Interactive systems engineering between design science and science of design

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The objective of this thesis is to study the design processes in interactive systems engineering through the lens of design theories, to propose a methodological prototype to address the issues identified and to test this methodological prototype on a concrete case study.

1st direction

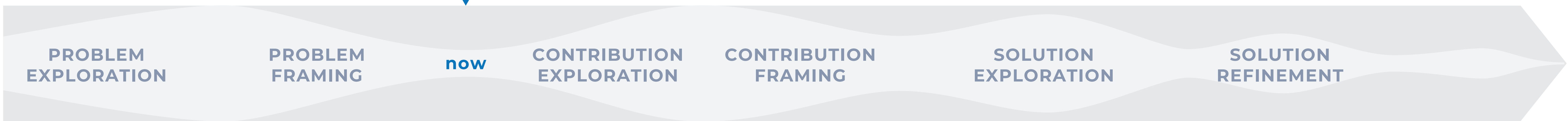### Building an interpersonal knowledge of the design supported by shared concepts

Interviews with practitioners revealed that, **often, past design choices go unchallenged and new solutions to new problems pile up.**
Because the design is fragmented in time, subject to evolution, and shared between several people (who might change over time).

To address this issue, we would like to **build a share knowledge of the project, based on the concepts of the design.** The notion of concepts is threefold: the **architectural concept [1]** as an intention, a vision of a desired future, the **embodiment concept [2]**, as a pivot between the function and the form, and the **conceptual model [3]**, as a mental representation of the functioning of a system.
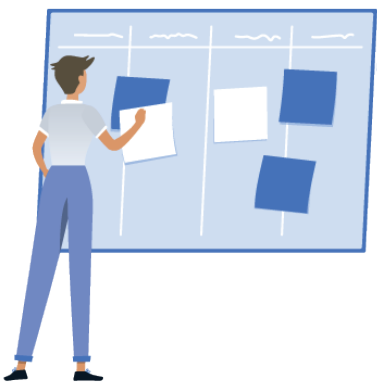
For this purpose, we could rely on the **C-K theory [4]** and adapt it to this context of use. Then we need to think about the integration of this "knowledge construction" in the design process. We will **work iteratively with professionals on a methodological prototype** (and why not a tool), and we will test it on a **concrete case study**.

PROBLEM EXPLORATION	PROBLEM FRAMING	now	CONTRIBUTION EXPLORATION	CONTRIBUTION FRAMING	SOLUTION EXPLORATION	SOLUTION REFINEMENT

2nd direction

Design interactive systems with a systemic vision of their impact at scale

The challenges of the ecological transition implies understanding the dynamics of the socio-technical system at scale.
Indeed, isolated technical solutions cannot be sufficient, as they can have counterproductive effects, by causing behavioral changes at scale (**rebound effect [5]**).

After having shifted from a performance perspective to a usability perspective and to a user experience perspective, the next step of HCI could be the **systemic design [6]**, relating systems thinking and design. There are already **toolkits for systemic designers [7]**, based on design thinking and systems thinking. But these are mostly adapted to designers who work for governmental agencies.

We would like to propose a **framework that allows designers of interactive systems to take into account the impact of their design at scale**, based on system dynamics. The methodological prototype would also be built iteratively with a systemic designer and tested on a practical case study.

Main references

- system thinking
- complex thinking
- system engineering
- human machine interaction
- design theories
- design thinking
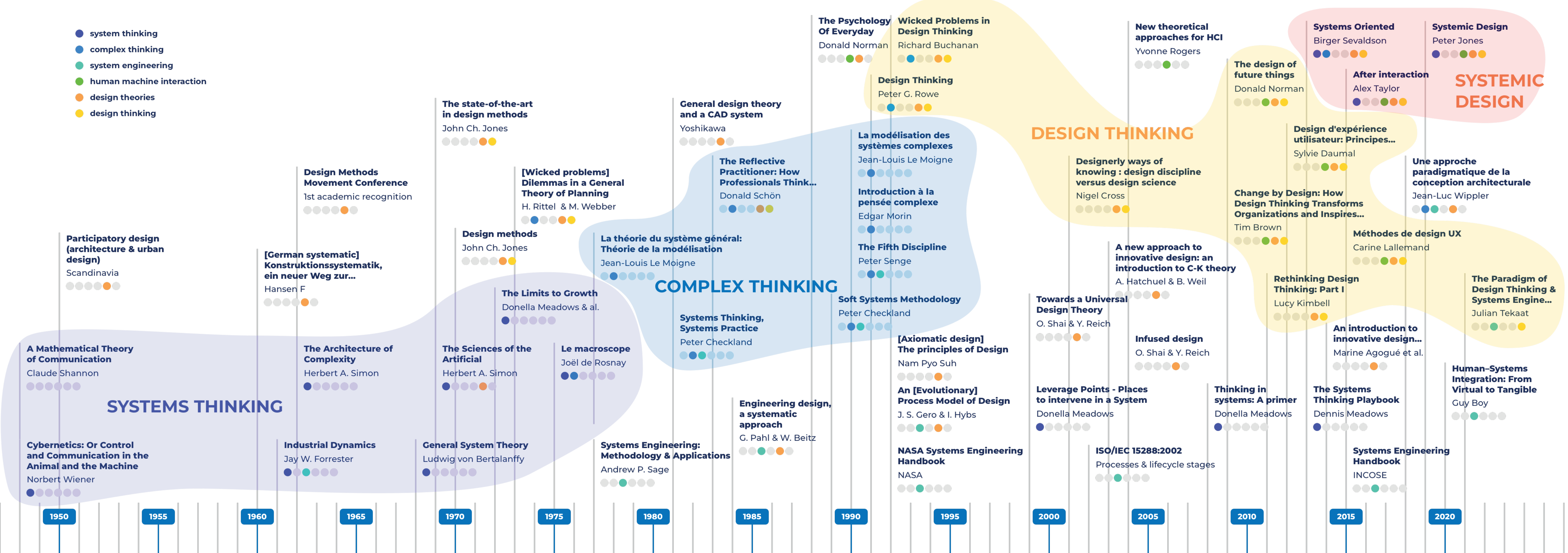
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[2] Crawley, E., January 2007. Introduction to system architecture, architecture to value in esd.34 system architecture. Massachusetts Institute of Technology : MIT OpenCourseWare, (MIT Course Number ESD.34).

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[4] An introduction to innovative design: elements and applications of C-K theory, 2014. , Sciences de la conception. Presses des Mines-Transvalor, Paris.

[5] Noureddine, A., 2022. Séminaire du Dr Jacques Combaz : L'effet rebond : une introduction (Logiciel Eco-Responsable, GT du GDR GPL) [WWW Document]. Mediakiosque. (accessed 2.1.22).

[6] Taylor, A., 2015. After interaction. interactions 22, 48–53. https://doi.org/10.1145/2809888

[7] Systemic Design Toolkit [WWW Document], n.d. URL https://www.systemicdesigntoolkit.org/ (accessed 2.1.22).