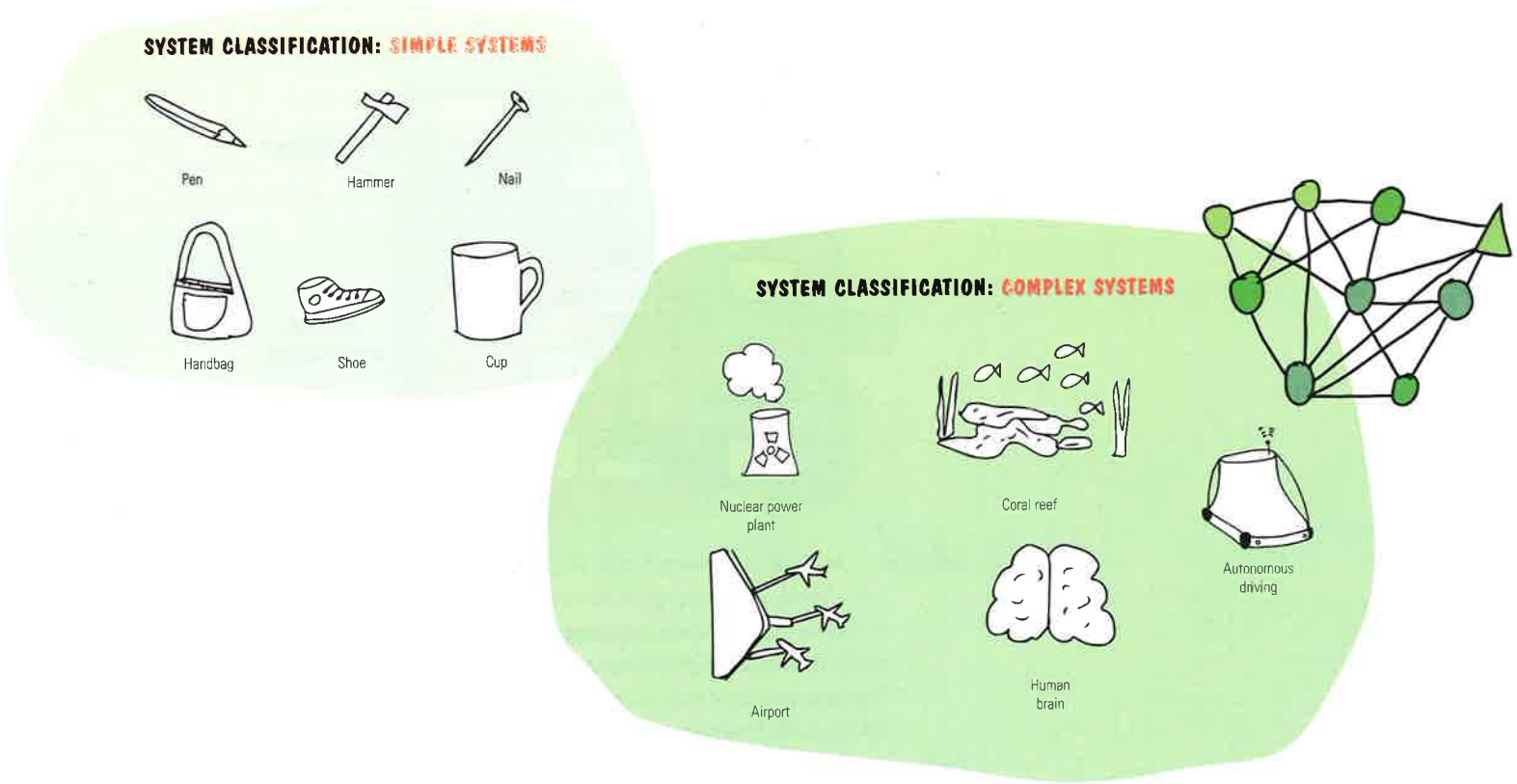
How complex is autonomous driving?

Many things can be understood as systems: products, services, business models, processes, and even our family or the organization in which we work. We use the term "system" to describe the interaction of several components (system elements) in a larger unit and its environment. All these elements fulfill a specific function or a purpose. In what follows, we use the terms "systems thinking" and "systems engineering" synonymously to a large extent.

Engineered systems have a reason for their existence: They implement a desired or required function. For example, we want to build a self-driving car for a stress-free drive from point A to point B. As an alternative, we can integrate the autonomous vehicle in a system of means of transportation and won't ever again have to search for a parking space, because the vehicle will be permanently be on the road as part of a larger system. For this, the responses from certain sensors and information in the vehicle are important for communicating the necessary parameters to the system on how it must adapt to its environment. A rain and cold sensor, for instance, in combination with a camera or radar can provide information on road conditions and thus be an indicator for the speed to be chosen. To achieve this, all components must interact. With regard to self-contained technical systems, complexity is manageable. But as soon as nature as such and our social systems come into play, forecasts are far more difficult. Traffic will increase when we no longer park our autonomous vehicles but have them circulate in the cities. It's our own motives in a system that are difficult to explore and comprehend.

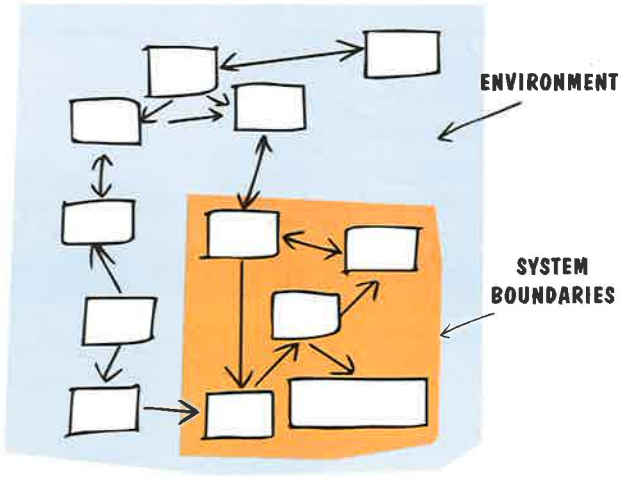


The tools and methods from systems thinking that go beyond drawing up and creating systems help us to model, simulate, and later produce complex systems in a future human–machine and machine–machine relationship—especially if we want to solve wicked problems with design thinking and are faced with the challenge of capturing the environment with its ever-growing complexity. Examples of complex systems are: coral reefs, nuclear power plants, or our introductory example of autonomous driving.



How is the modeling done (mapping of reality)?

Delimitation of systems is a central task of modeling. Especially because effectiveness and efficiency today are more important than ever for the development of new systems. It is obvious that the error probability of complex systems is greater than that of its individual elements. With the use of modules and sub-elements and the introduction of redundancies, we attempte to reduce the probability of failure of the system as a whole.



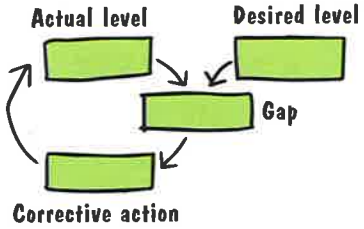
This is based on the assumption that we can influence and change the elements within the system boundaries. The elements within the system boundaries are the strengths and weaknesses known to us. The elements outside these boundaries are the opportunities and risks that affect our system.

What are the elements a systems thinking process consists of?

Put simply, systems thinking is another problem-solving method that uses a variety of elements to optimize the system.

Response and feedback are vital elements of systems thinking. Unlike linear models, which consist of cause/effect chains (A causes B causes C causes D, etc.), in system thinking the world is seen as a connecting unit with various relationships (A causes B causes C causes A, etc.).

The advantage of a model with feedback is that it does not just map what happens at what time, but yields information on how something happens and why it happens. In this way, we learn how a system behaves. Over time, feedback loops increase the response; it can go in both directions: positive and negative. For this reason, it is important to stabilize the feedback loops. Using the feedback only for the optimization of the gap between the target state and the actual situation is a good way of stabilizing.

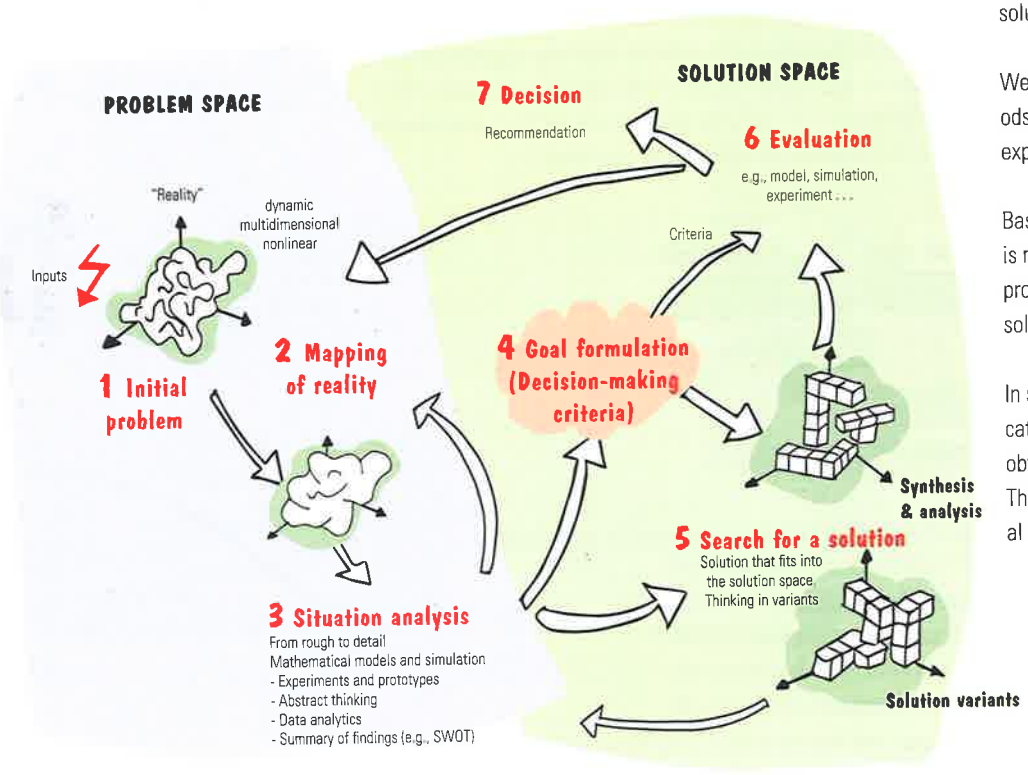


When we deal with the implementation of systems, we must ask ourselves five core questions:

- Which gaps affect our systems, and to what degree?
- Do we know the gaps and are we able to describe them?
- How do we monitor the gaps?
- What possibilities do we have to close the gaps?
- How great is the effort to close the gaps, and how much time do we have to do so?

How does systems thinking work?

In systems thinking, a specific initial problem from the real world (1) marks the beginning. With complex problems, the real world is usually multidimensional, dynamic, and nonlinear. In a first step, we try to understand the system and map the reality (2). This mapping, or system representation, helps us to understand the situation (3). The situation analysis is about comprehending the situation step by step—from rough to detail. We can use various methods here, such as mathematical models, simulations, or experiments, and prototypes. We summarize the findings of the situation analysis in a SWOT analysis, for example, on the basis of which we formulate the goals (4) to be fulfilled by the solution. This way, we obtain the decision-making criteria for the assessment of the solution.



The situation analysis is important for finding out where there are still gaps with regard to the target state. At this point, improvements are usually still necessary, or we simply still lack information to close the gap.

Only once the problem and the situation are really known do we begin with the search for a solution (5). It is now important to identify solutions that actually do fit into the solution space.
In this phase, we endeavor to find several solutions (i.e., to think in variants). By way of synthesis and analysis, we generate different solutions, which we evaluate in the next step (6).

We apply decision-making criteria to the evaluation. Tools and methods such as evaluation matrix, logical argumentation, simulations, experiments, and so forth, have proven their effectiveness.

Based on the evaluation, a recommendation is given and a decision is made (7). If the solution meets our requirements and solves the problem, that's good; otherwise, we iterate the process until we have solved the problem completely.

In systems thinking, a strong focus is on the continuous communication with the stakeholders. This means that their consent can be obtained at an early stage during critical phases of the development. The output of our representation can be documented as the operational concept (ref. ISO/IEC/IEEE 29148).

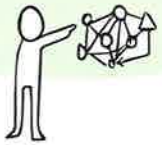
What mindset does a systems thinker live?

Systems thinking is an interdisciplinary approach whose primary goal is solving complex problems or implementing technical systems that depend heavily on each another. As mentioned, the system is divided into subsystems. The individual elements are specified and processed. In so doing, the entire problem (e.g., across the entire life cycle) and the technical, economic, and social framework conditions of all customers or stakeholders should be taken into consideration. Systems thinking offers a team-oriented structured approach for doing so.

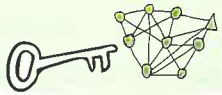
A good systems thinker, therefore, masters different ways of thinking and concentrates correspondingly on the requirements on hand. He switches the perspective, such as from individual parts to the whole, or from structures to processes.

We always have our eyes on the big picture.

We take the time to penetrate even complex interconnections.

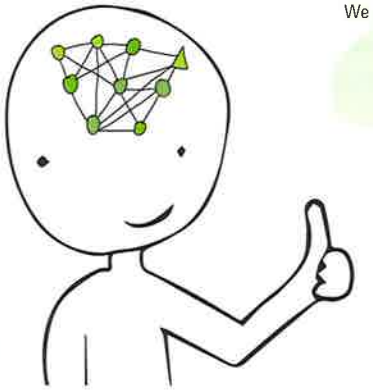


We search for the "key" to the system.

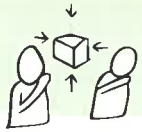


We think positively of a way to improve the system and don't complain when it doesn't work.

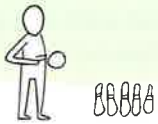
MINDSET OF A SYSTEMS THINKER



We consider facts from various perspectives.

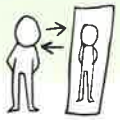


We accept that change takes place gradually and that interconnections also trigger changes.

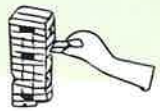


We check the results and improve the result with every iteration.

We reflect on our way of thinking because it affects what will happen.



We identify the effects that are triggered by an action.



Where and how do the design thinking and the systems thinking mindsets converge?

The mindsets of design thinking and systems thinking have some similarities; differences are of a complementary nature, so the convergence of the two approaches is quite exciting.
What both paradigms have in common is the goal of better understanding the problem and the situation. To achieve this goal, we work on interdisciplinary teams, using different methods and tools. It is important that the team always knows where it is in the process and that it acts in a goal-oriented way. Visualization and modeling are factors of success in both approaches.

The similarities are:

- Coverage of the same or similar thematic areas.
- The purpose and goal is the solution of (complex) problems and the simultaneous definition and expansion of the solution space.
- It's important to clarify the critical variables and functionalities at the onset of the project to reduce risks.

From the terms used so far, we quickly realize that the focus of systems thinking is on the system, while the focus of design thinking is on the human being, the user. Both paradigms use a clearly defined but differently aligned problem-solving cycle as well as an iterative approach. Iteration in systems thinking aims at gradual refinement; in design thinking, many iterations enable us to understand the situation better and to approximate a potential solution.
By combining systems thinking and design thinking, the combined application of systemic, analytical, and intuitive models of thinking is also supported—and thus the finding of holistic solutions.

Systems thinking	Complementary mindset	Design thinking
Focus on the system	Different focus	Focus on users and needs of people
Systematic analytical problem-solving cycle	Clearly defined but different (problem-solving) process	Intuitive, circular problem-solving cycle
White box view with a focus on solution space	Design and architecture of systems	Black box view with focus on problem statement
Gradual refinement of the system	Iterative procedure	Carry out a great many iterations quickly
Systems thinking	**Similar mindset**	**Design thinking**
Create clarity through the consideration of the system and changes over time	Create clarity	Create a common understanding and clarity
Establish clear structures and anticipate life cycle considerations	Process understanding important (be mindful of process)	Process understanding is important
Mapping and modeling of the system	Visualization	Visualization and prototyping are important
Use of methods from systems thinking	Use of various tools and methods	Use of methods from design thinking
Collaboration and the exchange of information with stakeholders is pivotal	Interdisciplinary collaboration on the team	Initiate radical collaboration
System understanding helps reduce uncertainty	Positive dealing with uncertainty	Perform experiments in order to learn
Conduct project management in a target-oriented way	Focus on action	Implementation-oriented and solution-oriented action

HOW MIGHT WE...
use systems thinking in design thinking?

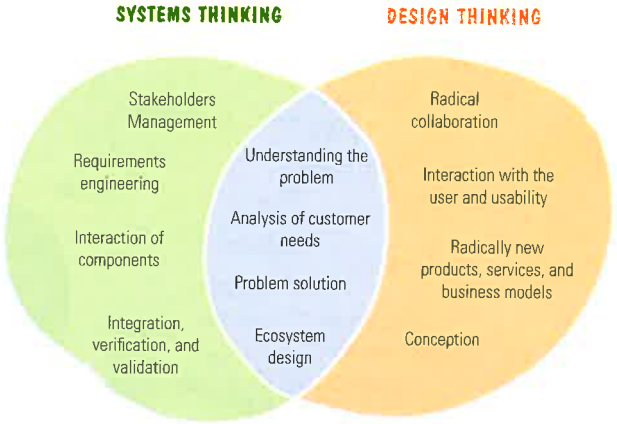
We don't want to get into philosophical speculations here as to whether design thinking is superimposed on systems thinking or whether the processes should be ranked in a hierarchy. From our experience, it is best when design thinking and systems thinking complement each other as the situation requires it.

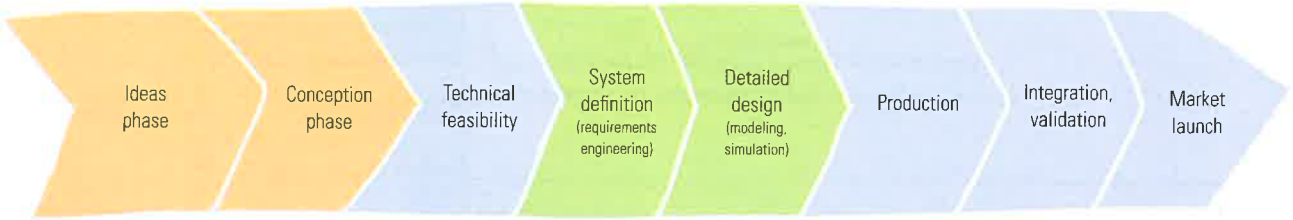
If we take a typical development process as a basis, we can assume that design thinking is a strong tool in an early phase (conception and feasibility). This is especially true when the issue is simple functionalities or the interaction with a potential user. For the interaction of components, the simulation of complex processes, or the engineering of requirements, systems thinking is predestined for many developments.

Thus design thinking can help not only during various phases in the development process, it also contributes a number of factors and mental attitudes, which are usually not part of systems thinking:

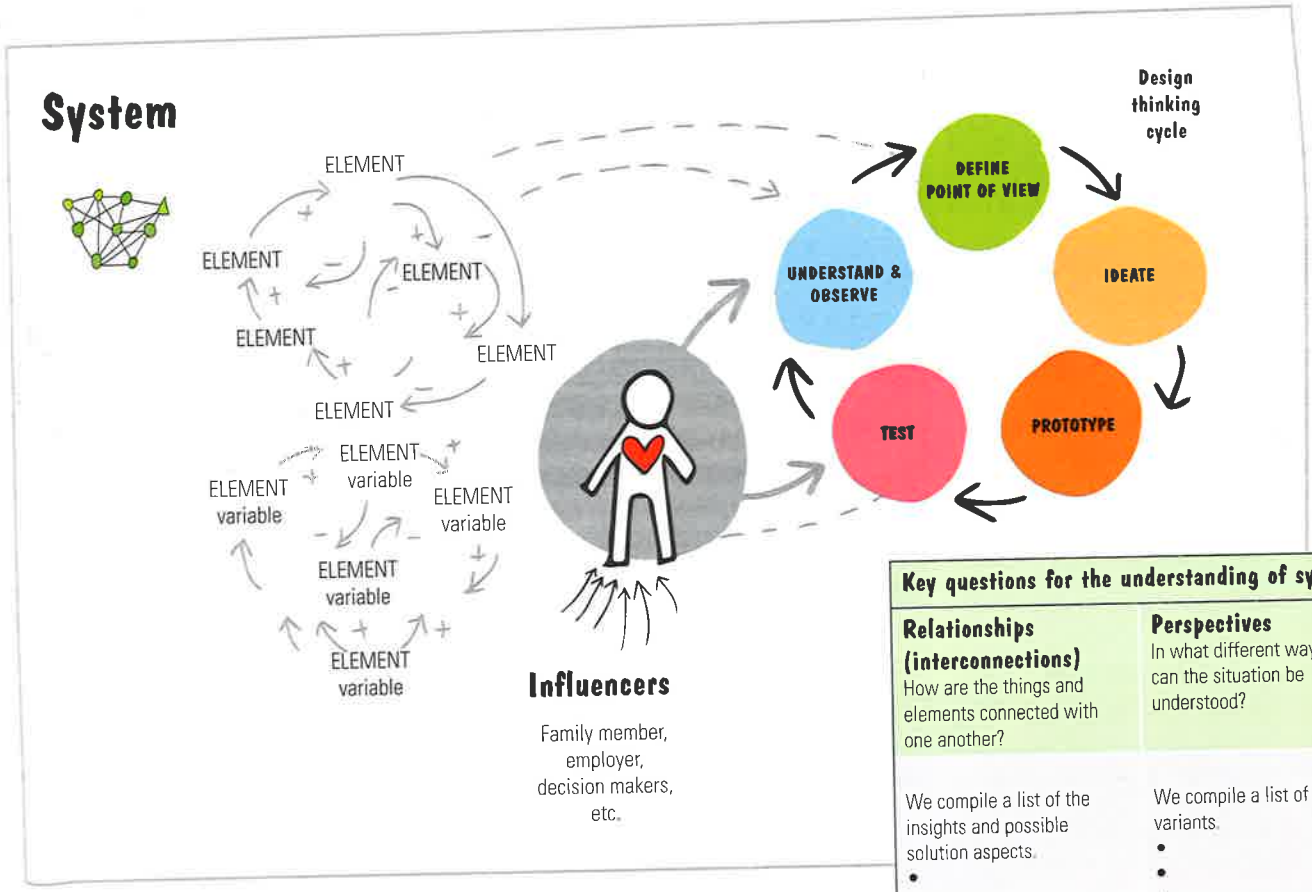
- Arriving at new solution approaches that are brilliant in their simplicity
- Focusing on systems-in-systems with an alignment to individuals or entire groups (360 degrees) in terms of empathy
- The iterative approach in relation to the building of simple prototypes during problem solving
- Doing it and not planning a long time

The combination of the two mindsets results in new opportunities and better problem solutions!





From the point of view of a design thinker, the way of thinking about systems and system boundaries in different situations can be helpful; for example, not just for a real, in-depth, and clear understanding of the problem space and solution space, but also for the identification of so-called blind spots and relationships between actors or for the generation of new ideas.



Key questions for the understanding of systems		
Relationships (interconnections) How are the things and elements connected with one another?	**Perspectives** In what different ways can the situation be understood?	**Framework conditions** What is inside the intervention system and what is outside of it?
We compile a list of the insights and possible solution aspects. • •	We compile a list of variants. • • •	We delimit the systems from one another and describe them. • •

HOW MIGHT WE...
apply systems thinking and design thinking in tandem?

As mentioned, the switch from systems thinking to design thinking and vice versa can help to alter one's focus and perspective. With this switch, we change our focus from a product-centric to a people-centric approach.

It makes us design thinkers more aware that we ourselves are a part of a system in its environment. With our actions, we affect the entire system; we can intelligently interact with it; but we also realize that other stakeholders/observers might have a different view of the system as a whole. The system of a family is a good example. We know the actors of our family. Living together consists of complex interactions, and we have the possibility of changing the system through our actions. In addition, people who do not belong to our family have a different perception of our clan than we have inside the family.

System: The Jones family

Communication
Cohesion
Relationship

Why should we take their point of view?

Systems thinking helps us to identify effective actions with the system. Our ability to learn is strengthened, and we build on the basis of human thinking when designing our systems. In addition, the system can have higher cognitive skills.

The basic questions posed to the system environment are:

1. What does the system produce? Is the result desirable?
2. How does the interaction of the system with us as human beings work? Does the interaction correspond to our needs?
3. What happens within the system? How do machines and sensors interact with one another? What do we want to achieve?