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REFRAMING FROM FUTURE TO PRESENT IN INDUSTRIAL DESIGN

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ABSTRACT
Design fiction supports the development of tangible prototypes to assess factors in a near future in a more concrete way. The feedback loop into the present, however, remains as a set of recommendations or guidelines for new product development. This paper describes a methodology that includes reframing specific factors from the future to the present by using two related problem formulations, one in the future and one in the present. The methodology is used in an MSc of Industrial Design course where student teams work on project formulations for Space settings in a near future and reframe the projects to situations on Earth where factors concerning the problem, context, users or working principles are revisited, interpreted and reworked to create a value proposition for the present in a concrete manner.
The findings indicate that insights can be interpreted at various levels of abstraction and, when combined with critical thinking, stimulate the reuse of processual aspects and reframing of specific factors addressed in the future formulation into the current project formulation.

Keywords: Reframing, wicked problems, industrial design, design fiction, future forecasting

1 INTRODUCTION
Industrial design always involves a degree of future forecasting since product development requires understanding and testing various factors of the context in which the product will be used. User-centred design methods enable anticipating and testing user needs, prototyping supports the iterative development of working principles, and engagement with relevant stakeholders support the creation of a coherent value proposition. One can argue that these design methods of traditional problem-solving address short and medium-term forecasting because under such framework, technological development or new user needs will be addressed through a new cycle of product development.
Methods for longer-term forecasting that encompass designing tangible outcomes includes speculative design [1] and design fiction [2]. Speculative design uses storytelling and design outcomes as prompts for building a tangible scenario in a potential future. The potential future is then critically reflected upon by addressing values, ethics and implications that lead to the formation of new perspectives. Design fiction shares the common ground of being critical towards the future. The tangible prototypes are also used as means to represent factors related to technology and culture in a potential future to spark discussion about the consequences of decision making. The focus is deeper on existing archetypes [2, p.87] which are ordinary artifacts of daily life. When compared to speculative design prototypes, design fiction prototypes are often less uncanny, and therefore more relatable. Therefore, such prototypes of design fiction focus away from storytelling and remain more closely related to prototypes used as prompts for immediate reflection on the implications for users, interaction within the envisaged context together with people and other systems. For this reason, I position design fiction prototypes as having a function in the design process that is closer to traditional prototypes used in industrial design.
The feedback loop into present product development is one of the most important aspects of producing tangible artifacts as probes into possible futures. Design fiction [2, pp. 194–209] proposes disseminating the results of critical thinking in form of recommendations that will impact strategy. This feedback loop affects organisations and product development from top-down, which is similar to the recommendations proposed by future foresight [3]. I hypothesise that if the use of prototypes enables a better understanding of the envisaged future, then, the feedback loop into the present might also include the development of tangible outcomes. To fulfil this premise, a degree of relationship between the envisaged future and the

present situation must be established. Accordingly, experiments, insights, sensemaking and frames [4] used to tackle the future may become a baseline to assess the present situation.

The main goal of the methodology presented in this paper is to test this hypothesis in an educational setting, and it unfolds as follows: 1) Proposing a hypothetical situation in the future as a way to probe on factors affecting present situations; 2) Addressing the future situation by designing a tangible outcome to critically reflect upon its implications; 3) Reflect-in- and through-action is applied to propose a second-order tangible outcome to address the present situation. Steps 1 and 2 are addressed using traditional industrial design methods and design fiction, and step 3 through reframing.

Reframing occurs in teams with different patterns from individual reflection-in-action [5], where team members "engage in if-then arguments, and some of the experiments interact with the prototype, to assess particular situations". Team members then create new frames based on the reflections and proceed on to redefine the problem and design a solution. Reframing in the present paper is based on the stages defined by Stompt and co-authors [5] and requires assessing corresponding problem formulations at a high abstraction level and linking relevant product functions to develop operational solutions for contexts sharing similar requirements.

This paper describes how the methodology was applied in a project module in an MSc in Industrial Design, in which students chose a living function and designed products to support human activities in future settlements in space (Moon or Mars). Secondly, they developed concepts to improve existing situations on Earth that shared certain requirements with the first solution. The analysis of the projects developed by students focuses on specific factors, in both Space and Earth project proposals. The assessment of what factors were maintained, reframed, or abandoned supports the reflection about the methodology. The paper discusses the application of the methodology in academia and design practice after an assessment of its potentials and shortcomings.

2 METHOD

The project formulation presented in this paper was part of a revision of a 20 ECTS course for students in the MSc in Industrial Design at Aalborg University. The learning objectives were already established and were not changed. Overall, the competencies that students must accomplish by the end of the course focus on the topic "technology innovation driven by design" which entails transforming technology opportunities into strategies, concepts and specific product proposals through integrated product development. This topic was interpreted as a potential to explore the interrelationships between science, engineering, and design as defined in Oxman's krebs of creativity cycle [6], by emphasizing design as the catalyst to addressing technological advancements in both visionary and operational ways. This requires designing products and production systems in tandem, working with limited infrastructure that is currently under R&D and bridging the gap between conceptual design and production.

2.1 Course structure

The course spanned over 12 weeks and included five milestones. The academic evaluation included the submission of a process report, followed by an oral exam that included a presentation and discussion of product proposals and respective design processes. Students worked in teams of four or five elements. Each team was supervised by a main supervisor with a background in industrial design and a technical supervisor with a background in materials and production. In total, four faculty members, two from each background supervised the six teams of students.

The five milestones were defined as follows: 1) Scope and principles; 2) Analysis of concepts; 3) Concept visualization; 4) Details and conclusion for the Space proposal; and 5) Reframing for proposal on Earth. Each student team presented their work and received verbal feedback from the four faculty members and colleagues during the milestones. Milestones were used as learning spaces where concepts were questioned and discussed, and the process was assessed based on the validity of the methods used in relation to the specific factors of the inquiry. Milestones also served as learning spaces for friction and uncertainty, allowing different perspectives to be debated based on the proposed visions, with the goal of constructing, complementing, or reframing the core questions.

The semester was divided as follows: the Space project proposal was developed over eight weeks, with four milestones; the reframing for the Earth concept proposal was developed over two weeks with one milestone. The finalization of submission material took two weeks, with one week of preparation for the exams.

2.2 The assignment

'From Space to Earth' was the semester's theme. The goal was twofold: first, to imagine how new technologies could support activities in human settlements on the Moon or Mars in the near future, and second, to consider how these new applications could be reframed to improve existing situations on Earth. To develop their projects, student teams chose one of the following living functions: 1) Food systems; 2) Clean air and water; 3) Leisure and physical activity; 4) Energy efficiency; and 5) Interior furnishing. All projects should consider transportation, manufacturing, and assembly feasibility.

Students address the intertwined relationship between science and design by developing concepts for the foreseeable future that are based on ongoing research and cutting-edge technology. Second, when reframing the project formulation for Earth, students apply critical thinking to identify a situation that has some degree of commonality with the one developed for Space and develop a concept to address it.

2.3 Limitations

The semester occurred during a Covid-19 lockdown in Spring of 2021. Accordingly, all work was done remotely, including all academic assessments. This limited access to workshops for physical prototyping and face-to-face access to key stakeholders (users, researchers, component suppliers). Remote work enabled, however, a higher level of empathy regarding future communications between Earth–Space.

3 RESULTS

Table 1 provides an overview of the main factors – problem, context, users and working principles – concerning the project formulations. Furthermore, it provides a basis for assessing the degree of alignment between project formulations (Space and Earth), classified as Y (yes), N (no), or P (partial). Based on the established order of factors, the following alignment of project formulations is observed: 1. YNNN; 2. PYYP; 3. YPPP; 4. PNNN; 5. PNNP; 6. YPPP. These strings enable to conclude that reframing in projects 1 and 4 have a lower alignment, medium alignment in project 5, higher in projects 2 and 3 and highest on project 6.

Table 1. Main factors of the project formulations for Space and reframing for Earth

Team #	Factors	Space project formulation	Earth project reframing	Align.
1	*Problem*	Food production (Moon)	Food production	Y
	Context	Farming site	Home	N
	Users	Community	Family	N
	Working principles	Modular, self-supporting structures	Wall-mounted individual vases	N
2	*Problem*	Wastewater disposal (Mars)	Solid waste disposal	P
	Context	Living pod to habitat structure	Apartment in high-rise building	Y
	Users	Inhabitants	Inhabitants	Y
	Working principles	Electromagnetic rail system, bag, valves	Electromagnetic rail system, plastic bin, fork frames	P
3	*Problem*	Circadian rhythm monitoring (Mars)	Circadian rhythm monitoring	Y
	Context	Living unit	General use	P
	Users	General	Specific / Blind	P
	Working principles	Wearable device, glasses, light sensors	Wearable device, wristwatch, temperature sensors	P
4	*Problem*	Water capturing and transport (Moon)	Water capturing	P
	Context	Extract site to treatment facility	Rooftops in vulnerable housing areas	N
	Users	Automated system	Citizens	N
	Working principles	Electromagnetic rail system, carbon fibre track, 3D printed metal	Plastic water tank, in-situ materials	N
5	*Problem*	Physical activity and mental health / gamification (Mars)	Learning and physical activity / gamification	P
	Context	Living unit	Primary schools	N

	Users	Astronauts	Children	N
	Working principles	AR lenses, vibration board, sound waves, interconnected computer networks	Touch board, lights, interconnected computer networks	P
6	*Problem*	Food production (Mars)	Food production	Y
	Context	Living units / scalable	Family housing in refugee camp / scalable	Y
	Users	Community / astronauts	Community / refugees	Y
	Working principles	Cradle-to-cradle, tarpaulin, ceiling-mounted structures	Cradle-to-cradle, tarpaulin, self-supported structures	P

3.1 Low alignment: one factor addressed or partially addressed

In project 1, only the problem of food production is addressed in both formulations. Despite this fact, the team stated that "research done during the Moon scenario was useful to determine the technologies [hydroponics] used in this new [Earth/home] scenario".

In project 4, the water capturing problem was partially addressed, a correspondence that was established only at a higher level of abstraction. "Something both proposals have in common is their ability to take advantage of the environment, which shares the same overall problem: accessibility to water. The impact of context in both cases had a major influence on the concept development. (…) It was difficult to find a way to reframe the product to Earth because the technologies used [for the Moon proposal] would not work in the environment on Earth, and transportation of water on Earth is not calling for a solution."

3.2 Medium alignment: two factors partially addressed

Project 5 addresses similar problems by using similar working principles in both proposals. "The project focuses on motivation to exercise the vestibular system as part of the obligatory training [on Mars]. This project not only accommodates an exercise tool but also boosts mental and physical health by making the training fun in a social community setting. (…) The approach of motivation and physical activity benefits the brain and will be used for reframing new learning experiences in primary schools. (…) The strategy for reframing incorporated key elements from the original product. Hereby the reframing centred around a holistic approach to motivating someone (…) through gamification. At the same time the active element, aesthetics and interaction were kept as a part of the concept."

3.3 High alignment: all factors fully or partially addressed

In project 3 both proposals address the problem of biomonitoring the circadian rhythm of users. The Mars proposal is a system encompassing circadian light glasses, a monitoring device, and a charging station. The glasses simulate "a regular day with the right light intensity and colour hue" to enable the daily levels of hormone production. Reframing focused on finding users on Earth that shared similar challenges of circadian rhythm due to no perception of light. "Circadian rhythm also can be manipulated through temperature. This is the working principle of [the product for Earth. It] allows blind people to reach a similar optimized perception of the day, by regulating through changes in body temperature, and providing them with an aid that can help them keep track of time during the day. This is all controlled by the watch."

Project 2 partially aligns problem and working principles and fully aligns context and users. "The strategy of reframing [from Space] to Earth started with an identification of [the Space proposal's] strongest and most innovative competencies and clarifying them. An investigation on latent problems on Earth was explored to find further possibilities suited to related aspects of [the Space proposal]. This both contained the field of similar situations, features, or related problem areas, such as transportation, containing and handling of substances."

Project 6 fully addresses the same problem formulation, context and users when analysed from a high abstraction perspective. These factors, however, could be characterised as partial if analysed in more detail. The self-sufficient food production problem for Mars further encompasses the creation of glucose as a source for bioplastic that would, in time, be used as building material to scale up the system. Such conceptualisation is not present in Earth reframing. The "reframed product proposal [is] developed on basis of some of the same principles and knowledge. (…) Common to both proposals is the focus on a temporary plant growing solution with minimum environmental impact, and the use of locally available resources."

A cradle-to-cradle approach was considered in both formulations. However, in the Earth formulation, for refugee camps, the tarpaulin used is refurbished from existing tents, thus applying a different circularity level. This process is informed by a reflection upon the overall application of cradle-to-cradle for Mars. “This approach prolongs the material lifetime while dealing with some of the trash issues in refugee camps and minimizing cost and environmental impacts of shipping and producing new materials.”

4 DISCUSSIONS

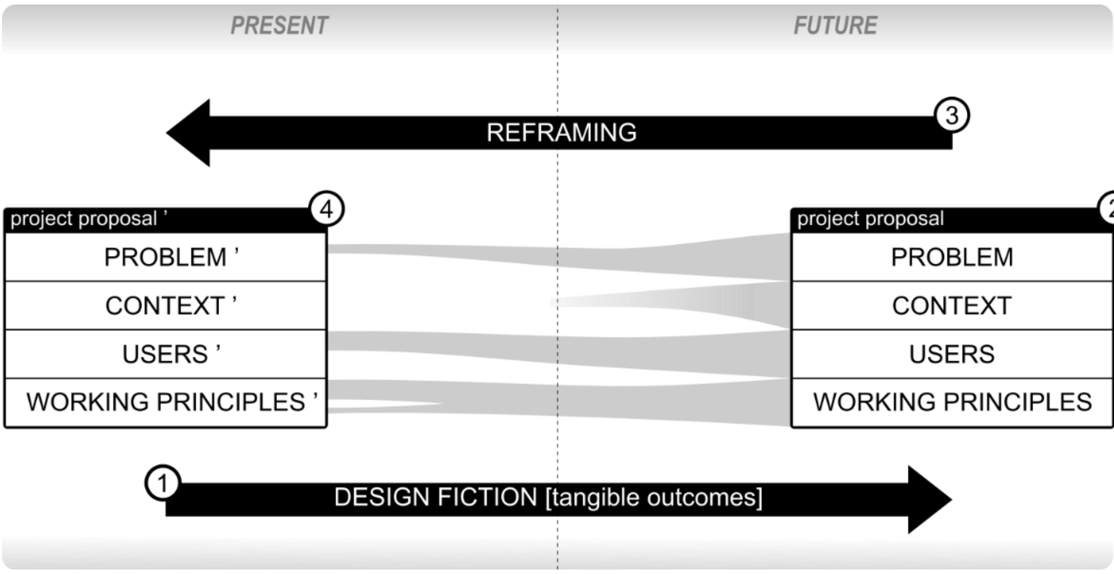

Figure 1. Proposed methodology for developing a project proposal for the future (2) by using design fiction (1) and reframing (3) it into the present (4) by bridging specific factors

The methodology presented in this paper (Figure 1) allows designers to use design fiction (1) in developing tangible outcomes that become part of developing a project proposal (2) for the near future, then reflect on several factors that define the proposal and reframe them (3) to create a project proposal for the present (4). The critical thinking involved in reframing for the present allowed design students to use the experience and findings from the project proposal for the future. Particular aspects from the problem, context, users and working principles provided a lens for finding real situations in which some of the factors were observed; and to address the discovered situation by reframing certain factors.

Reframing as a method for the feedback loop into the present differs from design fiction in that it does not include a set of recommendations reached after reflection. Comparatively, reframing allows for addressing the present at a more concrete level of abstraction, due to the development of tangible outcomes. However, because the future and present project formulations are not identical, this can be considered a limitation that must be addressed before this methodology can be used in design practice. An example of this assumption is that the loop in design fiction, while more abstract, still addresses similar factors from the future project formulation, and this may be included in a design brief for new product development in the present. Despite this limitation, reframing enables to tackle particular factors in present situations based on an experience gained from a problem-solving activity (developed to address the future situation). The creation of bridges between specific factors in the two project formulations (future and present) may allow designers to exercise critical thinking in ways other than mapping and analysis. It positions it more closely to reflection in- and through- action [7].

Overall, reframing from future-to-present facilitates mapping important elements of a problem-solution pair (as defined by [8] and tested with design teams by [9]) without biases that may arise when assessing a somewhat more familiar present situation rather than a future one. Furthermore, developing a specific product for the future that serves as a proxy for the present establishes a baseline for assessing both process- and product-related factors regarding the current problem formulation, requiring a new level of immersion in problems and their respective nuances. This process facilitates sensemaking by building on prior experience as well as previously established and reflected insights. Because both project formulations are addressed through tangible outcomes, I argue this constitutes a designerly way of knowing [10] for industrial designers in the context of design education.

Understanding a design proposal as a system that is part of a supersystem and includes interreacting sub-systems, all evolving in a continuum of past-present-future is not novel [11]. I consider that the methodology here described enables students in developing critical thinking towards established factors of present situations that sometimes are implicitly accepted at the outset of design activity (e.g., quality of infrastructure, uninterrupted supply chain, resources availability, etc.). The presented case demonstrated that students were able to reflect on previously created insights and reframe them into new user groups and contexts and relate them with business (supply chain, cost, etc.) and technical aspects (technology development, materials, production, waste, etc.).

5 CONCLUSIONS

Future designers are expected to deal with increasing wicked problems and upfront dynamic complexity. The methodology here presented offers an approach to engage with underlying factors of wicked problems, learn from direct experience, and use tangible outcomes as a central part of the learning experience. The findings indicate that insights can be interpreted at various levels of abstraction and, when combined with critical thinking, stimulate the reuse of processual aspects and reframing of specific factors addressed in the future formulation into the current project formulation.

Future research can address the application of this methodology in project formulations for specific product typologies and predetermined time frameworks. This exploration can be pursued either in learning contexts or design practice. This would allow clarity on which factors are more prone to be reframed and how situations could be effectively described in correspondent problem formulations to allow designers to approach them in unbiased ways.

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