

Prototyping Inconvenience: A pedagogical experiment on designing for debate in design education.

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Abstract. With design having more impact than ever, there is an increased need for critical inquiries into design research and education that engage designers to question established disciplinary assumptions. One prevailing myth is the convenience ideal: the obsession with comfort, efficiency, smoothness, and smartness that relates to a trend of envisioning super-convenient futures. By combining iterative prototyping, anti-solutionist strategies, and tactics of critical and speculative design, we built a counter-approach to conventional design processes: *Inconvenient Design*. With convenience as the topic for debate, we explored its potential in the course *Stranger Things–Prototyping Inconvenience*. This paper provides an overview of the approach and course format, using examples of student projects to illustrate how it encouraged them to reflect and debate directly in the design process in a tangible way, enabling them to craft alternatives. Lastly, we discuss the opportunities our methodological approach can bring to design research and education.

Keywords: Inconvenient design, design for debate, critical design, speculative design, prototyping, provocation, design fiction, design methods, research through design, design education.

1 Introduction

Design and design-oriented disciplines, with a prevailing solutionist mindset, have contributed to a vision of the future in which every problem can be solved with technology. Established methods and approaches, broadly human-centred, focus on the immediate needs and desires of consumers and the market while ignoring the serious consequences of related design decisions [1,2]. While many of the world's wicked problems, such as the climate crisis, could be seen as direct consequences of the capitalist idea of progress, mainstream design and design-oriented disciplines, at the service of the market economy, are mainly still responding with the same principles that created them—and doing so with a lack of critical inquiry [2].

A particular problem of solutionist design lies in the paradigm of *designing for convenience*. For many years, a basic assumption in design has been the ideal of user-friendliness, smartness, and efficiency, which offers positive, joyful, seamless, and even endless user experiences. Frictions in everyday life are addressed and smoothed

over through interfaces, products, or services. This “friction-obsessed” mindset could be provocatively defined as *Convenient Design*. While convenience in itself is not inherently problematic, seemingly optimal design solutions, when not reflected upon, may make us increasingly comfortable and passive in our behaviour; this, in turn, may have a direct impact on our mental and physical health [3,4]. Moreover, its implications on a socioeconomic, political, and ecological scale are overlooked. By distorting our interaction with other fellow human beings and our environment, designing for convenience may create hierarchical relations that establish new social inequalities (e.g., through services that embrace hidden models of contemporary serfdom, such as delivery services [5]), and sustain unreflected consumption and unsustainable behaviours that deteriorate the environment and climate [1,2].

When traditional solutionist approaches seem no longer to be an answer but are themselves a part of the problem, there is a need for new designerly ways of addressing complexity that question prevailing trajectories and create counterpoints. Recent years have seen a growing disciplinary awareness of the responsibilities of design, and many voices have highlighted the need for more responsible ways of utilising technology and undergoing design [6,7] This “implies a reflection of the contingencies of our world today, and of the practices for creating, imagining, and materialising new worlds” [8]. To this end, new discursive methods and resources are required that provoke and irritate designers in the design process to confront interiorised assumptions and enable them to discover new insights and opportunities to materialise alternatives.

This demand also extends to design education. We consider the convenient mindset as one of the “myths taught at design school” [9]. Particularly in mainstream design education, students are often still trained in this solutionist approach and human-centric ideal of comfort. New discursive and critical pedagogical formats are needed that create new spaces for debate directly in the classroom and that actively serve to create counterpoints to this mindset. Design students, as designers of the future, should learn and develop design processes that are not only solution-oriented, but also critical and demand reflection, using methods and resources that interweave theory and practice to open debate in tangible and accessible ways. Leveraging the “beginner’s mindset” [10] of students, this step—the adoption of reflective practices— should already start in design education, before design processes are fully assimilated and established. To this end, the research presented in this paper aimed at developing a practice-based discursive design approach as an alternative to conventional design processes and applying it as part of the design programme curriculum at our university.

As convenience and its implications are directly connected to specific designed patterns, interaction paradigms, and user experiences, we chose *convenience* as a potential topic for debate and reflection. Accordingly, we developed *Inconvenient Design*—a first attempt at a counter-approach to understand and debate the entanglements of convenience, to visualise its implications, and to investigate the design opportunities (e.g., design patterns, interaction paradigms) that may result from removing convenience as a “constraint” [6]. On a methodological basis, we combined iterative prototyping sessions, anti-solutionist strategies, tactics of critical and speculative design, as well as other material practices and experimental resources in design and design-oriented human-computer interaction (HCI). We then unfolded this practice-based approach as the basis of *Stranger Things—Prototyping Inconvenience*,

a design course held as part of the graduate and undergraduate design programmes at our university.

In this paper, we present the conceptual and methodological framings of our counter-approach, the course outcomes, and the key findings from this case study on developing and implementing a practice-based research approach for designing for debate in design education. We extend a preliminary summary [11] presented at the online workshop *Speculative and Critical Design in Education: Practice and Perspectives*, at the ACM *Designing Interactive Systems* (DIS) conference in July 2020. This paper includes how we tackled—both as researchers and lecturers—the disciplinary challenge of creating new tools for reflection, as well as how we implemented these in an educational context, presenting the course format and structure, and a selection of the methods and tactics. The reflections on this study are summarised and illustrated through the outcomes of both preliminary exploratory prototyping sessions and the final projects. The findings, main learnings, and final considerations are based on the analysis of the resulting design projects and the evaluation of the *proto-card* [12], a qualitative method developed for tracking the students’ design decisions and irritations along their design processes. This study shows by way of example how our counter-approach offered a critical framing for renegotiating notions of value and meaning in the classroom through practice-based debate, and through this, opened new perspectives for rethinking the way to design things.

2 Related Work

Our work relates primarily to research on current discourses and practices on new forms of critical and speculative inquiries that address the grey area between “affirmative” and “critical” design [13,14] through the lens of design research (especially interaction design research) and design-oriented HCI. There are ever-increasing interrogative approaches that investigate ways to transcend this dichotomy between “design for use” and “design for debate” towards “critical use” and alternative notions of problem-solving [15], including practice-based participatory research approaches that do so to leverage sustainable transitions [16] and social innovation [17]. In this context, “criticality” has grown in relevance in recent years in the HCI community, broadening and deepening its connection with design [18].

Some related research investigates the use of provisional and alternative artefacts to address matters of concern in the design process. “Intermediary objects” are produced by designers along the research process as a medium for communication and discussion between team members in collaboration processes, as a means to frame and guide the process of research [19]. Other work includes the conceptual framing of material speculations [20], research products [21] and the critical artefact methodology [22]. Critical artefacts are crafted and used in the design process as provisional provocations, as mediators to foster debate and open new design possibilities for alternative innovation.

On a methodological level, there is a small but growing body of research that explicitly rejects the search for *solutions* and suggests rather *anti-solutionist* strategies as a means to define the disciplinary problem space around *solutionism*, and through

practice, to offer designers new experimental approaches that impact the way to design things. Such strategies strongly build on critical and speculative approaches as well as other experimental techniques. These include the design of para-functionality and user-unfriendliness [23], uselessness [24], and even absurd artefacts [25] and silly fictions [26]. The research on a useless, pataphysically-infused design practice has shown how the use of irony, satire, and absurdity as design principles may open new opportunities to redefine the notion of “usefulness” [24,25] and “design solution” [26], among others. Furthermore, Pierce and Paulos [27] question the idea of functionality by investigating the value of “counterfunctionality” as a resource for design. Through the design of “counterfunctional things”, the authors adopt a critical view towards the mainstream attitude about designing digital devices, and they demonstrate how countering some of their “essential functionality”, that is, “removing, inhibiting or otherwise countering familiar features” can open new and unexpected possibilities for re-interpreting existing technologies [27].

Inconvenience has been addressed in critical design practice as a means to engage a critical perspective on design patterns, as well as to show the structural violence embedded in unpleasant design patterns in public spaces, for example, for controlling or avoiding people’s behaviours in cities through inconvenient furniture [28]. Related work in design research and design-oriented HCI links debate to the design of provocations [29], highlighting the importance of provocation and criticality in interaction design [14]. Critical inquiry in design research and design-oriented HCI has become increasingly relevant in practice, as related research has demonstrated how the design of frictions [30,31,32], limitations [27], discomfort [33,34], unconventional functions [35], ambiguity [36,37] or open-endedness [37] can be beneficial for a variety of purposes. Such provocations may intentionally trigger personal dilemmas through use and interaction with the design artefact [38]. For instance, the design of embedded frictions has been proved beneficial for prompting moments of reflection that foster sustainable behaviours [30], well-being [31], and conscious decision-making [32]. Moreover, the potential of integrating discomfort has recently been advocated as a novel research path for HCI research, built on numerous studies that show how it supports resilience and adaptation and, with this, well-being and mental and physical health [3,4].

3 Inconvenient Design: Counter-Approach

Inconvenient Design was built as a counter-approach to conventional design processes and developed as a practice-based research. It combines tactics of critical and speculative design, such as the use of fictional narratives or design fictions, and stylistic devices such as satire or dark humour, as well as anti-solutionist strategies and other experimental and material practices within interaction design research and interrogative HCI.

Our approach claims prototyping-led ideation, design for perspective change, iteration, practice-driven reflection, object-mediated discussion, and the design of discursive counter-solutions. In pursuing these aims, it is driven by the principles of absurdity, uselessness, ambiguity, exaggeration, estrangement or irony, as well as the

inconvenient principles of provocation, irritation, user-unfriendliness, unpleasantness, discomfort, friction, limitations, and constraints.

The term Inconvenient Design is a provocation and references its inherent aim at disrupting the interiorised routines of designing things, creating an alternative design process. It claims its purpose of confronting designers and causing them to question current design myths in a tangible way. The goal is to enable them to stretch the boundaries of functionality and thereby open new perspectives and design opportunities (e.g., novel design patterns and interaction paradigms).

On a methodological level, our approach aims at creating multiple iterations along the design process that, through the production of numerous scenarios, speculations, and uncanny artefacts creates constant irritation. By eliciting repeated reflection in the designer and discussion within the design team [39], this process aims at leveraging a shift from speculative scenarios and objects that depict problems, to functional but still discursive artefacts—in other words, *counter-solutions*. These artefacts, informed by the multiple irritations along the process, express criticism but offer solutions at the same time, covering the grey area between design for use and design for debate.

4 Inconvenient Design as a Pedagogical Strategy: *Stranger Things* – Prototyping Inconvenience

The course *Stranger Things—Prototyping Inconvenience* served as a case study to critically address the convenience ideal in design education and as a means to investigate the potential of Inconvenient Design as a discursive approach to design. The course was offered in 2019 at our university as part of the design curriculum. It was addressed to graduate and undergraduate students within three design tracks: interface design, industrial design, and communication design, as well as to graduate students from the Urban Futures master's programme. A total of 17 students enrolled in the course.

4.1 Course Format and Goals

Based on the practice-based nature of our counter-approach, the course was designed to link theory and practice by combining theoretical input, group discussions, and hands-on workshops. All of these were strongly interwoven in order to approach a complex topic in a tangible and accessible way. The course was open and unbiased in terms of the expected outcomes or aesthetics. We aimed at teaching students a novel practice-based way to reflect and debate, and through the process, to experimentally explore the richness and variety of results that such an experimental counter-approach can provide.

4.2 Debate-through-Making: Iterative Prototyping

In design education, critical thinking and design critique are traditionally taught by lecture in design theory courses. For some years, design programmes and courses have attempted to include practice-based critical and speculative design approaches in their curricula [40]. Still, most practical seminars in mainstream design education are solution-oriented and lack critical framing. While it is very important that design students acquire a basis in critical theories, there is still a cognitive distance between critique and creation.

In our course, we combined theory and practice using iterative prototyping as a leveraging strategy. Prototyping was utilised throughout the course sessions for both making and reflecting in iterative, short, on-site workshop units.

Prototypes concretise complex topics in tangible objects. They force designers to specify details of the concept or design [41] while filtering out other irrelevant dimensions [42]. Experiencing the materiality of prototypes as “material anchors” with their own senses [43], students can observe and try out ideas. We engaged students to think, reflect, and debate directly through making. The fact that prototypes are unfinished drafts fosters debate since people can read them in different ways [44]. The use of low-fidelity (lo-fi) prototyping was intentionally chosen as a tactic in terms of its accessibility and capability for quickly concretising and materialising ideas. It also aimed at including non-designers in the design process (e.g., students from the Urban Futures master’s programme), considering that they have less experience in drawing and building.

Prototyping was not applied for the traditional purpose of building preconceived ideas and translating them into material form. Instead, it was used as an ad hoc ideation technique, following Gill and Dix [45]: “Rather than pre-existing ideas being represented in an external form, the idea is itself formed in the process of presentation”. The purpose of combining the processes of thinking, making, and reflecting lies in offering a “set of processes, practices and questions that allow for *both* production and reflection, analysis and making, critique and creation” [40].

4.3 Research through Education: Double Roles and the Proto-Card

Adopting a research-through-design approach [46], the course aimed at conducting research on the potential of Inconvenient Design as a counter-approach directly through applying it. In this sense, we ourselves and the students adopted a double role in the course: we as lecturers as well as researchers and the students as learners and co-researchers.

To this end, we developed the *proto-card*, a textual and visual log for facilitating self-reflection on the prototyping process [12]. After every prototyping activity, students documented each prototype with a proto-card. In teams, each student filled in a separate proto-card for the same prototype to collect different points of view.

The proto-card consists of a free-form questionnaire with textual questions focusing on the emotions arising while prototyping (Fig. 1, left). In addition to textual questions, the proto-card also engages visual reflection on the prototyping process and its outcomes (Fig. 1, middle), accompanied by photographs of the prototype (Fig. 1, right).

The method thus contains elements of a “cultural probe” as it facilitates self-observation: students can express their personal experience in an emotional and visual way, unfolding their “beliefs and desires”, as well as their “aesthetic preferences” [47]. Through this reflective instrument, students were able to document the design of each prototype and its use, as well as reflections that occurred along the prototyping process. In total, 78 prototypes were logged by 17 students. As a research method, the proto-card aimed at providing us, the lecturers, with data that enabled us to track decisions and irritations through the design process, as well as the evolution of prototypes and design projects.



Fig. 1. Filled in *proto-cards*. A classification of the prototype by its fidelity and between the “affirmative” vs. “critical” poles, as well as a textual log with questions about the prototype, asking “what”, “how”, and “why” was prototyped (e.g., “What is the purpose of the prototype?”). Other questions are categorised by “anger” (e.g., “What did not work?”, “Which negative emotions arose?”), “wow” for surprises (e.g., “What came as unexpected?”) and “&” for further insights (left). Visual meta-reflections associated with the documented prototype (middle). Images of the documented prototypes (right).

4.4. Course Structure

The course was structured in 12 sessions (4 hours each). Eight sessions were active seminars containing input presentations, group discussions, and hands-on workshops. The four remaining sessions were used for interim presentations, two individual group consultations, and a final presentation. After the course, the final projects and course outcomes were exhibited at the annual exhibition at our university. Our pedagogical concept was divided into two blocks: *Understanding Convenience and Inconvenience* and *Designing with In*convenience*. Both blocks combined theoretical input, group discussions, and short iterative prototyping sessions. Each prototyping session addressed aspects of the theory, followed by a reflection on the corresponding process and its outcomes.

Block 1 – Understanding the Topic of Debate: Convenience and Inconvenience.

The first block of the course aimed at building an understanding of what convenience and inconvenience are. For this, we engaged students to analyse and critically reflect on how they are experienced in everyday life and how they are (or could be) designed. These questions were explored throughout multiple prototyping sessions. Through these sessions, we gained a first idea of convenient and inconvenient design patterns

and experiences and identified potential topic fields to be approached by the students in their final projects.

Table 1. Block 1 – Understanding the topic of debate: convenience and inconvenience.

Session	Content	Workshops
Session 1	Kick-off Input and discussion: <i>What is convenience?</i>	Prototyping: <i>The Design of In*convenient Everyday Things</i>
Session 2	Input: <i>Usability, Frictionless Design and Dark Patterns</i>	Prototyping: <i>Designing with frictions, limitations, and provocations</i>
Session 3	Interim presentation: <i>In*convenience Diary</i>	Prototyping: <i>Inconvenient Counterproposals</i>
Session 4	Final presentation: <i>In*convenience Diary</i>	Workshop and discussion: <i>Mapping Convenience and Inconvenience—Clustering topic fields and patterns</i>

Table 2. Block 2 – Final Projects: Designing with in*convenience.

Session	Content	Workshop
Session 5	Input: <i>Introduction to Speculative Design Practice</i>	Prototyping: <i>Material speculations – Things from the Future</i>
Session 6	Input: <i>Design Fiction and Story making</i>	Story making: <i>Speculation Ping-Pong. Getting out of the utopia-dystopia binary</i> discussion
Session 7	Input: <i>Discursive Approaches in Design-oriented HCI. Counterfunctionality and Functional Provocation</i>	Ideation and prototyping: <i>Counterfunctional Speculations. Creating Estrangement through Limitations</i>
Session 8	Input and discussion: <i>Staging</i>	Ideation: <i>Exhibition planning</i>
Session 9	Interim presentations and group discussion: Follow-up of final projects	–
Session 10	Individual consultations	–
Session 11	Individual consultations	–
Session 12	Final presentations	–

Block 2 – Final Projects: Designing with In*convenience. The second block of the course focused on applying the learned strategies into the final student projects. In groups, students developed different case studies from different topic fields. Here, the goal of the workshops was to *irritate* the design process with different methods. These aimed at provoking a creative friction that pushed students to break known design routines and with it, motivate unusual, unexpected and sometimes even undesirable (yet useful) design solutions.

4.5 Implementation of Selected Methods and Outcomes

The Design of In*convenient Everyday Things. On the first day, we conducted a kick-off prototyping workshop combined with a group discussion. As a way to immediately start with the hands-on work, we provided students with scrap and recycling materials, among other things. Students crafted both super-convenient and inconvenient reinterpretations of familiar everyday objects. The workshop had the purpose of approaching the course topic in an accessible way via prototyping. The one-hour prototyping session resulted in diverse outcomes (Figs. 2 and 3). Some students approached convenience and inconvenience by altering aspects of materiality or the functionality of objects (Fig. 2). While the resulting everyday products are still visually familiar, the chosen materials or forms did provide a sense of uselessness and dysfunctionality (Fig. 2, left) or discomfort (Fig. 2, right), among other qualities. These resulting experiments are reminiscent of Carelman’s *Catalogue d’objets introuvables* [48], or the *Chindogu* “unuseless” inventions [49].



Fig. 2. Results of the workshop *The Design of In*convenient Things*. *Inconvenient forks* by Sophia Grote and Marjolein Mulder (left): These forks are unusable through different material properties, such as size, flexibility, fragility or unpleasant surface haptics. *Inconvenient water tap* by Daniel Boubet and Hsuan Lee (right): spikes in the surface make the handling of the tap unpleasant, forcing users to only use water if absolutely necessary.

Other students pushed the boundaries and looked beyond familiar forms and functions, crafting more radical speculative artefacts (Fig. 3). It was interesting to observe that inconvenient reinterpretations tended to be more functional and atemporal or were placed in an alternative present (such as the examples in Fig. 2). By contrast,

the super-convenient artefacts were rather speculative and placed in a future setting (such as the examples in Fig. 3). These first reflections on their material experiments were facilitated through a subsequent discussion and the proto-card.



Fig. 3. Results of the workshop *The Design of In*convenient Things*. *Convenient fork* by Fabian Gamp and Annika Rauch (left): “Forks” are attached to the body to collect “air food” when needed, speculating with the idea that food is not handled anymore but is part of the air pollution. *Convenient toothbrush* by Lennart Franz (right): shooting a “teeth cleaning bullet” into the mouth makes teeth cleaning frictionless and almost instantaneous.

The In*convenience Diary: A Cultural Probe for Self-Observation. To support the exploration of how convenience and inconvenience are experienced in everyday life, we conducted a self-observation study. This study aimed at developing a critical perspective on design patterns and other daily routines and crises that occur in our private and public lives. With the *In*convenience Diary*, a “cultural probe” [47], students collected self-observations over two weeks on convenient and inconvenient experiences (Fig. 4), starting from the course’s first session. They were asked to observe themselves and write field notes, not only related to existing designs or technologies, but also to further experiences, situations, and interactions in their everyday lives experienced as such (e.g., waiting times, physical activities, disorder, etc.). This cultural probe in the form of an informal and personal diary facilitates revealing emotions, expectations, and beliefs [47]. Following an “autoethnographic” approach for collecting “personal narratives” [50], students write and reflect selectively about subjectively important moments or even crises to show and tell these to others [50].



Fig. 4. *The In*convenience Diary*: the diary (left); a filled-in example (right) with diary-like entries of inconvenient experiences on the left page, and a detailed textual and visual explanation of a chosen experience on the right.

Informed by the observations collected with the In*convenience Diary, we performed a prototyping workshop (third session of the course's first block) in which each student had to craft an inconvenient counterproposal or intervention to an everyday experience or situation experienced as convenient or comfortable (Fig. 5). With this, students had to reflect on what in particular made the situation convenient, what were the problems related to it, and what were the opportunities that opened up by the designed inconvenient counterproposal.



Fig. 5. Inconvenient Counterproposals. *Money Workout* by Fabian Gampp (left): bank clients must exercise in order to withdraw money; the amount of money allowed is defined by the workout time. *Inconvenient Escalator* by Sophia Grote (right): social interactions are mandatory for this “smart escalator”, and its users need a conversation partner in order to make it move.

With the insights gained with the In*convenience Diary and the related prototyping sessions and reflections, we ended the first block of the course in session 4 by conducting a mapping workshop. For every documented everyday situation experienced as inconvenient, students collected the *means* and *purposes*. *Means* are the qualifiers, that is, the tactics and stylistic variables (e.g., functional or aesthetic) for something to act as inconvenient, frictional, unfriendly, or uncomfortable (e.g., integrate waiting times, physical exercise, etc.). The *purposes* are the goals to be achieved by this given inconvenience (e.g., motivate reflection, focus, socialise, develop a more sustainable behaviour, etc.). In this way, we clustered which means make a situation, object, or experience convenient or inconvenient. In addition, we collected potential themes and topic fields (e.g., consumerism, communication, education) that students could address in their final projects in the second block of the course.

Design Fiction and Story Making. Throughout all course sessions and combined with all methods and prototyping iterations, we engaged students to not only craft artefacts, but also the stories surrounding them. Design fiction is an established tactic in critical and speculative practice. It is used as a means for imagining and communicating fictional narratives around new designs and technologies, as well as a useful practice for interrogation and development, in design research [8], research through design [51], and design education [52]. While we introduced and engaged students to utilise this tactic from the first day, we sharpened its use in the final projects. “The Thing from the Future” imagination game by Situation Lab [53] served us in a kick-off workshop

conducted on the first session of the course's second block (course's session 5) as a practice-based method for teaching design fiction in more depth. Through this game, we could insist in a practical way on the importance of the interplay between objects and their narratives when imagining alternative worlds.

Throughout our course, we applied design fiction both as an ad hoc method for ideation and interrogation and as a method for communication and presentation of concepts. For the creation of fictions along the design process, we encouraged the use of common practices in design such as sketches, storyboards, user journeys, or role plays, among others (Fig. 5, left; Fig. 8, right). By focusing on known techniques, we aimed at helping students to focus on the story and concept—not the medium. Design fictions were developed in the interplay between making (prototyping material artefacts), story making and storytelling (fictional contexts), and debating (team-intern and open discussions). Through this exchange, putting prototypes (as speculative objects) into mundane situations helped students to interrogate their ideas as well as to reduce complexity and concretise their concepts. This also allowed them to sharpen their inquiries, ensuring a clearer communication, and facilitating the debate in the classroom. For the presentation of their final projects, students used other staging media, such as videos, posters, product placements, advertisements, or user manuals, among others.

Speculation Ping-Pong: Getting out of the Utopia-Dystopia Binary. We designed this method to achieve a balance between the utopia-dystopia binary commonly found in speculative fictions, inspired by the thoughts of the science fiction author Ursula K. LeGuin in “Utopiyin, Utopiyang” [54]. We built as well on methods that show the benefits of creating contrasting visions (positive and negative) for gaining multifaceted insights on a same topic [55]. The *Speculation Ping-Pong* consists of performing short iterations between utopian and dystopian scenarios, intertwining convenient and inconvenient perspectives (Fig. 6). In each iteration, a scenario is developed that builds on the ideas of the previous one, concatenating contrasting representations. First, a utopia with a convenient mindset is drafted; next, a convenient-driven dystopia that counters key aspects of the previous utopia is then developed. The cycle continues in this way. By stretching future narratives to opposed contrasting boundaries, this method aims at leveraging a shift from a convenient utopia (the trend in mainstream design) towards an inconvenient utopia. This was used to identify positive inconveniences and support students to find a balance for creating counter-narratives.

The Speculation Ping-Pong was implemented in the second session of the course's second block (session 6 in the course). The 13 student groups already had a topic field for debate and had developed early ideas, but the possibilities were still broad. The goal of the workshop was to reveal new perspectives for all projects and engage a class discussion on the positive and negative aspects of convenience and inconvenience for each of them. In four iterations of 20 minutes each, performed clockwise, students crafted scenarios that included combining notes, sketches, storyboards, collages, or personas, and so on. Student groups were asked to switch to a different project in each iteration of the Speculation Ping-Pong so that they could engage in different projects and topics. After all iterations were completed, each project had received ideas and input from different perspectives. At the end, we moderated a debate on the potentials, challenges, and critical issues of each project. In this way, we aimed at making all

students reflect collaboratively on all topics for debate and on the opportunities that positive inconveniences could contribute.

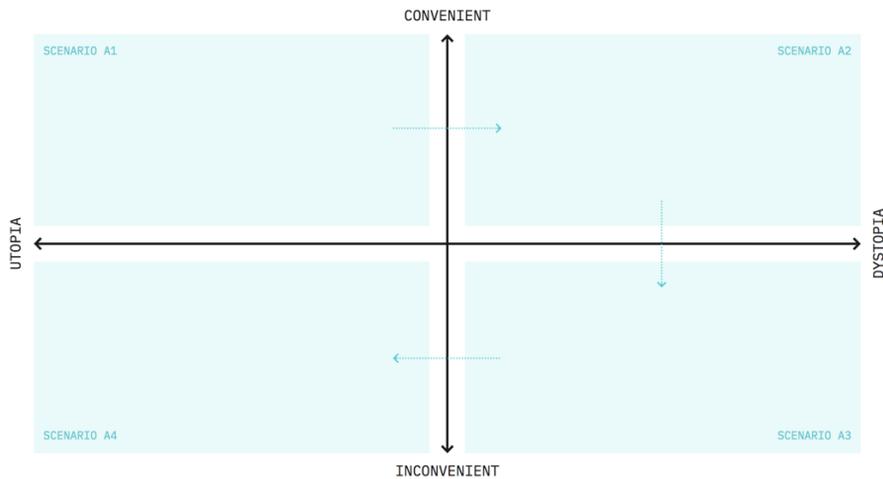


Fig. 6. The *Speculation Ping-Pong* workshop board. It combines four intertwined scenarios to find a balance between the utopian-dystopian and convenient-inconvenient polarities.

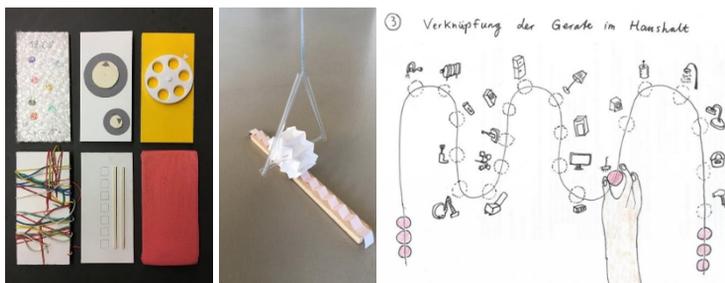


Fig. 7. Outcomes of the *Counterfunctional Speculations* workshop. *Counterfunctional Dumbphones* by Julian Brooks (left): Multiple experiments on limiting smartphone use to only one function and one tangible interaction. *Counterfunctional Gadgets for the Smart/Dumb Home* by Marjolein Mulder: Light intensity can only be set by carefully handling the *Counterfunctional Dimmer* (middle), a challenging pendulum-like device; with the *Counterfunctional Electricity Management Board* (right) users can negotiate which electrical products are needed at a given moment in a household where only a limited amount of devices can be simultaneously used.

Counterfunctional Speculations: Creating Estrangement through Limitations. As a means to explore design possibilities within the grey area between functionality (closer to design for use) and speculation (closer to design for debate), we conducted this workshop on the third session of the course's second block (session 7 in the course). In the workshop, we questioned students about the essential purpose and functionality

of their ongoing projects, engaging them to counter them. To do this, we built on the concepts of “counterfunctionality” and “counterfunctional thing” [27]. As in the original approach, limitations in our workshop were applied to counter some “essential functionality” of the prototypes [27]. However, while the original method is applied to familiar digital devices (e.g., a camera), ours was extended to also address speculative artefacts only existent in the narrative of their projects. Accordingly, students were asked to identify essential functional features (real or fictional) of their devices, and then redesign around the removal or obstruction of these features. In addition, we extended the method to also constrain or disrupt further actions or processes related to critical aspects addressed by the students’ final projects (e.g., everyday rituals, compulsive shopping, waste disposal). Some students countered functional aspects of existing everyday things, resulting in counterfunctional objects with unusual forms and functions (Fig. 7).

Other projects countered primary aspects of the story, including processes, user journeys or experiences, and resulted in dysfunctional situations and narratives. Some of them had elements of creepiness and dark humour, akin to critical and speculative designs (Fig. 8).



Fig. 8. Outcome of the *Counterfunctional Speculations* workshop. *Counterfunctional Shopping* by Hsuan Lee: A lo-fi prototype of a clothes hanger and rail, attached to each other “holding hands”, representing a parent and their child (left). A storyboard shows the shopping process, including the use of the prototype (right): When getting a desired article, the clothing rail will show resistance (right, strips 4 and 5), forcing the consumer to pull with strength in order to “break the parental bond”. When achieving the article, the clothes rail will bleed (right, strip 6). This project visualises with cynicism and violence the direct relationship between mass consumption and child labour.

Intertwining functionality with the fictional and speculative mindset pushed the boundaries of feasibility, supporting students as they drafted unusual interactions and narratives for their projects. The design of limitations and impeding frictions, acting as provocations, enabled the creation of functional but also social estrangement. This helped students to sharpen and refine their inquiries.

5 Final Works

In the second block of the course, *Designing with In*convenience*, students developed 13 design projects. In this section, we present a mapping of these works. First, we position them within a matrix; second, we identify the main themes challenged by the student projects; and third, we suggest four taxonomies of project outcomes, illustrated by examples. Next, we unfold two design processes in order to illustrate how our methodological approach leveraged different shifts within the grey area between design for use and design for debate and show how these shifts opened new perspectives that enabled the development of alternative design patterns and counter-solutions.

5.1 Mapping

Our methodological approach addressed two tensions commonly found in critical practice. The first tension is between speculative futures and alternative (functional) presents [56]; the second tension is between the tendency towards either problem finding (traditionally, design for debate, “critical”) and problem solving (traditionally, design for use, “affirmative”) [13,15]. We created a matrix with these tensions as axes, and mapped the 13 final works, accordingly, as a means to analyse the course outcomes as well as to evaluate how our strategy contributes to filling in the grey area between the corresponding endpoints. Figure 9 shows the plurality of outcomes. The works positioned around the middle of the vertical axis transcend the dichotomy between “design for use” and “design for debate”, providing design artefacts for use and for reflection. With an embedded criticism, these works represent “critical use” [15]; they propose design solutions, while making problems tangible at the same time through their use and experience.

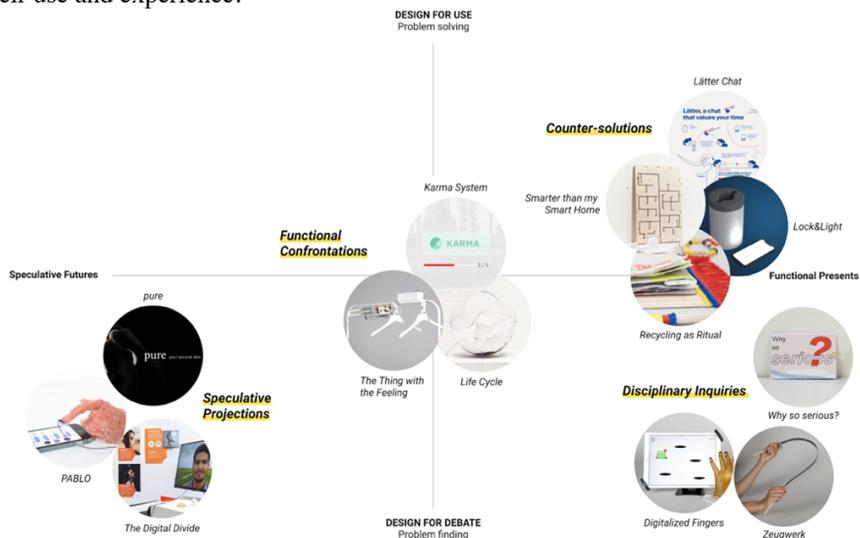


Fig. 9. Mapping of the 13 final student projects classified by two tensions: speculative futures vs functional presents (horizontal axis), and design for use vs design for debate (vertical axis).

Themes. The student works identify some themes traditionally challenged by critical and speculative design practice, such as radical consumerism, the relationships and interactions between individuals and future technologies, and the impact that unreflected technologies may have on inequality and social orders. In addition, 11 of the 13 works address, through a critical lens, topics traditionally related to interaction design and HCI such as usability, the design of new gestures and feedback, the design of new interaction patterns (e.g., for mobile applications or digital assistants), the design of smart objects and environments, and the tangibility of future digital communication. Lastly, three projects addressed critical issues within the design practice itself, including the power of design tools, the understanding of usefulness, and the creation of inconvenient design methods.

Taxonomy of Outcomes. Identified within the two given tensions, the works include the following: *speculative projections* addressing “inconvenient conveniences” in speculative futures (Fig. 9, bottom left corner); near-future scenarios containing familiar fictional products with *functional confrontations* (Fig. 9, middle); and *counter-solutions*, which are research products that embed functional provocations, triggered by friendly frictions (Fig. 9, top right corner). Other projects addressed *disciplinary inquiries* that debate the use of design tools or design methods (Fig. 9, bottom right corner). All works, as well as their design processes, provided a wide variety of outcomes combining prototypes and fictions as both physical (e.g., objects, sketches, storyboards, role plays) and digital artefacts (e.g., app screens, click-dummies, videos).

Speculative Projections. The projects under this taxonomy extrapolate aspects of the status quo into speculative futures, showing how a continuation of the convenience ideal would affect social orders and relationships in our day-to-day lives. The three works are ambiguous and materialise *inconvenient conveniences*; that is, they depict convenience in the future as something positive and utopian, but the confrontation with the artefacts and built narratives cause unpleasant feelings of creepiness and social estrangement, which engage critical reflection. Moreover, they also reveal how inconvenient apparently convenient solutions can be, depending on the perspective from which they are encountered. With an ambivalence between satire and seriousness, these works use distortion, exaggeration, and allegory to make the negative consequences of convenience visible and tangible. This approach towards technocratic visualisations is often employed in speculative design practice as a means to engage debate [57], and the projects in this taxonomy can be considered clear speculative design works.

In his project *PABLO—Personal Assistant Biologic Operator*, Daniel Boubet presents a speculative product that allows individuals to breed living assistants using their own skin tissue. When *PABLO* has grown, tasks can get delegated to it to make free time for “things that matter”. A functional prototype (Fig. 10, left) is supported by narrative artefacts, such as a product user manual that shows how *PABLO* works (Fig. 10, right). In a busy western society that pushes individuals to self-optimisation, increasingly more everyday decisions are governed by algorithms, and tasks are taken over by technological products. Transferring biotechnology from the laboratory to an

everyday setting, this project illustrates and questions the close relation between convenience and the western optimisation-driven society.

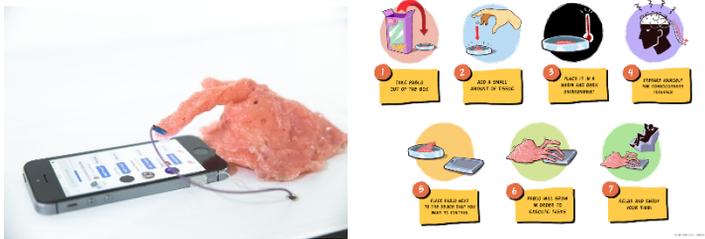


Fig. 10. *PABLO – Personal Assistant Biologic Operator* by Daniel Boubet. The functional prototype of the living assistant accepts or declines friendship requests in a social media platform (left). The product user manual shows the steps for breeding one’s own assistant (right).

Functional Confrontations. In this taxonomy, we find works that stay in the middle between the radicality of speculations and the functionalism of design solutions. Functional confrontations reveal social issues by disrupting the known usability and experience of familiar products or services (e.g., a clothes rail in a retail store, an online shopping platform, and an intelligent personal assistant) through uncomfortable frictions and interactions. Although the designed functional objects and interactions speak by themselves, it is still necessary to embed them into everyday life actions in near-future narratives (e.g., shopping in a retail store, doing online shopping, at home). The designed interactions explore the limits of inconvenience as a design paradigm; they use satire, dark humour, and a degree of violence and obscenity—typical of critical design [57]. They trigger a functional and, at the same time, social estrangement that provokes and confronts the users through use. The resulting aesthetic experiences embed two tensions. The first is between the familiar usability of the given everyday product or service addressed by the project and the unpleasant or uncomfortable usability of the proposed inconvenient counter-design. The second tension is between the violence of the functional solutions adopted and the violence of the social problems they address. This makes visible the violence of design. The results are then ambiguous; they could represent discursive ways of problem solving but are still too radical or exaggerated to be considered serious design solutions; therefore, they are adopted as counter-solutions.

In their project *Karma System*, Clara Lozano, Lennart Franz, and Robin Müller present a near-future scenario in which a mandatory “parasitic interface”, the *Karma System*, is attached to every shopping platform to monitor the consumption footprint of every citizen. It shows the social and environmental implications of every product, such as oppressive labour conditions, water pollution or carbon footprint, and so on (Fig. 11, left). Every citizen keeps a general “karma score” (Fig. 11, middle), which has a limit. Once the karmic limit is exceeded, different types of impeding frictions are built into the system to make the implications of consumption visible (Fig. 11, right), punishing consumers and encouraging them to reflect. In this project, the students explored how interaction design can irritate the purchasing process to confront users with the

frictionlessness of western consumerism. The system treats users as consumers (as in affirmative design) but through an ironic and critical lens (as in critical design). The *Karma System* highlights the violence and paradox of convenience—how products and services that are supposed to make our lives more comfortable entail (hidden) negative consequences for other stakeholders.

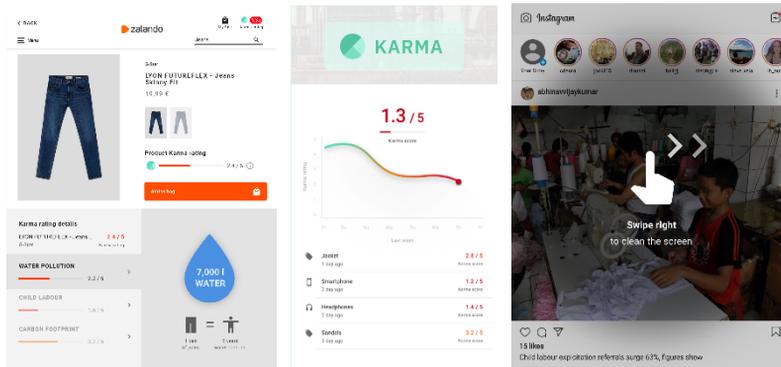


Fig. 11. *Karma System* by Clara Lozano, Lennart Franz, and Robin Müller. A parasitic gadget is embedded in every online shopping platform and shows the social and environmental implications of every product (left). The system monitors the “consumption footprint” and quantifies a global consumer’s karma score (middle). Consumer and functional restrictions are applied and supported with visual and haptic feedback when the karmic limit is reached—for example, by blurring the users’ device screens with smog when their consumption leaves a high CO₂ footprint (right).

Counter-solutions. In this taxonomy we find everyday design objects that provide solutions and express criticism through use at the same time. Criticality-through-use was also found in functional confrontations; nevertheless, counter-solutions are not as radical and violent as the previous taxonomy and can instead be considered serious design products. Counter-solutions trigger reflection through direct experience of the designed objects. These implement limitations or (friendly) functional or aesthetic frictions that create a functional estrangement. This confrontation provokes a personal dilemma [38] that fosters self-reflection [30,31]. Like traditional design products, counter-solutions include a framing that puts them into their context of use; however, their criticism is object-embedded, and a narrative is not strictly necessary. Counter-solutions offer alternative and discursive ways of problem-solving and could be classified as research products of discursive design or HCI practice.

In her discursive counter-solutional project, *Lock&Light*, Annika Rauch presents a lamp that only turns on when users lock their smartphones inside of it (Fig. 12). Its discursive purpose is to encourage screen-free time. The user-lamp interaction recreates the gesture of using a key (the smartphone) to open a lock (turning on the lamp). By forcing users to decide between light or smartphone use, the lamp integrates a designed inconvenience that fosters self-reflection. In this way, *Lock&Light* questions the overuse of technology in everyday life, taking our relationship with smartphones as a mundane example. It exposes a problem (overuse of technology) while offering a

solution at the same time: with light as a mediator for self-reflection, the lamp supports digital detox.



Fig. 12. *Lock&Light* by Annika Rauch. User pushing a smartphone into the paper prototype (left). User locking the smartphone in the paper prototype (middle). Lamp-functioning visualisation: the lamp turns on when locking a smartphone inside of it (right).

Disciplinary Inquiries. The projects under this taxonomy question disciplinary issues, such as the power and influence of design tools, the convenience of design methods, and the trend in design towards overloading products with functions (e.g., causing multitasking). These works are addressed specifically to designers and not to a general audience or users. The reflection is experienced through the use and direct confrontation with the prototypes. This involves a functional estrangement that creates a sense of alienation. Nevertheless, the projects are highly conceptual and require a strong narrative that puts them into their context of debate, so that their inquiry is fully understood. Disciplinary inquiries, like the objects of “associative design”, have an embedded narrative and take design methods or processes of production as their object of exploration and critique [57]. However, their outcomes, unlike associative design objects, are not familiar design products (e.g., a chair, a coach, a toaster). Although disciplinary inquiries’ prototypes are usable and experienceable, they are rather ambiguous and strange meta-objects. In other words, an associative design object (e.g., a chair) without critical context is still the design object with its mode of use (e.g., the chair). A disciplinary inquiry object without contextualisation is rather useless. Disciplinary inquiries aim at raising questions for debate, not giving answers. Their main purpose is engaging designers to reflect.

In their disciplinary inquiry, *Zeugwerk*, Nina Blume and Alma de Andrade Sanderink question the closed-off nature of design tools and how these strongly influence our design skills and outcomes. The prototype series *Zeugwerk* (Fig. 13) presents discursive design tools that lean on known tools (as saws or hammers) but deviate so much from them that their function is ambiguous and not clearly recognisable. Some tools, as the flexible saw, even seem unusable (Fig. 13, right). They invite designers (their target group) to experimentally interact with them and constantly renegotiate their utility and purpose, to ultimately find individual strategies for how to use them. *Zeugwerk* is a wordplay with the composed German word for tool: *Werkzeug*. By turning over both parts of the word, the students suggest doing the same with the relationship between tools and our design skills and practices, between means and ends. While designers tend to “routinise” the use of specific methods and tools, inconvenience is here experienced through the open-endedness and ambiguity of use, which makes the tools fluctuate between usefulness and uselessness, and leads to a confrontation to reappropriate, readapt, and reinvent.



Fig. 13. *Zeugwerk* by Nina Blume and Alma de Andrade Sanderink. The product series, vaguely reminiscent of familiar tools, consists of ambiguous design tools made of simple shapes and seemingly useless functions (left). Product example: the flexible saw (right).

5.2. Process Shifts

The methodological approach of the course leveraged different *shifts* from fictional futures to functional presents, from design for debate to design for use. Along the design process, all projects temporally fluctuated between those tensions. Iterations provided different outcomes, such as sketches, physical and digital prototypes at different fidelity stages, and fictional narratives, among others. In what follows, we illustrate two design processes that exemplify this and show how our methodological approach enabled different shifts that led to the design of alternative artefacts.

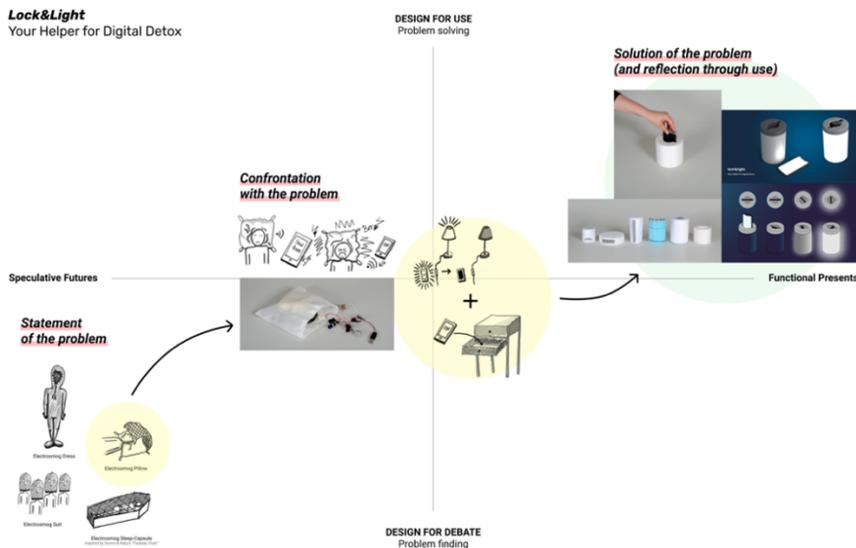


Fig. 14. *Lock&Light*'s design process. Final project by Annika Rauch.

From Speculative Problem-Finding to Counter-Solutions: *Lock&Light*. This project started questioning the overuse of technology and the consequences of electrosmog. Early sketches depicted a dystopian scenario with products for

electrosmog isolation that resemble the *Faraday Chair* by Anthony Dunne [23] (Fig. 14, bottom left corner). Through the design process, functional provocative prototypes and concepts were developed. One example is a cheeky bed pillow that through annoying feedback bothers users until they turn off their smartphones before going to bed (Fig. 14, middle). In the process, this prototype raised debate when contemplating the recurring paradox: Why keep using technology (e.g., sensors, electronics) for solving a problem (electrosmog) created by technology overload? This crisis disrupted the concept, which was concretised into the final counter-solutionist discursive product: the *Lock&Light* lamp (Fig. 14, top right), shown earlier in Fig. 12.

From Stretching Boundaries to Balance of Estrangement: Karma System. This project started questioning Western consumerism and its ties to unfair labour conditions and the environmental crisis. The outcomes from the prototyping and story-making sessions stretch the boundaries between criticality and solutionism, from dystopian critical speculation (Fig. 15, bottom left) to functional (un)friendly friction (Fig. 15, top right).

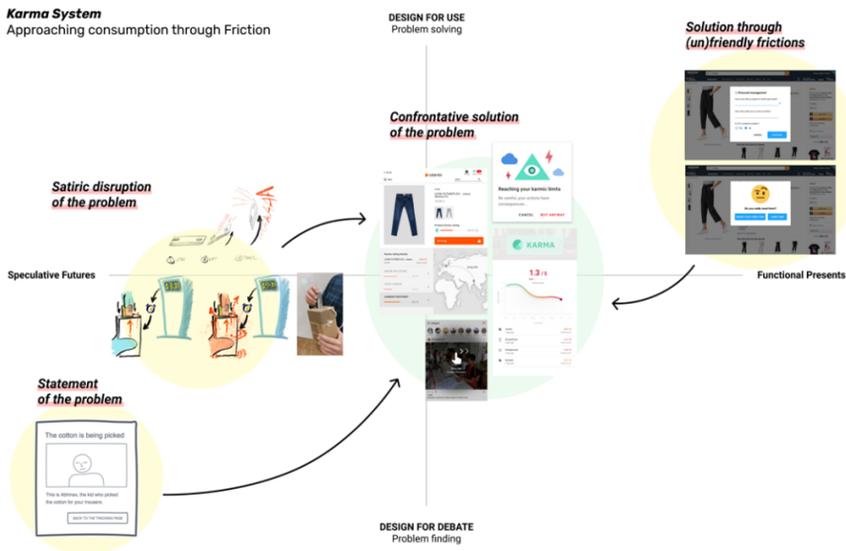


Fig. 15. *Karma System*'s design process. Final project by Clara Lozano, Lennart Franz, and Robin Müller.

During the prototyping sessions, students explored different ways to disrupt moneyless payment processes, developing numerous experiments through digital and physical prototypes (Fig. 15, middle left). Figure 16 shows a concept developed during the counterfunctionality session. The lo-fi artefact (Fig. 16, right), which spits out the credit card when a money limit is reached, helped to make the concept with its use of frictional feedback experienceable. This tangible solution was not further developed, but motivated the central idea of the final project, shown earlier in Fig. 11.



Fig. 16. *Payment Transparency*, an early prototype of the *Karma System* by Clara Lozano, Lennart Franz, and Robin Müller.

6 Findings: Main Learnings and Reflections

6.1. Reflections on Critical Practice

Potential of Inconvenient Design for addressing the grey area between critical and speculative design and interaction design research practices. The themes found in student works include some of the main themes challenged by critical and speculative design practice, as well as topics traditionally approached in design research or design-oriented HCI, addressed through a critical lens. Most projects intertwine elements of both. This combination of themes shows how this approach and course format can be applied in different educational contexts within this grey area, not only in critical and speculative design courses. There is potential for Inconvenient Design to also be useful for fostering reflection and critical skills in practical (and solutionist) design and design-oriented HCI courses, as a means to explore the design of alternative paradigms and counter-solutions.

Approaching the Taxonomy of Outcomes. From the analysis of the course outcomes, we identified four different object taxonomies: speculative projections, functional confrontations, counter-solutions, and disciplinary inquiries. All these taxonomies contributed to fostering individual reflection and discussion, both during the design process within the teams as well as in course presentations and the final exhibition with the whole audience. As this course was a first attempt to utilise our counter-approach in design education, we implemented it to be open and unbiased in terms of expected outcomes or aesthetics. Moreover, we investigated how broad and diverse the course outputs might get. In further courses and research, it would be interesting to set these object taxonomies upfront as expected design outcomes. Students or lecturers could choose one of them, so that projects can be developed within its specific framing. The focus on one taxonomy from the beginning could serve as a creative limitation. By concentrating on one single object type, students could develop expanded narratives and material in greater depth. This would broaden the scope and inner diversity of each taxonomy.

Potential for crafting discursive designs between use and debate. Among the four

taxonomies, both functional confrontations and counter-solutions transcend the traditional dichotomy between “design for use” and “design for debate”, with works that represent both. In these works, provocations are designed as moments of irritation and confrontation (at different levels and intensities). These inconveniences are embedded in the artefacts and are experienced when interacting with the object. While similar provocative objects can be found in related works within critical and HCI research practices, our main contribution lies rather in the process and methodological approach—that is, in how to practically address complex topics to then inform, motivate, and develop the design of alternative design solutions. The process shifts (Figs. 14 and 15) analysed in this paper have illustrated how our counter-approach can contribute to this.

6.2. Reflections on the Methodological Approach

Anti-solutionist and experimental methods help students to approach complexity with playful easiness. The humour provided by our inconvenient anti-solutionist approach helped students to understand and address a complex topic in an accessible way. After *The Design of In*convenient Everyday Things*, the kick-off prototyping workshop on the first day, one student wrote down in a proto-card (the tool for self-reflection on the prototyping process): “I had never addressed such a complex topic in such a fun and easy way!” [proto-card]. Removing feasibility and seriousness as constraints, combined with lo-fi prototyping, helped students to “go from concept to form and material very quickly” [proto-card]. Moreover, the use of satire, exaggeration, and the anti-solutionist mindsets gave projects a sense of playful easiness. This helped students to stretch the boundaries of possibilities for their design projects. This enabled them to quickly make multiple concepts tangible, and thereby find concretion and a focus.

Potential of Inconvenient Design as a methodological approach for addressing complex problems. By arguing that more reflective and critical design processes are needed in design and design education, we developed Inconvenient Design as a methodological approach. Our observations during the process revealed the inherently irritating nature of the tactics used (e.g., design with frictions and limitations, discomfort, or user-unfriendliness, among others). These tactics make the design process itself inconvenient as they disrupt our internalised design routines and ideals. Inconvenient Design presented itself as a powerful tool for renegotiating instilled myths and addressing complex topics and inquiries such as sustainability and the climate crisis, or the deterioration of mental health through digital over-consumption. Further research and application of Inconvenient Design in education is needed to further explore and develop our approach.

Prototyping is an irritating practice that supports speculation. With prototyping used as an ad hoc ideation technique, students must engage with the prototyping materials as a medium for thinking as “the idea itself is formed in the process of presentation” [45]. This confrontation forced a constant negotiation, or “reflective conversation” [58], between the designer, the prototype, and the materials. This

facilitated speculation and the creation of radical ideas: “The prototype opens new conceptual spaces to think outside the box” [proto-card]. Indeed, experimentation and critical inquiry were fostered by the irritating quality of the prototype: “The prototype creates irritation and plays with expectations. It invites people to play, experiment and ask questions” [proto-card]. With the limitations set by the given materials, prototyping cannot be planned in detail; it relies rather on improvisation, which provokes serendipity [59]. Designers must face the friction or “resistance” of the material [41]. Nevertheless, as we discovered, this limitation can have positive effects: “Through limitation of the materials I had to leave my comfort zone. I developed ideas that would not have come up just by imagination. I was inspired by the materials” [proto-card].

Discursive prototypes foster discussions on complex topics. The iterations between theory and practice, between making and reflection, provided a dynamic and accessible way to address a complex topic. Students used prototyping to build a common understanding of the course topic by making ideas tangible and touchable. Akin to speculative practice, in which critical artefacts aim to foster discussion, prototyping (through the design process) and the resulting artefacts served as a discussion opener and stimulated debate—both within the design team and the whole group. Sometimes discussions were initiated by “people laughing about the irony of the prototype” [proto-card]. One student observed: “The prototype raises questions about how it should be used. Hereby it creates an atmosphere of experiment and interchange” [proto-card]. Drawings in the proto-cards show the thoughts of two students concerning how prototyping helps make ideas tangible and addresses abstraction and complexity (Fig. 17).

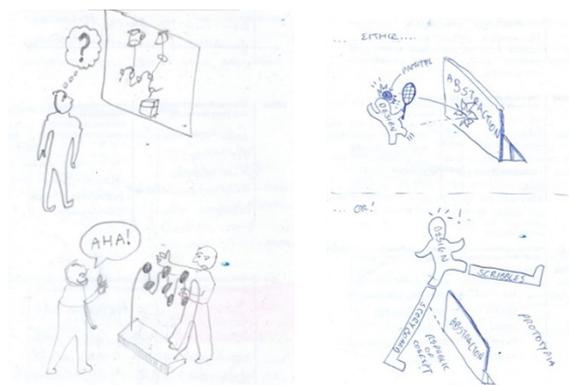


Fig. 17. Visual reflections from the proto-card: the benefits of prototyping for making ideas tangible and understandable, by Marjolein Mulder (left); the benefits of prototyping, in combination with scribbling and story making, for addressing abstract complex topics, by Lennart Franz (right).

Autoethnography and cultural issues. The In*convenience Diary served as a “cultural probe” [47] for self-observation through documentation of “autoethnographic personal narratives” [50]. With this method, students approached the course topics from their subjective perspective, documenting their own perceptions and experiences, as

well as situations observed from other people as an “intimate eyewitness account” [50]. This method enabled students to quickly relate to convenience and inconvenience, engaged them in reflection, and provided a basis for discussion. While this enabled a first draft for a definition of what convenience and inconvenience are, the “I” perspective only gave us a biased point of view [60]—a privileged one from a North-European university. At its best, autoethnography should aim at making visible experiences of heterogeneous people and cultural identities of different race, gender, age, class, education, religion, sexuality, and dis/abilities [50]. That being said, the perspectives depicted in the diaries are only as diverse as our students. This issue was also discussed in the course. Autoethnographic data is deeply personal and emotional [50]; however, knowledge is never neutral and is always “situated” in partial perspectives [61]. From our experience, the In*convenience Diary was a good starting point. Nevertheless, further research and courses should include tactics to confront the self-perspective, train students to reflect on their own privileged positions, and enable them to include (and not exclude) other people’s voices beyond their “own experience of the world” [40]. This is particularly recommended for autoethnographic work as a means to disclose and acknowledge positionalities and potential biases. This would contribute to gaining a more critical, inclusive, diverse, and intersectional view of the world they are designing for.

Reflections on combining research, learning, and teaching. The potential for combining research, learning, and teaching manifests when both the lecturers and students profit from the process. Through the course, the lecturers and students learned from each other about the prototyping process and the potential of Inconvenient Design. The self-observation tools (the proto-card and the In*convenience Diary) served exactly this purpose, characteristic of cultural probes—that is, as a two-sided inspiration that fosters reflection on a practice [47]. On the one hand, we as lecturers and researchers could reconstruct the students’ intentions and iterations, reveal their blind alleys during the design process, and empathise with their emotions (e.g., the frustration when a prototype did not work out). In particular, the visual reflection engaged by the proto-card (Fig. 17) proved to be remarkably insightful. On the other hand, students themselves also learned from this process, which provided them with a set of skills for critical self-reflection. These tools and methods enabled them to pause along their design process to reflect on their intentions, tactics, and challenges, and then to continue with a deeper understanding of their actions and implications. Furthermore, conducting research on design students—and especially conducting research together *with* them—benefits from the “beginner’s mindset” [10]: students reflect more and are more conscious about their own actions than experienced designers as they have not internalised routines that are difficult to verbalise.

6.3. Reflections on the Context for Debate: Convenience and Other Topics

Convenience and inconvenience are in constant interplay; their relationship may establish or shift power relations. Inconvenient designs exist beyond the dichotomy between the convenient and the inconvenient. This interplay can have positive and negative effects. The analysis demonstrated this ambiguity: products and services that

are supposed to make our lives easier and more comfortable also produce uncomfortable results for other stakeholders. The relevant questions are: “Convenient for whom?”, and “Who is suffering from this convenience?”. This effect also manifests in the reverse direction; that is, when designing inconvenience, students were astonished at how convenient the effects could be from other perspectives: “the intentionally inconvenient design proposal for the individual user turns out to have a beneficial effect on the environment” [proto-card]. Another student noted: “we first looked at inconvenience in an ironic way, and then realised how inconvenience could have a positive impact on our lives” [proto-card]. The applied methods helped us to acknowledge these interrelationships. Further research needs to be conducted in order to develop tools for supporting designers along the design process to critically address and counter possible “privileges” and “oppressions” [61,62,63] and environment-threatening behaviours [1] that may emerge from their designs. This approach would contribute to adopting a relational, more intersectional, less oppressive, and more-than-human position in design.

Potential of convenience as a topic for debate. The diversity of course outcomes (from speculative scenarios to functional counter-solutions) has shown the potential of convenience as a topic for debate. The results have also illustrated through multiple counterproposals (inconvenient designs) the numerous design opportunities that may emerge by removing convenience as a constraint. By showing that alternative solutions, as well as other notions of meaning and value, are possible, this case study has illustrated through practice the potential of questioning the convenience ideal in design research and education. In our course, convenience was the focus of inquiry, but since the convenience ideal is so strongly tied to design at different levels (e.g., it is the basis of usability and user experience), we believe the same tactics and methods can be applied to other topics of study. For instance, our approach showed potential for addressing and countering the use of convenience-driven approaches (e.g., efficiency, automation) in given areas of research such as Smart Technologies, AI, or the Internet of Things. Further case studies in these areas, among others, are needed.

7. Conclusions

In this work, we have pointed out the urgent need in design research and design education for new discursive methods and resources that irritate designers in the design process, as a means to confront interiorised routines and assumptions, engage reflection and debate through making, and open alternatives. We have affirmed the importance of questioning the convenience ideal in design for its broad implications and proposed the design *through* and *with* inconvenience as a topic for exploration and inquiry for redefining values. Under these premises and building on iterative prototyping, anti-solutionist strategies, tactics of critical and speculative design, and other discursive and interrogative practices in design research and design-related HCI, we have presented a first approximation of Inconvenient Design, a practice-based counter-approach to traditional design processes. Moreover, we have described its application as a discursive course format in the graduate and undergraduate design programmes at our

university. Together with the students, we researched and learned on our counter-approach by directly applying it, facilitated by tools for self-observation and reflection. Akin to research through design, we have explored the potential of Inconvenient Design through prototyping inconvenient designs. From the outcomes, we have suggested four taxonomies: speculative projections, functional confrontations, counter-solutions, and disciplinary inquiries, which cope with the grey area between design for use and design for debate. This diversity of results (both the final projects as well the prototypes crafted throughout the process) demonstrates the potential of our approach as a pedagogical strategy for engaging debate in design education, as well as an interrogative methodological approach for design research and design-oriented HCI. We hope that our research can contribute to the work on other discursive, critical, and speculative approaches and practices.

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References

1. Wakkary, R.: Things we could design: For more than human-centered worlds. MIT press (2021)
2. Nathan, L. P., & Parvin, N.: A story of paradise: interactive, digitally enhanced, and radioactive, *Interactions*, 27(1), pp. 74–76 (2019)
3. Schraefel, M., Tabor, A., & Murnane, E.: Discomfort design, *Interactions*, 27(2), pp. 40–45 (2020)
4. Owen, N., Healy, G. N., Matthews, C. E., & Dunstan, D. W.: Too much sitting: the population-health science of sedentary behavior, *Exercise and sport sciences reviews*, 38(3), 105 (2010)
5. Fineman, M. A., Mattsson, T., & Andersson, U. (Eds.): Privatization, vulnerability, and social responsibility: a comparative perspective, Taylor & Francis (2016)
6. Auger J., Hanna J., Encinas E.: Reconstrained design: Confronting oblique design constraints. *Nordes*, 7(1) (2017)
7. Lindtner, S., Bardzell, S., & Bardzell, J.: Reconstituting the utopian vision of making: HCI after technosolutionism. In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, pp. 1390-1402, May (2016)
8. Grand, S., & Wiedmer, M.: Design Fiction: A Method Toolbox for Design Research in a Complex World. In: *Proceedings of the DRS International Conference 2010: Design and Complexity*, Montreal, Canada (2010)
9. Auger J., Hanna J.: How the Future Happens, *Journal of Futures Studies*, 23(3), pp. 93–98 (2019)
10. Suzuki, S.: Zen mind, beginner's mind: informal talks on zen meditation and practice. NY and Tokyo, John Weatherhill (1970)
11. Tost, J., Schuster, P. L., & Heidmann, F.: "Stranger Things - Prototyping Inconvenience": A Case Study On Critical Design In Design Education. Workshop presentation in ACM DIS

- 2020 Workshop "Speculative and Critical Design in Education: Practice and Perspectives" (2020)
12. Schuster, P. L.: Prototyping in der Designpraxis: Zwecke, Akteur:innen, Rollen, Dimensionen und Dilemmata. Unpublished master's thesis, University of Applied Sciences Potsdam (2020)
 13. Dunne, A., & Raby, F.: *Speculative Everything: Design, Fiction, and Social Dreaming*, MIT press (2013)
 14. Bardzell J., Bardzell S.: What is "critical" about critical design?. In: Proceedings of the SIGCHI conference on human factors in computing systems, pp. 3297--3306 (2013)
 15. Schmeer, J.: *Xenodesignerly Ways of Knowing*, Journal of Design and Science, <https://jods.mitpress.mit.edu/pub/6qb7ohpt> (2019)
 16. Hesselgren, M., Eriksson, E., Wangel, J., and Broms, L.: *Exploring Lost and Found in Future Images of EnergyTransitions: towards a bridging practice of provoking and affirming design*. In: Proceedings of the DRS International Conference 2018: Design as a catalyst for change, Limerick, Ireland (2018)
 17. Olander, S.: *Critique and Post-Critique in Social Innovation Projects: between speculation and realism*. In: Proceedings of the DRS International Conference 2018: Design as a catalyst for change, Limerick, Ireland (2018)
 18. Pierce, J., Sengers, P., Hirsch, T., Jenkins, T., Gaver, W., & DiSalvo, C.: *Expanding and refining design and criticality in HCI*. In: Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems, pp. 2083-2092, April (2015)
 19. Gourlet, P., & Mollon, M.: *The three stances of the designer in a research team*, in EAD 11 The Value of Design Research (2015)
 20. Wakkary, R., Odom, W., Hauser, S., Hertz, G., & Lin, H.: *Material speculation: Actual artifacts for critical inquiry*. In: Proceedings of The Fifth Decennial Aarhus Conference on Critical Alternatives, pp. 97--108, August (2015)
 21. Odom, W., Wakkary, R., Lim, Y. K., Desjardins, A., Hengeveld, B., & Banks, R.: *From research prototype to research product*. In: Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems, pp. 2549--2561, May (2016)
 22. Bowen, S. J.: *A critical artefact methodology: Using provocative conceptual designs to foster human-centred innovation*, Doctoral Dissertation, Sheffield Hallam University (2009)
 23. Dunne, A.: *Herzian tales: an investigation into the critical potential of the electronic product as a post-optimal object*, Doctoral dissertation, Royal College of Art (1997)
 24. Rosenbak, S.: *Prototyping a useless design practice: What, why & how?*, *Artifact: Journal of Design Practice*, 3(4), pp. 5--1 (2015)
 25. Brandalise, I, & Eira, H.: 'Patadesign': a pedagogical experiment on design of exception, absurd artifacts, and imaginary interfaces, *Dearq*, No. 26, pp. 36--43 (2020)
 26. Blythe, M., Andersen, K., Clarke, R., & Wright, P.: *Anti-solutionist strategies: Seriously silly design fiction*. In: Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems, pp. 4968--4978, May (2016)
 27. Pierce, J., & Paulos, E.: *Counterfunctional things: exploring possibilities in designing digital limitations*. In: Proceedings of the 2014 conference on Designing interactive systems, pp. 375--384, June (2014)
 28. Savicic, G., & Savic, S. (Eds.): *Unpleasant design*, GLORIA (2013)
 29. Bardzell S., Bardzell J., Forlizzi J., Zimmerman J., Antanitis J.: *Critical design and critical theory: the challenge of designing for provocation*. In: Proceedings of the Designing Interactive Systems Conference, pp. 288--297 (2012)
 30. Laschke, M., Diefenbach, S., & Hassenzahl, M.: "Annoying, but in a Nice Way": an inquiry into the experience of frictional feedback, *International Journal of Design*, 9(2) (2015)
 31. Cox, A. L., Gould, S. J., Cecchinato, M. E., Iacovides, I., & Renfree, I.: *Design frictions for mindful interactions: The case for microboundaries*. In: Proceedings of the 2016 CHI

- Conference Extended Abstracts on Human Factors in Computing Systems, pp. 1389--1397 May (2016)
32. van Lieren, A., Calabretta, G., and Schoormans, J.: Rational Overrides: Influence Behaviour Beyond Nudging. In: Proceedings of the DRS International Conference 2018: Design as a catalyst for change, Limerick, Ireland (2018)
 33. Benford, S., Greenhalgh, C., Giannachi, G., Walker, B., Marshall, J., & Rodden, T.: Uncomfortable interactions. In: Proceedings of the SIGCHI conference on human factors in computing systems, pp. 2005--2014, May (2012)
 34. Raptis, D., Jensen, R. H., Kjeldskov, J., & Skov, M. B.: Aesthetic, functional and conceptual provocation in research through design. In: Proceedings of the 2017 Conference on Designing Interactive Systems, pp. 29--41, June (2017)
 35. Spaa, A., Wakkary, R., Frens, J., Durrant, A., & Vines, J.: '71/2 and weekend alarm: Designing alarm clocks for the morality of sleep and rest'. In: Proceedings of the 4th Biennial RTD Conference, Delft and Rotterdam, The Netherlands (2019)
 36. Gaver, W. W., Beaver, J., & Benford, S.: Ambiguity as a resource for design. In: Proceedings of the SIGCHI conference on Human factors in computing systems, pp. 233--240, April (2003)
 37. Boon, B., Rozendaal, M., and Stappers, P.: Ambiguity and Open-Endedness in Behavioural Design. In: Proceedings of the DRS International Conference 2018: Design as a catalyst for change, Limerick, Ireland (2018)
 38. Ozkaramanli, D., & Desmet, P.: Provocative design for unprovocative designers: Strategies for triggering personal dilemmas. In: Proceedings of the DRS International Conference 2016: Future Focused Thinking, Brighton, United Kingdom, pp. 2001--2016 (2016)
 39. Mollon, M., & Gentes, A.: The Rhetoric of Design for Debate: triggering conversation with an "uncanny enough" artefact. In: Proceedings of the DRS International Conference 2014: Design's Big Debates: Pushing the Boundaries of Design Research, Umeå, Sweden, pp. 1049--1061 (2014)
 40. Ward, M.: Critical about Critical and Speculative Design, SpeculativeEdu website, <http://speculativeedu.eu/critical-about-critical-and-speculative-design/> (2019)
 41. Schulz-Schaeffer, I., & Meister, M.: Laboratory settings as built anticipations--prototype scenarios as negotiation arenas between the present and imagined futures, *Journal of Responsible Innovation*, 4(2), pp. 197--216 (2017)
 42. Lim, Y.-K., Stolterman, E., & Tenenber, J.: The Anatomy of Prototypes as Filters, Prototypes as Manifestations of Design Ideas, *ACM Transactions on HCI*, Vol. 15, No. 2, Article 7 (2008)
 43. Adenauer J., & Petruschat J. eds. Was wir denken, in *PROTOTYPE! physical, virtual, hybrid, smart. tackling new challenges, in design & engineering, form+zweck*, Berlin, pp.12--37 (2012)
 44. McGrath, L., Bresciani, S., & Eppler, M.: We walk the line: Icons provisional appearances on virtual whiteboards trigger elaborative dialogue and creativity, *Computers in Human Behavior* Vol. 63 (2016)
 45. Gill, S., & Dix, A.: The Role of Physicality in the Design Process, in *PROTOTYPE! physical, virtual, hybrid, smart. tackling new challenges in design & engineering, form+zweck*, Berlin, pp. 54--79 (2012)
 46. Zimmerman, J., Forlizzi, J., & Evenson, S.: Research through design as a method for interaction design research in HCI. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 493--502 (2007)
 47. Gaver, B., & Dunne, T. P. E. Design: Cultural Probes. *Interactions*, 6(1) (1999)
 48. Carelman, J.: *Catalogue d'objets introuvables: et cependant indispensables aux personnes telles que acrobates, ajusteurs, amateurs d'art*, Vol. 2, Balland (1976)
 49. Kawakami, K.: 101 unuseless Japanese inventions: the art of Chindogu, in *WW Norton & Company* (1995)

50. Ellis, C.; Adams, T. & Bochner, A.P.: Autoethnography: an overview, *Historical Social Research*, 36(4), pp. 273–290 (2010)
51. Blythe, M.: Research through design fiction: narrative in real and imaginary abstracts. In: *Proceedings of the SIGCHI conference on human factors in computing systems*, pp. 703–712, April (2014)
52. Ward, M.: Design Fiction as Pedagogic Practice. <https://medium.com/@matthewward/design-fiction-as-pedagogic-practice-9b1fbba7ae2b> (2013)
53. Situation Lab: The Thing From Tee Future, <http://situationlab.org/project/the-thing-from-the-future/>
54. Le Guin, U. K.: *No Time to Spare: Thinking about what Matters*, Houghton Mifflin Harcourt (2017)
55. Mancini, C., Rogers, Y., Bandara, A. K., Coe, T., Jedrzejczyk, L., Joinson, A. N., ... & Nuseibeh, B.: Contravision: exploring users' reactions to futuristic technology. In: *Proceedings of the SIGCHI conference on human factors in computing systems*, pp. 153–162, April (2010)
56. Auger, J.: Speculative design: crafting the speculation. *Digital Creativity*, 24(1), pp. 11–35. (2013)
57. Malpass, M.: *Critical Design in Context; History, Theory and Practice*, Bloomsberg (2017)
58. Schön, D.: *The reflective practitioner: How professionals think in action*, Basic Books; inc., USA (1983)
59. Frye, A.: *Design und Improvisation: Produkte, Prozesse und Methoden*, transcript-Verlag, Bielefeld (2017)
60. Galloway, A.: Towards Fantastic Ethnography and Speculative Design, *Ethnography Matters*, <http://ethnographymatters.net/blog/2013/09/17/towards-fantastic-ethnography-and-speculative-design/> (2013)
61. Haraway, D.: Situated Knowledges: the Science Question in Feminism and the Privilege of Partial Perspective. In: *Feminist Studies*, Vol.14, No.3 (Autumn): pp.575--599 (1988)
62. Prado de O. Martins, L.: Privilege and Oppression: Towards a Feminist Speculative Design. In: *Proceedings of the DRS International Conference 2014: Design's Big Debates: Pushing the Boundaries of Design Research*, Umeå, Sweden, pp. 980–990 (2014)
63. Carey, H.: Anti-Oppression Mindsets for Collaborative Design. In: *Proceedings of the DRS International Conference 2010: Synergy*, Held online (2020)