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A Taxonomy of Design Futures Processes for Ethical Reflection on Technologies

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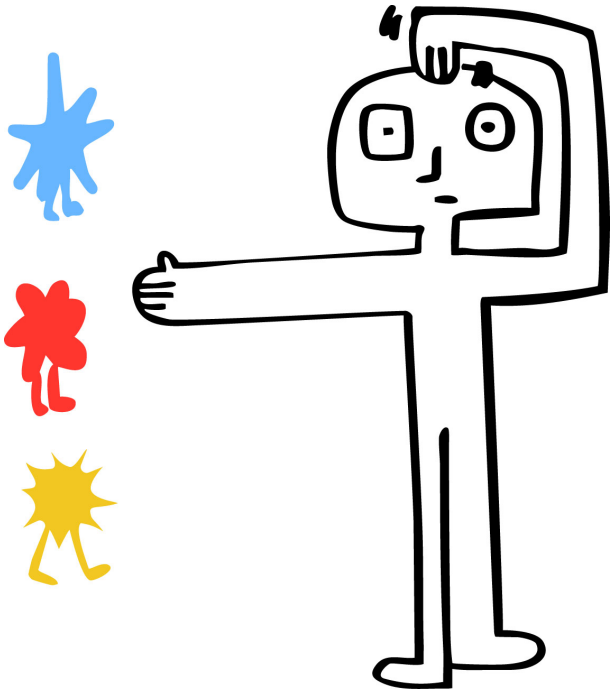


Figure 1: This image represents the motivation for our methodological study on Design Futures processes that support ethical reflection on technologies.

Abstract

Anticipating the ethical and societal risks of emerging technologies has become an urgent challenge as their rapid integration into everyday life can produce far-reaching social consequences. In response, Design Futures practices are gaining traction within HCI and design as approaches to critically examine and anticipate the implications of technology. Yet, systematic knowledge on how these practices are structured to foster ethical reflection remains limited. To address this gap, we conducted a scoping review of 32 case studies employing Design Futures to engage with ethical concerns. Drawing from this review, we present a *Taxonomy of Design Futures Processes for Ethical Reflection*, which illustrates how different activities, actors' involvement, and types of futures generated shape the scope of ethical discussion. This taxonomy provides researchers and practitioners with practical guidance for creating Design Futures activities that foster ethical reflection on technology.

CCS Concepts

• **Human-centered computing** → *HCI theory, concepts and models.*

Keywords

Design Research Method, Design Future Practices, Ethics of Technologies, Literature Study

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1 Introduction

Digital technologies have promised significant societal benefits, transforming domains such as healthcare, education, and policing [95]. However, at the same time, numerous social and ethical issues emerge, such as algorithmic discrimination and bias, as well as privacy and surveillance concerns [25–28].

Within the HCI and Design community, several design practices have been used to critically examine and anticipate the ethical implications of technology. Among them, Speculative Design [29], Design Fiction [9], and Experiential Futures [18] that emerged over the past three decades in response to the need for imagining desirable futures and mitigating unfavourable outcomes [19, 54, 59]. By combining storytelling, speculative scenarios [47], and diegetic artefacts [9, 29, 59], these practices translate abstract futures into tangible experiences, making them accessible to audiences beyond expert circles [54]. These approaches share a commitment to generating alternative sociotechnical narratives, which can open up discussion about emerging societal and ethical issues.

Despite these similarities, the field remains characterised by significant terminological and methodological complexity and blurriness. Different scholars use overlapping umbrella terms—such as *Design Futuring* [54], *Speculative Design* [23], or *Discursive Design* [84]— to refer to these practices. In this work we adopt the term *Design Futures*, following Maze [69] and Harb [46], because it explicitly foregrounds the role of design in giving form to futures while remaining broad enough to encompass multiple practices without imposing hierarchy among them.

Alongside terminological variation, these approaches are characterised by a high degree of flexibility and adaptability across contexts and application domains. While this flexibility is a strength, it also contributes to a lack of clear articulation around processes and methodological choices [58]. Existing literature provides valuable conceptual and theoretical accounts—through definitions [46, 65], classifications [2], and design exemplars [29]—yet offers limited systematic knowledge on how Design Futures processes unfold in practice [23, 78]. Much work focuses on research *through* Design Futures, while literature that research *into* Design Futures [38, 58] investigates only isolated aspects such as participant engagement [30], prototyping strategies [59], or qualities of good speculation [78]. To the best of our knowledge, only a recent study, by Cordova et al. [23] addresses this methodological gap by identifying the phases and methods that constitute what they define as Speculative Design work.

However, within the current landscape of technological development, where ethical concerns should not be an afterthought, understanding how Design Futures can meaningfully and intentionally support ethical reflection becomes critical. Although these practices are inherently critical and have addressed ethical and societal questions [29, 65], it remains unclear *how* specific processes, strategies, and design choices enable ethical reflection in practice, or how different configurations shape the kinds of ethical reasoning that emerge. This creates challenges for researchers and practitioners who wish to select or construct an approach suitable for their aims. To address this gap, we conducted a scoping review of case studies that adopt Design Futures to foster ethical reflection on technology. Our review examines two research questions: **RQ1:** *What are the key stages, activities, and methods through which Design Futures processes promote ethical reasoning about technology futures?*, and **RQ2:** *What types of ethical reasoning are enabled by Design Future practices, and how do different processes shape them?*

Based on this review, we developed a *Taxonomy of Design Futures Processes for Ethical Reflection*, which highlights the main aspects of Design Futures processes—such as activities, actors' involvement, and types of futures generated, their typical configuration, and how these factors influence the scope and outcomes of ethical discussions. Our aim is not only to provide a supporting tool for designing a Design Futures activity for ethical discussion, but also to further clarify what "ethical discussion" means in this context, whether it involves analyzing risks and benefits, exploring value conflicts, or examining ethical principles. It is not the goal of this study to determine what constitutes the most effective or appropriate way of addressing the ethics of technology. Instead, we aim to document the emerging specific use of Design Futuring to enable ethical reflection in HCI, and to describe how such reflection is currently enacted within Design Futures case studies.

Although the main contribution of this study is a "Taxonomy of Design Futures Processes for Ethical Reflection," it should not be read as a prescriptive, or exhaustive "how-to" manual. Rather, it offers an orienting framework and constitutes an initial step towards building structured and comprehensive knowledge about the potential of Design Futures practices for ethical discussion. The taxonomy is intended for researchers and practitioners who wish to engage with these approaches and who may benefit from understanding the design choices available when constructing a Design Futures activity aimed at fostering ethical reflection. Rather than consulting multiple sources, future researchers can use the taxonomy to identify the approaches, processes, and outputs best suited to their scopes and contexts. In this way, the taxonomy serves as a practical tool, supporting informed design choices when developing Design Futures activities aimed at fostering ethical discussion of emerging technologies.

Concurrently, the taxonomy can serve as a resource for researchers conducting studies *into* Design Futures. By analyzing connections between the taxonomy components—processes, actors and outcomes—our work highlights knowledge gaps and research opportunities that future studies can address, contributing to strengthening the methodological foundations of these practices.

2 Related work

2.1 Need for Critical Anticipatory Ethical Reflection on Technology

Digital technologies are not neutral. As scholars have long argued, they can embody and reinforce values, politics, and power dynamics [96]. The rapid adoption of digital technologies has intensified ethical challenges, with documented negative effects ranging from discriminatory practices in hiring [1, 20] to the polarization of public discourse through algorithmically curated social media feeds [79], alongside issues of algorithmic opacity and bias [15, 31] and surveillance practices [26, 27].

To ensure that technological development remains truly beneficial, researchers have argued that ethics must be addressed as a central concern rather than an afterthought [13, 41, 83]. Yet early

engagement remains challenging due to the "Collingridge dilemma," [21] which claims that technologies are easiest to reshape early in their development when their consequences are least predictable, and hardest to alter once effects become clearer. This highlights the need for methods that can grapple with uncertainty and anticipate long-term implications [39].

The HCI community has long engaged with these challenges through various approaches that explicitly integrate ethics into design and development processes. These range from structured tools such as ethical checklists [74], to reflective prompts for interrogating the responsibilities of computing systems [32], to long-standing card-based methods for surfacing ethical concerns [8, 60]. However, researchers have argued for the need to move beyond value-neutral framings of technological development and toward more pluralistic and nuanced perspectives on ethics. Two influential traditions rosen within this shift are Participatory Design (PD) [71] and Value Sensitive Design (VSD) [37]. PD emerged as a politically grounded practice centred on democratic participation and the situated expertise of user with the power to questions assumptions about technologies in different contexts [11, 71]. VSD offers a methodological framework for identifying and embedding human values into technology design [92]. While its early conceptualizations leaned toward universal and prescriptive values, more recent work has shifted toward situated and culturally aware methods [12]. All the above-mentioned approaches do have a value in engaging with people and identifying implications of technological systems. However, they remain primarily within an affirmative rather than critique spaces and are bound by present-day and near-term design interventions or feasible design solutions [81].

Given ongoing calls within HCI for more nuanced, plural, and anticipatory approaches to ethics [81], there is a need for practices that can engage publics in critical reflection about possible technological futures without being constrained by existing systems or feasible solutions.

Design Futures practices offer distinctive potential in this regard. By working with speculation, imagination, and alternative sociotechnical narratives, they create critical spaces that extend beyond current constraints and allow diverse publics to interrogate future trajectories. Design Futures can surface hidden assumptions, reveal emergent system-level effects, and support ethical reflection before technologies are deployed.

2.2 Design Futures in HCI

Future Studies can be defined as the methodological and systematic exploration of possible, probable, and preferable futures, aimed at building pathways toward desirable and sustainable futures at both societal and individual levels [68]. At the intersection between Future studies and design practices [46], Design Futures practices have emerged over the past three decades as a response to the limitations of traditional design approaches in addressing long-term uncertainties and as a critique to the status quo. These practices critically examine sociotechnical imaginaries and propose alternatives that surface underlying values, needs, and ethical concerns [19, 97].

Among the most prominent practices are Speculative Design, Design Fiction, and Experiential Futures, each characterised by particular approaches to world-building, storytelling, and prototyping [47]. Speculative Design employs hypothetical artefacts and scenarios to challenge assumptions and provoke critical discourse, often about the far future [2, 29]. Design Fiction builds on this by embedding technological artefacts within narrative worlds—what Kirby terms "diegetic prototypes" [51]—which act as rhetorical devices to suspend disbelief and engage an audience with near-future imaginaries [9, 82]. Experiential Futures extends these approaches by creating immersive, multi-sensory experiences that allow participants to inhabit future scenarios and reflect on them viscerally [18, 43].

In HCI, these approaches have been adopted to anticipate the implications of emerging technologies and to foster ethical deliberation [44, 97]. Blythe [10] explicitly situates Design Fiction within HCI, framing it as a way of doing "research through design fiction" and highlighting its potential for critical reflection. Wakkary [93] places Design Futures within a broader landscape of "things we could design," situating speculative practices as a means to question norms and reimagine socio-technical relations. Finally, Frauenberger [35] explicitly links speculative design to ethics, arguing for "entanglement HCI" as a way to foreground responsibility in how technologies are envisioned.

While these approaches share a commitment to imagining alternatives futures, they often differ in scope, in the focus on the critique, in their approaches, and in how futures are translated and produced. This diversity contributes to make it even more complex to define ethical reflection in relation to Design Futures, considering that every practice approaches ethics in different ways, with different scopes and granularity.

2.3 Lack of Comprehensive Design Futures Knowledge

Practices encompassed under the Design Futures umbrella are increasingly used in HCI and Design to examine the ethical and societal implications of technology. Yet, despite this widespread adoption, the literature reveals a persistent lack of clarity on how these activities are structured. Contributions often focus on *using* Design Futures to generate insights, while fewer reflect on the practices themselves, the activities undertaken, the actors involved, or the scope and output of the ethical discussion. This lack of reflection makes it difficult to understand how Design Futures can be systematically adopted for ethical discussion.

Attempts to structure Design Futures practices remain relatively scarce or limited across the broader landscape. Auger [2]'s taxonomy categorises speculative artefacts by intent but does not describe the processes through which they are created. Malpass [65] traces the theoretical roots of speculative design yet offers little practical guidance on collaborative or methodological choices. Farias et al. [30] provides a taxonomy of participation, but because their aim was to critique elitism within speculative practices, the framework does not link participation to process structure or to the kinds of outcomes that emerge. Harb [46] contributes a detailed account of motivations behind Design Futures, but similarly remains at a high theoretical level without addressing how concrete design decisions shape reflective outcomes.

Within this fragmented landscape, Design Fiction stands out as the practice with the most substantial attempts at formalisation. Grand and Wiedmer [40] introduced a "method toolbox"; Knutz et al. [53] proposed a four-step process (*envisioning, narrating, prototyping, reflecting*); and Lindley [59] offered one of the field's most comprehensive definitions, although largely centred on narrative and prototyping choices rather than considering elements like participation or design rationale. Even Bleecker's influential definition linking Design Fiction to the production of artefacts [9] has been inconsistently applied, with many contemporary works presenting only fictional scenarios [3, 55, 63, 66]. These inconsistencies highlight ongoing tensions between traditional conceptions of Design Fiction and its current uses. Rather than relying solely on theoretical definitions, our study responds to this need by deriving grounded insights from contemporary Design Futures practices.

A recent contribution addressing this methodological gap is the systematic review by Cordova et al. [23], which identifies recurring phases and methods employed in Speculative Design practice. The framework offers valuable conceptual clarification, detailing phases such as speculative exploration and speculative transformation, along with techniques associated with each. However, the analysis focuses exclusively on studies self-described as "Speculative Design," leaving aside related Design Futures approaches such as Design Fiction or Experiential Futures. Moreover, it does not examine ethical reflection, and how specific design choices shape the kinds of reflections that emerge. Our taxonomy complements this work by offering a process–outcome perspective grounded specifically in case studies that use Design Futures to elicit ethical risks, implications, and values.

Finally, while a growing body of literature has examined the artefacts produced through Design Futures, from prototypes and interfaces to speculative manuals and diegetic artefacts [9, 18, 59], these studies focus mainly on the outputs themselves. Artefacts can indeed act as provocations, prompts, or boundary objects that enable publics to reflect on socio-technical issues [43, 97], but the relationship between these outputs and the design processes that generate them remains underexplored. This gap further motivates our contribution, which examines how processes, participants, artefacts or scenarios, together shape the ethical discussions that Design Futures practices make possible.

3 Methodology

3.1 Scoping Literature Review

To address our research questions, we conducted a Scoping Literature Review (SLR) following the PRISMA Extension for Scoping Reviews (PRISMA-ScR) checklist [86]. Two databases were selected after a preliminary scan of the field: *Scopus*, for its broad coverage of peer-reviewed literature, and the *ACM Digital Library* (ACM-DL), for its strong focus on HCI and technology ethics.

The review investigates how researchers and practitioners adopt Design Futures practices to reflect on the ethical implications of technologies, with particular attention to the design choices made during these processes and the resulting outputs. Although *critical* reflection is recognised as an inherent dimension of Design Futures [29, 46], not all Design Futures projects place *ethics* at the centre of their inquiry. Many works employ these practices to articulate future imaginaries [57], explore design spaces, or construct alternative visions [50, 73] without explicitly analysing the ethical implications of emerging technology. Because our research questions focus specifically on how Design Futures processes support ethical reasoning, we restricted our corpus to studies in which ethics was an intentional and explicitly articulated aim. Accordingly, our database queries combined the term *ethic** with keywords associated with Design Futures. This ensured that the included studies explicitly framed their processes around ethical reflection. Table1 summarises the search queries and filters used in each database.

Table 1: Search Strings and Filters used in each Database

Database	Search String	Filters	Results
ACM	(Title OR Abstract OR Keywords:(Speculat* AND Ethic* AND Design)) OR (Title OR Abstract OR Keywords:("Design Fiction*" AND Ethic*)) OR (Title OR Abstract OR Keywords:(Experiential* AND Futur* AND Ethic*))	Citation > 0	230
Scopus	TITLE-ABS-KEY (Ethic* AND Design AND Speculat*) OR TITLE-ABS-KEY (Ethic* AND "Design fiction") OR TITLE-ABS-KEY (Ethic* AND Futur* AND Experiential)	Citation > 0	686

We carried out the review in three phases: *Identification*, *Screening*, and *Eligibility*, detailed in the following sections (also see Figure 2).

3.1.1 Screening. All 836 records were manually screened on title, keywords, and abstract. Papers were included when they met all of the following criteria:

(1) The study reports a case study or project in which a Design Futures practice (e.g. speculative design, design fiction, experiential futures) is used as a main or secondary research method.
(2) The study explicitly reference that the Design Futures practice was employed to explore a technology or technological system.
(3) The study indicate that ethical discussion, reflection, elicitation, or assessment is a central objective, research outcome, or intermediate analytic step.

The first author repeated the screening process twice, and each time discussed unsure cases with the last author to ensure accuracy and reliability. This phase reduced the corpus to 98 papers, which were then subjected to full-text eligibility assessment.

3.1.2 Eligibility assessment. The first author conducted a full-text screening to verify the eligibility of the publications. During this phase, 66 papers were excluded for different reasons. Some papers presented only a fictional scenario or artefact without describing

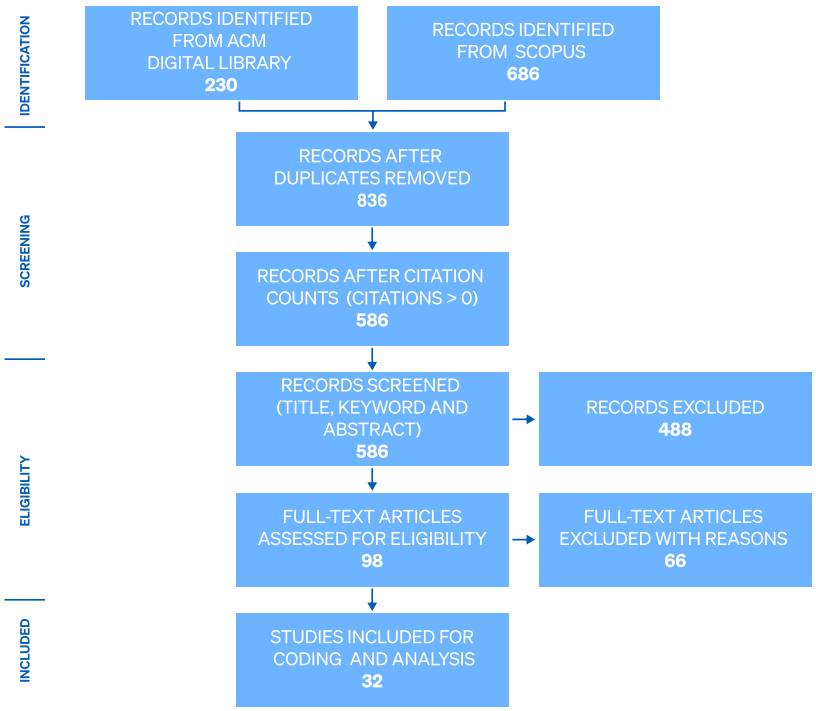


Figure 2: PRISMA flow diagram showing the literature collection and screening process.

the design process or its goals. Others did not focus on technology, while a further group consisted of theoretical reflections on Design Futures without reporting an empirical study. Finally, several workshop papers that had not been identified in the earlier screening stages were also excluded. As a result 32 papers were included in our literature analysis. Figure 2 provides an overview of the complete selection process.

3.2 The corpus

The final corpus of 32 publications reflects a diverse and representative sample of Design Futures practices. Several studies explicitly adopted well-defined approaches such as Speculative Design [4, 7, 24, 36, 42, 48, 52, 61, 72, 80], Design Fiction [3, 6, 22, 55, 63, 66, 77, 88, 90, 91, 94, 100, 103], or Ethnographic Experiential Futures [62]. Others employed broader or less common labels, such as Critical Design [87], Speculative Scenario [75, 98, 99], and in one case, Participatory Speculative Design [49].

Most of the documented activities took the form of workshops, typically lasting a few hours, although some extended across several days or over longer periods. The included papers were published between 2014 and 2024.

With regard to their aims, the majority of papers applied a single or a combination of Design Futures practices to enable participants to explore and reflect on the ethical implications of technology. A smaller set focused instead on evaluating the practices themselves and their effectiveness in eliciting ethical reflection. These different objectives influenced the level of methodological detail reported: studies that centered on method evaluation often provided rich procedural accounts, while those prioritising ethical insights tended to describe the process more briefly. This differences influenced the development of our Taxonomy, resulting sometimes in uneven levels of detail across the selected case studies; we discuss this limitation in Section 5.4. Despite these differences, we argue that the final corpus provides a fair overview of current Design Futures work and offers a solid foundation for a first attempt at systematising knowledge on the processes, actors, and outcomes of these practices.

For a complete list of all the case studies included in the analysis, along with their corresponding identification codes used in the taxonomy figures see Table 2 in Appendix A.

3.3 Analysis and Synthesis

The collected and screened papers were analysed and coded over a two-month period (June–July 2025) by the first and last author. This study employs reflexive thematic analysis, as outlined by Maguire and Delahunt [64], to examine how researchers have adopted Design Futures to reflect on the ethics of technologies. This method enabled us to inductively capture the nuances with which Design Futures processes are adopted to foster ethical discussion and the kinds of outcomes they generate. The first author carried out the primary analysis; the last author provided supervision and helped with the refinement of the themes.

Familiarisation. The first author read every paper in full, extracting sentences that referred, directly or indirectly, to elements of the Design Futures process. Relevant material was found mainly in Introduction and Methodology sections and covered:

(1) Descriptions of the structure (e.g. *"Participants were invited to present their ideas about key interactions to the rest of participants who were invited to discuss them."*[61], *"We presented narrative concepts to introduce a fictional, near-future AI documentation assistant, explaining to each participant a definition of AI"* [94]);
(2) Descriptions of how the future world was made experienceable—such as scenarios and artefacts—(e.g. *"In the prototyping phase, participants created a visual artifact in the form of a website promoting and explaining the fictional service or product."* [48];
(3) How these experienceable elements—such as scenarios and artefacts—were used during the process (e.g. *"This speculative exercise (scenario development) helped generate creative and unexpected designs (artefacts)."* [75]).
(4) Descriptions of what was the scope of the ethical reflection and how it was done (e.g. *"Participants create speculative design artifacts to communicate or protect against potential ethical implications and collectively navigate design trade-ofs."* [42]

Open coding. The first author cleaned the dataset and generated an initial set of codes capturing four main aspects: Process Steps, Participant Roles (e.g. "reflexive", "co-envisioning") and expertise, Forms of Manifesting the Future (e.g. "visual artefact", "snippet scenario"), and Scopes of Ethics. For the process-related codes, each entry was summarised as a sentence beginning with either *The researcher…* or *The participant(s)…*, followed by a short description of the action performed.

Themes generation. Similar codes were clustered to form initial themes. These themes remained largely descriptive, representing recurring patterns in how activities were organised.

Themes review and refinement. The first and third authors iteratively reviewed the themes, examining how activity steps, participant roles, and future manifestation qualities combined to shape each Design Futures process and its outcomes. Through iterative discussions, we refined theme boundaries, merged overlaps, and clarified naming. The final set of themes constitutes the taxonomy presented in the following sections.

4 Results: The Taxonomy of Design Futures

Based on the analysis of the 32 papers, we developed the *Taxonomy of Design Futures Processes for Ethical Reflection.*

The taxonomy provides a descriptive and relational analysis of the elements that constitute a Design Futures process. It defines each element, highlights its function within the process, and outlines its relationships with other elements. In doing so, it offers a structured vocabulary for planning and designing such processes—not only in terms of *what* the elements are, but also *how* they interact. The taxonomy is organised into two main dimensions: the **Process**, which captures how a Design Futures process unfolds, and the **Outcome**, which captures the forms of ethical reflection it generates.

4.1 Taxonomy Structure

The taxonomy is organised into two main dimensions (Figure 3). The **Process** dimension describes how a Design Futures process unfolds, and includes Actions, Stages, Actors' Roles, Future Manifestations. Process Archetypes are derived from different combinations of these elements. The **Outcomes** dimension captures the results of the process showing both the Ethics Conceptualization and the Ethics Breadth.

In the following paragraphs, we first introduce the two dimensions, and briefly describe the elements that compose them, their relations, and hierarchies. We then present a vertical analysis of the most significant elements in Subsection 4.2 and describe the emerging Process Archetypes in Subsection 4.3.

4.2 The Process

The Process dimension defines the elements that constitute how a Design Futures activity unfolds.

4.2.1 Actions. Actions are the smallest units of a Design Futures process: individual steps carried out by either researchers or participants, always with a clear beginning and end. Examples include the "analysis of the technology" [49] or the "identification of stakeholders" [97].

4.2.2 Stages. Stages form the structural backbone of the process, grouping together actions with similar scopes. From the corpus, we identified five main stages:

(1) *Exploration*: actions aimed at understanding the technological or sociocultural context before speculating about futures. This stage included activities such as interviewing experts or stakeholders [22, 63], conducting desk research on trends or existing systems [49, 75], or sharing insights through group discussions [24]. These activities were grouped together because they all focus on building a knowledge base that informs later speculative work.
(2) *Generation*: actions in which Future Manifestations are created. This includes writing storyworlds, futuristic autobiographies, or scenarios [6, 22, 77], producing sketches or concepts for future products and technologies [36, 66, 103], and crafting speculative artefacts [7, 75, 100]. We also grouped under this stage activities such as iterating, selecting, or collectively refining these Future Manifestations [49, 90, 100].
(3) *Interaction*: actions where participants or researchers engage with the generated manifestations. Interaction took the form of individual engagement during interviews [52, 98], collective activities such as focus groups [66], public exhibition encounters [72, 99], or prolonged engagement with artefacts in everyday settings [75]. These activities were clustered because they involve encountering and interactive with the future world.
(4) *Reflection*: actions focused on debating and reflecting on the Future Manifestations. Reflection could be individual—through interviews [4, 22] or written responses [7]—or collective, through facilitated group discussions [3, 88].
(5) *Analysis*: actions in which researchers examine the material generated in previous stages—such as Future Manifestations or records of participant reflections—typically through thematic analysis. This stage was included only when the ethical outcomes were not directly articulated by participants during the activity.

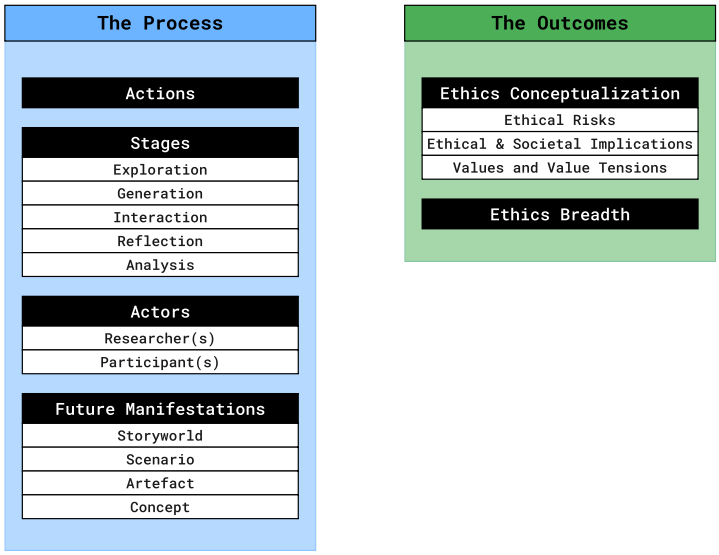


Figure 3: Overview of the taxonomy. The figure presents the two dimensions of the taxonomy—*Process* and *Outcomes*—along with their corresponding elements and subcomponents.

Not all stages are present in every case study; the only stage that exists in all papers is *Generation*.

4.2.3 Actors' Roles. Actors' roles describe who is actively involved in the process. During the analysis we gathered data on the actors involved in the Design Futures process. This enabled us to understand not only how Design Futures activities are conducted, but also who is involved, with what role and the distribution of agency across the identified stages. From the corpus, we identified two main actor types: *Researchers* and *Participants*. The term *Researchers* includes the authors of the studies and other members of the research team. Their involvement typically reflects actions such as designing the activity, preparing materials, facilitating sessions, or analysing outputs. In some cases [61, 72, 77, 90, 91], researchers also took part in the generation of Future Manifestations (e.g. by creating initial scenarios or artefacts).

We use the term *Participants* to refer to all individuals invited to take part in the Design Futures activity who were not part of the research team. This term covers a heterogeneous group with diverse forms of expertise. Participants included: industry stakeholders [3, 22], technology end-users [91, 94], students [6, 100], exhibition visitors [72, 99], or members of affected communities [88]. Across the corpus, participants were included either for their domain expertise, their experiential knowledge of a sociotechnical context, or their lived experience of an issue shaped by the technology.

4.2.4 Future Manifestations. Future Manifestations are the tangible and concrete expressions of a vision of the future. They are generated during activities in the *Generation Stage* and serve as support to subsequent stages such as Reflection. For this reason, they are considered part of the Process rather than the ethics-related Outcome. Within the taxonomy, Future Manifestations are characterised by their *form*. Future Manifestations is an umbrella term that refers to the narrative or tangible expressions through which a vision of the future becomes experiential for an audience that extends beyond designer or researcher. We use the term *Future Manifestations* to capture both the future-oriented nature of these expressions and the intentional designerly act through which ideas are translated into experiential forms [45]. Prior work has conceptualised this process as "designerly formgiving" [54], emphasising the creative act of giving shape to possible futures. While this notion foregrounds the designer's agency and positionality, it places less emphasis on the artefacts, scenarios, or storyworlds that ultimately mediate ethical reflection. Our use of *Future Manifestations* instead centres the produced outcomes themselves, their narrative, forms, and experiential qualities, and how these forms function within Design Futures processes.

From the literature corpus, we identified four types of Future Manifestations: **Storyworlds, Artefacts, Scenarios,** and **Concepts.** They differ in the way in which they captures and represents the future world. Different Manifestations also vary in the amount and type of information they convey about the possible future.

The Storyworld is the broadest and least specific Future Manifestation. In the literature, the term is sometimes used interchangeably with *scenario* or *narrative* [49], yet these are distinct. A Storyworld is the overarching fictional environment or setting created through world-building activities, derived from narratology and fiction but adopted in Design Futures. A Storyworld does not contain a single plot or perspective; rather, it provides the narrative space in which multiple *scenarios* can unfold [67, 70]. In terms of granularity, it offers breadth and coherence, but little detail about specific events or characters.

The Scenario is sometimes referred to as a *story* [55, 87], a *narrative* [91], or even as *Design Fiction* [63], which contributes to terminological ambiguity. More specifically, a Scenario is a Future Manifestation that sits within a Storyworld and develops a plot around particular characters and events. Scenarios highlight specific aspects of a possible future—such as value tensions, ethical principles, or interactions between technologies and stakeholders [61, 91]. They range in granularity from brief snippet Scenarios [63, 97], which focus on a single issue—such as a specific value tension—to more complex Scenarios that weave together multiple, sometimes contrasting, elements and perspectives. While Scenarios usually present the future from an external perspective, sub-types such as Futuristic Autobiographies (FABs) [22] immerse participants as protagonists, fostering a more intimate connection with the imagined future. Scenarios can take different forms. For instance, Lee et al. [55] generated a textual Scenario that followed the daily life and interactions of Vincent, an AI chatbot. In contrast, during a workshop by Lupetti and Cila [61], participants created an interaction board composed of vignettes that illustrated the story between the robot and other stakeholders in different situations.

The Artefact is a tangible Future Manifestation, often referred to as a *diegetic prototype, fictional object, probe* [62], or *provotype* when intentionally provocative. Unlike Storyworlds or Scenarios, Artefacts do not describe the future from a distance; instead, they are situated within it, enabling audiences to directly interact with an object from that possible world. Through its material qualities—features, aesthetics, and functions—the Artefact conveys multiple aspects of a future and fosters reflection by allowing participants to "experience" rather than merely "observe" it. Artefacts can also take a variety of forms. For example, Craigon et al. [24] developed several Artefacts ranging from a mobile app prototype to fictional meeting memos and even a "documentary from the future." In another case, Wilcox et al. [94] created a fictional informed consent document. Others, such as Benton et al. [7], produced physical Artefacts that were fully functional and interactive.

The Concept is the most abstract Future Manifestation, typically expressed through textual or visual sketches, or a combination of both. Concepts articulate early ideas of future technologies or products, but lack the tangibility of Artefacts and the narrative environment of Scenarios. Concepts are often used as starting points or triggers within the Design Futures process for the creation of other manifestation [49, 91, 94]. An example of a Concept comes from French et al. [36], who generated annotated sketches to represent future playful technologies for animals, such as wearables that would allow them to play chase together.

4.3 Process Archetypes

By examining how stages were distributed across the corpus, we identified recurring patterns. Papers that shared similar stage compositions were clustered together, leading to the identification of four *Processes Archetypes*. These Archetypes represent the main ways in which a Design Futures process can be structured, offering researchers and practitioners an entry point for planning processes aimed at ethical reflection.

Although they emerge from stage distribution patterns, the archetypes also present different dynamics of researcher and participant involvement, different patterns of Future Manifestations, and therefore different routes through which ethical reflection is elicited. Figure 4 illustrates the four archetypes and shows how actor types are distributed across stages in each Process Archetype. Figure 5 shows the distribution of Future Manifestation across different Stages and Archetypes.

The value of these Archetypes is twofold. First, they provide a higher-level understanding of the diverse ways in which Design Futures is currently practiced. Second, they offer a practical resource for researchers and practitioners: by recognizing which Archetype they want to align their activity with, they can choose the roles participants will play, the types of manifestations likely to emerge, and the modes through which ethics can be engaged.

4.3.1 Archetype 1: Researcher-led Exploration Process. This archetype begins with an Exploration Stage focused on understanding the topic and context. Exploration is conducted primarily by researchers, often through interviews with participants or stakeholders (see Figure 4).

Future Manifestations are then generated mainly by researchers, typically *Scenarios* or *Artefacts* (see Figure 5). The Interaction Stage follows, where participants engage with these manifestations through task-based exercises [63], interviews [22], or longer-term engagements in everyday settings [62, 75]. Reflection Stage usually comprises surveys, interviews, or analysis of outputs. Finally researchers typically identified the Outcomes during the Analysis Stage, through thematic analysis of participants' outputs or interview data.

Overall, Archetype 1 highlights the central role of researchers throughout the process. Participants mainly engaged during the Interaction Stage, while researchers were predominant in the generation of Future Manifestations and the analysis of ethical reflections. The thematic analysis led in most of the case studies to the identification of Ethical risks as showed in Figure 6. Ethical risks were identified only in those case studies that adopted Artefacts as primary or only Future Manifestation. Overall, This archetype illustrates a strong researcher-driven approach, that led to the generation of Artefacts and Scenarios and to the identification of ethical risks. Moreover, despite most of the case study included participants during the design future process, their contributions were primarily mediated and interpreted by the research team.

4.3.2 Archetype 2: Reflection-driven Iterative Process. This archetype is defined by participant-led exploration, iterative generation, and reflection as the primary driver of ethical outcomes.

Archetype 2 begins with an Exploration Stage, in which participants conduct desk research on the context or on the technologies under consideration (see Figure 4). The exploration is followed by a Generation phase that unfolds across two iterations: first producing textual or visual manifestations such as *Scenarios* and *concepts* [24, 49, 66, 80, 88, 97], followed by collective reflection and analysis. In the second iteration, participants refine or extend their work, often producing tangible *Artefacts*[80, 88]. Another feature of this archetype is the near absence of the Interaction Stage. Instead, the process moves directly into Reflection, which in many cases serves as the final stage of the activity. The outcomes are generally identified within this stage, directly by participants, either through

self-reflection [28, 80] or during group discussions [66, 97]. In some projects, reflection is followed by a separate Analysis Stage, in which researchers examine the outputs in more depth [49, 88]. As a results of the Reflection Stage, different Ethics Conceptualizations were elicited. Similarly to the previous archetype, ethical risks were identified, specifically in those case studies that generated Artefact. However, differently from Archetype 1, there is a much higher presence of case studies in which the reflection lead to the identification of participants or stakeholder values [42, 66] (Figure 6).

Another notable difference compared to Archetype 1 is the distribution of agency across the process. In Archetype 2, participants take on a much more active role (see figure 4). In most of the reviewed papers, participants carried out nearly the entire Design Futures process themselves, from exploration through to elicitation, while researchers only supported and facilitated the activities.

4.3.3 Archetype 3: Collaborative Generation Process. The third archetype, *Collaborative Generation Process* bypasses an initial Exploration Stage and begins directly with Generation, carried out iteratively by both researchers and participants (see Figure 4).

In the first part of the Generation Stage, researchers often create an initial Future Manifestation, typically a *technology concept* [91, 94] or a *Scenario* [7, 61, 87, 90] (see Figure 5). This researcher-generated Future Manifestation is then presented to participants, who use it either as a starting point for developing their own manifestations [7, 52, 90, 94] or as material to further elaborate the one introduced by the researchers [61, 87].

Participants are frequently supported in this process by scaffolding tools, such as templates [61, 94] or card decks [91], which facilitate and structure the creation of manifestations.

The Reflection stage often led directly to the identification of Outcomes by participants themselves. In other cases, the Outcomes were identified later by researchers through a separate analysis. Archetype 3 shows and equal distribution of Ethics Conceptualizations between Ethical Risks [7, 90, 91] and Ethical Implications [61, 87, 94], with no notable correlations between the Future Manifestations generated during the process and the Ethics Conceptualizations.

Overall, Archetype 3 highlights a strong participatory character, with participants actively engaged in crafting Future Manifestations. What distinguishes this Archetype, however, is the relationship between researchers and participants: rather than acting separately, the two groups collaborate as co-authors. Unlike in the other archetypes, the generation of Future Manifestations here emerges from a joint process, where researchers and participants contribute together across iterative stages.

4.3.4 Archetype 4: Researcher-led Process. This archetype represents the most traditional model of Design Futures, structured as a linear sequence with predefined roles.

The process begins with researchers generating Future Manifestations, usually in the form of *Artefacts* or *Scenarios* (see Figure 5). Participants then interact with these manifestations through interviews [4, 52, 98], exhibitions [72, 99], or workshops [36, 48].

After interaction, the Reflection Stage follows. Here, reflection is carried out exclusively by participants, for instance through group discussions [36, 55], think-aloud interviews [4, 98], or questionnaires [48, 77]. Only after this stage do researchers conduct Analysis, which is consistently performed through thematic analysis and leads to the identification of the Outcomes. The thematic analysis leads in most cases to the identification of *ethical risks* [36, 48, 52, 72, 77, 99, 100]. In other case studies, researchers identified *ethical implications* [4, 55] or *participants values* [3, 98]. As for Archetype 1 and 2, the identification of risks often follows the generation of an *Artefact* as primary Future Manifestation.

Overall, Archetype 4 shows a more "traditional model" of Design Futures, in which researchers generate the Future Manifestations and participants primarily engage in reflection rather than generation. In this process, participants assume a more passive role, compared with Archetypes 2 and 3, and are positioned as respondents to futures created by researchers rather than as co-creators [30].

4.4 The Outcome

The second dimension composing the taxonomy is the *Outcome*, which captures the results of the ethics reflection that are generated at the end of the process. To analyze this element, first we provide a categorization of how ethical reflection is *conceptualised*, clarifying how "reflecting on ethics" manifests in Design Futures. Second, we identify differences in the *breadth* of ethical reflection, showing how practices vary from broad, open-ended elicitation to highly specific, risk-driven discussion.

4.4.1 Ethics Conceptualization. This quality refers to how researchers and participants conceptualize and translate "ethics" within their Design Futures processes, and the connotation they assign to ethical reflection. The three Ethics Conceptualizations highlight how ethics in Design Futures is not a single concept but a spectrum varying from broader implications, to targeted risks or value inquiry. The presented forms of Ethics Conceptualizations did not derive from pre-existing definitions. Instead, we adopted the terminology and framing used by the authors of the reviewed studies. Figure 6 shows the distribution of Ethics Conceptualizations across the different Archetypes.

Ethical Risks are the most common conceptualization of ethics in the reviewed corpus. This manifestation represents a narrower conceptualization of ethics, focused specifically on identifying negative consequences or harms. Projects in this group aimed at reflecting and identifying specific issues such as bias, accountability, privacy, or surveillance [6, 36, 48, 52, 62, 75, 77, 90, 91, 99, 100]. This conceptualization positions ethics as the identification of risks to be mitigated, often framing the discussion in issue-oriented terms. For example, Baumer et al. [6] identified risks ranging from privacy concerns, such as systems accessing applicants' personal data to influence hiring decisions, to broader challenges related to transparency and accountability in data sharing.

Ethical and Societal Implications is understood as the identification of consequences that technologies may produce, both positive or negative, and across individual, societal, or systemic levels. This ethical manifestation appears in projects focusing on *ethical implications* [3, 7, 28, 55, 72, 94, 103] as well as those that explicitly extend the reflection to *societal implications* [49, 80, 87, 97]. Some studies combine multiple orientations, simultaneously eliciting ethical, societal, and even legal implications [4]. This conceptualization

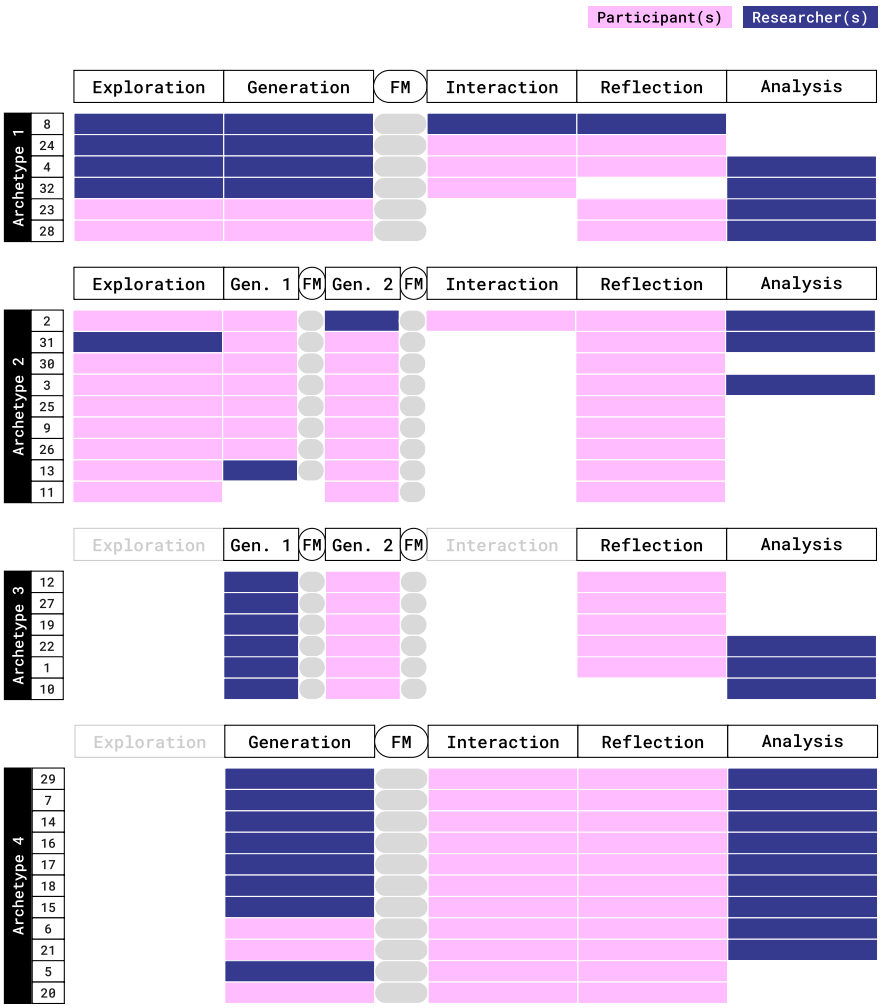


Figure 4: Taxonomy of Design Futures Processes for Ethical Reflection: Actors Distribution. The figure shows the distribution of five Stages across four Archetypes of Design Futures Processes. Rows represent individual reviewed papers (identified by numerical codes). The figure also shows the distribution of two types of actors, Researchers (dark blue) and Participants (pink), across the four Process Archetypes. The figure highlights patterns of agency across Archetypes. Archetypes 1 and 4 are predominantly researcher-led in the early and generative stages, with participants becoming more involved during Interaction and Reflection. By contrast, Archetypes 2 and 3 grant participants a more active role in Generation, and, when present, also in Exploration.

captures ethics on a broad scale, highlighting both risks and benefits. For example, in their study Craigon et al. [24] used a card deck to prompt participants to reflect on both the potential benefits and harms of a Data Trust system. Through this process, participants discussed positive aspects such as supporting "due process," while also identifying risks related to fairness and bias.

Values and Value Tensions steer reflection away from the consequences and towards the principles and perspectives that shape technological futures. Some projects elicit *participants' own values* in relation to certain future technology applications [22, 66], while others explicitly surface *value tensions* that technologies might create or exacerbate [42, 98]. This conceptualization shifts ethical reflection toward plural perspectives and lived experience. Unlike implications or risks, this orientation does not evaluate outcomes but instead situates ethical reflection within participants' or stakeholders' values. For example, Wong et al. [98] focused on eliciting participants' reflections on values such as privacy and surveillance, and further examined how these values differed across social identities.

4.4.2 Ethics Breadth. This quality refers to the breadth of ethical reflection and elicitation. By breadth, we do not mean the number of outputs generated, but rather the scope through which ethical reflection is approached.

In many projects, reflection is intentionally broad and open-ended: participants or researchers are invited to identify as many

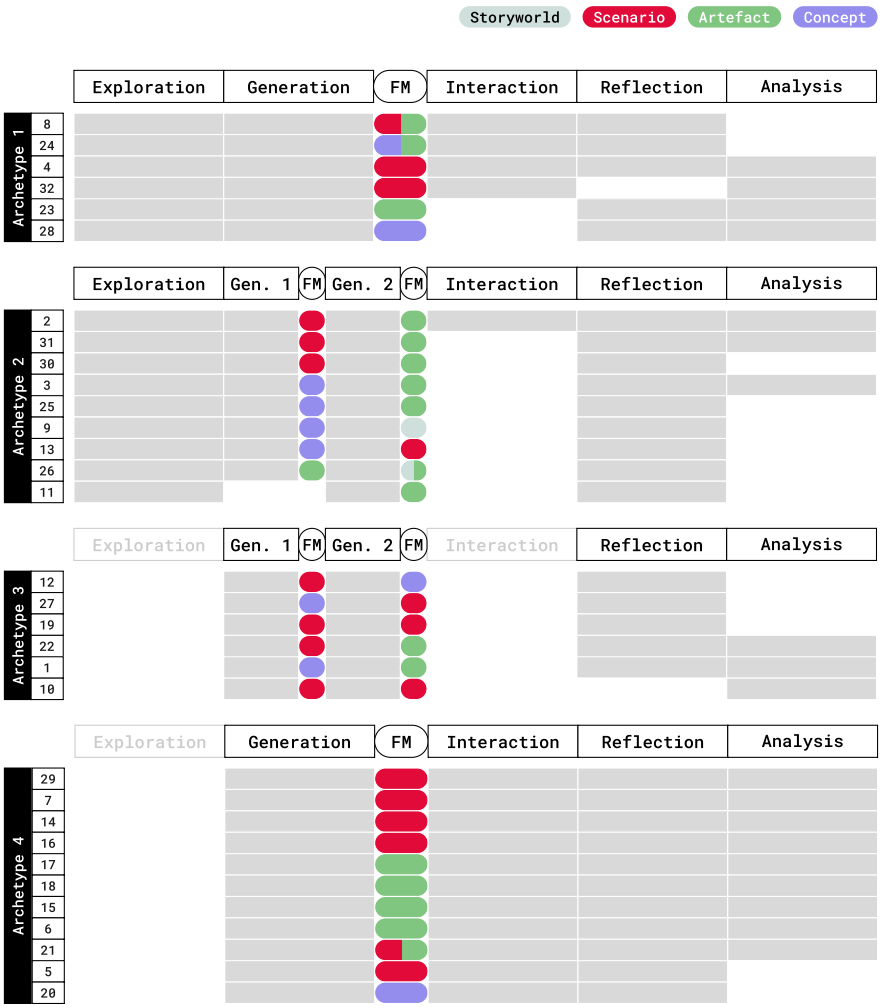


Figure 5: Taxonomy of Design Futures Processes for Ethical Reflection: Future Manifestation Distribution. The figure shows the distribution of five Stages across four Archetypes of Design Futures Processes. Rows represent individual reviewed papers (identified by numerical codes). The figure also shows the distribution of four types of Future Manifestations across the four Process Archetypes. Each Manifestation is represented by a different color: Storyworld (light blue), Scenario (red), Artefact (green), and Concept (purple).

ethical, social, or legal implications as possible, without predefined constraints. In others, scope is more structured: participants are asked to consider implications from the point of view of the stakeholders involved [3, 7, 97], or to reflect on a predefined set of values or principles. A third approach narrows breadth even further by focusing discussion on one or two specific issues, such as privacy [52, 75], bias and accountability [80], or a targeted value tension [98].

4.4.3 Process and Ethics Conceptualizations. To conclude our analysis, we investigated the relation between the Ethics Conceptualizations and the process elements and archetypes described in the previous subsections (Figure 6). Overall, all Archetypes lead to all three forms of conceptualization, with the exception of Values, which did not emerge from Archetype 3. The figure also highlights correlations between the various Future Manifestations and the types of Ethics Conceptualizations identified. Artefacts were most often associated with the recognition of Ethical Risks, while Scenarios appeared more frequently in case studies that identified Ethical Implications and Values. These patterns indicate a tendency for different Future Manifestations to prompt the identification of different kinds of Ethics Conceptualization.

5 Discussion

In response to the lack of structured and methodological guidance on how to adopt Design Futures practices to foster ethical discussion on technology, we developed the taxonomy presented in this study. This work moves beyond viewing Design Futures solely as a way to envision and debate alternative futures, positioning them

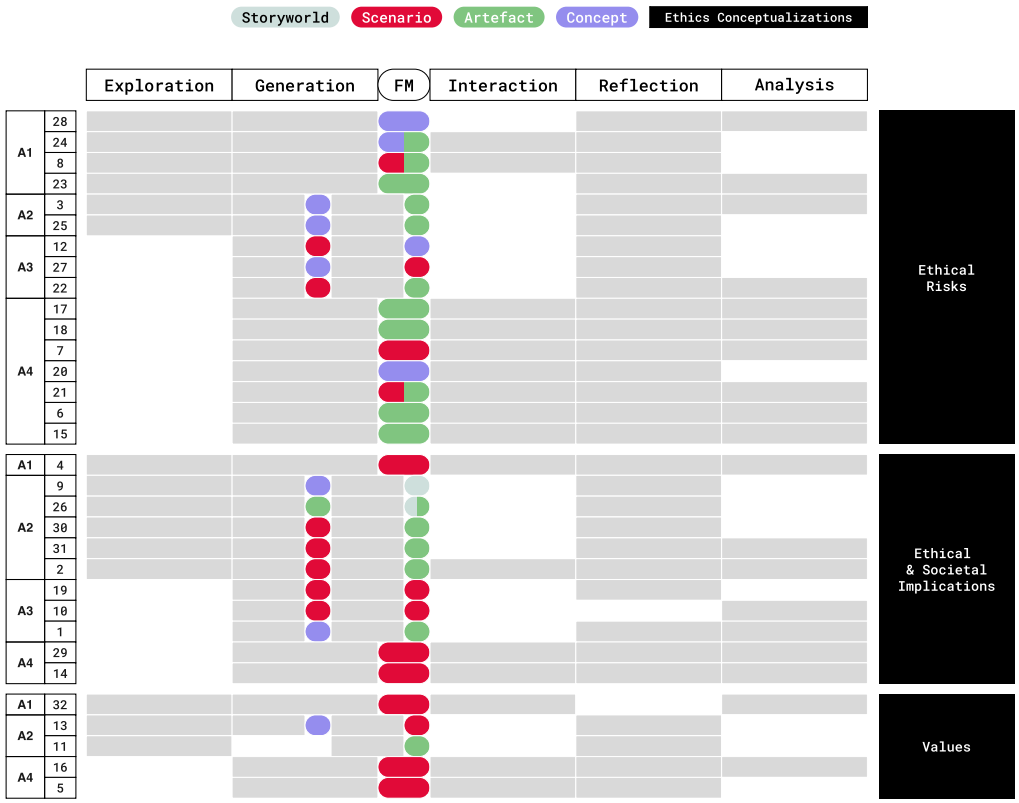


Figure 6: Taxonomy of Design Futures Processes for Ethical Reflection: Outcomes. The figure shows three types of Ethics Conceptualizations—Ethical Risks, Ethical and Societal Implications, and Values—distributed across the papers. Papers are grouped according to the Ethics Conceptualization identified in their process. Rows represent individual papers (identified by numerical codes), with Archetype numbers indicated in boxes on the left. The figure also preserves information on the type of Future Manifestations generated: Storyworld (light blue), Scenario (red), Artefact (green), and Concept (purple).

instead as a possible approach through which researchers and practitioners can support ethical reflection on technologies. In doing so, the taxonomy addresses the tension between the growing interest in adopting Design Futures for engaging with technology ethics within HCI and their limited recognition as valuable and reliable research methods.

In the following subsections, we build on the main insights that emerge from the taxonomy. Specifically, we discuss: (1) how different Future Manifestations influence the Ethics Conceptualization and Breadth; and (2) how the actors who create the Future Manifestations are often the same actors who identify the ethical implications. These findings underscore the relationship between the elements that constitute the Design Futures process and the scope and outcomes of ethical reflection. We conclude the discussion by reflecting on the value of the taxonomy as a practical tool for researchers and practitioners, and by considering the challenges and limitations of our work.

5.1 The Generated Future Manifestations Shape Ethical Reflection

One of the central insights of this study is that the type of ethical reflection elicited in a Design Futures process is closely tied to the form of the Future Manifestations generated during the activity. Our initial hypothesis was that different ways of structuring a Design Futures process would shape the scope and content of ethical discussion. The taxonomy supports this hypothesis, revealing patterned relationships between Future Manifestations and the kinds of Ethics Conceptualizations identified. In doing so, our findings extend and details Kozubaev et al. [54]'s claim that different forms of "designerly formgiving" strategically open up or close down particular ways of thinking about futures.

Across the corpus, Artefacts were predominantly associated with the identification of ethical risks. Artefacts are highly specific and situated: rather than providing a broad representation of a future world, they show a narrow slice of it, foregrounding a concrete interaction, stakeholder, or system behaviour [6, 36, 42, 61, 77]. Prior work describes such objects as "future props" [43], whose specificity draws attention to immediate and tangible consequences. Our analysis suggests that this specificity "closes down" the future space [54], directing attention towards particular risks or harms, such as privacy breaches, biases, or failures of accountability.

By contrast, Scenarios were more likely to support the identification of broader ethical implications and stakeholder values. Scenarios can narrate a sequence of events, populate the future with

characters, and expose tensions and contradictions across multiple situations. Their narrative breadth "opens up" conceptual space, enabling audiences to reason more analytically and systemically about emerging consequences [14]. This resonates with the long tradition of scenario-based reasoning in HCI, where scenarios help maintain analytical distance and support coneptual reflection on possible implications [76]. Our findings extend this account by showing how scenario-based futures tend to elicit not only implications but also underlying values and value tensions. Despite offering a less immersive experience than artefacts, scenarios still engage participants with "human-scale futures" [17], allowing them to recognise how technological systems intersect with lived experience.

Storyworlds, though less common in our corpus, were also used to identify ethical implications. Their broader scope foregrounds large-scale narratives rather than specific interactions providing fewer cues for value-level reflection. This may explain why value identification was more often tied to scenarios than to storyworlds.

Taken together, these findings align with, but also extend, existing theoretical accounts of future-making in design. While prior work has discussed how different forms of designerly formgiving shape the experience of the future and imagination [17, 43, 54], our study provides the evidence showing how these forms systematically orient the types of ethical reasoning that emerge in practice. For researchers and practitioners, this underscores that the selection of Future Manifestations is not a neutral choice but a methodological decision that carries epistemic and ethical consequences. If the aim is to surface concrete risks, artefacts may be particularly suited; if the goal is to uncover broader implications or values, scenarios or storyworlds may be more appropriate.

At the same time, we emphasise that these relationships are not prescriptive nor deterministic. Design Futures practices remain inherently flexible, and the ethical insights they produce are shaped by multiple interacting factors, including facilitation choices, participant expertise, cultural context, and the positionality of both designers and audiences. Rather than offering fixed rules, the taxonomy highlights tendencies and affordances that can support more intentional and critically reflective design of futures-oriented activities. Researchers should therefore draw on these insights while embracing the necessary messiness and unpredictability of Design Futures practice.

5.2 The Role of Participation in Shaping Ethical Reflection

The presented taxonomy highlights a strong presence of participant engagement in Design Futures activities, spanning different stages of the process and involving varying roles and levels of agency. This finding aligns with a broader turn in Design Futures over the last decades, where practices have increasingly opened up to participatory approaches [30]. Traditionally, Design Futures practices were widely criticised for being elitist and exclusive [49, 56, 85]. In response, recent literature has sought to counter this dynamic by foregrounding participation and including those who were historically marginalised and excluded [5, 30, 49].

The earliest moves toward participation often relied on exhibitions of speculative artefacts and scenarios, where participants acted primarily as spectators. These formats often limited the scope of participant agency, positioning audiences as interpreters rather than co-authors of futures. By contrast, our taxonomy shows that participants are increasingly positioned as active contributors who shape not only the content of the futures but also the ethical discussions they enable.

This evolution resonates with the taxonomy proposed by Farias et al. [30], which identified multiple levels of engagement ranging from spectatorship to co-creation and full ownership of speculative processes. Similar dynamics have been documented in the growing body of Participatory Speculative Design (PSD) work, where participation is not only a matter of inclusion but a deliberate strategy to surface conflict, plurality, and divergent imaginaries [33, 101]. PSD scholars note that when individuals with different cultural backgrounds, political perspectives, or lived experiences co-create futures, value tensions inevitably arise and that such tensions deepen ethical reflection.

From this perspective, the patterns observed in our taxonomy mirror long-standing principles in Participatory Design (PD), particularly regarding democratic agency and situated expertise [11]. Indeed, the correlation we identified, between the *actor generating* the Future Manifestations and the *actor identifying* the outcomes, echoes PD's core assertion that those who participate in shaping artefacts or representations are also better positioned to articulate their implications.

In those case studies in which participants were in charge of the generation stage, the outcomes of the reflections were identified by the participants themselves, directly during the Design Futures activity, without the need for the researchers to conduct a thematic analysis. When participants actively generate Future Manifestations, they are prone to reflect on the implications of the technology [16]. This often leads to a more direct identification of its issues and ethical concerns.

At the same time, our review suggests that participatory dynamics operate differently in Design Futures than in PD. Because Design Futures work does not require feasibility, it offers participants a space of critique, imagination, and provocation. For example, in French et al. [36], participants co-created speculative technologies for animals; freed from feasibility constraints, they were able to explore implications and value tensions that would have been difficult to articulate within a more conventional PD process. We therefore argue that PD and Design Futures should be seen as complementary: PD grounds design in present-day practices and democratic inclusion, while Design Futures introduces temporal, imaginative, and speculative tools that help participants interrogate alternative technological trajectories.

The overlap between PD and Design Futures thus represents a promising methodological frontier. PSD research shows that combining speculation with participatory practice can expand whose futures are considered, make conflicts visible, and challenge sociotechnical assumptions, while maintaining a speculative space not bounded by feasibility. Our taxonomy contributes to grounding this emerging space: it shows that when participants generate Future Manifestations, they not only diversify the futures explored but also shift the centre of ethical reflection, becoming the primary interpreters of technological implications.

5.3 The Value of the Taxonomy

We argue that the presented taxonomy provides a valuable tool for both researchers and practitioners within the Design and HCI communities.

A Decision-Support Tool. The taxonomy offers practical guidance for researchers and practitioners who wish to adopt Design Futures to reflect on the ethical, societal, and value implications of technologies. It provides an accessible overview of the diverse ways in which a Design Futures activity can be structured. Grounded in empirical studies, the taxonomy also acts as a record of cases that successfully elicited ethical reflection, showing that Design Futures can indeed support such discussions when carefully designed.

We argue that the taxonomy can be approached as a decision-support tool from three different entry points, depending on researchers' aims and contexts. The first entry point is the **scope of ethical reflection**. By starting from the type of ethical manifestation they wish to identify (see Figure 6), researchers can work "backwards" through the taxonomy to identify the archetypes and stages most likely to support this outcome.

A second entry point is the **Future Manifestations**. Since different types of manifestations (e.g. artefacts, scenarios, storyworlds) enable different kinds of ethical reflection, researchers can select the one that aligns both with their intended outcomes and with practical considerations such as available skills, materials, and time. In participatory activities in particular, these constraints strongly shape what can be crafted and discussed.

Finally, the third entry point concerns the **level of engagement and participation**. As discussed in Section 5.2, involving participants directly in the exploration and generation stages enables them to take ownership of the process and to identify the different type of Ethics Conceptualization themselves. The taxonomy therefore encourages researchers to reflect on the roles they wish to assign to participants and to themselves, balancing facilitation role and participant agency.

A Methodological Foundation. The taxonomy contributes to the ongoing effort to strengthen the methodological foundations of Design Futures practices [58, 78] in two main ways. First, it supports the establishment of a shared terminology, particularly through the section on Future Manifestations. By functioning as a glossary, it consolidates diverse terms used to describe speculative outputs. By clarifying definitions and highlighting where terms are often used inconsistently or as synonyms, the taxonomy supports clearer communication within the field.

Second, the taxonomy points to future research opportunities. By mapping connections between processes, actors, and outcomes, it reveals potential correlations that deserve further study and highlights gaps where methodological reflection remains limited. In this sense, it offers a foundation for future knowledge creation; researchers can build on this taxonomy to examine Design Futures practices more systematically and to advance methodological discussions in the field.

5.4 Limitations and Future Work

The main limitation of this study, already noted in Section 4, derives from the nature of the selected material. Most of the included papers did not document thoroughly their Design Futures process or outcomes; rather, they employed these practices to explore a specific technological context. As a consequence, the amount and granularity of information on design choices was often limited. In several cases, the activity structure was only briefly mentioned in the *Methodology* section, without reflecting on how it supported the results. This made the level of detail we could extract vary widely across the corpus. We stress that this is not a problem of our selection criteria, but rather an intrinsic issue in the way Design Futures practices are reported in the literature. In order to strengthen the methodological value of these practices, clearer explanation of processes and outcomes are needed. We recognize this as an important implication for future publications in the domain of Design Futures.

Another limitation lies in the scope of the taxonomy. Our study should not be considered as a comprehensive taxonomy of all Design Futures case studies that engage with ethical discussion, but rather as a first attempt to structure these practices, grounded in existing cases. Still, the taxonomy draws from activities that have already proven successful in sparking ethical discussions about technology, and therefore provides a reliable point of reference for both researchers and practitioners.

Our analysis was also based only on published case studies. Other strategies could have offered complementary insights. For example, including projects from grey literature or online repositories, as done by Farias et al. [30], might have provided more detailed accounts of processes and decision-making. Similarly, interviewing some of the authors of the selected projects could have offered a richer understanding of how specific design choices shaped each activity. Such an approach would necessarily have reduced the number of cases included, but could provide a different balance between breadth and depth.

Finally, we acknowledge that the selected research queries may have excluded projects where ethical considerations were implicit rather than foregrounded. We argue that for the purposes of analysing the relationship between process and ethical reasoning, this focus provided the conceptual precision needed to develop the taxonomy. However, future work may expand this scope by integrating cases where ethical reflection is embedded more tacitly within speculative practice.

6 Conclusion

Through a scoping review of 32 case studies that used Design Futures to engage with ethical concerns of technology, we developed a *Taxonomy of Design Futures Processes for Ethical Reflection*. The taxonomy maps how activities are structured across stages, actors, and manifestations, and how these elements shape the kinds of ethical reasoning that emerge.

Rather than a prescriptive method, we offer the taxonomy as an orienting guide for researchers, designers and practitioners to navigate Design Future practices for ethical reflection and make sense of the diverse processes reported in the literature. It is intended to support more deliberate choices about participation, activity design, forms of future-making, and the scope of the ethical discussions. Beyond practice, the taxonomy also advances methodological understanding by connecting process and outcome, showing how design choices shape ethical discussion. Our contribution is positioned within the ongoing methodological inquiry of Design Future

practices. We encourage further refinement, reinterpretation, and extension of the taxonomy, particularly as the adoption of Design Futures approaches to support ethical debate continue to evolve.

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References

[1] Lori Andrews and Hannah Bucher. 2022. Automating discrimination: AI hiring practices and gender inequality. *Cardozo L. Rev.* 44 (2022), 145.

[2] James Auger. 2013. Speculative design: Crafting the speculation. *Digital Creativity* 24, 1 (3 2013), 11–35. doi:10.1080/14626268.2013.767276

[3] Stephanie Ballard, Karen M. Chappell, and Kristin Kennedy. 2019. Judgment call the game: Using value sensitive design and design fiction to surface ethical concerns related to technology. In *DIS 2019 - Proceedings of the 2019 ACM Designing Interactive Systems Conference*. Association for Computing Machinery, Inc, New York, NY, USA, 421–433. doi:10.1145/3322276.3323697

[4] Gabriel Diniz Junqueira Barbosa, José Luiz Nunes, Clarisse Sieckenius De Souza, and Simone Diniz Junqueira Barbosa. 2023. Investigating the Extended Metacommunication Template: How a semiotic tool may encourage reflective ethical practice in the development of machine learning systems. In *Proceedings of the XXII Brazilian Symposium on Human Factors in Computing Systems* (Maceió Brazil). ACM, New York, NY, USA, 1–12.

[5] Karl Baumann, Ben Caldwell, François Bar, and Benjamin Stokes. 2018. Participatory Design Fiction: Community Storytelling for Speculative Urban Technologies. In *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) *(CHI EA '18)*. Association for Computing Machinery, New York, NY, USA, 1. doi:10.1145/3170427.3186601

[6] Eric P.S. Baumer, Timothy Berrill, Sarah C. Botwinick, Jonathan L. Gonzales, Kevin Ho, Allison Kundrik, Luke Kwon, Tim LaRowe, Chanh P. Nguyen, Fredy Ramirez, Peter Schaedler, William Ulrich, Amber Wallace, Yuchen Wan, and Benjamin Weinfeld. 2018. What would you do? Design fiction and ethics. In *Proceedings of the International ACM SIGGROUP Conference on Supporting Group Work*. Association for Computing Machinery, New York, NY, USA, 244–256. doi:10.1145/3148330.3149405

[7] Laura Benton, Asimina Vasalou, and Sarah Turner. 2023. Location, Location, Security? Exploring Location-Based Smart Device Security Concerns and Mitigations within Low-Rent Homes. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference* (Pittsburgh, PA, USA) *(DIS '23)*. Association for Computing Machinery, New York, NY, USA, 1060–1077. doi:10.1145/3563657.3596077

[8] Karl Emil Kjær Bilstrup, Magnus H. Kaspersen, and Marianne Graves Petersen. 2020. Staging reflections on ethical dilemmas in machine learning: A card-based design workshop for high school students. In *DIS 2020 - Proceedings of the 2020 ACM Designing Interactive Systems Conference*. Association for Computing Machinery, Inc, New York, NY, USA, 1211–1222. doi:10.1145/3357236.3395558

[9] Julian Bleecker. 2009. *Design Fiction A short essay on design, science, fact and fiction*. Near Future Laboratory. http://cli.gs/VvrmvQ

[10] Mark Blythe. 2014. Research through design fiction: narrative in real and imaginary abstracts. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Toronto, Ontario, Canada) *(CHI '14)*. Association for Computing Machinery, New York, NY, USA, 703–712. doi:10.1145/2556288.2557098

[11] Susanne Bødker and Morten Kyng. 2018. Participatory Design that Matters—Facing the Big Issues. *ACM Trans. Comput. Hum. Interact.* 25, 1 (Feb. 2018), 1–31.

[12] Alan Borning and Michael Muller. 2012. *Next Steps for Value Sensitive Design*. ACM, New York, NY, USA. 3228 pages.

[13] Philip A E Brey. 2012. Anticipatory ethics for emerging technologies. *Nanoethics* 6, 1 (April 2012), 1–13.

[14] Anne Burdick. 2019. Designing futures from the inside. *Journal of Futures Studies* 23 (3 2019), 75–92. Issue 3. doi:10.6531/JFS.201903_23(3).0006

[15] Jenna Burrell. 2016. How the machine "thinks": Understanding opacity in Machine Learning. *Big Data & Society* 3, 1 (2016), 1–12.

[16] Faith Campbell, Nicole Hassoon, Khalil Jiwa, Julia Ridsdill-Smith, Amie Smith, Helen Wilson, Kirsten Jack, and Helen Rogers. 2023. Co-creation to develop interventions to facilitate deep reflection for dental students. *Perspect. Med. Educ.* 12, 1 (March 2023), 76–85.

[17] Stuart Candy and Jake Dunagan. 2017. Designing an experiential scenario: The People Who Vanished. *Futures* 86 (2 2017), 136–153. doi:10.1016/j.futures.2016.05.006

[18] S Candy and K Kornet. 2019. Turning Foresight Inside Out: An Introduction to Ethnographic Experiential Futures. *Journal of Futures Studies* 3 (2019), 3–22. https://www.researchgate.net/publication/338129083

[19] Manuela Celi and Ammer Harb. 2023. The Critical Catalyst: A Critical Approach to Design Futures Literacy. *DIID* 01, 79 (5 2023). doi:10.30682/diid7923h

[20] Xinyu Chang. 2023. Gender bias in hiring: An analysis of the impact of Amazon's recruiting algorithm. *Advances in Economics, Management and Political Sciences* 23, 1 (Sept. 2023), 134–140.

[21] David Collingridge. 1980. *The Social Control of Technology*. St. Martin's Press, New York.

[22] Tommaso Colombino, Danilo Gallo, Shreepriya Shreepriya, Yesook Im, and Seijin Cha. 2021. Ethical Design of a Robot Platform for Disabled Employees: Some Practical Methodological Considerations. *Frontiers in Robotics and AI* 8 (8 2021), 643160. doi:10.3389/frobt.2021.643160

[23] David Cardenas Cordova, Nick Kelly, and Leo Rezayan. 2025. A systematic literature review of the speculative design process and a proposed framework for speculative design. doi:10.1017/dsj.2025.10030

[24] Peter J. Craigon, Justin Sacks, Steve Brewer, Jeremy Frey, Anabel Gutierrez, Naomi Jacobs, Samantha Kanza, Louise Manning, Samuel Munday, Alexsis Wintour, and Simon Pearson. 2023. Ethics by design: Responsible research & innovation for AI in the food sector. *Journal of Responsible Technology* 13 (4 2023), 100051. doi:10.1016/j.jrt.2022.100051

[25] Kate Crawford and Ryan Calo. 2016. There is a blind spot in AI research. *Nature* 538, 7625 (Oct. 2016), 311–313.

[26] Kate Crawford, Roel Dobbe, Genevieve Fried, Elizabeth Kaziunas, Amba Kak, Varoon Mathur, Rashida Richardson, Jason Schultz, Oscar Schwartz, Sarah Myers West, and Meredith Whittaker. 2018. *AI Now 2018 Report*. Report. AI Now Institute, New York.

[27] Kate Crawford and Meredith Whittaker. 2019. *Discriminating Systems: Gender, Race, and Power in AI*. Technical Report. AI Now Institute, New York. https://ainowinstitute.org/wp-content/uploads/2023/04/discriminatingsystems.pdf

[28] Virginia Dignum, Matteo Baldoni, Cristina Baroglio, Maurizio Caon, Raja Chatila, Louise Dennis, Gonzalo Génova, Galit Haim, Malte S. Kließ, Maite Lopez-Sanchez, Roberto Micalizio, Juan Pavón, Marija Slavkovik, Matthijs Smakman, Marlies Van Steenbergen, Stefano Tedeschi, Leon Van Der Toree, Serena Villata, and Tristan De Wildt. 2018. Ethics by Design: Necessity or Curse?. In *AIES 2018 - Proceedings of the 2018 AAAI/ACM Conference on AI, Ethics, and Society*. Association for Computing Machinery, Inc, New York, NY, USA, 60–66. doi:10.1145/3278721.3278745

[29] A Dunne and F Raby. 2013. *Speculative Everything: Design, Fiction, and Social Dreaming*. MIT Press, London, England.

[30] Pedro Gil Farias, Roy Bendor, and Bregje F. van Eekelen. 2022. Social dreaming together: A critical exploration of participatory speculative design. In *Proceedings of the Participatory Design Conference 2022 - Volume 2* (Newcastle upon Tyne, United Kingdom) *(PDC '22)*. Association for Computing Machinery, New York, NY, USA, 147–154. doi:10.1145/3537797.3537826

[31] Luciano Floridi, Josh Cowls, Monica Beltrametti, Raja Chatila, Patrice Chazerand, Virginia Dignum, Christoph Luetge, Robert Madelin, Ugo Pagallo, Francesca Rossi, Burkhard Schafer, Peggy Valcke, and Effy Vayena. 2018. AI4People—An Ethical Framework for a Good AI Society: Opportunities, Risks, Principles, and Recommendations. *Minds and Machines* 28 (12 2018), 689–707. Issue 4. doi:10.1007/s11023-018-9482-5

[32] B. J. Fogg. 1998. Captology: the study of computers as persuasive technologies. In *CHI 98 Conference Summary on Human Factors in Computing Systems* (Los Angeles, California, USA) *(CHI '98)*. Association for Computing Machinery, New York, NY, USA, 385. doi:10.1145/286498.286852

[33] Laura Forlano and Anijo Mathew. 2014. From design fiction to design friction: Speculative and participatory design of values-embedded urban technology. *J. Urban Technol.* 21, 4 (Oct. 2014), 7–24.

[34] Laura E Forlano and Megan K Halpern. 2023. Speculative histories, just futures: From counterfactual artifacts to counterfactual actions. *ACM Trans. Comput. Hum. Interact.* 30, 2 (April 2023), 1–37.

[35] Christopher Frauenberger. 2019. Entanglement HCI The Next Wave? *ACM Trans. Comput.-Hum. Interact.* 27, 1, Article 2 (Nov. 2019), 27 pages. doi:10.1145/3364998

[36] Fiona French, Ilyena Hirskyj-Douglas, Heli Väätäjä, Patricia Pons, Sabrina Karl, Yoram Chisik, Eleonora Nannoni, Anna Zamansky, Mandeep Mangat, Patrizia Paci, Haruka Kasuga, and Dana Vilker. 2021. Ethics and Power Dynamics in Playful Technology for Animals: Using speculative design to provoke reflection. In *ACM International Conference Proceeding Series*. Association for Computing Machinery, New York, NY, USA, 91–101. doi:10.1145/3464327.3464366

[37] Batya Friedman, Peter H Kahn, and Alan Borning. 2002. Value Sensitive Design: Theory and Methods. (2002). www.ischool.washington.edu/vsd

[38] William Gaver. 2012. What should we expect from research through design?. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Austin Texas USA). ACM, New York, NY, USA, 937–946.

[39] Audley Genus and Andy Stirling. 2018. Collingridge and the dilemma of control: Towards responsible and accountable innovation. *Res. Policy* 47, 1 (Feb. 2018), 61–69.

[40] Simon Grand and Martin Wiedmer. 2010. Design fiction: A method toolbox for design research in a complex world complex world. https://dl.designresearchsociety.org/drs-conference-papers/drs2010/researchpapers/47.

[41] David H Guston and Daniel Sarewitz. 2002. Real-time technology assessment. *Technol. Soc.* 24, 1-2 (Jan. 2002), 93–109.

[42] Nava Haghighi, Matthew Jörke, Yousif Mohsen, Andrea Cuadra, and James A. Landay. 2023. A Workshop-Based Method for Navigating Value Tensions in Collectively Speculated Worlds. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference* (Pittsburgh, PA, USA) *(DIS '23)*. Association for Computing Machinery, New York, NY, USA, 1676–1692. doi:10.1145/3563657.3595992

[43] Derek Hales. 2013. Design fictions an introduction and provisional taxonomy. *Digital Creativity* 24, 1 (3 2013), 1–10. doi:10.1080/14626268.2013.769453

[44] Joachim Halse, Eva Brandt, Brendon Clark, and Thomas Binder (Eds.). 2010. *Rehearsing the Future* (1 ed.). The Danish Design School Press.

[45] Nicolai Brodersen Hansen and Peter Dalsgaard. 2012. The productive role of material design artefacts in participatory design events. In *Proceedings of the 7th Nordic Conference on Human-Computer Interaction: Making Sense Through Design* (Copenhagen, Denmark) *(NordiCHI '12)*. Association for Computing Machinery, New York, NY, USA, 665–674. doi:10.1145/2399016.2399117

[46] Ammer Harb. 2023. Design as a critical catalyst. Interrogating futures by design: context, rational and motivation.

[47] Ammer Harb. 2024. The critical forms of design futures scenarios: Introducing unconventional ways of scenarios making. In *Springer Series in Design and Innovation*. Springer Nature Switzerland, Cham, 367–376.

[48] Michel Hohendanner, Chiara Ullstein, Yosuke Buchmeier, and Jens Grossklags. 2023. Exploring the Reflective Space of AI Narratives Through Speculative Design in Japan and Germany. In *ACM International Conference Proceeding Series*. Association for Computing Machinery, New York, NY, USA, 351–362. doi:10.1145/3582515.3609554

[49] Michel Hohendanner, Chiara Ullstein, Dohjin Miyamoto, Emma F Huffman, Gudrun Socher, Jens Grossklags, and Hirotaka Osawa. 2024. Metaverse Perspectives from Japan: A Participatory Speculative Design Case Study. *Proceedings of the ACM on Human-Computer Interaction* 8 (11 2024), 1–51. Issue CSCW2. doi:10.1145/3686939

[50] Cayla Key, Fiona Browne, Nick Taylor, and Jon Rogers. 2021. Proceed with care: Reimagining home iot through a care perspective. In *Conference on Human Factors in Computing Systems - Proceedings*. Association for Computing Machinery, New York, NY, USA. doi:10.1145/3411764.3445602

[51] David Kirby. 2010. The Future is Now: Diegetic Prototypes and the Role of Popular Films in Generating Real-world Technological Development. *"Soc. Stud. Sci."* 40 (2010), 41–70. Issue 1. doi:10.1177/0306312709338325

[52] Max Van Kleek, Dave Murray-Rust, Amy Guy, Kieron O'Hara, and Nigel Shadbolt. 2016. Computationally mediated pro-social deception. In *Conference on Human Factors in Computing Systems - Proceedings*. Association for Computing Machinery, New York, NY, USA, 552–563. doi:10.1145/2858036.2858060

[53] Eva Knutz, Tau U Lenskjold, and Thomas Markussen. 2016. Fiction as a resource in participatory design. In *Proceedings of DRS*. Design Research Society, Brighton, UnitedKingdom.

[54] Sandjar Kozubaev, Chris Elsden, Noura Howell, Marie Louise Juul Søndergaard, Nick Merrill, Britta Schulte, and Richmond Y Wong. 2020. Expanding modes of reflection in design futuring. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu HI USA), Vol. 2. ACM, New York, NY, USA, 1–15.

[55] Minha Lee, Lily Frank, Yvonne De Kort, and Wijnand Ijsselsteijn. 2022. Where is Vincent' Expanding our emotional selves with AI. In *ACM International Conference Proceeding Series*. Association for Computing Machinery, New York, NY, USA, 1–11. doi:10.1145/3543829.3543835

[56] Ann Light. 2021. Collaborative speculation: Anticipation, inclusion and designing counterfactual futures for appropriation. *Futures* 134, 102855 (Dec. 2021), 102855.

[57] Lauren Lin and Duri Long. 2023. Generative AI Futures: A Speculative Design Exploration. In *Proceedings of the 15th Conference on Creativity and Cognition* (Virtual Event, USA) *(C&C '23)*. Association for Computing Machinery, New York, NY, USA, 380–383. doi:10.1145/3591196.3596616

[58] Joseph Lindley. 2016. A Pragmatics Framework for Design Fiction. In *11th EAD Conference Proceedings: The Value of Design Research*. Sheffield Hallam University, Sheffield, United Kingdom.

[59] Joseph Lindley and Paul Coulton. 2015. Back to the future: 10 years of design fiction. In *ACM International Conference Proceeding Series*. Association for Computing Machinery, New York, NY, USA, 210–211. doi:10.1145/2783446.2783592

[60] Ewa Luger, Lachlan Urquhart, Tom Rodden, and Michael Golembewski. 2015. Playing the legal card: Using ideation cards to raise data protection issues within the design process. In *Conference on Human Factors in Computing Systems - Proceedings*, Vol. 2015-April. Association for Computing Machinery, New York, NY, USA, 457–466. doi:10.1145/2702123.2702142

[61] Maria Luce Lupetti and Nazli Cila. 2019. Envisioning and Questioning Near Future Urban Robotics. In *DeSForM19 Proceedings*. PubPub, Cambridge, USA.

[62] Michal Luria and Stuart Candy. 2022. Letters from the Future: Exploring Ethical Dilemmas in the Design of Social Agents. In *Conference on Human Factors in Computing Systems - Proceedings*. Association for Computing Machinery, New York, NY, USA. doi:10.1145/3491102.3517536

[63] Sus Lyckvi, Yiying Wu, Maria Huusko, and Virpi Roto. 2018. Eagons, exoskeletons and ecologies: on expressing and embodying fictions as workshop tasks. In *Proceedings of the 10th Nordic Conference on Human-Computer Interaction* (Oslo, Norway) *(NordiCHI '18)*. Association for Computing Machinery, New York, NY, USA, 754–770. doi:10.1145/3240167.3240269

[64] Moira Maguire and Brid Delahunt. 2017. Doing a Thematic Analysis: A Practical, Step-by-Step Guide for Learning and Teaching Scholars. *. *AISHE-J* (2017), 3351. Issue 3. http://ojs.aishe.org/index.php/aishe-j/article/view/335

[65] Matt Malpass. 2017. *Critical Design in Context* (1 ed.). Bloomsbury Academic, London. Hardback, 168 pp., 31 b/w illustrations.

[66] Eleni Margariti, Vasilis Vlachokyriakos, and David Kirk. 2023. Understanding occupants' experiences in quantified buildings: results from a series of exploratory studies.. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg, Germany) *(CHI '23)*. Association for Computing Machinery, New York, NY, USA, Article 640, 15 pages. doi:10.1145/3544548.3581256

[67] Ilaria Mariani and Mariana Ciancia. 2019. Character-driven Narrative Engine. Storytelling System for building interactive narrative experiences. In *DiGRA Digital Library*. Digitial Games Research Association DiGRA.

[68] E. Masini. 1993. *Why Futures Studies?* Grey Seal, London, UK. https://books.google.nl/books?id=GBhmAAAAMAAJ

[69] Ramia Maze. 2019. Politics of Designing Visions of the future. https://doi.org/10.6531/JFS.201903_23(3).0003. Accessed: 2025-11-26.

[70] Brian J McAllister. 2024. Marie-Laure Ryan. 2022. *A New Anatomy of Storyworlds: What Is, What If, As If.* Columbus, OH: The Ohio State University Press, x + 226 pp., 6 illustr., 3 tables, $89.95. *Anglia* 142, 1 (April 2024), 202–206.

[71] Michael J Muller and Sarah Kuhn. 1993. Participatory design. *Commun. ACM* 36, 6 (1993), 24–28.

[72] Joyce Nabuurs, Anouk Heltzel, Willemine Willems, and Frank Kupper. 2023. Crafting the future of the artificial womb - speculative design as a tool for public engagement with emerging technologies. *Futures* 151 (8 2023), 103184. doi:10.1016/j.futures.2023.103184

[73] Bojana Nikolovska, Maria Normark, and Helga Sadowski. 2025. Imagining with the Body: Speculative Designs for Women's Embodied Empowerment in Feminist Self-Defense. In *Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems (CHI '25)*. Association for Computing Machinery, New York, NY, USA, Article 406, 13 pages. doi:10.1145/3706598.3713975

[74] Elin Palm and Sven Ove Hansson. 2006. The case for ethical technology assessment (eTA). *Technol. Forecast. Soc. Change* 73, 5 (June 2006), 543–558.

[75] James Pierce, Richmond Y Wong, and Nick Merrill. 2020. Sensor illumination: Exploring design qualities and ethical implications of smart cameras and image/video analytics. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu HI USA). ACM, New York, NY, USA, 1–19. doi:10.1145/3313831.3376347

[76] Corbin Raymond, Andrew Morrison, and Henry Mainsah. 2022. Framing scenario thinking in a mode of futures by design inquiry. In *DRS2022: Bilbao*. Design Research Society. doi:10.21606/drs.2022.688

[77] Jeba Rezwana and Mary Lou Maher. 2023. User perspectives on ethical challenges in human-AI co-creativity: A design fiction study. In *Creativity and Cognition* (Virtual Event USA). ACM, New York, NY, USA, 62–74.

[78] Ronda Ringfort-Felner, Judith Dörrenbächer, and Marc Hassenzahl. 2025. The Quality of Speculation – A Scoping Review. In *Proceedings of the 2025 ACM Designing Interactive Systems Conference*. ACM, New York, NY, USA, 2373–2394. doi:10.1145/3715336.3735794

[79] Ermelinda Rodilosso. 2024. Filter bubbles and the unfeeling: How AI for social media can foster extremism and polarization. *Philosophy & Technology* 37, 2 (2024), 71.

[80] Marie-Monique Schaper and Aurelio Ruiz Garcia. 2023. Three recommendations to engage At-Risk Students in Critical Reflection on Intelligent Technologies through Remote Learning. In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg Germany). ACM, New York, NY, USA, 1–8.

[81] Katie Shilton. 2018. Values and ethics in human-computer interaction. *Foundations and Trends in Human-Computer Interaction* 12 (2018), 107–171. Issue 2. doi:10.1561/1100000073

[82] B. Sterling. 2005. *Shaping Things*. MIT Press, London, England. https://books.google.nl/books?id=fluqQgAACAAJ

[83] Jack Stilgoe, Richard Owen, and Phil Macnaghten. 2013. Developing a framework for responsible innovation. *Res. Policy* 42, 9 (Nov. 2013), 1568–1580.

[84] Bruce M Tharp and Stephanie M Tharp. 2022. *Discursive design*. MIT Press, London, England.

[85] Cameron Tonkinwise. 2014. How we intend to future: Review of Anthony Dunne and Fiona Raby,*speculative everything: Design, fiction, and social dreaming. Des.*

Philos. Pap. 12, 2 (Dec. 2014), 169–187.

[86] Andrea C. Tricco, Erin Lillie, Wasifa Zarin, Kelly K. O'Brien, Heather Colquhoun, Danielle Levac, David Moher, Micah D.J. Peters, Tanya Horsley, Laura Weeks, Susanne Hempel, Elie A. Akl, Christine Chang, Jessie McGowan, Lesley Stewart, Lisa Hartling, Adrian Aldcroft, Michael G. Wilson, Chantelle Garritty, Simon Lewin, Christina M. Godfrey, Marilyn T. MacDonald, Etienne V. Langlois, Karla Soares-Weiser, Jo Moriarty, Tammy Clifford, Özge Tunçalp, and Sharon E. Straus. 2018. PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. 467–473 pages. doi:10.7326/M18-0850

[87] Giovanni Maria Troiano, Matthew Wood, and Casper Harteveld. 2020. "and this, kids, is how I met your mother": Consumerist, mundane, and uncanny futures with sex robots. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu HI USA). ACM, New York, NY, USA, 1–17.

[88] Emmanuel Tsekleves, Andy Darby, Anna Whicher, and Piotr Swiatek. 2017. Co-designing design fictions: A new approach for debating and priming future healthcare technologies and services. *Archives of Design Research* 30 (5 2017), 5–21. Issue 2. doi:10.15187/adr.2017.05.30.2.5

[89] Emily Tseng, Fabian Okeke, Madeline Sterling, and Nicola Dell. 2020. We can learn. Why not?. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu HI USA). ACM, New York, NY, USA, 1–14.

[90] Tommaso Turchi, Alessio Malizia, and Simone Borsci. 2024. Reflecting on Algorithmic Bias With Design Fiction: The MiniCoDe Workshops. *IEEE Intelligent Systems* 39, 2 (3 2024), 40–50. doi:10.1109/MIS.2024.3352977

[91] Tommaso Turchi, Giuseppe Prencipe, Alessio Malizia, Silvia Filogna, Francesco Latrofa, and Giuseppina Sgandurra. 2024. Pathways to democratized healthcare: Envisioning human-centered AI-as-a-service for customized diagnosis and rehabilitation. *Artificial Intelligence in Medicine* 151 (5 2024), 102850. doi:10.1016/j.artmed.2024.102850

[92] Steven Umbrello and Ibo Van De Poel. 2021. Mapping value sensitive design onto AI for social good principles. *AI Ethics* 1 (2021), 283–296. doi:10.1007/s43681-021-00038-3

[93] Ron Wakkary. 2021. Things We Could Design.

[94] Lauren Wilcox, Robin Brewer, and Fernando Diaz. 2023. AI Consent Futures: A Case Study on Voice Data Collection with Clinicians. *Proceedings of the ACM on Human-Computer Interaction* 7 (10 2023), 1–30. Issue CSCW2. doi:10.1145/3610107

[95] Alan F T Winfield and Marina Jirotka. 2018. Ethical governance is essential to building trust in robotics and artificial intelligence systems. *Philos. Trans. A Math. Phys. Eng. Sci.* 376, 2133 (Oct. 2018), 20180085.

[96] Langdon Winner. 1980. Do Artifacts Have Politics? *Daedalus* 109, 1 (1980), 121–136.

[97] Richmond Y. Wong and Tonya Nguyen. 2021. Timelines: A World-Building Activity for Values Advocacy. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (Yokohama, Japan) *(CHI '21)*. Association for Computing Machinery, New York, NY, USA, Article 616, 15 pages. doi:10.1145/3411764.3445447

[98] Richmond Y. Wong, Jason Caleb Valdez, Ashten Alexander, Ariel Chiang, Olivia Quesada, and James Pierce. 2023. Broadening Privacy and Surveillance: Eliciting Interconnected Values with a Scenarios Workbook on Smart Home Cameras. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference* (Pittsburgh, PA, USA) *(DIS '23)*. Association for Computing Machinery, New York, NY, USA, 1093–1113. doi:10.1145/3563657.3596012

[99] Niels Wouters, Ryan Kelly, Eduardo Velloso, Katrin Wolf, Hasan Shahid Ferdous, Joshua Newn, Zaher Joukhadar, and Frank Vetere. 2019. Biometric mirror: Exploring values and attitudes towards facial analysis and automated decision-making. In *DIS 2019 - Proceedings of the 2019 ACM Designing Interactive Systems Conference*. Association for Computing Machinery, Inc, New York, NY, USA, 447–461. doi:10.1145/3322276.3322304

[100] Yiying Wu and Leon Buker. 2024. Unfinished feminist futures: Designer's fiction, theorist's interpretation, and educator's reflection. doi:10.1080/14606925.2024.2433344

[101] Yingfei Ye and School of Design, Hunan University, Changsha, China. 2024. Co-creating pluralistic futures: A systematic literature review on participatory speculative design. In *Proceedings of DRS*. Design Research Society.

[102] Emily York and Shannon N. Conley. 2020. Creative Anticipatory Ethical Reasoning with Scenario Analysis and Design Fiction. *Science and Engineering Ethics* 26, 6 (12 2020), 2985–3016. doi:10.1007/s11948-020-00253-x

[103] Emily York, Shannon N. Conley, Anne D. Henriksen, Dorothy Caserta, Noah Etka, Nolan Harrington, Meghan Jennings, Samuel Kodua, Riley Pates, Zachary Sevison, Elizabeth Terry, Sydney VanNostrand, and Karla Vargas. 2019. Co-Imagining the Futures of Implementation Precision Medicine Using Scenario Analysis and Design Fiction. *OMICS A Journal of Integrative Biology* 23, 7 (7 2019), 340–349. doi:10.1089/omi.2019.0083

A Appendix

Table 2: Reviewed Papers. The table lists the 32 papers included in the literature review. Each paper is identified by a numerical code, its full title, and a reference key. The codes correspond to the identifiers used in the taxonomy figures.

Code	Title	Ref.
1	AI Consent Futures: A Case Study on Voice Data Collection with Clinicians	[94]
2	Co-designing design fictions: A new approach for debating and priming future healthcare technologies and services	[89]
3	Metaverse Perspectives from Japan: A Participatory Speculative Design Case Study	[49]
4	Eagons, exoskeletons and ecologies: On expressing and embodying fictions as workshop tasks	[63]
5	Judgment Call the Game: Using value sensitive design and design fiction to surface ethical concerns related to technology	[3]
6	Unfinished feminist futures: Designer's fiction, theorist's interpretation, and educator's reflection	[100]
7	User Perspectives on Ethical Challenges in Human-AI Co-Creativity: A Design Fiction Study	[77]
8	What would you do? Design fiction and ethics	[6]
9	Ethics by design: Responsible research innovation for AI in the food sector	[24]
10	"And This, Kids, Is How I Met Your Mother": Consumerist, Mundane, and Uncanny Futures with Sex Robots	[87]
11	A Workshop-Based Method for Navigating Value Tensions in Collectively Speculated Worlds	[42]
12	Reflecting on Algorithmic Bias With Design Fiction: The MiniCoDe Workshops	[90]
13	Understanding occupants' experiences in quantified buildings: results from a series of exploratory studies	[66]
14	Where is Vincent? Expanding our emotional selves with AI	[55]
15	Biometric Mirror: Exploring Ethical Opinions towards Facial Analysis and Automated Decision-Making	[99]
16	Broadening Privacy and Surveillance: Eliciting Interconnected Values with a Scenarios Workbook on Smart Home Cameras	[98]
17	Computationally mediated pro-social deception	[52]
18	Crafting the future of the artificial womb – speculative design as a tool for public engagement with emerging technologies	[72]
19	Envisioning and Questioning Near Future Urban Robotics	[61]
20	Ethics and Power Dynamics in Playful Technology for Animals: Using speculative design to provoke reflection	[36]
21	Exploring the Reflective Space of AI Narratives Through Speculative Design in Japan and Germany	[48]
22	Location, Location, Security? Exploring Location-Based Smart Device Security Concerns and Mitigations within Low-Rent Homes	[7]
23	Ethical Design of a Robot Platform for Disabled Employees: Some Practical Methodological Considerations	[22]
24	Sensor Illumination: Exploring Design Qualities and Ethical Implications of Smart Cameras and Image/Video Analytics	[75]
25	Three recommendations to engage At-Risk Students in Critical Reflection on Intelligent Technologies through Remote Learning	[80]
26	Timelines: A World-Building Activity for Values Advocacy	[97]
27	Pathways to democratized healthcare: Envisioning human-centered AI-as-a-service for customized diagnosis and rehabilitation	[91]
28	Co-Imagining the Futures of Implementation Precision Medicine Using Scenario Analysis and Design Fiction	[103]
29	Investigating the Extended Metacommunication Template: How a semiotic tool may encourage reflective ethical practice in the development of machine learning systems	[4]
30	Creative Anticipatory Ethical Reasoning with Scenario Analysis and Design Fiction	[102]
31	Speculative Histories, Just Futures: From Counterfactual Artifacts to Counterfactual Actions	[34]
32	Letters from the Future: Exploring Ethical Dilemmas in the Design of Social Agents	[62]