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Mind the Future Gap: Introducing the FOD Framework for Future-Oriented Design

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Abstract

There are many uncertainties and ambiguities in the design of future-oriented artifacts. Societal and environmental developments are unclear; technologies not ready; target users not accessible. Nevertheless, designing future-oriented artifacts provides opportunities to either create radical innovations that present a competitive advantage, or to engage with relevant stakeholders in a speculative way. This paper provides a framework for developing, discussing, and evaluating future-oriented artifacts, which was developed based on literature and conceptual theorizing. It consists of a process model and a morphological box, outlining eight categories of relevance along with several options to choose from. Subsequently, we applied the framework to an existing future design project to illustrate its applicability. The framework spans the space of possible design and evaluation approaches and, hence, provides a guiding schema for researchers and practitioners to discuss the potentials and implications of design concepts for future-oriented artifacts.

Keywords: design science research, futurology, future artifacts, speculative design.

1. Introduction

The design of socio-technical IT artifacts is one of the main goals of the Computer Science and Information Systems (IS) disciplines. One of the peculiarities of designing lies in the attempt to change the status quo—as famously stated by Herbert Simon: to change existing situations into preferred ones (Simon, 1996), or, in other words, to create better futures.

We distinguish two fundamentally different strategies for designing future-oriented artifacts: (1) designing realistic artifacts for a (near) future that might not yet be possible or reasonable—either because the required technologies are not there yet, or because the envisioned context scenario has not yet occurred. The designed artifact is expected to solve a problem of the future or somewhat improve the status quo. Such artifacts have the potential to become radical innovations and, thus, present the designers with a competitive advantage. We call this strategy *futuristic design*. By contrast, (2) "artifacts from the future" are speculative designs that are created to engage today's audiences with possible futures (Peter et al., 2020). These artifacts would provide, for example, policy-makers or other decision-makers with material for thought and discussion, possibly with the goal to create preferred futures or prevent undesired ones. We call this strategy *speculative design* (Dunne, 2008; Dunne & Raby, 2013; Jakobsone, 2017). Throughout this paper, we refer to "future-oriented design" as an umbrella term for both strategies.

The question arises, how to develop future-oriented artifacts, how to discuss and evaluate them, based on what criteria, and with whom to test them if future users are not yet accessible. Consequently, this paper is guided by the following research question:

> *RQ: How could future-oriented artifacts be developed and evaluated?*

2. Theoretical underpinning

In the following section, we look into relevant theories and concepts that address the three main areas of interest of this paper: (1) different types of future-oriented artifacts, (2) how to develop an understanding of the future, and (3) evaluating and testing of future-oriented artifacts.

2.1. Future-oriented artifacts

As outlined above, we distinguish two different strategies for future-oriented artifacts, which we call "futuristic design" and "speculative design". Both concepts are described in more detail in the next subsections.

Futuristic design. We use the term "futuristic design" throughout this paper to refer to artifacts that aim at a (near) future. In contrast to speculative design, futuristic artifacts have the goal to actually become reality at some day and possibly solve a future problem or user need. In that sense, futuristic design provides

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opportunities for designers and companies to develop innovations and to gain a competitive advantage. However, sometimes radical innovations were developed too early—before the context emerged and technology or society were “ready” for the idea. Nevertheless, designing for future scenarios might provide opportunities for such radical innovations and, hence, yield a competitive advantage (Verganti, 2009, 2011). Being the first on the market to address an emerging problem or offering a novel technology might lead to business success, as long as the company can survive until the market is ready.

One potential strategy for developing such radical innovations could be science fiction as a design strategy (Thoring & Mueller, 2012b) or as a “what if…?” thought experiment (Steinmüller, 2003). Another approach for developing radical innovation for the near future is to match emerging technologies with relevant use cases. A good understanding of possible future developments and contexts, along with a visionary mindset are prerequisites for developing successful futuristic artifacts.

Speculative design. The term “speculative design” was coined by designer Anthony Dunne in 1999 (Dunne, 2006). Since then, the concept has gained lots of interest in the design and artistic fields. Related concepts are “critical design” (Jakobsone, 2017) (which has its roots in the “Italian Radical Design” movement of the late 1960s), “design for debate” (Dunne, 2008), and “design fiction” (Sterling, 2005). All these concepts aim at developing artifacts that have no commercial purpose but rather try to instigate discussion and engagement about various topics in a critical manner (Malpass, 2017). Speculative design is peculiar in the way that it tries to instigate discussion about possible future developments. Speculative design artifacts are designed as if they were from a possible future, sent back through time to the present day. They allow people to interact with them and to build an opinion on whether the related future would be desirable or not.

Also in the IS discipline, speculative design artifacts are discussed. For example, Peter, Riemer, and Hovorka (2020) refer to the term “artifacts from the future” to describe speculative design artifacts which engage audiences (like policy makers and innovators) in the discussion of emerging technologies. The authors present a typology of future artifacts, distinguishing them into historical artifacts, science fiction artifacts, artifacts demonstrating future technology, artifacts creating vicarious experiences, artifacts creating an intended impact, and thought experiments.

2.2. Understanding the future

We argue that when designing for future scenarios, we first need to (try to) understand the possible future context. Or, in other words, we need to acquire knowledge about the possible future. There are several aspects that have to be considered in this regard, which will be discussed in the next subsections.

Design knowledge. One aspect of particular interest is design knowledge because it has peculiar characteristics that influence the way we can engage with the future. In the design field, Thoring et al. (2022) presented a unified model of design knowledge that distinguishes several types and levels. One type of particular interest is *artifact knowledge*, which allows us to extract knowledge from (future) artifacts when evaluating them, or to embed knowledge into artifacts when developing them. Another relevant type of design knowledge is design intuition, which is similar to tacit knowledge (Polanyi, 1966). Design intuition comes from experience, trial-and-error, observation, and residing in relevant environments (Thoring, Mueller, et al., 2022). Furthermore, there are different knowledge qualities, for example *situatedness*, which refers to the capability of transferring knowledge into other contexts (in this case, from the future into the present and vice-versa), *expertise*, which determines the skill level and proficiency of a designer, expert, or user, which could indicate their usefulness for future design projects, and *content*, which refers to knowledge specific to a domain (Thoring, Mueller, et al., 2022). The question arises, how these knowledge types and qualities might help transfer design knowledge to future contexts, which we will explore in the following sections of this paper.

Simon and Newell (1971) introduced a theory of human problem-solving, consisting of a problem space and a solution space. In the IS field, vom Brocke et al. (2020) picked up these concepts and presented a framework of design knowledge in Design Science Research, which also distinguishes between a problem space and a solution space. The problem space contains several components for the application “context”, as well as so-called “goodness criteria” that would determine how well a design solution solves the problem in context. Between the problem space and the solution space, “evaluations” link solutions to problems and provide evidence whether a solution solves the problem well or not.

Future knowledge gap. We refer to the philosophical theory of “epistemic injustice” (Fricker, 2009) to describe the challenge of obtaining knowledge from the future. Epistemic injustice refers to the phenomenon of inequality of knowledge access and creation. People from different backgrounds and with different resources have different opportunities to gain and contribute knowledge. One type of epistemic injustice is called "hermeneutical injustice", which occurs when people are not able to express their needs and wishes, due to a "gap" in our collective hermeneutic resources. We argue that this "gap" could also be established by the time lag between the now and the future. In a sense, people from the future are epistemically discriminated against because they do not have a voice that can be heard by today's designers. Future users cannot be adequately researched and understood, simply because the future is not yet here. Today's designers cannot empathize and interview future users. This situation leads to knowledge asymmetry—one of the main challenges when designing or evaluating future-oriented artifacts.

Futurology. There exist several methods for exploring and understanding the future in the area of future studies or "futurology". Many of these methods aim at future or trend *forecasting*, for example through extrapolating developments of the present or past into the future. One example of this approach is the so-called Delphi study that involves a panel of experts who rate and comment on given hypotheses or future scenarios in several rounds, with the goal to reach a consensus (Linstone & Turoff, 1975). Another, more quantitative approach is scenario planning, a technique mainly developed by the Shell Corporation to develop future strategies (Shell International BV, 2008). Scenario planning combines known facts (such as demographics) with information from industry, politics, or military, as well as with additional key driving forces identified by social, technical, economic, environmental, and political forces—the so-called STEEP framework (Szigeti et al., 2011). Hovorka and Peter (2019) present and discuss futurology methods and approaches with regards to the IS discipline.

2.3. Evaluating future-oriented artifacts

Design validity. Research validity is an established concept in the social sciences and deals with the quality and traceability of scientific claims (Gilbert et al., 1998). More recently the concept of design validity was introduced in DSR (Larsen et al., 2020). Design validity goes beyond asking merely about the usefulness and quality of an artifact but about the strengths of its research claims and about the procedures for validating them. However, designing future-oriented artifacts raises several challenges for establishing design validity. First, there is the non-existing or not-yet-existing future context. Contrafactual antecedents might make the validation of a claim impossible or might shield the claim from criticism. Second, IS is concerned with socio-technical systems which are not static and not completely governed by known eternal scientific laws. Therefore, the epistemic status of design claims might change in the future.

Idea and artifact testing. Testing and iterating ideas and artifacts with exemplary users is one of the core concepts of user-centered design and designing in general. It is crucial to identify potential problems of the artifact itself or regarding the interaction with it, as early in the process as possible. Only then it is possible to avoid the risk of wasting resources by producing an artifact that does not solve any actual user needs. Consequently, a typical design process is an iterative cycle of designing, testing, and improving the artifact. This approach is particularly widespread in the design thinking field (Brown, 2008). Another common approach to user-testing in the Human-Computer-Interaction (HCI) field is usability testing (Barnum, 2010; Li et al., 2022), a method for controlled analysis of users' interaction with technologies in a laboratory environment. Also in the IS discipline, a user-centered approach with testing and iterating the design of IS artifacts has become a quasi-standard (Toms, 2018). There exist various methods for testing newly developed artifacts, such as the FEDS Framework (Venable et al., 2016). Also, Roseman and Vessey (2008) suggest improving the relevance of IS artifacts by validating them through a so-called applicability check. Through this process, IS artifacts can be evaluated regarding their importance, accessibility, and suitability for practice. When designing for the future, appropriate test users that understand the future context might not be accessible for testing and evaluating artifacts, though. This problem has rarely been discussed in the IS field (Carmel et al., 2011).

Lead users and early adopters. According to American speculative fiction author William Gibson, "The future is already here—it's just not very evenly distributed" (Gibson, 2003). What that quote means is that while the average people (the ones in the middle of a typical technological adoption bell curve) are living in the present, there are some people who are ahead of their times (the ones on the far left of the bell curve). These people are called lead users or early adopters. They are the first ones to use specific products, open to try new technologies, and they enjoy beta-testing products that are not yet on the market and providing feedback.

Moore's Law states that the number of transistors on a CPU roughly doubles every 18 months. This leads to an exponential increase of computing power for a constant financial budget and enables the gradual mass adoption of technologies through more and more affordable prices. If, however, lead users want to 'live in the future' they need to 'compute in the future', that means, to pay exponentially more to use a computing environment that is out of reach at the present moment for the majority of users.

Von Hippel (1986) suggested that data from lead users and early adopters has the potential to improve new product development in rapidly changing fields. Consequently, we argue that lead users have a great potential for future-oriented design, which is also supported by Brem et al. (2022).

In design thinking, one typical approach involves so-called extreme users (Brown & Katz, 2011). These include lead users and early adopters as well, but also consider the other end of the bell curve—novices or those users who have never used the technology or artifact before. In a similar vein, also "opponents" of the concept in question (such as professional thieves when designing a burglary protection system) are considered useful interview partners or research subjects. However, for developing future-oriented artifacts, we argue that one should focus mainly on lead users and early adopters, because these will most likely provide more useful insights for future-oriented design than novices or non-experts. We argue that the selection of appropriate users as representatives of *future* users is a crucial step in future-oriented design projects. Identifying lead users can be challenging, but the following characteristics could indicate potential lead users and experts as research participants: they are recognized by the media (e.g., giving public speeches or interviews), have many years of experience in the field, and/or are active in newsgroups and other social communities. The potential to identify lead users through netnography and crowdsourcing is discussed by Brem and Bilgram (2015)

3. Toward a framework for future-oriented design (FOD)

The insights from the theoretical underpinning, discussed in the previous sections, will inform our development of the FOD (Future-Oriented Design) Framework. It consists of two models: (1) a process model, and (2) a morphological box, which are discussed in the following subsections.

3.1. FOD process model

We propose two (iterative) cycles when developing and evaluating future-oriented artifacts (Figure 1). Following the classification suggested by vom Brocke et al. (2020), we call the first cycle *Problem Cycle*, which aims at understanding the future context and problem space, and the second cycle we call *Solution Cycle*, which aims at developing and/or evaluating the future-oriented artifact. We argue that the design and evaluation can only be performed after the designers have investigated the future context, which is why the *problem* cycle should come first. Only then, the designers can engage with developing or evaluating *solutions*. Developing and evaluating are placed within the same cycle, because a typical design process is an iterative cycle of designing, testing, and iterating (as outlined in Section 2.3).

Figure 1 illustrates the two iterative cycles. In the first "problem cycle" (red), selected representatives of future users should start by engaging with the future context to gain intuitive and factual knowledge. This knowledge leads to defining "goodness criteria" (vom Brocke et al., 2020), which will inform the users or designers when developing or evaluating a future-oriented artifact. In one or more iterations of the problem-cycle, the problem might be reframed, according to the gained knowledge (Dorst, 2015; Getzels, 1979). Then, the second "solution cycle" (blue) begins. The artifact is intended for the future context, which is again evaluated through the goodness criteria, and informs the users about the appropriateness of the artifact for the future context. These cycles can be run through several times, until a satisfying result is achieved.

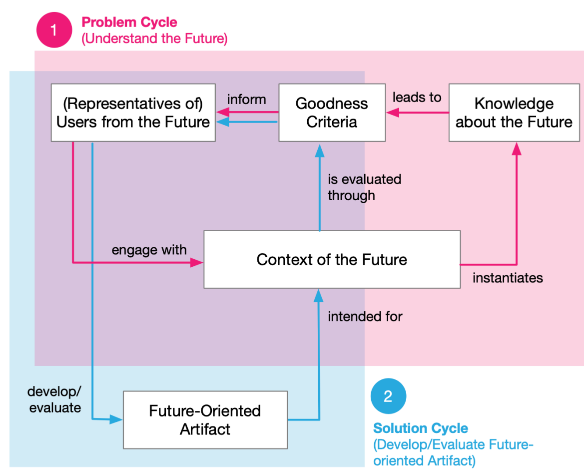

Figure 1. FOD process model (red: problem cycle; blue: solution cycle).

3.2. FOD morphological box development

Next, we look into the details of each step in the two cycles illustrated in Figure 1. Based on the insights from the theoretical underpinning discussed in Section 2, we defined eight different dimensions (entities) that appeared to be relevant for the problem and solution cycles. The dimensions were aligned as horizontal rows of a morphological box. A morphological box is a framework for modeling complex socio-technical systems with more than two variables (Ritchey, 2011).

Through conceptual theorizing, enriched by the researchers' personal experiences from past projects on future artifact design, we defined a set of possible choices for each entity. These choices were developed iteratively by constantly comparing and clustering the options until theoretical saturation occurred, that is, no new options emerged. For each category we checked whether the dimensions were complete, consistent, appropriate, and non-redundant. The choices were aligned horizontally to each entity. This procedure was performed by two researchers (both authors of this paper). The result is a morphological box, outlining the space of possible choices when developing or evaluating future-oriented artifacts.

To illustrate the applicability of the morphological box, we mapped it to an exemplary case—a design project aiming at developing futuristic artifacts. This procedure resulted in several iterations of the morphological box. For clarity reasons, we first describe the final morphological box (in the following section 3.3) and only in the subsequent section (Section 4) we describe its applicability through the exemplary case.

3.3. FOD morphological box

The suggested morphological box (Figure 2) consists of eight dimensions, derived from the insights presented in the previous section, as well as a set of options to choose from. In the following, we describe each dimension and the respective options briefly.

Future-oriented artifacts. As outlined in detail above, we distinguish two types of future-oriented artifacts: (1) futuristic artifacts that have the potential for radical innovations and a competitive advantage in the near future, and (2) speculative design artifacts that are meant as a means for critically discussing possible futures with relevant stakeholders.

Knowledge about the future context. In order to develop or evaluate future-oriented artifacts, we need to gain specific knowledge about the possible future and its context. Building on vom Brocke et al. (2020) and Thoring et al. (2022), we suggest the following aspects as relevant: (1) *domain* (or content)- specific knowledge, (2) knowledge about the *stakeholders* or user needs, (3) knowledge about the *time* horizon (are we designing for 3 or 30 years into the future?), (4) knowledge about the *place* (geographical and spatial location), and (5) knowledge about future language, which might create barriers to understanding the future (Frank, 2017) and is required to address and discuss the "unprecedented" (Hovorka & Peter, 2021a, 2021b).

(Representatives of) users from the future. As outlined above, there are no future users available in the presence. Due to this knowledge asymmetry, which is typical for future-oriented projects, one needs to "improvise" and try to find people who are able to represent the future users in the best possible way. We suggest four options within this dimension: (1) A future expert or futurologist, who is concerned with exploring future trends and scenarios. (2) A topical expert in the field to be addressed. This expert will be able to provide the latest cutting-edge knowledge within the field. (3) a lead-user or early-adopter. This person will be familiar with the latest knowledge,

Dimensions	Options					
Artifact Type	Futuristic Artifact	Speculative Artifact				
Knowledge About the Future Context	Domain	Stakeholder/ User	Time	Place	Language	
(Representative) User From the Future	Future Expert (Futurologist)	Content Expert (e.g. Technologist)	Lead User, Early Adopter	SciFi Author		
Inquire Context of the Future	Roleplay	Serious Gaming	Imagination	Expert Focus Group	Living Lab	Simulation
Epistemic Stance	Design the Future	Predict the Future	Prevent Undesired Future	Explore Alternative Future	Explain the Future (Post-Mortem)	
Approach for Future Artifact Design	Future-ready design research process	Delphi Design Sprint	Speculative Design	Co-Creation with Future Users		
Contextual Goodness Criteria	Privacy	Equality	Environment	Society	Policy	Justice	Health
Goodness Criteria for Artifact Evaluation	Desirability of Future Artifact	Feasibility of Future Artifact	Sustainability of Future Artifact	Viability of Future Artifact	Importance of Future Artifact	Accessibility of Future Artifact	Suitability of Future Artifact

Figure 2. FOD morphological box outlining the dimensions and options for developing and evaluating future-oriented artifacts.

technologies, and insights from the area to be investigated. And (4) a science fiction writer. This person will have insights into far-fetched futuristic ideas and lots of imagination (see previous sections for details).

Inquiry of the context of the future. The context of the future, such as social, political, and environmental developments, is difficult to assess. We propose six different strategies for inquiring the context of the future: (1) through *role-playing*. Acting out an unfamiliar context and situation allows people to empathize with the future users and to better imagine the situation (Thoring & Mueller, 2012a), which could lead to acquiring tacit knowledge, or design intuition about the future (see Section 2.2). The context could be inquired through (2) *serious gaming*, which describes the act of playing for non-entertainment reasons. This approach enables people to explore a serious topic, such as a future-oriented environment, in a playful way. According to Roos and Victor (1999), serious games allow for imaginative strategy-building, which can be highly useful for imagining future contexts. A serious game can be a video game, but also an analog game, such as Lego bricks (Lego Serious Play, 2006). The context could also be inquired through (3) *imagination*. This approach requires the participants to envision future scenarios, which could be triggered, for example, through inspiring stimuli (e.g., science fiction movies or literature). Another option for inquiring the future context is (4) through *expert focus groups*, which involve a panel of experts discussing the future context and bringing in their various expertise (Tremblay et al., 2010). A particular approach involving experts for exploring specific (future) contexts is a Delphi study (Alarabiat & Ramos, 2019). The future context could also be explored through (5) *living labs* (Almirall & Wareham, 2008; Bergvall-Kareborn et al., 2009), which provide a specific environment to engage the general public into exploring a topic of interest, for example new technologies. Finally, (6) a *simulation* is a digital environment that allows people to make certain decisions and observe their impact (Kushniruk & Patel, 2004).

Epistemic stance. Building on Hovorka and Peter (2019) we distinguish five different epistemic stances when engaging with future contexts: (1) designing the future, (2) predicting the future, (3) preventing undesired futures, (4) exploring alternative futures, and (5) explaining the future.

Approaches for future-oriented design. Systematic approaches for future-oriented artifact design are scarce. One example is (1) the future-ready design research (FRDR) process (Pee et al., 2021). This approach provides guidelines for researchers in order to raise their awareness for possible futures (desired and undesired ones) and prompts them to act accordingly. Another structured method for future-oriented design is (2) the Delphi Design Sprint (Thoring, Klöckner, et al., 2022), which is a novel method combining a Delphi study with fast-paced design sprints (Knapp et al., 2016). The method involves a panel of experts who develop and validate future scenarios and subsequently evaluate the futuristic artifacts that were developed in several rounds of design sprints, according to the developed scenarios. (An exemplary case of the Delphi Design Sprint is presented in Section 4). (3) Speculative design also provides several methods and approaches for developing future-oriented artifacts. The last example is (4) co-creation (Sanders & Stappers, 2008) with the involvement of (representatives) of the future users (Brem & Bilgram, 2015).

Contextual goodness criteria. Building on the goodness criteria for the problem cycle, as suggested by (vom Brocke et al., 2020) and by the STEEP analysis framework (Szigeti et al., 2011), we suggest the following goodness criteria for defining the future problem context: (1) implications for *privacy*, (2) implications for *equality*, (3) implications for the *environment*, (4) implications for *society*, (5) *political* implications, (6) implications for *justice* or legal implications, and (7) implications for *health* and wellbeing.

Goodness criteria for future artifact evaluation. We propose seven criteria for evaluating a future-oriented artifact. (1) *Desirability* determines in how far the artifact would fulfill user needs and wishes or solves a future problem. (2) *Feasibility* determines whether the artifact could be realized with future technologies in a given time. (3) *Viability* determines whether the artifact could be turned into a profitable product and succeed on the future market. (Criteria 1, 2 and 3 stem from the design thinking paradigm (Brown, 2008)). (4) *Sustainability* determines whether the artifact would be technically and socio-technically sustainable in the future. More specifically, one should assess the extent to which the artifact is designed to minimize risks and will continue to be useful in future (Pee et al., 2021). (5) *Importance* determines whether the artifact would be important for future users, based on the question whether it addresses a future problem. (6) *Accessibility* determines whether the artifact is understandable and usable for future users. And finally, (7) *Suitability* determines whether the artifact could be applied in the future context and whether it provides guidance for future users (Criteria 5, 6, and 7 stem from the applicability check procedure (Rosemann & Vessey, 2008)).

4. Exemplary illustration through a future-oriented design project

In order to illustrate the applicability of the suggested morphological box, we apply it to a real design project in which several futuristic artifacts were developed.

4.1. Project background

The project "Office of the Future" was a design research project in the year 2021, held in an international master program of a German design school. The project focused on post-pandemic scenarios and interventions for future offices. It applied and validated a novel design method combining Delphi studies with Design Sprints, called the Delphi Design Sprint (Thoring, Klöckner, et al., 2022), which aims at combining the scientific rigor of future scenario forecasting with the agility of validation via a design sprint. The project involved 20 experts from various fields, including futurologists, science fiction writers, and topical experts (e.g., office planners, architects, technology experts). The selected experts were considered to represent a broad range of experts and lead users and, hence, would act as representatives of the future users. Yielding diverse scenarios and interventions for near-future office environments, the results reflected an approach to gain confidence in ambiguous future settings.

4.2. Scenario development (problem cycle)

The future scenarios have been developed in a rather classical Delphi study, tethering the foresight expertise of the 20 experts. Within the project's first iteration, 23 future scenarios have been developed by the students and evaluated by the expert panel (Figure 3).

Figure 3. Scenario cards developed and validated within the "problem cycle" of the project.

This scenario development represents the "problem cycle" and informed both the future context and the future user's needs (through their representatives, the experts).

4.3 Development of futuristic artifacts (solution cycle)

Simultaneously and iteratively, the students conducted several design sprints (which represent the "solution cycle"). Based on feedback from the expert panel to first idea sketches and user journeys, 14 future-oriented design concepts were developed. In several rounds, solution and problem cycles interacted more closely through the developed concepts, backed by expert evaluation regarding goodness, context suitability, and future user's needs. Three iterative problem and solution cycles resulted in 14 refined concepts. One exemplary result is presented in the next subsection.

4.4. Exemplary result "Focus Cover"

The "Focus Cover" was developed in response to the scenario "digital detox zone", as depicted in Figure 4.

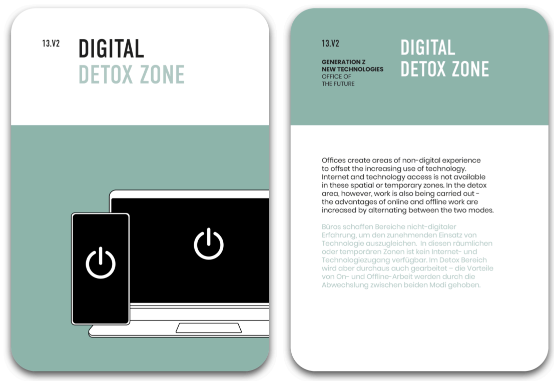

Figure 4. Scenario card "Digital Detox Zone".

The scenario "digital detox zone" suggests that the future users' need is increasingly guided by the desire to obtain temporary or spatial distance between different work modes. It argues that both open plan office environments and home-offices of the near future will provide heterogeneous conditions such as visual and acoustic distractions, which will increase interference with individual working condition needs.

The "Focus Cover" has been developed and iterated based on conceptual descriptions and visualization with the panel of user representatives. The project underwent several further iterations with feedback from the experts, leading to a committee-validated concept as follows:

"Focus Cover" is a ring-shaped personal infrastructure that provides an optimized working environment offering multiple stimuli around the worker's individual space. The structure is positioned over the head of the worker's desk where it can also serve as a focus lamp or provide ambient light conditions. If desired, it can be lowered to encapsulate the worker's head and act as a shield to prevent distractions (Figure 5). The interface inside the ring-shaped structure offers different work modes, ranging from meditation, to email and internet access, to video meetings. Stimuli include augmented reality, ambient light and sound modes, and individualized air conditioning (Figure 6). A physical prototype was created to allow for tangible experiences in the evaluation cycle.

Figure 5. Different usage modes of futuristic artifact "Focus Cover".

Figure 6. Hardware and user interface mockup.

The innovative solution aims to establish a flexible synthesis between conventional solutions such as noise-cancellation headphones or cubicle-like static room dividers and wearable AR/VR solutions.

4.5. Project discussion

To iterate and validate the morphological box (Figure 2), we compared it with the project's setting, the taken decisions, and the exemplary result of this future-oriented design project. The following options from the morphological box were covered:

Artifact type: The project was targeting the development of *futuristic artifacts* for a near future.

Knowledge about future context: The project's domain was *office planning*; the stakeholders were *office workers*; the time horizon was *5 to 10 years into the future*; and the target place was *open plan offices in technologically-developed countries*.

Representative users: The project involved *futurologists*, *content/domain experts* (office planners and technology experts), and *science fiction writers*.

Context inquiry: The future context was mainly inquired through *imagination* and several *expert focus group* workshops.

Epistemic stance: The epistemic goal of the project was first to *predict the future* through the development of hypothetical scenarios, and then to *design the future* in the form of futuristic artifacts.

Design approach: *Delphi Design Sprint.*

Contextual goodness criteria: The featured design solution "Focus Cover" had implications on people's *privacy*, on their *health* and wellbeing, and on their interaction with *society*.

Goodness criteria for artifact evaluation: The artifact was mainly evaluated regarding the potential *desirability* and technical *feasibility*.

Dimensions	Options						
Artifact	Futuristic Artifact	Speculative Artifact					
Knowledge About the Future Context	Domain	Stakeholder/ User	Time	Place	Language		
(Representative) User from the Future	Future Expert (Futurologist)	Content Expert (e.g. Technologist)	Lead User, Early Adopter	SciFi Author			
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Goodness Criteria for Artifact Evaluation	Desirability of Future Artifact	Feasibility of Future Artifact	Sustainability of Future Artifact	Viability of Future Artifact	Importance of Future Artifact	Accessibility of Future Artifact	Suitability of Future Artifact

Figure 7. Morphological box with selected options marked in yellow.

Figure 7 shows the chosen options from the morphological box marked in yellow. When mapping the project's decisions and results to the morphological box, several insights emerged:

(1) The approach with involving mainly experts served well for developing the scenarios and context (problem space) and for evaluating the artifact's *feasibility*. However, the *desirability* and future users' needs were difficult to assess. Consequently, we suggest improving the Delphi Design Sprint approach in the future by involving also lead users for testing the user needs.

(2) Apparently, the focus group of experts led mainly to factual knowledge but did not yield much empathy for the future users. Involving *role-play* and *bodystorming* techniques might serve better for triggering tangible experiences and empathy.

(3) Moreover, when matching the focus cover artifact with the requirements from the problem cycle (goodness criteria), the experts provided mixed feedback. Some found it inspiring and useful, others were concerned about it being confining. This calls for more iteration cycles with physical prototypes to allow tangible experiences.

(4) Despite the underlying scenario "digital detox", the resulting artifact "Focus Cover" still had many digital components, which were implemented

based on the feedback of the experts. This insight illustrates that the artifact needs also to reflect the problem context and try to resolve any contradictions. An office without digitality is not possible, which is why the solution cycle needs to reframe the problem (Dorst, 2015) and establish a reasonable compromise. This is the reason why the two cycles in Figure 1 are designed as a double loop, and not as a waterfall, and why there is an overlap between both cycles where the problem reframing happens.

5. Discussion and conclusions

This paper addresses the research question of *how future-oriented artifacts could be developed and evaluated*. We introduce the FOD Framework for future-oriented design which consists of a process model depicting the double loop of problem and solution cycle, and a morphological box that spans the solution space of relevant dimensions and options. The morphological box was then mapped to an exemplary design project in which artifacts for "the office of the future" had been developed.

The paper focuses introducing and developing the FOD Framework. Future work will focus on developing more specific guidelines of how to use the framework, and how the individual choices relate to each other (e.g., which choice to use for which approach).

The developed framework provides a foundation for further research that, for example, aims at building methods for engaging with future and possible worlds. Practitioners can use the framework as an inspirational overview of the solution space of different design choices, configuration options, and relevant concepts, as well as to position their own future-oriented design project accordingly. The application of future-oriented design in IS has been illustrated by the development of future artifacts with a focus on smart products, including both a physical and a behavioral dimension. This is of special interest for action systems and their relation to future users. For further evaluation we suggest to conduct studies with high fidelity prototypes of action systems with lead users.

One possible limitation of this paper is that the morphological box might not be exhaustive. It was developed based on an extensive literature review and iterated by mapping it to a case from the "futuristic design" category. Future work will need to map it to other future-oriented design projects, specifically to a "speculative design" project to investigate whether new dimensions or options emerge.

We acknowledge that futures are not knowable and cannot be limited to extrapolation from known facts, only (Hovorka & Peter, 2018). On the other hand, we can also not delegate all future research to speculative design and design fiction (Tonkinwise, 2014). We argue that design's main goal is and should still be "problem-solving", as suggested already by Simon and Newell (1971), also when it comes to future problems. The question of how these future problems could be identified and understood could be derived either from expert knowledge or from speculative envisioning. Our suggested framework provides tools and strategies for both approaches. Hence, we believe that the framework presented in this paper will help conceptualize, design, and evaluate future artifacts, shape future-oriented design projects, and, hence, bridge the gap between the now and the future.

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