# BRINGING SYSTEMIC DESIGN IN THE EDUCATIONAL PRACTICE: THE CASE OF GENDER EQUALITY IN AN ACADEMIC CONTEXT

**Jacoby, Alexis JP;**
**Van Ael, Kristel**

University of Antwerp

## ABSTRACT

The field of design practice and design education is reaching out to address problems that cannot be solved by introducing a single product or service. Complex societal problems such as gender inequality cannot be solved using a traditional problem-solving oriented design approach. The specific characteristics of these problems require new ways of dealing with the dynamics, scale and complexity of the problem.
Systemic design is a design approach integrating systems thinking in combination with more traditional design methodologies, addressing complex and systemic problems. This paper reports a systemic design approach in an educational context for the case of academic gender inequality. We show the way the problem was addressed and how design students were invited to take a systemic perspective, provide integrated interventions and take first steps in providing instruments for implementation. We conclude with the learnings from this case study, both on the process and the results.

**Keywords**: Complexity, Conceptual design, Design education

**Contact**:
Jacoby, Alexis JP
University of Antwerp
Product Development
Belgium
alexis.jacoby@uantwerpen.be

**Cite this article:** Jacoby, A. J. P., Van Ael, K. (2021) 'Bringing Systemic Design in the Educational Practice: The Case of Gender Equality in an Academic Context', in *Proceedings of the International Conference on Engineering Design (ICED21),* Gothenburg, Sweden, 16-20 August 2021. DOI:10.1017/pds.2021.58

## 1 INTRODUCTION

Product design and development students at the university of Antwerp, can choose for elective courses in strategic design, interaction design and technology-driven design as from the first master's year. Strategic design focuses on the early stages of innovation, both from the perspective of an industrial organization or from a societal perspective. The learning lines in the educational programme are mainly product and product-service driven but in order to comply with emerging needs from the design work field, additional courses are introduced to initiate the paradigm of systemic design and to apply a systemic design methodology in a project-driven course. The course addresses social problems that can be described as wicked (Buchanan, 1992) or complex, systemic problems. They are characterized by the fact that there is a non-independence of elements, non-linear causal relations, long latencies, multiple scales and dynamically changing operating characteristics. They are also embedded in a social, political and economic framework in which multiple perspectives lead to incompatible constraints. On top, these complex problems are associated with human behaviour and cognition and the way systems are incompatible with human aspects, motivation and capabilities (Norman and Stappers, 2015).

Nevertheless, systemic problems can be addressed on different levels.
Consider, for instance, that a design or innovation project addresses the problem of homelessness. A design project or course can handle this problem on three different impact levels: a product level, a product-service systems (PSS) level or a systems level. On a product level, starting from the analysis of the context in which the homeless people have to survive, the design process would eventually lead to a new personal shelter solution: a better tent or weather resistant clothing for the homeless. If the analysis and design are performed well, the specific solution could definitely add value to the specific conditions of the homeless people. On a Product Service Systems (PSS) level, starting from the analysis of the interaction between homeless people and the supporting community services, the design process would eventually lead to an optimized community service where shelter and additional services for meals and hygiene are provided. The solution consists of a better service, perhaps integrated with specific products such as lockers, field toilets, … The solution will probably add value in terms of effectiveness and efficiency to the way cities take care of homeless people. And the overall experience of homeless people in the way they are treated will improve significantly. For this specific case it is obvious that design solutions on both the product level and the product-service system (PSS) level are useful and can provide innovative value by design, but they do not solve the real problem: the fact that people become homeless. Systemic design addresses design problems on a systems level. People becoming homeless is a societal problem and is the result of various laws, regulations, actors, activities and interactions in a complex societal systems context. Design projects, on this systems level, start by understanding the existing system and try to define interventions that could possibly leverage and transform the system. Systemic problems arise mainly from the complex interactions between the constituting parts. Systemic problems are defined by large-scaled and multi-organizational complexity and by the fact that they cannot be solved with the tools and methodologies of classic problem solving. They are also characterized by the fact that no causal relationship can be found between the problem and a single solution.

In this paper, we describe a systemic design project on the topic of gender representation among the staff in an academic context. The university of Antwerp strives for a balanced gender representation in its academic staff. Nevertheless, the actual statistics depict that the gender balance is still largely in favour of male professors. During the actual career path of both men and women, we can see that, at the start, the balance between male and female university students is almost equal (University of Antwerp, 2014). The further on the career path, the unbalanced ratio between male and female staff members becomes gradually larger. Over the last 6 years, for the grade of full professors, there is a ratio of approximately 70% - 30% in favour of men.
Gender balance is one of the strategic goals of the University. In 2014, the university defined a strategic action plan with strict regulations on gender balance for all governing bodies of the university, forcing strict quota in boards and selection committees. The plan deploys different incentives on various levels, to support the transition to a more gender balanced university (University of Antwerp, 2014). Together with all Flemish universities, a charter was signed to yield action and to monitor the progression towards a gender balanced staff. Five action fields were defined around education, selection and promotion, representation in committees, culture and monitoring.



https://doi.org/10.1017/pds.2021.58 Published online by Cambridge University Press

The case of gender balance was chosen as the subject for the systemic design assignment for first master students in product development in order to assimilate the rationale of a systemic design methodology and deploy it in a real-life case. The case of gender balance was chosen for several reasons. Primarily because gender inequality can be defined as a systemic problem. The causes for this inequality cannot be allocated from one single or specific perspective. It is related both to human as well as to organizational issues. It is embedded in a large socio-economic framework. Secondly, at the same time, the case is limited by the context of the organization and the stakeholders are easily accessible for students as they belong to the same organization. In the organisation, there is a strong willingness to contribute to this project. Specific staff members are assigned to projects related to gender and diversity in the academic context.

## 2 A SYSTEMIC DESIGN APPROACH

Introducing a systemic design approach in an educational context holds different goals. From a broad perspective education should lead to new knowledge, skills and attitudes. Specifically for the context of design education we can add the need to introduce a specific mindset, a methodology, and tools (Costa, Diehl and Snelders, 2019). The educational programme for product development comprises clear development lines for developing generic design skills and attitudes. When it comes to the mindset and the methodology, the programme builds merely on more traditional product and service driven approaches. With regard to tools, we could state that there is a mixed approach. Some generic tools qualify for product and systems driven approaches. We could conclude, however, that the tool set introduced over the years does not comprise specific tools for addressing systemic problems.
A systemic design project has to follow a radical different approach compared to traditional design methodologies. Although it starts from a similar abductive reasoning setting, developing a desired outcome starting from the definition of the problem and the definition of the way to reach that desired outcome (Dorst, 2011), the inherent complexity requires adapted methodology and tools (Jones, 2014). Traditional design and problem-solving approaches can follow the base cycle of design covering analysis, synthesis, simulation, evaluation and decision phases in an iterative way (Roozenburg & Eekels, 1995). Due to the lack of causality between the systemic problem and a systemic solution and the long latencies between intervention and result, simulation and evaluation activities have a different character or are non-existent. Furthermore, the analysis regarding systemic problems asks for a specific approach in order to be able to deal with the complexity of the systemic problem and the dynamics of the context it is situated in. Students in a product design and development educational programme are not familiar with the techniques and the scope of this kind of problems.


*Figure 1. Systemic design process adapted from Ryan (2014) and Jones (2014)*

The methodology followed builds on soft systems thinking and prior design models by Ryan (2014) and Jones (2014). We elaborate on the three-phase model for addressing complex problems (Figure 1). The first phase in the process is to understand the dynamics of the systems-as-is, building on systems thinking and system mapping (Sedlacko et al., 2014). In the second part, the designer's skillset to synthesize is addressed in order to define integrated intervention models that could affect the system in a positive way. The third part is about designing the transition. Interventions are not a single solution that can be implemented in a well-defined time frame. Instead, implementing interventions is a process that must be guided over time and in which the stakeholders play a dominant role. The essential characteristic of this design approach is to integrate both soft systems thinking and design thinking.

### 2.1 Added value by design

The relatively new discipline of systemic design contributes to systemic challenges by applying the designers' capabilities in order to understand and define the way a system behaves and the way it



https://doi.org/10.1017/pds.2021.58 Published online by Cambridge University Press

affects people. While other disciplines work on societal problems as well, there is a growing consensus on the fact that design can contribute to systemic challenges by bringing in a human-centered and design-driven perspective (Pourdehnad, et al., 2011). Design is characterized by its ability to integrate knowledge and insights from various fields and disciplines in order to define new and innovative concepts. Design is also characterized by a focus on human aspects and an approach based on empathy. This is perceived as an effective enabler in this field (Norman & Stappers, 2015).
In order to integrate the specific designer's capabilities in the process, we use an elaborated methodology (Figure 2) for systemic design (Van Ael, 2018) that integrates elements from both systems thinking and design thinking. System framing and systems mapping build on soft systems thinking (Kauffman, 1980). There is a major focus on the integration of analysing and synthesizing process steps. The act of creating a vision of the future and developing intervention models are core design activities. These activities induce the designers' core capabilities as described by Whitney (2015): the capacity to reframe, abstract, visualize, detect relationships and define new values. The entire systemic design process is defined as participatory design, integrating stakeholders throughout the process. However, the limitations in time and workload reduce this aspect to essential collaboration for understanding the problem and the context. Stakeholders are not engaged in a cocreation process.

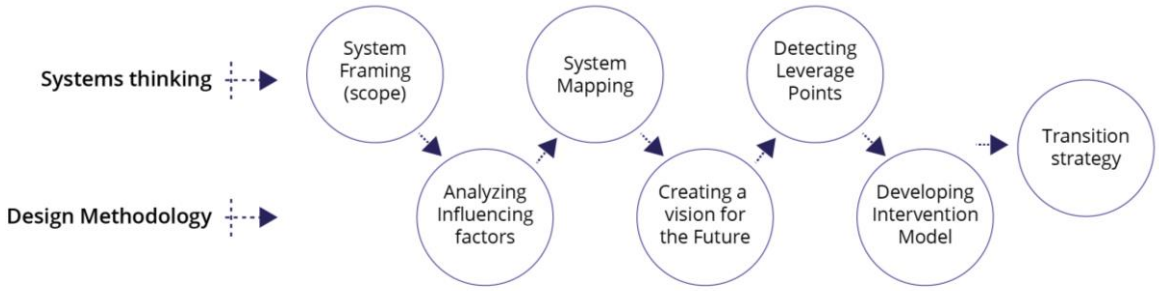


*Figure 2. Systemic design process (Van Ael, 2018)*

### 2.2 Learning outcomes

The learning outcomes for the systemic design course define that a student must understand the nature of systemic (complex) problems, what systemic design is and in which multidisciplinary roots it is grounded. It also states that a student should be able, under supervision, to address systemic problems, using a systemic design methodology, and to define an integrated intervention model for the addressed complex problem.

## 3 THE ASSIGNMENT

The course of systemic design is a compact 7-weeks course, spread over a 17-week semester. 42 students participated in 6 teams. The course comprises both consecutive individual as group assignments. During the first four weeks the students collaborate to analyse the system. After a 10-week internship break, they proceed by developing an intervention model as a team and to elaborate on one specific touch point individually. Whereas the intervention model is a broad plan, including all kinds of initiatives (products, services, information flows, incentives, events, structures, new regulations, …), the touch point is one specific interaction point between a user and the system. The students have built a lot of expertise throughout their prior study programme on developing single solutions such as products and services. Developing combined interventions beyond the traditional product and service is completely new to them.
The entire individual workload for the course is 150 hours. In the end, the groups present their group result during a 15-minute presentation with Q&A. The individual contributions were submitted as a visual report. The course's main goal is to educate students on the systemic design methodology and the related systemic mindset. As such it is more process oriented than result oriented.
The concise problem briefing was to determine how we could make that the men-women ratio in academic staff would become more balanced over time.
The deliverables were defined as follows (table 1):


https://doi.org/10.1017/pds.2021.58 Published online by Cambridge University Press

*Table 1. Deliverables*

| | Individual deliverables | Group deliverables |
|---|---|---|
| Understanding the system | Interview transcripts, mini system maps | Synthesis map, including a system map |
| Defining the intervention model | Individual intervention model | Intervention model, to be included in the synthesis map. |
| Implementation: designing the transition | High level definition of a specific touchpoint | Intervention tool |

The individual deliverables were defined as individual preparations and contributions to the final group deliverables. The high-level definition of a touchpoint was defined as an individual elaboration on specific aspects of the systemic interventions.
The group deliverables reflect the three main phases of the systemic design approach: the analysis (understanding) of the existing system, the intervention model (synthesis) that impacts the system and the intervention tool that would support the university staff, responsible for gender and diversity, to implement solutions over time, and thus developing a transition strategy (Figure 2).
The students used the systemic design tool kit (Van Ael, 2018) in a step-by-step approach to support the design process. Every step was grounded in theory, introducing and discussing seminal papers regarding the different process steps of the methodology and the underlying rationale. All steps in the process were supported by dedicated paper templates to guide the exercise.
We will give a brief overview of the approach followed.

### 3.1 Understanding the system

Understanding the systems refers to both understanding the composing building blocks or parameters of a system, as well as understanding how the system is to be positioned and framed in a larger context.
In order to understand the system, the students were asked to identify the scope of the project and the actors involved in the system. The scope was determined by looking into existing initiatives and structures within the context of the university but also outside the context of the university itself and take a broad perspective on the stakeholders, the eco-system and society. The students were guided by the question who owns relevant knowledge and relevant power to impact the local system.
In a second step, in line with Geels (2005) the students were asked to look into emerging niche initiatives on different levels (practices, structures, cultures, ...) and by which socio-economic trends this existing situation could be impacted on the long term. These combined elements create a big picture of the context the gender-related system can be situated in. The stakeholders were identified together with the personal dimensions or characteristics that could be used to define them. These parameters were expressed in their most extreme form in order to detect the extremities of stakeholder dimensions.
All students were asked to interview one staff member of the university, both men and women, in different career situations: PhD students, post-doc researchers, professors, deans, … The output of the interviews was supposed to provide the input for mapping the system. In the interview transcripts, students were to look for causal-loop descriptions, which could be used to draw one single system loop (Figure 3) or connection of nodes between different parameters (Kaufmann, 1980). Based on the different mini-system diagrams, the teams worked in a group session to complete a full systems map, bringing into account all parameters as building blocks of the existing system, including the interactions and influencing directions of those nodes (Sedlacko et al., 2014). This visual representation of the system provides the basis to understand the bigger picture. The different causal-loops or flow diagrams opened up possibilities to categorize groups of similar parameters and to detect the core underlying reasons why the existing status-quo is a logical consequence.
The system analysis and the first conclusions were synthesized in a map. This synthesis map (Figure 5a) was the first group deliverable in the process providing a visual overview of the problem statement and an understandable interpretation of the complexity of the problem. The students were asked to reinforce the readability of the map using a strong visual metaphor. Synthesis mapping builds on prior work by Jones (2017).


https://doi.org/10.1017/pds.2021.58 Published online by Cambridge University Press

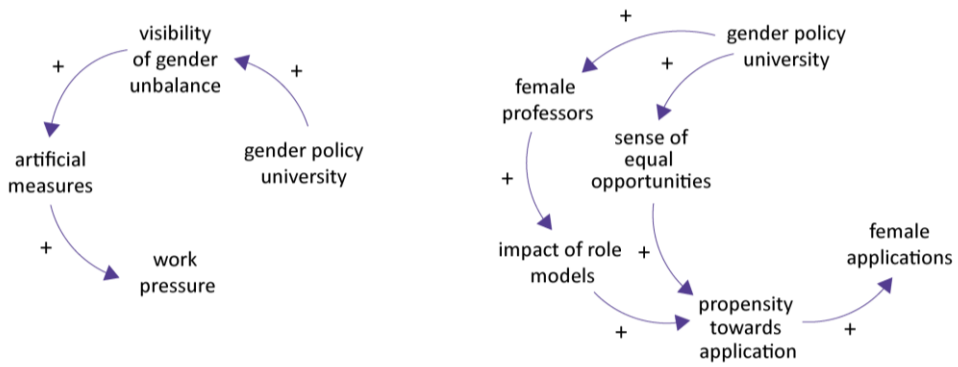


*Figure 3. Example of simple causal-loop diagrams*

## 3.2 Developing the intervention model

The intervention model describes which interventions to perform on specific leverage points in the system, starting from an overall value proposition one wishes to obtain on the long term.

### *3.2.1 Focus on added value*

From an analysis mode in the earlier phase, students are guided into a design mode in order to develop a set of interventions that could possibly impact the system in a positive way. The design process is driven by the explicit description of a desirable future. The students look with different lenses (economic, social, psychological, ecological) towards the added value they strive for on the individual, the organization and societal level. They use large templates in order to collaborate with stakeholders, to discuss alternative options and to reach consensus (Figure 4a). The obtained values delimit the innovative goals and aspirations.

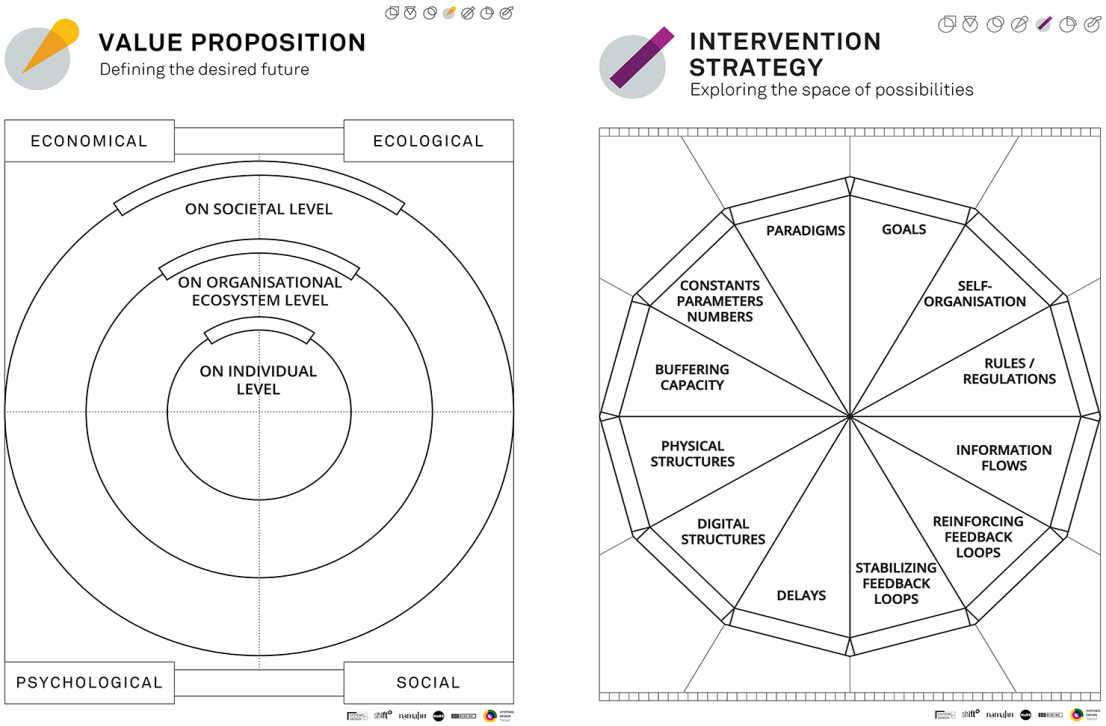


*Figure 4a and 4b. Value proposition (4a) and intervention strategy (4b) templates (Van Ael, 2018)*

### *3.2.2 Intervention models*

Starting from the systems map and the core loops identified, student teams are asked to detect leverage points in the system by closely looking into the nodes of the system. Nodes with multiple entries or outgoing relations yield opportunities for leveraging the system. It is a process of reading and interpreting the system and detecting the underlying opportunities.



https://doi.org/10.1017/pds.2021.58 Published online by Cambridge University Press

As from there, students are asked to define interventions for specific leverage points and to combine them into innovative concepts. A background tool (Figure 4b) based on the work of Meadows (1999) triggers the students to check whether specific kinds of interventions can provide added value on a specific leverage point. It is the start of a diverging design phase looking into multiple intervening solutions and multiple combinations of solutions.

#### *3.2.3 Enriching the intervention models*

In order to pursue the better intervention model and to extend the range of possibilities, students are triggered to review the ideas for intervention models in three ways. Firstly, they check proposed intervention models from the perspective of the user using empathy mapping (Gray, 2017). It forces them to stay close with the users and the effects of their proposed ideas on their situation. Secondly, students are triggered by the use of paradox cards to look into paradoxical opposites. The paradox cards are a specific tool set based on the work of Dorst (2011). If students have proposed a digital intervention solution, the paradox cards force them to think about analogue solutions. If a specific intervention is free, the opposite term forces them to rethink it as a paid service, and so on. The tool also triggers the designers' mindset to overcome apparent opposites or constraints.
Thirdly, students are asked to vary their intervention models according to different contexts. The context of a PhD student is different than the context of a dean or a full professor. The context variation is a stress test to broaden the applicability of the solutions and to define variations on the intervention models.

### 3.3 Feedback and implementation

Although the intervention models proposed may be valuable, they don't hold a clear solution for implementation. In this case of gender and diversity, the students are asked to present their concepts in such a way that the university staff responsible for gender policy can understand the concepts and the added value they present, can challenge these concepts with the stakeholders and implement specific aspects eventually.
The students are asked to develop an intervention tool that holds a double function. Firstly, it provides the opportunity to obtain feedback on the intervention model by the stakeholders. The tool can be defined as a game or a card deck. It is to be an easily accessible instrument that enables stakeholders to reflect on specific proposed interventions in a specific context. The instrument, one way or another, should provide an easy-to-understand overview of eventual interventions and the impact they could have on the existing system for the specific stakeholders involved. Secondly, the tool supports the university staff to understand how new concepts for interventions can shift the existing gender balance system in the right direction. It enables the team to understand the concepts, to work dynamically with the context-related combinations of interventions and eventually, progress with implementing new actions or act on specific boundary conditions necessary to obtain change.
The intervention tool is a design exercise on its own. It forces students to come down from the abstract level they have been working on and to translate their findings to less informed stakeholders. It also helps in deconstructing the solution space to its constituting parts and to develop a supporting rationale.

## 4 THE RESULTS

The group results mainly resulted in a visual synthesis map, compiling the systemic problem analysis and the solution space (figure 5a) and a visual representation of the intervention tool (figure 5b). Due to the restrictions under Covid-19 regulations, the intervention tool results were not prototyped but merely visualized and explained by means of an instruction manual.
The main intervention outcomes can be allocated to 9 categories:

- Education: interventions leading to new stakeholder insights that could affect behaviour
- Work-life balance: interventions supporting and anticipating on specific work-life balance issues
- Personal support: interventions to provide support, adapted to individual needs
- Inspiration: interventions to inspire, present best practices and introduce role models
- Information & sensibilization: interventions to provide clarity and to induce awareness
- Experiences: interventions yielding confidence through positive experiences
- Team-related aspects: interventions for strengthening the team unity and mutual respect


https://doi.org/10.1017/pds.2021.58 Published online by Cambridge University Press

- Understanding & recognition: interventions leading to mutual understanding
- Networking, connecting & blending: interventions to engage in a large network,

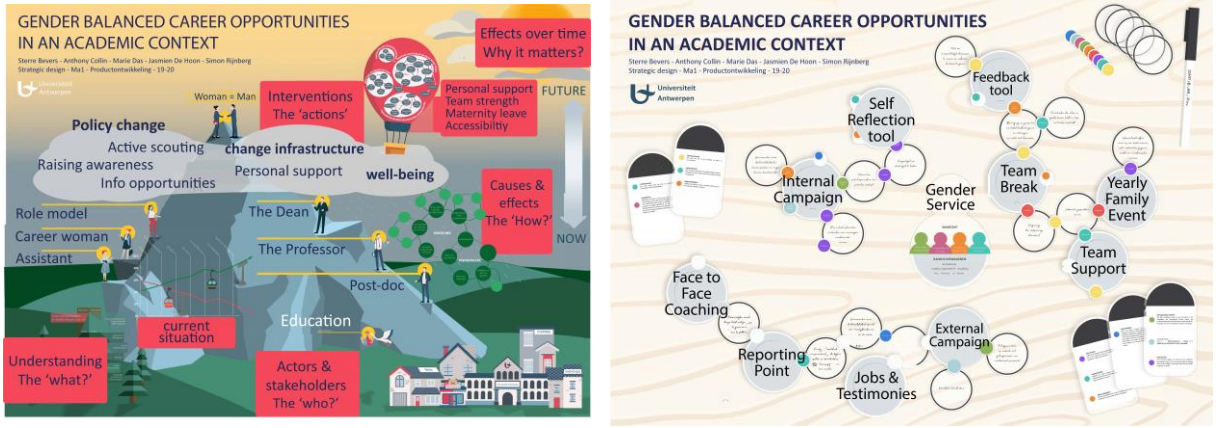


*Figure 5a and 5b: (simplified) synthesis map (a) and intervention tool (b) examples*

Although the intervention models propose a wide variety of combinations on these drivers, we will not elaborate on the specific outcomes or how these interventions were combined to concepts. That is beyond the scope of this paper. But it is clear that the concepts combined new events, organizational structures, supporting staff, digital backbones, new regulations and so on. The innovative value, to a large extent, was defined by the innovative way interventions were combined and the way the strengths of the existing system were intensified by the interventions.

## 5 LEARNINGS

The specific case of gender equality in the academic context revealed itself an appropriate case to transfer the new methodology and the new mindset. The problem was rather easy to frame, and the stakeholders were accessible and willing to collaborate. The case provided enough challenges on the level of analysis and understanding the complexity but perhaps provided not enough room for very innovative solutions on the synthesis level. More importantly than the case itself are the learnings regarding the applied systemic design process.

### 5.1 Systems thinking

System analysis and systems mapping are the most difficult part of the process. It requires extensive exercise for students to be able to describe the systemic parameters in a useful way. The causal-loop diagram examples are well understood by most students but when it comes to applying the practice to the proper case, many students do not succeed in generating system maps that are consistent and complete. During this project, time was too limited to discuss in-between results thoroughly. Although the system representations could benefit from more elaboration, they did not affect the next process steps. It would be interesting, however, to provide a more complete system map for the next steps in the process after the full student trials. Introducing systems thinking earlier in the curricula would be beneficial for developing the required basic skills gradually over time.

### 5.2 Added value by design

The systemic design project asks for a disruptive approach in which students are learning a new mindset and a new methodology. The new mindset requires to think beyond the traditional product and service solutions and to address the existing system as a dynamic changing environment. Due to the limited time frame and the need to address a lot of different aspects throughout the project, the students show difficulties in creating added value by design. The main added value should reveal itself in the diverging phase of the intervention model idea generation phase. But the preceding tasks of understanding the system and developing the intervention tool put pressure on the actual design attitude. As a result, they could not always see clearly where their deep-rooted design skills and attitude should have emerged and made a difference.



https://doi.org/10.1017/pds.2021.58 Published online by Cambridge University Press

### 5.3 The systemic level

During the course, the main challenge for students is to keep designing on the systemic level. In line with their prior experiences in design education they have a tendency towards the definition of products, services or product-service combinations. The focus of the systemic approach is to define a broad systemic intervention concept which integrates interventions regardless of the nature of the intervention or the place in the system it would intervene. This is so much a disruption compared to earlier work, that it needs specific attention during the process. On many occasions, the student teams had to be pointed in the right direction, overcoming the reductionist approach as if a single product or service could alter the system.

### 5.4 The intervention Tool

The design and development of the intervention tool is a positive element in the course process. It requires a design attitude, and it provides a valuable educational alternative for developing a transition strategy as it operationalizes the interventions proposed and creates awareness on the implementation and the specific related challenges. The transition strategy in systemic design projects, however, remains a challenging aspect. It requires deep-rooted stakeholder involvement, and this is difficult to simulate in a design course project.

## 6 CONCLUSIONS

Short term design courses oppose to the long-term pace of socio-technical systems change. This constraint also exists in a product or product-service driven design courses but becomes more extreme in the context of systemic design. It might lead to an unrealistic perception for design students towards systemic problems or the process that seeks to address these problems. However, the main goal is to bring a new mindset and methodology to design students. They learn how problems can be addressed on different impact levels and which design rationale is to be followed accordingly. The broader perspective on real boundary conditions can be provided by supporting the students with theoretical grounding and best practices.

Implementing a course in systemic design definitely broadens the perspective for future designers. It reveals possibilities they couldn't imagine before and opens new and challenging horizons to their own career. However, the course also reveals that systemic design is a bridge too far for some students, even if they made a conscious choice for strategic design. And although that is very plausible, it also opens the discussion whether or not a systemic design course, on the long term, should be integrated in the compulsory programme or not. Differentiation in design capabilities becomes more explicit and necessary, together with the evolution of the field of design and product development. It will highly impact the field of design education.

Literature, on different occasions, points at the fact that we need new methodologies or approaches for systemic design (Costa, Diehl and Snelders, 2019). This case reveals that the systemic design toolkit (Van Ael, 2018) can provide a genuine how-to approach. It opens up the complexity of the problem and provides techniques to adopt a design-driven approach to the problem. The approach is suitable for a participatory process.

The case proposed could not validate the design practice as we could not show that the designed intervention models actually would shift the system towards a more gender balanced academic setting. That would have been a nice conclusion, but it was out of scope for this course. The main purpose was process driven: opening the mindset of design students and expand the instruments they can use to address all kinds of design problems on different impact levels. Five of the six student groups were able to propose an integrated solution on a systems impact level. One group revealed a solution on a product-service impact level. More importantly, the impact of the course is visible in the master thesis projects that succeed this course. 2 Students (out of 68) specifically started a master thesis project addressing a systemic problem and applying the systemic design methodology. Three other students started to apply specific tools of the new methodology, either for systems analysis or synthesis activities, in their self-defined innovation projects (in the master thesis). Although these numbers are limited compared to the entire group, they show that students are able to map the specific methodology to the design problems they encounter.



https://doi.org/10.1017/pds.2021.58 Published online by Cambridge University Press

## REFERENCES


Buchanan, R. (1992) 'Wicked Problems in Design Thinking', *Design Issues*, 8(2), pp. 5–21.

Costa, J., Diehl, J. C. and Snelders, D. (2019) 'A framework for a systems design approach to complex societal problems', *Design Science*, 5. https://dx.doi.org/10.1017/dsj.2018.16.

Dorst, K. (2011) 'The core of "design thinking" and its application', *Design Studies*, 32(6), pp. 521–532. https://dx.doi.org/10.1016/j.destud.2011.07.006.

Dorst, K. and Hansen, C. T. (2011) 'Modelling paradoxes in novice and expert design', ICED11, 18th International Conference on Engineering Design, Lyngby/Copenhagen, Denmark, 15.-19.08.2011, pp.142–150.

Geels, F. W. (2005) 'Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective', *Technological Forecasting and Social Change*, 72(6 SPEC. ISS.), pp. 681–696. https://dx.doi.org/10.1016/j.techfore.2004.08.014.

Gray, D. (2017), *Updated Empathy Map canvas*. Xplane. Available at: https://medium.com/the-xplane-collection/updated-empathy-map-canvas-46df22df3c8a (accessed 14/03/2021).

Jones, P. H. (2014) 'Systemic Design Principles for Complex Social Systems', in Metcalf, G. S. (ed.) *Social Systems and Design*. Tokyo: Springer, pp. 91–128. https://dx.doi.org/10.1007/978-4-431-54478-4_4.

Jones, P. and Bowes, J. (2017) 'Rendering Systems Visible for Design: Synthesis Maps as Constructivist Design Narratives', She Ji. Elsevier, 3(3), pp. 229–248. https://dx.doi.org/10.1016/j.sheji.2017.12.001.

Kaufman, D.L. (1980), *Systems one: an introduction to systems thinking*, Pegasus Communications, Place of publication. DOI (if present). D. L.

Meadows, D. (1999) *Leverage Points: Places to Intervene in a System*, *The Sustainability Institute*. Hartland.

Norman, D. A. and Stappers, P. J. (2015) 'DesignX: Complex Sociotechnical Systems', *She Ji*, 1(2), pp. 83–106. https://dx.doi.org/10.1016/j.sheji.2016.01.002.

Pourdehnad, J., Wexler, E. R. and Wilson, D. V. (2011) 'Systems & design thinking: A conceptual framework for their integration', *55th Annual Meeting of the International Society for the Systems Sciences*, (July 2011), pp. 807–821.

Ryan, A. (2014) 'A Framework for Systemic Design', *FormAkademisk - forskningstidsskrift for design og designdidaktikk*, 7(4). https://dx.doi.org/10.7577/formakademisk.787.

Sedlacko, M. et al. (2014) 'Participatory systems mapping for sustainable consumption: Discussion of a method promoting systemic insights', *Ecological Economics*. https://dx.doi.org/10.1016/j.ecolecon.2014.07.002.

Universiteit Antwerp (2014) Duurzaam genderbeleid voor academisch personeel, Strategisch Actieplan Universiteit Antwerpen. Available at: https: //www.uantwerpen.be/nl/overuantwerpen /organisatie/missie-en-visie/diversiteit/thema-s/gender/ (Accessed: 6 December 2020).

Van Ael, K. (2018), *Systemic Design Toolkit*, Brussels: Namahn.

Whitney, P. (2015). Design and the Economy of Choice. She Ji: The Journal of Design, Economics, and Innovation, Volume 1, Issue 1, Autumn 2015, Pages 58-80




https://doi.org/10.1017/pds.2021.58 Published online by Cambridge University Press