Scenarios in Computing Research: A Systematic Review of the Use of Scenario Methods for Exploring the Future of Computing Technologies in Society

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Abstract

Scenario building is an established method to anticipate the future of emerging technologies. Its primary goal is to use narratives to map future trajectories of technology development and sociotechnical adoption. Following this process, risks and benefits can be identified early on, and strategies can be developed that strive for desirable futures. In recent years, computer science has adopted this method and applied it to various technologies, including Artificial Intelligence (AI). Because computing technologies play such an important role in shaping modern societies, it is worth exploring how scenarios are being used as an anticipatory tool in the field—and what possible traditional uses of scenarios are not yet covered but have the potential to enrich the field. We address this gap by conducting a systematic literature review on the use of scenario building methods in computer science over the last decade ($n = 59$). We guide the review along two main questions. First, we aim to uncover how scenarios are used in computing literature, focusing especially on the rationale for why scenarios are used. Second, in following the potential of scenario building to enhance inclusivity in research, we dive deeper into the participatory element of the existing scenario building literature in computer science.

1 Introduction

The use of narrativized scenarios in research has been a longstanding method dating back to the 1950s with early work focusing on military planning, public policy analysis, and strategic management decisions (Amer, Daim, and Jetter 2013; Ramírez and Selin 2014; Ramirez and Wilkinson 2016; Van der Heijden 2005). This method has gone by many names, spanning speculative design, what-if scenarios, scenario building, and more. Regardless of the terminology, the central thread of using scenarios is to transform complex information into a short story-like version that conveys essential information in an easy to understand manner to enable various stakeholders (experts or laypersons) to make informed opinions about possible futures. As Carroll puts it, "Scenarios are not the traditional activity logs of human factors ... they are meaningful to and discussable by users; they are couched at the level at which people understand and experience their own behavior" (Carroll 1995).

Due to the fragmented nature of scenario methods across various domains—there is no unified terminology for the method—it can prove difficult to understand the landscape of objectives researchers seek to achieve through the use of scenarios. For instance, researchers may get siloed in one body of work such as speculative design, and miss out on other areas like scenario planning and scenario building—which may result in blind spots and missing out on the potential for a more holistic application of scenarios. The use of scenarios in research can also enable a participatory element to engage with lay-stakeholders by making complex technology and its impacts more tangible and understandable. This paper thus offers (1) a springboard for those who already use scenarios to understand different objectives they can achieve, and (2) an introduction to scenarios and their potential for those who have never used them before.

To understand this collective body of work within computing literature specifically, we have conducted a systematic literature review of the use of scenario methods in computer science over the last decade. We reviewed all research papers published in the Association for Computing Machinery (ACM) digital library from January 1 2015-January 31 2025 that use scenarios to perform futuring for any emerging technology. In particular, this paper explores the objectives computer science researchers are pursuing through the use of scenarios, as well as the degree of participation this method has enabled in the field of computing.

Our formal research questions are:

- **RQ1**: What are the objectives of scenario building as described in computing literature, and what form are these scenarios taking?
- **RQ2**: How strong is the participatory element in scenario building studies, and how are researchers using scenario building to achieve this goal of participatory methods?

This paper makes two concrete contributions. First, it identifies five main ways that researchers in computing are using scenarios in their work: (1) to gather stakeholder needs and values, (2) to empower marginalized groups to imagine technology futures, (3) to provoke ethical reflection and promote critical awareness, (4) to anticipate threats and risks of these technologies, and (5) to explore perceptions and impacts of novel technologies before they launch. Second, it explores and quantifies the degree of participation this

method can and has enabled in the computing literature.

2 Background

2.1 The Use of Scenarios in Research

A scenario can be understood as a description of a potential future situation that traces back to current events, trends, and policies (Amer, Daim, and Jetter 2013). Scenario building does not need to describe *one* state but opens the possibility to explore different future alternatives (Börjeson et al. 2006). We define ***scenario building*** as a method that utilizes scenarios (typically in natural language text, but also in other media such as speech or video) that seeks to describe potential and alternative future outcomes and realities. Scenario building is often used as a strategic tool to reflect on potential strategies that might need to be taken if certain events take place (e.g., military strategies), or for business in respect to changing governance structures, business decisions, or changing user patterns (Selin 2006). Consequently, scenario building has had a long research tradition in the academic fields of economics and policy research, but also for research focusing on emerging technologies that has even resulted in the establishment of distinct academic journals like *Futures* and *Journal of Forecasting*. In addition to its use in scholarship, scenario building has also achieved broad adoption in companies (Varum and Melo 2010).

Scenarios let users weigh multiple environmental impacts at once and reflect on the complexity of the world (Amer, Daim, and Jetter 2013). They do not predict the future; they help users "recognize, consider and reflect on the uncertainties they are likely to face" (Varum and Melo 2010). Reducing uncertainty helps decision-makers prepare for and adapt to different situations (Nanayakkara, Diakopoulos, and Hullman 2020; Urueña 2019). Scholars emphasize synthesizing key elements into plausible, internally consistent future scenarios (Burnam-Fink 2015; Ramírez and Selin 2014). Scenarios are not neutral: "Despite the aim to create objective or equally plausible scenarios, specific future worlds are sketched out and in the end scenarios are always selective and political" (Selin 2006). They can amplify business strategies or highlight the voices of marginalized groups, invoking a participatory approach to sense-making. These participatory methods can emerge in *participatory foresight* practices (Nikolova 2014).

Scenario building encompasses a wide variety of approaches. For instance, Börjeson et al. distinguish between *predictive*, *explorative*, and *normative* scenarios, framed by "What will happen?, What can happen? and How can a specific target be reached?" (Börjeson et al. 2006). Each type favors distinct methods—from quantitative predictive models to qualitative, value-driven explorations of desirable or undesirable futures (Amer, Daim, and Jetter 2013). Scenario building can be achieved by the means of surveys, workshops, Delphi methods, etc., which also result in a large variance in the number of scenarios created and the time-frame of the scenarios (Börjeson et al. 2006). Under the umbrella term "scenario building," different sub-categories and methods have evolved, including but not limited to *science fiction prototyping* (Bray et al. 2022; Burnam-Fink 2015), *storytelling* (Rasmussen 2005), and *speculative design* (Bray and Harrington 2021; Hohendanner et al. 2024).

With their focus to illuminate plausible future developments, scenarios are especially useful to uncover trajectories of technology development. There has been scholarly work on using scenario building as an anticipatory tool for emerging technologies, especially those that might have severe consequences (Diakopoulos and Johnson 2021; Mittelstadt, Stahl, and Fairweather 2015). Brey states, "The exploration of possible and plausible futures may provide valuable information. First, by giving glimpses of what may happen, it allows for better anticipation of the future than would be possible in a situation in which one has no idea what may happen. Second, by projecting possible future applications and uses of the technology and resulting consequences, it is possible to identify potential risks and benefits" (Brey 2017).

Many major recent technological developments—from virtual reality tools to AI—stem from computing. To anticipate their impact, scenario methods have entered computing disciplines, and scholars in this discipline have begun to adapt this research method to fit their objectives. Research disciplines shape the adoption of methodological toolkits to their practices, and computing will reshape scenario methods to fit its technological artifacts. Given computing's societal reach, we explore how scenarios are used as an anticipatory tool in the field—and what traditional uses of scenarios remain untapped. To our knowledge, existing reviews focus only on scenario building in the field of future studies (Amer, Daim, and Jetter 2013; Börjeson et al. 2006; Varum and Melo 2010). This paper closes that gap with a review of scenarios in the field of computing.

2.2 Participatory Methods and Anticipatory Governance in Computing

Understanding the vast assortment of risks and challenges from emerging technologies has traditionally been an expert-heavy endeavor (Herdel et al. 2024; Solaiman et al. 2023; Weidinger et al. 2021), which have been shown to be prone to biases (Bonaccorsi, Apreda, and Fantoni 2020; Brey 2017). However, there has been a recent call to attention for the need of more inclusive methods to involve a more diverse variety of stakeholders (Kieslich, Helberger, and Diakopoulos 2025; Metcalf et al. 2021)—whether laypeople or "other experts" from adjacent domains (Nikolova 2014). This is especially important when considering the disciplinary, political, and societal goal is to design emerging technologies in alignment with "agreed upon" morals of society, which are ever-changing and differ vastly when you query different stakeholders (Baum 2020).

Participatory methods also involve including diverse voices who may otherwise not have the chance to contribute to the trajectory of a project, initiative, or other endeavor (Delgado et al. 2023). Sclove (2010) specifically defines participatory technology assessment as enabling "people who are otherwise minimally represented ... to develop and express informed judgments concerning complex topics." Scenario building is particularly apt at assisting laypeople with the development of informed judgments concerning complex topics since they are able to interact with tangible narra-

tives around technologies, or even transform their own ideas into short stories or excerpts.

Beyond any moral arguments, participatory methods have been described as an approach that can improve the quality of future simulations by making them more realistic for a wider array of people (Barreteau et al. 2013). Participatory foresight in particular—a technique to anticipate future outcomes—proposes including diverse stakeholders (whether different types of "experts" or laypeople) to provide a more realistic and socially grounded image of reality and impact (Nikolova 2014).

Delgado et al. (2023) outline four levels of participation with stakeholders in participatory designs: (1) consult (2) include (3) collaborate, and (4) own. Various methods can satisfy different levels, and scenario building can fulfill all four levels, depending on how it is used. Other expert-heavy methods including red teaming (Feffer et al. 2024) and algorithmic audits (Bandy 2021) have gained popularity specifically with generative AI models.Various methods have emerged for the *design* of new technologies that integrate participatory approaches which can tackle some overlapping aspects of impact assessment early on, such as user-centered design (Council 2005) or participatory design (Gregory 2003; Simonsen and Robertson 2013). Andersen, Hansen, and Selin (2021) note various methods that integrate stakeholder input and their respective drawbacks: workshops are time consuming and have asymmetric engagement, and interviews have limited knowledge sharing among participants. Scenario building can be used to complement and offset the drawbacks of various other participatory methods. It can be deployed in a quick and efficient manner for participants if needed, take the form of a collaborative group discussion if preferred, or even be integrated to workshops, interviews, or a survey-based structure.

3 Data and Methodology

In order to comprehensively examine these research questions, we conducted a systematic literature review (SLR) of full research articles published in the ACM digital library over the last ten years. In order to be transparent and replicable, the reporting of this SLR was guided by the standards of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al. 2021). We first established search criteria, then conducted an abstract screening phase, and then assessed the full text of the articles for inclusion eligibility. Our final coding documents are available at: https://tinyurl.com/scenario-slr.

3.1 Search Strategy

Inclusion and Exclusion Criteria ***Formatively*** we analyzed full research articles published in English in the ACM digital library that utilized scenario building in their methods or analysis. We excluded extended abstracts, book chapters, write-ups proposing workshops or panels, short papers, and any other non-full-length research article. We analyzed the full contents of these works including supplemental material in the main PDFs. We did not consult outside material such as websites with accompanying appendices.

Temporally we analyzed works that had been published in the last ten years. We decided to scope the time frame to ten years in order to track the latest developments in computing technologies—including the recent rise of generative AI—but also give space for other technologies that emerged during this time span. For the context of this work, that meant they were published between January 1, 2015 and January 31, 2025. This covers a comprehensive snapshot of how computer scientists are currently utilizing scenario building, as well as provides some historical context for how use of the method has morphed over the last decade.

Topically these papers had to be about using scenario building to explore future possible developments or impacts of emerging technologies. This excluded works that were using scenario building for non-technology futuring, such as exploring future ways to design museum exhibits. It also excluded works conducting scoping analyses or other SLRs (one explored speculative design in sustainable HCI (Soden, Pathak, and Doggett 2021), and the other explored 11 works that automatically constructed scenarios (Davis, Jetter, and Giabbanelli 2023)). We lean on the definition proposed by Rotolo, Hicks, and Martin (2015) of an ***emerging technology***, which identifies the key attributes as "(i) radical novelty, (ii) relatively fast growth, (iii) coherence, (iv) prominent impact, and (v) uncertainty and ambiguity." We are liberal in our application of this definition (erring on the side of inclusion), for instance we consider any new technology warranting the writing of a full research paper to qualify as "prominent impact." We found the description of radical novelty quite useful, however, as it allowed us to exclude descriptions of "new" technologies that had mostly matured or were simply being applied in a new context. We also exclude technologies that were entirely based on fiction (as of Spring 2025) such as technology manipulating time (Behzad 2023) or dreams (Bønlykke, Madsen, and Jenkins 2024). The emphasis on uncertainty and ambiguity aligns well with the goal of scenario building for uncovering potential impacts and developments of technologies.

Keyword Search Based on this inclusion and exclusion criteria, we arrived at a final list of keywords with which to query the ACM digital library. We start with the main list of terms we are familiar with to describe scenario building, such as "scenario writing" and "speculative fiction," and then we bolster our list with those identified by Amer, Daim, and Jetter (2013) in their review of scenario planning. The finalized set of query terms for the ACM digital library was:

- (Abstract OR Title contains: "scenario*building" OR "scenario*writing" OR "scenario*based" OR "scenario*driven" OR "speculative*fiction" OR "speculative*design" OR "predictive*forecast" OR "what-if*scenario" OR "explorative*scenario" OR "strategic*scenario" OR "normative*scenario" OR "transforming*scenario") AND
- E-Publication Date: (01/01/2015 TO 01/31/2025)

We noticed that the most recent proceedings of AI, Ethics, and Society (AIES '24) were not present in the ACM digital library yet part of the the broader ACM catalogue even

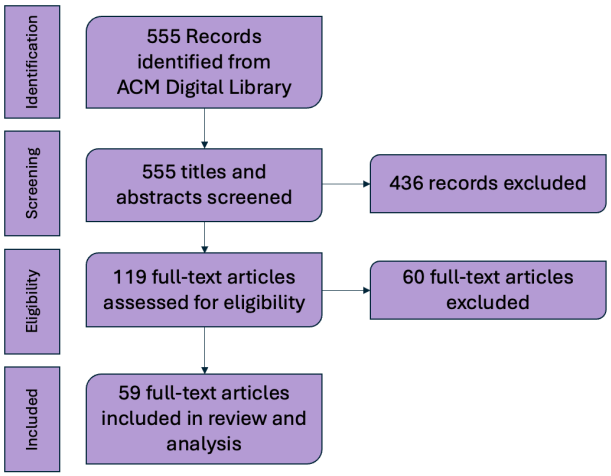

Figure 1: PRISMA flow diagram detailing the corpus of research articles screened and analyzed in this work. We started with 555 records from the ACM digital library (including 4 identified manually from the AIES '24 proceedings), removed 436 records during the abstract screening phase, and removed 60 full-text articles during the PDF eligibility assessment phase. This resulted in a final dataset of 59 full-text articles included in our review and analysis.

though past years were, so we also manually queried the AIES proceedings page[1] with the same set of keywords to identify four more records to include in our search.

3.2 Title and Abstract Screening

Two authors conducted the abstract screening of the 555 articles identified through our search. This was conducted in multiple rounds of 50 papers each until a high inter-rater reliability score was reached for inclusion of works with a Cohen's Kappa of 0.94. After this agreement was attained, one author coded the remaining 355 abstracts for inclusion.

Of the original 555 records, we excluded 436 papers during this stage. The exclusion criteria is detailed in Section 3.1. Of these exclusions, the vast majority were due to not being about scenario building ($n = 183/436; 42\%$) but rather some type of analysis mentioning scenarios. Often times this captured "scenario-based" designs such as a predetermined set of variables or characteristics a self driving car might encounter for the purposes of testing; not futuring scenarios to consider impacts. The second most common reason to exclude was for works that were not full-text research articles ($n = 167/436; 38\%$); these typically took the form of extended abstracts or works in progress published in the ACM digital library, though some were proposals or descriptions of workshops or panels. The third most common exclusion reason during the abstract phase was the subject matter not being about an emerging technology ($n = 76/436; 17\%$). The remaining three reasons for exclusion were scenario building being mentioned offhand but not the actual focus of the work ($n = 6/436; 1\%$), scoping reviews or SLRs ($n = 2/436; 0.5\%$), and finally fictional technologies that do not yet exist ($n = 2/436; 0.5\%$).

[1]https://ojs.aaai.org/index.php/AIES/search/search

3.3 Full Text Screening

We next obtained the PDFs of the remaining 119 full-text articles and assessed them for eligibility, ultimately excluding 60 papers during this stage. Here we identified a new category for exclusion: speculative design works that aimed to iteratively improve on specific design features of existing technologies or prototypes through querying potential users rather than focusing on future impacts of the technology on communities or society at large. Though they sometimes used an adjacent technique to scenario building, the goal of these works was to result in technology adaptations more suitable to specific user bases, such as works that conducted interviews with their potential users to understand how they would like to see prototypes altered. For example, one work used scenario-based HCI methods to create design recommendations for cemetery design (Hirsch, Hild, and Obaid 2022) and another explored methods to make genAI code more explainable (Sun et al. 2022). We excluded $n = 7/60$ articles for this reason. Our most common exclusion criteria was again works that were not about scenario building ($28/60; 47\%$), followed closely by works not considering emerging technologies ($24/60; 40\%$). We also excluded one paper ($1/60; 2\%$) for not being written in English. There were no other reasons for exclusion during this stage.

3.4 Descriptive Statistics

The final corpus for inclusion in this work consisted of 59 papers from the ACM digital library (2 of which were identified in the extra inclusion of the AIES '24 proceedings). The conferences with at least 3 papers in our final database (no journals met this criteria) were:

1. CHI: Human Factors in Computing Systems ($n = 14/59; 24\%$)
2. DIS: Designing Interactive Systems ($n = 9/59; 15\%$)
3. CSCW: Computer-Supported Cooperative Work & Social Computing ($n = 6/59; 10\%$)

For the qualitative analysis, we iterated among three authors until we agreed on standard definitions for all variables for which we were coding. During this stage we coded for the type of emerging technologies studied, the dominant terminology used to describe scenario building, the scenario generation process (e.g., who wrote them, method to generate), the scenario evaluation process (e.g., how many evaluators, evaluator expertise), content of the scenarios, metadata of scenarios (e.g., medium, language), their goal of using scenario building, and degree of participatory design.

As shown in Figure 2, there has been a recent and growing surge of the use of scenario based methods in computer science for works concerning emerging technologies. 11, 14, and 15 papers used these methods in 2022, 2023, and 2024, respectively, compared to an average of 2 papers per year from 2015-2020. We categorized the type of emerging technology that was the focus of these works, and grouped them in "other" if only one work discussed the topic. Of the 59 papers in our final corpus, $21/59; (36\%)$ were predominantly

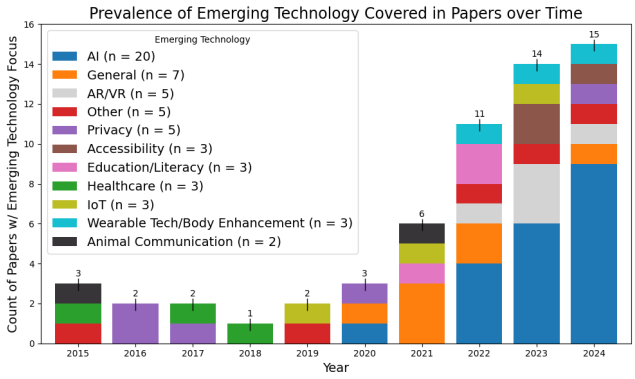

Figure 2: Stacked bar plot displaying the count of papers with a focus on the categorized emerging technologies over time. Works were categorized into "other" if only one paper covered that topic.

about AI, with all but one of those papers published in 2022 or later. Aside from "general" emerging technologies and "other," our next most common emerging technologies were augmented reality/virtual reality (AR/VR) and privacy focused technologies, which tied at $5/59; (8\%)$ papers each discussing these topics. All of the AR/VR papers were published in 2022 or later, whereas all of the privacy focused papers were published in 2020 or earlier with 80% of them published between 2016-2017.

The terminology that researchers ascribe to this method is diverse, with six different nomenclatures present in our corpus. "Speculative design" was the most popular terminology, with $33/59; (56\%)$ papers predominantly referring to this method by that term, followed by "scenario-based" ($n = 19/59; 32\%$). The other four terms dominantly used for the method in our corpus each appeared in 2 papers: "scenario building," "scenario writing," "speculative fiction," and "what-if scenarios." There were no notable temporal trends, other than "scenario writing" and "scenario building" did not appear in computing literature until recently (once in 2021 and three times in 2024). Otherwise there has been a consistent usage of both "speculative design" and "scenario-based." It is important to note that speculative design is used as a much larger umbrella term that covers non scenario-based methods. "Scenario-based" similarly includes a large body of work that deals with more variable setting simulation based works, such as those defining specific scenarios for testing in autonomous vehicles or mathematical models. To distinguish this distinct narrative style use of scenarios for futuring analyzed in this work from the larger existing bodies of speculative design and scenario-based methods, we decide to move forward with the use of "*scenario building*" to describe this method, though note that all of these terminologies could mean the same thing in various settings.

4 Analysis

The goal of this paper is to examine how researchers have utilized scenarios in computing research to meet various needs in order to provide a comprehensive snapshot of these types of methods in the field. In this section we first go through the objectives of using scenarios in the works in our corpus, as well as the form their scenarios took in terms of medium, content, and format. We then take a deeper look at the participatory element enabled by using scenarios by examining the generation process, the evaluation process, and the level of participation from lay stakeholders.[2]

4.1 Thematic Analysis: How Are Scenarios Being Used in Computing Literature?

We seek to understand the objectives that researchers seek to achieve through the use of scenarios in computing literature. Of the 59 papers included in our final corpus, we qualitatively analyzed the objectives of using scenarios as stated explicitly by the researchers (either in the form of research questions, contributions, or in their methods and analysis sections). We identified through inductive analysis five main categories to group these objectives; in order of frequency they are: (1) **gather stakeholder needs and values** ($n = 22/59; 37\%$); (2) **empower marginalized groups to imagine technology futures** ($n = 12/59; 20\%$); (3) **provoke ethical reflection and promote critical awareness** ($n = 10/59; 17\%$); (4) **anticipate threats and risks of these technologies** ($n = 10/59; 17\%$); and (5) **explore perceptions and impact of novel technologies** ($n = 5/59; 8\%$).

Gather stakeholder needs and values We define this objective for works that primarily used scenario building to understand the desires and needs of stakeholders so that they can inform design of technology or policy that would govern the use of these technologies in society. Scenario building is an effective method for this goal since researchers are able to contextualize complex technologies and concepts in short narratives to frame stakeholders with all the needed information to make an informed opinion in a short period of time. This was by far the largest category of use in our corpus with $n = 22/59$ papers. These works were, especially in recent years, typically using scenario building to gather stakeholder needs and values around various AI technologies ($n = 12/22$), though people have used this method for many other emerging technologies as well.

The terminology used for this objective was predominantly "scenario-based" ($n = 9/22$), though "speculative design" closely following ($n = 8/22$), and every other terminology was used except for "speculative fiction." As the most frequently used objective, it also showed the greatest diversity in application. Some papers used is a springboard to gather stakeholder values about technology ethics, such as understanding Japanese citizens' perceptions of the Metaverse (Hohendanner et al. 2024) or to map public perception of AI chatbots (Kieslich, Helberger, and Diakopoulos 2024). As Hohendanner et al. (2024) put it: this method "can assist with placing the needs and doubts of the actual user of the technology at the center of design decisions."

Researchers also pursued this objective in the context of healthcare, well-being, and care-focused technology fu-

[2]Tables of the all the works in our corpus categorized by theme and participation level are available in the appendix of our preprint: https://arxiv.org/pdf/2506.05605.

tures. In these works, they focused on a targeted group of stakeholders to evaluate the scenarios, such as understanding older adults' expectations of how a voice assistant should behave when providing health information (Brewer et al. 2022), or the use of chatbots to meet the healthcare needs of migrant workers (Tseng, Jarupreechachan, and Lee 2023).

Some of these works consulted specific end users (rather than the general public) to understand how they perceived the risks and benefits of existing technologies, such as one method that used a Dungeons and Dragons style scenario method with journalists to understand their perception of possible deepfake identification technology (Sohrawardi et al. 2024). Another consulted social housing tenants to understand their particular security concerns in relation to smart home devices (Benton, Vasalou, and Turner 2023). In that vein, another study used scenarios to gain a deeper understanding of the perceptions of Australians with green energy technologies in their homes towards data sharing of everyone in their community in regards to privacy concerns and public responsibility for curtailment (Snow et al. 2021).

The uniting thread among these works is that they were interested in the values of non technology stakeholders—whether that was end users, lay stakeholders, or key players such as journalists. They utilized scenarios to frame these technologies in a way that was easily understood by these stakeholders so that they could make informed and pointed value judgments on the perceived future implications of these technologies, whether positive or negative.

Empower marginalized groups to imagine technology futures We define this objective for works that used scenarios specifically to empower a marginalized group through speculative and participatory methods to understand the specific concerns, needs, and visions of these communities. These projects worked specifically with and/or for communities that are typically left out of larger discussions surrounding technology futures. The most common were works that dealt specifically with BIPOC communities ($n = 5/12$), followed by communities of people with chronic diseases or disabilities ($n = 4/12$), followed by works dealing with indigenous communities ($n = 2/12$), and finally one work that focused on Iraqi refugees in Australia ($n = 1/12$).

Works in this category predominantly referred to the method as "speculative design" ($n = 11/12$), with one paper referring to it as a "scenario-based" method. These works often focused on "general" emerging technologies and technology futures ($n = 5/12$), but some also dealt with accessibility focused new technologies ($n = 3/12$), and then one each focused on AI, green technology, education empowering technologies, and healthcare technology. Instead of focusing on different technologies, these works tended to focus on different communities.

Within the works for BIPOC communities, these papers often referred to the concept of "Afrofuturism," which artist Sanford Biggers describes as "a way of re-contextualizing and assessing history and imagining the future of the peoples of the African Diaspora via science, science fiction, technology, sound, architecture, the visual and culinary arts, and other more nimble and interpretive modes of research and understanding" (Winchester III 2018). Harrington and Dillahunt (2021) point out that "Marginalized populations are very rarely, if ever, represented in popular scenarios of technology design fictions ... the needs of white affluent citizens from financially-wealthy countries are at the center of such scenarios." Bray and Harrington (2021) describe using this method to empower Black and brown communities as "an accessible resource that can be readily used by designers and nondesigners alike in addressing community concerns." Beyond focusing on BIPOC communities, these works also are likely to highlight other less dominant groups such as Black women, Femmes, or Non-Binary people (Klassen et al. 2024), or working-class Detroiters (Lu, Wikstrom, and Dillahunt 2024).

Within the works focusing on using scenarios to empower communities with chronic illness or disabilities ($n = 4/12$), one focused generally on people with chronic illnesses (Hoang et al. 2018), one focused generally on people with disabilities and their access to technology (Hsueh et al. 2023), one focused on blind and low vision users (Phutane et al. 2023), and one focused on autistic Twitch livestreamers (Mok et al. 2024). All four of these used at least one non-text medium, with the work for blind and low vision users exclusively using speech scenarios. As Hsueh et al. (2023) put it, "Disabled people have long been doing critical design – they critique existing built environments and (re)make them in ways that are often rendered invisible in history;" they use scenario building in their work to make those designs visible. This type of work demonstrates the versatility of scenarios and how they can empower different people to take part in designing their own desired technological futures.

There were two works that focused on indigenous communities in this section: one worked with an indigenous group in Northwestern Namibia and Southwestern Angola called ovaHimba (Muashekele et al. 2023), and the other worked with Imazighen, the native people in remote Morocco (Rüller et al. 2022). Both works took extreme care to fully situate themselves within the context of these communities, and both projects are working with established collaborations between the researchers and the indigenous communities that have been going on for many years. The work with ovaHimba sought to understand the citizen desires of the use of green energy through group "future walk" studies where they would collectively take a walk through their communities and discuss desired potential technology to help them (Muashekele et al. 2023). The other focused on illiteracy and ways to ameliorate the negative effects of this through new technologies (Rüller et al. 2022).

Provoke ethical reflection and promote critical awareness We define the objective for this group of works to mean the use of scenarios to prompt people to think through social and ethical ramifications of technologies, question norms, and imagine other possible futures. This was tied for the third most common objective, with $n = 10/59(17\%)$ works having this as the primary objective for their use of scenarios.

Works in this group also favored the terminology "speculative design" ($n = 6/10$), but it was also referred to

using "scenario-based" ($n = 2/10$), "scenario building" ($n = 1/10$), and "speculative fiction" ($n = 1/10$). There were three works in this category focusing on wearable technology/body enhancement technology ($n = 3/10$), two each that focused on AI, animal communication technologies, and privacy focused technologies ($n = 2/10$ each), and one that focused on emerging technologies in general. Works in this category focused on different methods to promote reflection of technology ethics and utilized the method as a way to surface ethical issues of technologies early.

One work used the popular television show *Black Mirror*, a science fiction dystopian show that focuses on dark potential impacts of technology, to cultivate ethical reflection in computer science eduction (Klassen and Fiesler 2022). In a similar vein, another work used the concept of "cinematic pre-visualization (previs)" techniques—they assert "using medium-fidelity previs methods can result in compelling visual artifacts that propel researchers' vision for their work, highlight concrete challenges and opportunities, and facilitate public discussion" (Ivanov et al. 2022). Another work analyzed how researchers could make use of "Model Cards" (documents providing benchmark evaluation information about trained machine learning models) to promote ethical reflection (Nunes et al. 2022). They found that while these cards prompted participants to "deliberat[e] on the ethics of their development decisions, they only recorded those that they considered to be ethical."

Some works in this category focused on understanding the driving factors behind different perceptions of human augmentation technologies (Villa et al. 2023) or "personal fabrication technologies," and the latter even used a narrative scenario in their research paper to educate the reader on how they define this technology and contextualize target users (Stemasov et al. 2022). Other works focused on the set of technologies aiming to facilitate communication with pets and provoke reflection on this "hypothesized future technology; our intention was to raise awareness of issues with products before they become public concerns, not afterwards" (Lawson et al. 2015), and found "speculative design proved to be a useful tool for provoking ideas and framing discussions around this theme" (French et al. 2021).

Anticipate threats and risks of these technologies We classified works into this objective when they primarily used scenarios as a method to anticipate potential threats of technology, security exploits, malicious uses, or other harms that could arise from the technology. This was tied for the third most common main objective, with $n = 10/59; (17\%)$ works having this as the primary goal.

Works with this goal predominantly referred to the method as "scenario-based" ($n = 5/10$), with "speculative design" falling in close second ($n = 4/10$), and one work using the term "speculative fiction" ($n = 1/10$). These works followed a trend of anticipating "hot topic" technologies of their year. One paper in 2019 focused on anticipating threats of internet of things (IoT)/smarthome technologies, followed by one in 2020 focusing on privacy. From 2022-23 there were three papers focusing on augmented reality/virtual reality (AR/VR) technologies, and then in 2024 there were four papers focusing on the threats of AI. These works all tried to anticipate threats of specific technologies before all of their harms have been realized in society.

One work focused on the specific risks of children utilizing IoT technology in order to anticipate the privacy, security and safety risks that emerge in the context of such uses (Knowles et al. 2019). Another work wove scenarios into a role-playing game to help software developers identify security threats (Merrill 2020). As the author asserts, "threat identification is a socially-situated practice. Multiple stakeholders and values collide with business imperatives to produce a socially contingent set of threats deemed relevant," which scenario based methods are perfect at eliciting.

The works on AR/VR all shared a concern that risks were unrecognized in these technologies in tandem with them becoming more pervasive. One used "dark scenarios" to explore how it "may be used to create deceptive designs taking advantage of users, or could lead to unintentional, but still equally harmful negative consequences" (Eghtebas et al. 2023). Another created scenarios in VR to explore the potential malicious use of perceptual manipulation in VR in order to explore threats within this space (Tseng et al. 2022).

The most recent of theses works focused on AI technologies and were all published in 2024. One used scenarios to generally understand AI researchers' concerns in regard to AI (Jantunen et al. 2024). To illustrate how important scenarios are in making complex threats manifest in a much more concrete and digestible way, one utilized scenarios to help users foresee AI harms, and one of their participants remarked "Why the heck didn't we think like this before? I've used tons of AI Ethics tools. My clients hate how abstract they are. This [process] is specific and customers would love it...this is the next leap from impact or risk assessments" (Ehsan et al. 2024).

Explore perceptions and impact of novel technologies The final objective was defined as works that used some sort of artifact to explore people's perceptions of novel technologies either through simulation of digital and physical artifacts or detailed descriptions of what they might look like. There were only $n = 5/59(8\%)$ works that fit this category, and they all focused on different technologies. Most of these works used the terminology "speculative design" ($n = 4/5$), and one used the term "scenario-based" ($n = 1/5$). Two of these works used videos as the primary form of scenario in their works ($n = 2/5; 20\%$), which is proportionally twice as often as the larger corpus.

One explored what intimate artifacts could look like in the future (Kaur et al. 2022) by encouraging users to design scenarios detailing them. Another used an "ethnographically-informed Walking & Talking method" to brainstorm possibilities of a new technology, in which they prototyped an "interactive smell-stick device" to share smells as you would photos on a smart phone (Stals, Smyth, and Mival 2019). Others explored a microchip-based contraceptive implant (Homewood and Heyer 2017), an anti-harassment system for social networks (Kim et al. 2024), and finally one explored both utopian and dystopian body perception transformation technologies (Turmo Vidal et al. 2023).

Researchers discussed how using scenario methods for these novel technologies "expanded the horizons...from what we had initially conceived from our secondary research" (Kaur et al. 2022). Others noted that this method "revealed key elements and design goals to consider" (Kim et al. 2024). Another work mentioned that "although described in the popular press and articles in the medical field, the technology needs to be critically examined from the perspective of how we will interact with it, and the role it may play in our lives" (Homewood and Heyer 2017). These all suggest that the use of scenarios in this manner can elucidate findings that other traditional methods cannot.

4.2 The Participatory Element of Using Scenarios

A recent work by Delgado et al. (2023) examining AI design detailed the levels of participation usually applied in "participatory designs," ranging from (1) consult, (2) include, (3) collaborate, and finally (4) own. We use these levels to analyze the manner in which scenario building in our corpus was used to achieve participatory means, especially in tandem with the level of expertise of those writing the scenarios. We assess the participation in relation to how stakeholders are involved in the general process of the scenario method—depending on the structure of the task, they were typically involved in creating, evaluating, or reflecting upon the scenarios. We provide our own detailed definitions used to apply these levels below:

1. **Consult:** ranking, feedback, or multiple choice type evaluation, such as those that had people deliberate about predefined policy options.
2. **Include:** the options are originally created by the researchers, but participants have the ability to shape the options and alter them or provide meaningful feedback that can change outcomes. Though they are not part of the creation process, they still have the power to shape the emerging technologies.
3. **Collaborate:** participants are part of the creation process, but they still do not have equal authority or power relative to the researchers.
4. **Own:** participants are central to the process, co-design everything, and have outcome authority. There is an equal partnership between researchers and participants, if not skewed more towards the participants.

In this section we also delineate between the inclusion of expert and non-expert stakeholders. We define experts to be users or participants with a professional background (either technical or domain based) in the technology that is being evaluated. Non-experts are people who have no formal training in either case, though they possess their own contextualized lived experience which constitutes its own form of situated expertise. An overview of the categorization of works in this section can be seen in Figure 3. There were only three papers in our corpus without a participatory element (the scenarios were written and evaluated by the authors alone), leaving us with 56 to analyze in this section. We also performed a cross analysis between the thematic analysis above and the participatory levels, but there were no salient patterns to note.

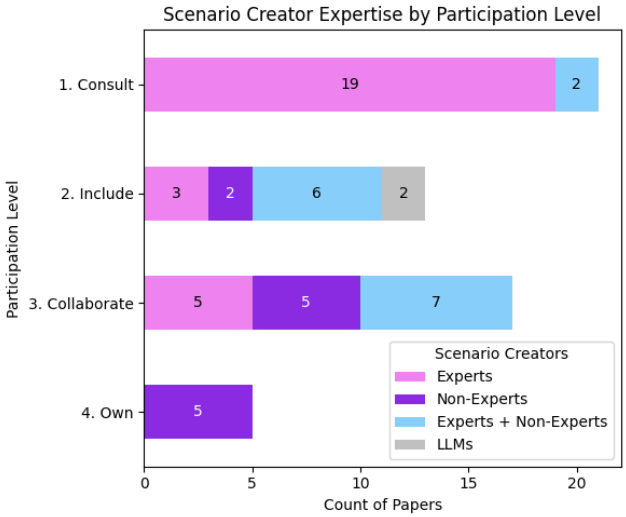

Figure 3: Stacked bar plot of the 56 papers in our corpus with participatory elements categorized by participation level and separated by expertise of the scenario creators.

Level 1: Consult This was the most common level of participation, with $n = 21/59$ works in our corpus meeting this level. These scenarios were almost entirely written by experts ($n = 19/21$), with $n = 2/21$ being written by a combination of experts and non-experts. However, in instances in which the creators of the scenarios were not the evaluators of the scenarios, ($n = 14/21$), non-experts tended to be the evaluators of the scenarios ($n = 9/14$).

These works took many forms, from eliciting ethical concerns from AI researchers and exploring how users reason about future consequences (Jantunen et al. 2024), to exploring how specific technology could aid or hinder coping with interpersonal racism (To et al. 2022), or to understand older adults' expectations of how a voice assistant should behave when providing health information (Brewer et al. 2022). The goal of this form of participation was to understand users' and stakeholders' perceptions of the impact of these technologies—not to iteratively create a better form of a specific design, but to understand in a larger sense how these technologies are viewed and impact lay stakeholders.

Level 2: Include This was the third most common category for works in our corpus, with $n = 13/59$ works meeting this criteria. These scenarios had a wide disparity of creators, with $n = 3/13$ written by experts, $n = 2/13$ written by non-experts, $n = 6/13$ written by a combination of the two, and $n = 2/13$ written by large language models (LLMs). Notably these were the only two papers in the entire corpus that used LLM created scenarios, and both did so for participatory means.

Some examples of works in this category include exploring and illustrating possible AI extended reality threats and harms to guide future mitigation efforts (Baldry et al. 2024) and uncovering children and caregivers' concerns for child-targeted navigation apps (Silva et al. 2022). Khan et al.

(2021) describe using this method "to understand the hurdles and possibilities for technological interventions that could help curtail the challenges facing the education sector and critically reflect on design possibilities and their anticipated consequences in order to work towards positive outcomes in the future." Works meeting this inclusion criteria of participation afforded more agency to the participants—as Benton, Vasalou, and Turner (2023) note, their "participatory approach to speculative design...allow[ed] opportunities for tenants to adapt the initial technological future proposed by the research team and then subsequently speculate about how this imagined future might manifest within their own domestic lives." Though the creation process was owned by the research team, the participants still had power to shape their technological futures.

Level 3: Collaborate This was the second most common level of participation in our corpus, with $n = 17/59$ works meeting this criteria. These works had a perfectly equal distribution of expert/non-expert scenario creators, with $n = 5/17$ each being written by experts and non-experts, and the remaining $n = 7/17$ being written by a combination of the two. The majority of these works had the creators of the scenarios also serve as the evaluators of the scenarios ($n = 12/17$), and most of those that did not had non-experts evaluate the scenarios ($n = 4/5$).

This category had the highest proportion of works (relative to the greater corpus) in which the authors wrote scenarios based on the observed and discussed experiences of the stakeholders for which they were conducting research ($7/17; 41\%$). It also had the highest proportion of works that used a workshop method to generate the scenarios ($n = 12/17; 71\%$, compared to the corpus of $20/59; 34\%$). This for instance could take the form of watching how participants interacted with digital or physical artifacts and then writing up scenarios based on those (Hohendanner et al. 2023), or the reverse, where participants brainstormed out loud as a group and then the authors created digital artifacts and scenarios to represent those (Klassen et al. 2024).

Some examples of works enabling this level of participation include one that empowered "marginalized communities—especially Black and LatinX youth—to envision and co-create equitable, identity-affirming futures through speculative design grounded in Afrofuturism" (Bray and Harrington 2021). Another described the method as useful to "help practitioners identify AI system weaknesses to enhance explainability & support user agency" (Ehsan et al. 2024). One other described the goal as to "gain a deeper understanding of deepfake detection tools and to offer guidance for the development of a reliable deepfake detection tool that empowers journalists to validate media sources, thereby enhancing the quality of their reporting" (Sohrawardi et al. 2024).

Level 4: Own This was the rarest level of participation in our corpus, with only $n = 5/59$ works meeting this criteria. Every work that fit the *own* criteria had solely non-experts write or create the scenarios. One of these worked with two indigenous communities in northwest Namibia and Southwestern Angola, and empowered this group to brainstorm their own technology futures with some facilitation from the researchers (Muashekele et al. 2023). Another worked with young Black adults to co-design futures they imagined (Harrington and Dillahunt 2021). By enabling participants to *own* the process, Lu, Wikstrom, and Dillahunt (2024) discuss using participatory speculative design as a "participatory space to disrupt the large-scale sociotechnical imaginaries shaped by institutions and markets and to allow for the emergence and articulation of community-held sociotechnical imaginaries that impacted communities can act upon."

5 Discussion

These findings highlight that deploying scenarios in computing is a versatile approach that can effectively incorporate participatory elements. We found the most common reason to use scenario building was to gather stakeholder needs and values, though this also happened to coincide with the least involved form of participation: consulting stakeholders. Other popular objectives researchers sought through the use of this method, such as empowering marginalized communities to imagine their own technology futures, tended to coincide with higher levels of participation like collaboration or ownership of the process. Scenarios were also a popular method to provoke ethical reflection of emerging technologies or even anticipating specific risks of them.

20% of the works in our corpus had exclusively non-experts create the scenarios, an additional 27% had a combination of experts and non-experts create them, and another 17% of the corpus has expert-written scenarios with non-expert evaluation. That makes 64% of the entire corpus where non-experts played a crucial role in either creation or evaluation of the scenarios. Scenario building is a method particularly apt at integrating non-expert knowledge due to the ability to contextualize complex and abstract ideas into a narrative for them to then make informed opinions about potential futures, especially given the human propensity for storytelling (Gottschall 2012). These scenarios do not even have to be designed for a literate community—we saw a variety of mediums including non-textual storyboards designed for illiterate communities (Rüller et al. 2022), as well as audio scenarios designed for blind and low vision stakeholders (Phutane et al. 2023).

An important element of the use of scenarios is determining *who* writes, evaluates, or reflects upon scenarios. As Carroll (1995) puts it, "Our best course is to develop rich and flexible methods and concepts ... ideally by involving the users themselves in the design process." Thus, researchers highlight the relevance of lay-stakeholders, i.e. people who have no technical or domain expertise, but have a contextualized knowledge through lived experience that constitutes its own unique form of expertise. As means to bring lay-stakeholder input to life, an interesting trend among the works in this corpus was the author creation of scenarios through observations of the subject communities. $32\%(19/59)$ of the works in our corpus followed this practice. This follows a trend of scenario-based design noted in the 90s where researchers "gather requirements by visiting their users' workplace, observing what was done and how it was done, even trying themselves to carry out the domain

activities" (Carroll 1995), indicating that computing scholars continue to iterate upon old trends of the method.

Something the forebearers of scenarios may not have foreseen is the use of LLMs to write scenarios, yet two ($n = 2/59$) works in our corpus did just that. Given their ability to produce comprehensive text, LLMs have the potential to write and re-write scenarios under any number of conditions and in high volume. As compact representations of actors, actions, events, and relationships, scenarios could almost be considered the "file format" of the social world, accessible to LLMs for manipulating in any number of ways. This allows for counterfactual exploration of a large space of possibility, while preserving legibility and salience which can facilitate stakeholder inclusion (e.g., via evaluation, surveys, stimulus, etc.) in different stages of the scenario building and evaluation process. In our corpus, one work used LLMs to create a large number of scenarios to iterate on the potential effectiveness of a policy condition under the EU AI Act (Barnett, Kieslich, and Diakopoulos 2024), and the authors later used these scenarios as a means to contextualize harms in order for lay-stakeholders to create informed suggestions for new policies (Barnett et al. 2025).

Our results show that the computer science literature adapted scenario methods close to the research tradition in the field of future studies (Börjeson et al. 2006; Van der Heijden 2005). Thus, most papers analyzed in this SLR present multiple plausible futures of technology development (Amer, Daim, and Jetter 2013). Two main goals of the use of scenarios in computing is to gather stakeholder feedback and include perspectives from marginalized communities, which is closely related to participatory foresight activities (Nikolova 2014). An aim of the use of scenarios in computing that diverges from traditional branches of the use of scenarios is to align technology development to the risk and benefit perceptions of stakeholders and imagine & develop new technologies relying on stakeholder input. For instance, in business literature one of the central aims of scenario use is to engage in strategic planning that steers business decisions in desired, mostly profit-oriented, directions (Selin 2006; Varum and Melo 2010). In the anticipatory governance literature, scenarios are mostly used to test, develop and inform policy interventions (Brey 2017).

The technology improvement centered use of scenarios might also explain the terminology used in many of the studies in this review. By and large, the emphasis lies on the term *speculative design*, which mostly entails the imagination and design of new or adopted technologies. Consequently, scenario use in computing literature adopts the key methodological elements of scenario methods (e.g., development of plausible future pathways, inclusion of stakeholders), but adapted toward technology centered questions, e.g., how technology development can be altered to reflect the needs of the ones affected. There is potential to expand the application of scenarios in computer science by incorporating different branches of related scenario work. For example, the stated goals of conferences such as ACM FAccT and AIES are to study the societal, political, and regulatory contexts and impacts of computing technology. This could lead to more extensive use of scenario methods for regulatory and policy-related issues. While some studies using these methods have been published at these conferences (Barnett, Kieslich, and Diakopoulos 2024; Barnett et al. 2025; Kieslich, Helberger, and Diakopoulos 2024), future work can build on this line of research to expand societal impact.

5.1 Limitations

While a central aspect of this SLR was to evaluate a comprehensive body of work using scenarios, we focused exclusively on works published in the ACM digital library. As such, we excluded venues outside of traditional computer science work that frequently use scenarios in the manner we describe, such as social science literature (Diakopoulos and Johnson 2021; Das et al. 2024), future studies (Börjeson et al. 2006; Van der Heijden 2005), ethics/philosophy (Floridi and Strait 2020; Schuijer, Broerse, and Kupper 2021), or legal studies (Helberger, Poort, and Makhortykh 2020; Helberger 2024). In a similar vein, we only included works focusing on emerging technologies to consider potential future impacts. As a result we excluded works that used this method for non-technological means or even mature technology that has reached a stable state in society.

We also chose to scope the time period for this work: with a 10 year horizon we might also miss connections back to earlier frames on the idea; for instance *Scenario-Based Design*, a seminal work in this space, dates back to 1995 and contains many of the trends discussed in this work (Carroll 1995), and other works in the early 2000s describe participatory design through storytelling (Muller 2002), which further emphasizes the long tradition of this methodology in HCI research under different guises and with sometimes different nomenclature. However, we found a surge in usage over the last three years (see Figure 2) strengthening our observation that the use of scenario methods gained traction in the computing field in the last few years.

We also excluded 167 out of our initial pool of 555 articles for not being full research articles. A large portion of these were extended abstracts that would have been otherwise relevant to the analysis. Scenario building can be a useful early stage of risk assessment, and thus well suited for exploratory early works. Analyzing these works, though outside of our scope to evaluate full articles that have gone through the peer review process, may have revealed additional insights about using this method early in the risk assessment process.

6 Conclusion

In this work we conducted a systematic literature review of research papers in the ACM digital library over the last decade that worked with scenarios to consider the potential future impacts of emerging technologies ($n = 59$). This work consolidated a fragmented space of scenario based methods within the computing literature and explored the various objectives for which researchers were using scenario building, as well as quantified the participatory element enabled by deploying the method. Future researchers can turn to this assessment of the scenarios in computing literature as a springboard for ways to deploy this method, as well as to understand the different objectives and participatory means that can be achieved through this type of work.

Ethical Statement

All authors declare no conflicts of interest for this work.

Ethical Considerations Statement

We do not see a large potential for ethical issues in regard to this work because this was a review entirely of secondary data to detail an overview of the way a method is deployed. However, we made editorial and scoping decisions for which works to include in this review, and thus we present a biased interpretation of this body of work. Our work only includes those written in English, and though this is a reflection of the wider trend of English being the predominant language of published scientific works (Drubin and Kellogg 2012), this certainly excluded any potential for non-English works such as the one we excluded in our review (Macedo et al. 2020). Further, by focusing on the ACM digital library alone, we perpetuate any biases encapsulated by this catalog of published work.

Additionally, the coding was done qualitatively by two authors on this work. It is possible that others may disagree with the works we chose to include, and that could thus change the results we present. In order to mitigate this potential concern, we provide all of our finalized coding documents at this link: https://tinyurl.com/scenario-slr.

Researcher Positionality Statement

This was an interdisciplinary collaboration, with two authors working at the intersection of computer science and communications, one working in communication and pursuing a career in the legal sector, and one identifying as a social scientist working as a postdoctoral researcher in an institute focusing on information law. Two of the authors identify as female, and two identify as male. Three of the authors identify as white, and one author identifies as Asian. As a predominantly non-BIPOC team, we took care to analyze the section on marginalized communities such as BIPOC groups by reporting on how these communities use this method rather than any prescriptive analysis; we used direct quotes when appropriate rather than our own take on the subject.

Adverse Impact Statement

We only captured methods utilizing scenarios in computing literature in this review. As we stated throughout our introduction, related work, and discussion, there are many other ways in which to use scenarios that were not covered in computing literature. One potential harm of this work is that people may see this as a prescriptive approach of the only ways to employ scenarios, thus stifling methodological creativity and excluding other established ways of using scenarios. We do not believe the methods and objectives covered in this work are the only ways that can or should be used, but we believe that is a potential negative impact of this work. Overall, we believe the benefits of this work far outweigh these potential risks.

References

Amer, M.; Daim, T. U.; and Jetter, A. 2013. A review of scenario planning. *Futures : the journal of policy, planning and futures studies*, 46: 23–40. ISBN: 0016-3287.

Andersen, P. D.; Hansen, M.; and Selin, C. 2021. Stakeholder inclusion in scenario planning—A review of European projects. *Technological Forecasting and Social Change*, 169: 120802.

Baldry, M. K.; Happa, J.; Steed, A.; Smith, S.; and Glencross, M. 2024. From Embodied Abuse to Mass Disruption: Generative, Inter-Reality Threats in Social, Mixed-Reality Platforms. *Digital Threats: Research and Practice*, 5(4): 1–36.

Bandy, J. 2021. Problematic machine behavior: A systematic literature review of algorithm audits. *Proceedings of the acm on human-computer interaction*, 5(CSCW1): 1–34.

Barnett, J.; Kieslich, K.; and Diakopoulos, N. 2024. Simulating Policy Impacts: Developing a Generative Scenario Writing Method to Evaluate the Perceived Effects of Regulation. In *Proceedings of the AAAI/ACM Conference on AI, Ethics, and Society*, volume 7, 82–93.

Barnett, J.; Kieslich, K.; Helberger, N.; and Diakopoulos, N. 2025. Envisioning Stakeholder-Action Pairs to Mitigate Negative Impacts of AI: A Participatory Approach to Inform Policy Making. *arXiv preprint arXiv:2502.14869*.

Barreteau, O.; Bots, P.; Daniell, K.; Etienne, M.; Perez, P.; Barnaud, C.; Bazile, D.; Becu, N.; Castella, J.-C.; Daré, W.; et al. 2013. Participatory approaches. *Simulating social complexity: A handbook*, 197–234.

Baum, S. D. 2020. Social choice ethics in artificial intelligence. *Ai & Society*, 35(1): 165–176.

Behzad, A. 2023. Co-shaping Temporality: Mediating Time through an Interactive Hourglass. In *Companion Publication of the 2023 ACM Designing Interactive Systems Conference*, 241–245.

Benton, L.; Vasalou, A.; and Turner, S. 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*, 1060–1077.

Bonaccorsi, A.; Apreda, R.; and Fantoni, G. 2020. Expert biases in technology foresight. Why they are a problem and how to mitigate them. *Technological Forecasting and Social Change*, 151: 119855.

Bønlykke, S. K.; Madsen, K. A. L.; and Jenkins, T. 2024. Taking the bizarre seriously: dreams as a material for interaction design. In *Proceedings of the 2024 ACM Designing Interactive Systems Conference*, 699–713.

Bray, K.; and Harrington, C. 2021. Speculative blackness: Considering afrofuturism in the creation of inclusive speculative design probes. In *Proceedings of the 2021 ACM Designing Interactive Systems Conference*, 1793–1806.

Bray, K. E.; Harrington, C.; Parker, A. G.; Diakhate, N.; and Roberts, J. 2022. Radical Futures: Supporting Community-Led Design Engagements through an Afrofuturist Speculative Design Toolkit. In *CHI Conference on Human Factors*

in Computing Systems, 1–13. New Orleans LA USA: ACM. ISBN 978-1-4503-9157-3.

Brewer, R.; Pierce, C.; Upadhyay, P.; and Park, L. 2022. An empirical study of older adult's voice assistant use for health information seeking. *ACM Transactions on Interactive Intelligent Systems (TiiS)*, 12(2): 1–32.

Brey, P. 2017. Ethics of emerging technology. *The ethics of technology: Methods and approaches*, 175–191.

Burnam-Fink, M. 2015. Creating narrative scenarios: Science fiction prototyping at Emerge.

Börjeson, L.; Höjer, M.; Dreborg, K.-H.; Ekvall, T.; and Finnveden, G. 2006. Scenario types and techniques: Towards a user's guide. *Futures*, 38(7): 723–739. ISBN: 0016-3287.

Carroll, J. M., ed. 1995. *Scenario–Based Design: Envisioning Work and Technology in System Development*. New York: John Wiley & Sons. ISBN 9780471076599.

Council, D. 2005. The 'double diamond' design process model. *Design Council*, 2(1).

Das, R.; Wong, Y. N.; Jones, R.; and Jackson, P. J. 2024. How do we speak about algorithms and algorithmic media futures? Using vignettes and scenarios in a citizen council on data-driven media personalisation. *New Media & Society*, 14614448241232589.

Davis, C. W.; Jetter, A. J.; and Giabbanelli, P. J. 2023. Towards An Automatic Construction Of Simulation Scenarios: A Systematic Review. In *2023 Winter Simulation Conference (WSC)*, 2494–2505. IEEE.

Delgado, F.; Yang, S.; Madaio, M.; and Yang, Q. 2023. The Participatory Turn in AI Design: Theoretical Foundations and the Current State of Practice. In *Equity and Access in Algorithms, Mechanisms, and Optimization*, 1–23. Boston MA USA: ACM. ISBN 9798400703812.

Diakopoulos, N.; and Johnson, D. 2021. Anticipating and addressing the ethical implications of deepfakes in the context of elections. *New Media & Society*, 23(7): 2072–2098.

Drubin, D. G.; and Kellogg, D. R. 2012. English as the universal language of science: opportunities and challenges. *Molecular biology of the cell*, 23(8): 1399–1399.

Eghtebas, C.; Klinker, G.; Boll, S.; and Koelle, M. 2023. Co-speculating on dark scenarios and unintended consequences of a ubiquitous (ly) augmented reality. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference*, 2392–2407.

Ehsan, U.; Liao, Q. V.; Passi, S.; Riedl, M. O.; and Daumé III, H. 2024. Seamful xai: Operationalizing seamful design in explainable ai. *Proceedings of the ACM on Human-Computer Interaction*, 8(CSCW1): 1–29.

Feffer, M.; Sinha, A.; Deng, W. H.; Lipton, Z. C.; and Heidari, H. 2024. Red-Teaming for generative AI: Silver bullet or security theater? In *Proceedings of the AAAI/ACM Conference on AI, Ethics, and Society*, volume 7, 421–437.

Floridi, L.; and Strait, A. 2020. Ethical Foresight Analysis: What it is and Why it is Needed? *Minds and Machines*, 30(1): 77–97.

French, F.; Hirskyj-Douglas, I.; Väätäjä, H.; Pons, P.; Karl, S.; Chisik, Y.; Nannoni, E.; Zamansky, A.; Mangat, M.; Paci, P.; et al. 2021. Ethics and Power Dynamics in Playful Technology for Animals: Using speculative design to provoke reflection. In *Proceedings of the 24th International Academic Mindtrek Conference*, 91–101.

Gottschall, J. 2012. *The storytelling animal: How stories make us human*. Houghton Mifflin Harcourt.

Gregory, J. 2003. Scandinavian approaches to participatory design. *International Journal of Engineering Education*, 19(1): 62–74.

Harrington, C.; and Dillahunt, T. R. 2021. Eliciting tech futures among Black young adults: A case study of remote speculative co-design. In *Proceedings of the 2021 CHI conference on human factors in computing systems*, 1–15.

Helberger, N. 2024. FutureNewsCorp, or how the AI Act changed the future of news. *Computer Law & Security Review*, 52: 105915.

Helberger, N.; Poort, J.; and Makhortykh, M. 2020. Four tales of sci-fi and information law. *Internet Policy Review*, 9(1).

Herdel, V.; Šćepanović, S.; Bogucka, E.; and Quercia, D. 2024. ExploreGen: Large language models for envisioning the uses and risks of AI technologies. In *Proceedings of the AAAI/ACM Conference on AI, Ethics, and Society*, volume 7, 584–596.

Hirsch, L.; Hild, F.; and Obaid, M. 2022. Design Recommendations for Historical Cemeteries Using Speculative Design. In *Proceedings of the 25th International Academic Mindtrek Conference*, 147–157.

Hoang, T.; Khot, R. A.; Waite, N.; and Mueller, F. 2018. What can speculative design teach us about designing for healthcare services? In *Proceedings of the 30th Australian Conference on Computer-Human Interaction*, 463–472.

Hohendanner, M.; Ullstein, C.; Buchmeier, Y.; and Grossklags, J. 2023. Exploring the reflective space of AI narratives through speculative design in Japan and Germany. In *Proceedings of the 2023 ACM conference on information technology for social good*, 351–362.

Hohendanner, M.; Ullstein, C.; Miyamoto, D.; Huffman, E. F.; Socher, G.; Grossklags, J.; and Osawa, H. 2024. Metaverse perspectives from Japan: A participatory speculative design case study. *Proceedings of the ACM on Human-Computer Interaction*, 8(CSCW2): 1–51.

Homewood, S.; and Heyer, C. 2017. Turned on/turned off: Speculating on the microchip-based contraceptive implant. In *Proceedings of the 2017 Conference on Designing Interactive Systems*, 339–343.

Hsueh, S.; Vincenzi, B.; Murdeshwar, A.; and Ciolfi Felice, M. 2023. Cripping data visualizations: Crip technoscience as a critical lens for designing digital access. In *Proceedings of the 25th International ACM SIGACCESS Conference on Computers and Accessibility*, 1–16.

Ivanov, A.; Au Yeung, T.; Blair, K.; Danyluk, K.; Freeman, G.; Friedel, M.; Hull, C.; Hung, M. Y.-S.; Pratte, S.; and Willett, W. 2022. One Week in the Future: Previs Design

Futuring for HCI Research. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*, 1–15.

Jantunen, M.; Meyes, R.; Kurchyna, V.; Meisen, T.; Abrahamsson, P.; and Mohanani, R. 2024. Researchers' Concerns on Artificial Intelligence Ethics: Results from a Scenario-Based Survey. In *Proceedings of the 7th ACM/IEEE International Workshop on Software-intensive Business*, 24–31.

Kaur, J.; Devgon, R.; Goel, S.; Singh, A.; Monteiro, K.; and Singh, A. 2022. Future of intimate artefacts: A speculative design investigation. In *Proceedings of the 13th Indian Conference on Human-Computer Interaction*, 57–66.

Khan, A. H.; Ejaz, N.; Matthews, S.; Snow, S.; and Matthews, B. 2021. Speculative design for education: Using participatory methods to map design challenges and opportunities in Pakistan. In *Proceedings of the 2021 ACM Designing Interactive Systems Conference*, 1748–1764.

Kieslich, K.; Helberger, N.; and Diakopoulos, N. 2024. My Future with My Chatbot: A Scenario-Driven, User-Centric Approach to Anticipating AI Impacts. In *Proceedings of the 2024 ACM Conference on Fairness, Accountability, and Transparency*, 2071–2085.

Kieslich, K.; Helberger, N.; and Diakopoulos, N. 2025. Scenario-based sociotechnical envisioning (sse): An approach to enhance systemic risk assessments.

Kim, H.; Lee, J.; Jang, J.-W.; and Kim, J. 2024. ReSPect: Enabling Active and Scalable Responses to Networked Online Harassment. *Proceedings of the ACM on Human-Computer Interaction*, 8(CSCW1): 1–30.

Klassen, S.; and Fiesler, C. 2022. "Run Wild a Little With Your Imagination" Ethical Speculation in Computing Education with Black Mirror. In *Proceedings of the 53rd ACM Technical Symposium on Computer Science Education-Volume 1*, 836–842.

Klassen, S.; Mendy, J. J. E.; Buford, M.; and Fiesler, C. 2024. Black to the Future-The Power of Designing Afrofuturist Technology with Black Women, Femmes, and Non-Binary People. In *Proceedings of the 2024 ACM Designing Interactive Systems Conference*, 2156–2172.

Knowles, B.; Beck, S.; Finney, J.; Devine, J.; and Lindley, J. 2019. A scenario-based methodology for exploring risks: children and programmable IoT. In *Proceedings of the 2019 on designing interactive systems conference*, 751–761.

Lawson, S.; Kirman, B.; Linehan, C.; Feltwell, T.; and Hopkins, L. 2015. Problematising upstream technology through speculative design: the case of quantified cats and dogs. In *Proceedings of the 33rd annual ACM conference on human factors in computing systems*, 2663–2672.

Lu, A. J.; Wikstrom, E. V.; and Dillahunt, T. R. 2024. Contamination, Otherness, and Negotiating Bottom-Up Sociotechnical Imaginaries in Participatory Speculative Design. In *Proceedings of the Participatory Design Conference 2024: Full Papers-Volume 1*, 173–186.

Macedo, M. P.; Paiva, R. O. A.; Gasparini, I.; and Zaina, L. A. M. 2020. Vis2Learning: a scenario-based guide of recommendations for building educational data visualizations. In *Proceedings of the 19th Brazilian Symposium on Human Factors in Computing Systems*, 1–10.

Merrill, N. 2020. Security fictions: bridging speculative design and computer security. In *Proceedings of the 2020 ACM Designing Interactive Systems Conference*, 1727–1735.

Metcalf, J.; Moss, E.; Watkins, E. A.; Singh, R.; and Elish, M. C. 2021. Algorithmic impact assessments and accountability: The co-construction of impacts. In *Proceedings of the 2021 ACM conference on fairness, accountability, and transparency*, 735–746.

Mittelstadt, B. D.; Stahl, B. C.; and Fairweather, N. B. 2015. How to Shape a Better Future? Epistemic Difficulties for Ethical Assessment and Anticipatory Governance of Emerging Technologies. *Ethical Theory and Moral Practice*, 18(5): 1027–1047.

Mok, T.; Hartley, T.; Tang, A.; McCrimmon, A.; and Oehlberg, L. 2024. Building Narratives and Probing Concepts: Preparing Materials for Co-Design with Autistic Livestreamers. *ACM Transactions on Accessible Computing*, 18(2): 1–25.

Muashekele, C.; Winschiers-Theophilus, H.; Rodil, K.; and Koruhama, A. 2023. Ancestral and cultural futuring: Speculative design in an Indigenous ovaHimba context. In *Proceedings of the 11th International Conference on Communities and Technologies*, 85–95.

Muller, M. J. 2002. *Participatory design: the third space in HCI*, 1051–1068. USA: L. Erlbaum Associates Inc. ISBN 0805838384.

Nanayakkara, P.; Diakopoulos, N.; and Hullman, J. 2020. Anticipatory ethics and the role of uncertainty. *arXiv preprint arXiv:2011.13170*.

Nikolova, B. 2014. The rise and promise of participatory foresight. *European journal of futures research*, 2: 1–9.

Nunes, J. L.; Barbosa, G. D.; De Souza, C. S.; Lopes, H.; and Barbosa, S. D. 2022. Using model cards for ethical reflection: a qualitative exploration. In *Proceedings of the 21st Brazilian Symposium on Human Factors in Computing Systems*, 1–11.

Page, M. J.; McKenzie, J. E.; Bossuyt, P. M.; Boutron, I.; Hoffmann, T. C.; Mulrow, C. D.; Shamseer, L.; Tetzlaff, J. M.; Akl, E. A.; Brennan, S. E.; et al. 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *bmj*, 372.

Phutane, M.; Jung, C.; Chen, N.; and Azenkot, S. 2023. Speaking with My Screen Reader: Using Audio Fictions to Explore Conversational Access to Interfaces. In *Proceedings of the 25th International ACM SIGACCESS Conference on Computers and Accessibility*, 1–18.

Ramirez, R.; and Wilkinson, A. 2016. *Strategic reframing: The Oxford scenario planning approach*. Oxford University Press.

Ramírez, R.; and Selin, C. 2014. Plausibility and probability in scenario planning. *Foresight (Cambridge)*, 16(1): 54–74. ISBN: 1463-6689.

Rasmussen, L. 2005. The narrative aspect of scenario building - How story telling may give people a memory of the

future. *AI & society*, 19(3): 229–249. ISBN: 0951-5666.

Rotolo, D.; Hicks, D.; and Martin, B. R. 2015. What is an emerging technology? *Research policy*, 44(10): 1827–1843.

Rüller, S.; Aal, K.; Tolmie, P.; Hartmann, A.; Rohde, M.; and Wulf, V. 2022. Speculative design as a collaborative practice: Ameliorating the consequences of illiteracy through digital touch. *ACM Transactions on Computer-Human Interaction*, 29(3): 1–58.

Schuijer, J. W.; Broerse, J. E. W.; and Kupper, F. 2021. Citizen Science Fiction: The Potential of Situated Speculative Prototyping for Public Engagement on Emerging Technologies. *Nanoethics*, 15(1): 1–18. ISBN: 1871-4757.

Sclove, R. E. 2010. Reinventing technology assessment. *Issues in Science and Technology*, 27(1): 34–38.

Selin, C. 2006. Trust and the illusive force of scenarios. *Futures : the journal of policy, planning and futures studies*, 38(1): 1–14. ISBN: 0016-3287.

Silva, C.; Prandi, C.; Nunes, N.; and Nisi, V. 2022. Addressing children and caregivers' concerns in the design of child-targeted locative systems. In *Proceedings of the 21st International Conference on Mobile and Ubiquitous Multimedia*, 100–109.

Simonsen, J.; and Robertson, T. 2013. *Routledge international handbook of participatory design*, volume 711. Routledge New York.

Snow, S.; Khan, A. H.; Glencross, M.; and Horrocks, N. 2021. Neighbourhood Wattch: Using Speculative Design to Explore Values Around Curtailment and Consent in Household Energy Interactions. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, 1–12.

Soden, R.; Pathak, P.; and Doggett, O. 2021. What we speculate about when we speculate about sustainable HCI. In *Proceedings of the 4th ACM SIGCAS Conference on Computing and Sustainable Societies*, 188–198.

Sohrawardi, S. J.; Wu, Y. K.; Hickerson, A.; and Wright, M. 2024. Dungeons & deepfakes: Using scenario-based roleplay to study journalists' behavior towards using AI-based verification tools for video content. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems*, 1–17.

Solaiman, I.; Talat, Z.; Agnew, W.; Ahmad, L.; Baker, D.; Blodgett, S. L.; Chen, C.; Daumé III, H.; Dodge, J.; Duan, I.; et al. 2023. Evaluating the social impact of generative ai systems in systems and society. *arXiv preprint arXiv:2306.05949*.

Stals, S.; Smyth, M.; and Mival, O. 2019. UrbanixD: From ethnography to speculative design fictions for the hybrid city. In *Proceedings of the Halfway to the Future Symposium 2019*, 1–10.

Stemasov, E.; Botner, A.; Rukzio, E.; and Gugenheimer, J. 2022. Ephemeral Fabrication: Exploring a Ubiquitous Fabrication Scenario of Low-Effort, In-Situ Creation of Short-Lived Physical Artifacts. In *Proceedings of the Sixteenth International Conference on Tangible, Embedded, and Embodied Interaction*, 1–17.

Sun, J.; Liao, Q. V.; Muller, M.; Agarwal, M.; Houde, S.; Talamadupula, K.; and Weisz, J. D. 2022. Investigating explainability of generative AI for code through scenario-based design. In *Proceedings of the 27th International Conference on Intelligent User Interfaces*, 212–228.

To, A.; Carey, H.; Shrivastava, R.; Hammer, J.; and Kaufman, G. 2022. Interactive fiction provotypes for coping with interpersonal racism. In *Proceedings of the 2022 CHI conference on human factors in computing systems*, 1–14.

Tseng, W.-J.; Bonnail, E.; McGill, M.; Khamis, M.; Lecolinet, E.; Huron, S.; and Gugenheimer, J. 2022. The dark side of perceptual manipulations in virtual reality. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*, 1–15.

Tseng, Y.-C.; Jarupreechachan, W.; and Lee, T.-H. 2023. Understanding the benefits and design of chatbots to meet the healthcare needs of migrant workers. *Proceedings of the ACM on Human-Computer Interaction*, 7(CSCW2): 1–34.

Turmo Vidal, L.; Vega-Cebrián, J. M.; D'Adamo, A.; Roel Lesur, M.; Dehshibi, M. M.; Díaz Durán, J.; and Tajadura-Jiménez, A. 2023. On Futuring Body Perception Transformation Technologies: Roles, Goals and Values. In *Proceedings of the 26th International Academic Mindtrek Conference*, 169–181.

Urueña, S. 2019. Understanding "plausibility": A relational approach to the anticipatory heuristics of future scenarios. *Futures*, 111: 15–25. ISBN: 0016-3287.

Van der Heijden, K. 2005. *Scenarios: the art of strategic conversation*. John Wiley & Sons.

Varum, C. A.; and Melo, C. 2010. Directions in scenario planning literature – A review of the past decades. *Futures*, 42(4): 355–369.

Villa, S.; Niess, J.; Nakao, T.; Lazar, J.; Schmidt, A.; and Machulla, T.-K. 2023. Understanding perception of human augmentation: A mixed-method study. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*, 1–16.

Weidinger, L.; Mellor, J.; Rauh, M.; Griffin, C.; Uesato, J.; Huang, P.-S.; Cheng, M.; Glaese, M.; Balle, B.; Kasirzadeh, A.; et al. 2021. Ethical and social risks of harm from language models. *arXiv preprint arXiv:2112.04359*.

Winchester III, W. W. 2018. Afrofuturism, inclusion, and the design imagination. *Interactions*, 25(2): 41–45.