Challenges of Scaling Participatory Design: A Systematic Literature Review

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Early participatory design (PD) projects tended to be of limited size and complexity. Over the last two decades, however, various attempts have been made to apply PD to large-scale information technology projects. Although studies have suggested that scaling the methodology to fit larger and more complex projects can be problematic, no attempts have been made to form a comprehensive overview of the associated challenges. To remedy this situation, a systematic literature review of relevant studies was conducted. From an initial 780 references retrieved from databases, 17 articles met the predefined criteria and were included in the review. The review resulted in the extraction of seven categories of challenges. A discussion of the identified challenges as a potential threat to the methodology's integrity is provided. The review offers a multifaceted understanding of the challenges related to the scaling of PD, which, given their nature, risk compromising core PD principles.

CCS CONCEPTS • Human-centered computing~Interaction design; Participatory design

Additional Keywords and Phrases: Large-scale IT project, scaling, user participation

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1 INTRODUCTION

Participatory design (PD) has a long tradition as a user-oriented design methodology in human–computer interaction (HCI)[35]. The methodology originated in Scandinavia in the 1970s and 1980s and was based on the political, social, and ethical standpoint that users should have a right to be included in the design of technology that will affect their daily lives [16]. From an initial focus on workplace democracy and the empowerment of industry workers (ibid.), the scope and application areas of PD have expanded considerably [7, 25] to capture new forms of user involvement across heterogeneous settings [17], communities [14, 44], political contexts [2, 4, 29, 40], and blurred boundaries between technology design and use [39]. Despite this evolution, PD is still characterized by its pursuit of user empowerment [26]— effects that go beyond the technical product being designed, such as learning and knowledge, new work procedures, and organizational arrangements [21], and include finding alternative uses and conceptualizations for information technology (IT) that are meaningful to users [31]. This inherent focus on emancipatory values distinguishes PD from other frequently applied methodologies in HCI, such as user-centered design [36].

In light of the growing scale and complexity of IT systems, however, PD has been presented with new challenges that potentially threaten its perspective as a democratic and empowering design approach. Early PD projects tended to engage in the design and development of IT systems of relatively low complexity, that is, local systems with a relatively small number of users [44, 45]. Today's IT systems are increasingly distributed, ubiquitous, interconnected, long-term, and intended to support multiple user groups [22, 44]. The development of such systems takes place in large IT projects that tend to involve multiple and complex stakeholder organizations (e.g., user and customer organizations, vendors, and authorities [40]). In recognition of the challenges that current large-scale IT projects represent for the successful application of PD, Simonsen and Hertzum [47] noted: "Participatory Design has achieved an international reputation and application. Nevertheless, its proponents still seem reluctant to engage it in the development of large-scale information systems. Participatory Design undoubtedly has a lot to offer; but as an approach, it also faces considerable challenges in claiming a serious influence on the design and implementation of large-scale information systems."

Seeking to further explore the nature of concerns related to the upscaling of PD, this paper is motivated by the following research question: *What challenges does PD face when applied in large-scale IT projects*?

To provide an answer to the question above, we offer a systematic review of qualitative research literature reporting on scaling issues associated with participatory approaches applied on a large scale. Despite the PD community's early awareness of scaling issues associated with participatory methods (e.g., [8, 9, 18, 27]), no attempts have been made to form a comprehensive overview of emerging challenges based on a systematic review of the existing research literature. The lack of such an overview makes it difficult to form an understanding of the aspects that come into play and how. This absence also makes it challenging to learn from previous experiences of relevant projects.

This study has involved three main steps:

1. *Identify and map of relevant studies*: First, we identified and mapped existing studies that addressed challenges related to the application of participatory methods in large-scale IT projects.
2. *Categorize and review challenges*: Second, we identified and grouped the challenges described in the corpus of relevant studies identified in Step 1 according to the nature of the challenges. A description of each group and an account of the literature from which it was derived are provided.
3. *Assess implications*: Third, drawing on the findings in Step 2, we provide a discussion of their implications for PD and its possibility to scale.

The article is structured as follows. In Section 2, we clarify what we mean by large-scale IT projects and explain in what sense scaling could represent a potential threat to PD's methodological integrity. Next, in Section 3, we describe the applied method. In Section 4, we describe and characterize the articles. In Section 5, we present the identified groups of challenges. In Section 6, we discuss the challenges in light of the core PD principles. Finally, some limitations of the review are discussed in Section 7, before we draw conclusions in Section 8.

2 THE CHALLENGE OF SCALE

2.1 Defining large-scale

This paper investigates the nature of the challenges that PD may face when applied to large-scale IT projects. What large-scale means when used to describe an IT project is ambiguous, as there is no standard, specific measurement that depicts the scale of an IT project. To explain the multifaceted understanding of what a large-scale project is, we can make a comparison with the opposite—that is, a small-scale project. In doing so, we use two well-known participatory

projects as examples—the (small-scale) UTOPIA project [5, 49] and the (large-scale) Health Information System Programme (HISP) initiative [3, 44].

In the UTOPIA project, the end users were a relatively homogenous group of graphics employees of whom seven were paid to participate in the project. HISP [23], in contrast, has conducted participatory activities with users (primarily health care workers) and deployed its health management information systems in more than 100 developing countries, thus potentially affecting 2.4 billion people. The number of stakeholders organizations in the two projects are also very different. UTOPIA involved four Nordic stakeholder organizations. HISP, on the other hand, involves numerous global stakeholder organizations such as Norad, the Global Fund, the Gates Fund, Gavi, UNICEF, WHO, and others, in addition to governments and regional authorities in the different countries that are involved. While the UTOPIA project lasted for four years (1981–1985), HISP has lasted almost 30 years.

Inspired by Roland et al.'s [44] work, we consider a *large-scale* IT project to be characterized by at least two of the following features: Distribution across heterogeneous settings, a variety of stakeholders involved (e.g., multiple user groups), multiple stakeholder organizations, and different uses of a software product over time. Large-scale projects typically have a duration of several years.

2.2 Scaling as a challenge to the "heritage" of participatory design

Having accounted for what a large-scale project means in the context of the present work, we need to explain in what sense scaling can represent a potential problem for PD. To do so, we rely on the six guiding principles described by Kensing and Greenbaum [26] as enduring characteristics or the "heritage" of PD. In many ways, this heritage can be understood as the methodological integrity of PD—in other words, what makes PD unique as a design methodology.

The fundamental principle, *equalizing power relations*, reflects PD's obligation to give voice in design processes to those who, for various reasons, may be disadvantaged vis-à-vis other stakeholders. This is considered an essential part of *democratic practices*, which embody PD's commitment to actively involve people who may be affected by a new design solution in its design process. Democratic practices are tightly rooted in *situation-based actions*. Situated-based actions refer to working directly with people in the actual setting designed for, as opposed to working with abstract representations of the setting and actions carried out. These actions present possibilities for *mutual learning*, which refers to co-creating knowledge and learning that can take place between individual participants and between participants and technology developers. PD is also defined by *tools and techniques* aimed at supporting participants' active engagement in design activities and processes. Finally, *alternative visions about technology* are the new ideas and concepts that are produced through PD processes and that often challenge existing technological solutions and/or organizational practices. As the description above suggests, the principles are interrelated in the sense that the first principle (equalizing power relations) is an integral part of the second principle (democratic practices), which again is rooted in the third principle (situation-based actions), and so forth.

To successfully scale, then, PD arguably needs to maintain its methodological integrity during the process. In other words, PD needs to adhere to the principles above independently of the scale of the project in which the methodology is applied. By investigating the nature of the challenges scaling represents for PD, we can arguably better understand the extent to which this is realistic, or even possible.

2.3 Related areas of concern

In some studies, the scaling of PD is conceptualized as being part of the problem of making PD sustainable [3, 24, 42]. However, the pursuit of methodological sustainability, as described by Iversen and Dindler [24] raises related issues,

such as maintaining, replicating and evolving participatory work. A systematic literature review of sustainability in PD was recently published by Poderi and Dittrich [43]. The present review in many ways complements that of Poderi and Dittrich (ibid.), as it focuses specifically on PD and the methodological challenges of scaling.

3 METHODS

With the growing size of IT systems and development projects, the challenges related to scaling PD have received increasing attention in the PD literature. This growth makes it progressively challenging for the individual practitioner to continuously maintain an overview of existing knowledge, critically evaluate that knowledge, and use it as a basis to plan research projects that can contribute to further advancing the current body of knowledge. Within several scientific disciplines, including HCI and PD (e.g., [1, 20, 28]), literature reviews have become essential tools for providing a complete summary of current literature relevant to a particular research question. Systematic reviews are transparent and rigorous type of literature review that aim to generate robust answers to a focused research question, based on available empirical evidence [33]. Especially, systematic reviews can reduce selection bias and provide replicability by using systematic and explicit methods to identify, select, and critically appraise studies [30].

3.1 Databases and search terms

The reviewed articles were collected on June 18, 2020, using four databases: ACM Digital Library, Engineering Village, Scopus, and Web of Science. Taken together, the four databases index a broad set of PD-related articles published in highly regarded computer science journals and conference proceedings and therefore were considered adequate for this review.

The query used to retrieve data from the databases were developed iteratively. Using specific terms found in articles returned from initial query and studies referred to by those articles, we gradually expanded the search string. Given the focus on scaling issues associated specifically with PD, we did not include terms associated with other user-oriented design approaches, such as user-centered design and value-sensitive design. The generated query was a combination of search terms describing the methodology in focus and the phenomenon of interest (Table 1). The full final query was as follows: *((("participatory design" OR "participatory approach" OR "participatory process" OR "participatory research" OR "participatory activities") AND ("large scale" OR "scalability" OR "scaling")))*. To accommodate the specific formats of each of the four databases, the syntax of the query was adapted accordingly.

Table 1: Search terms.

Methodology	Phenomenon
participatory design	large scale
participatory approach	scaling
participatory processes	scalability
participatory research	
participatory activities	

3.2 Selection process

A research protocol was established to ensure the systematic selection of studies for the review. In addition to the search terms and associated search strings, the inclusion and exclusion criteria used to identify relevant studies for the review (Table 2) were also specified in the protocol. The protocol contained content- and quality-specific criteria.

The general process for selecting studies for review is illustrated in Figure 1 and is explained in the following. Querying the four databases resulted in a set of 780 potentially relevant studies (the results per search engine are shown in Table 3). The set was screened by the first author to discard studies that met the exclusion criteria (Table 2, right column), eliminating 442 studies from the original set. Next, the titles, keywords, and abstracts of the 338 remaining studies were screened independently by all three authors to identify papers that met the inclusion criteria (Table 2, left column). Articles fulfilling the inclusion criteria but containing fewer than 5,000 words excluding references were also discarded (cf. exclusion criteria), as the empirical depth of shorter publications of qualitative case studies is generally limited. Studies about which the authors did not agree were marked and temporarily included. An additional 291 studies were discarded through the screening, resulting in a set of 47 studies subject to full-text screening vis-à-vis the inclusion and exclusion criteria. As part of the full-text screening, the first author assessed the remaining 47 studies, while the second and third authors assessed 24 and 23, respectively. Thirty-three studies were discarded as a result of the full-text screening, leaving 14 studies for inclusion in the review. To compensate for potential limitations in the original search string in terms of identifying relevant studies, we also performed a ("snowball") assessment of articles cited in the 14 studies. Articles identified as potentially relevant were then screened using the inclusion and exclusion criteria for the initial screening. This screening resulted in three studies (i.e., [4, 37, 52]) being added to the 14 studies, yielding a final set of 17 articles for the review.

Table 2: Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
The study reports on challenges of applying participatory methods in the large-scale IT projects	Duplicate records
	Non-English articles, books, dissertations, or literature reviews
	Non-peer reviewed article
The reported challenges draw on empirical findings that are described in the study	Articles published in conference proceedings with acceptance rate > 30%
	Studies published before the year 2000
	Articles containing less than 5000 words excluding references (e.g., short papers, extended abstracts, and poster presentations)

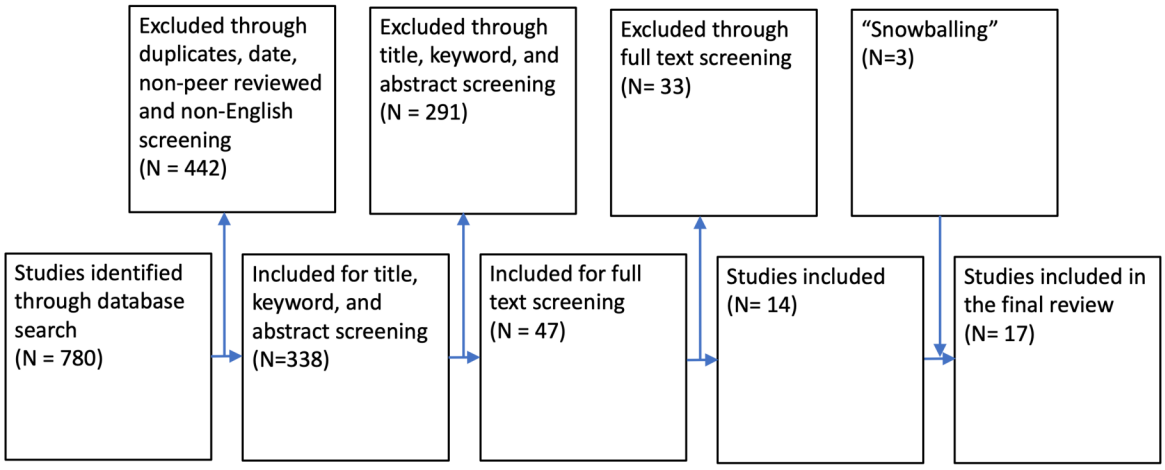

Figure 1: Selection process.

Table 3: Studies of potential relevance per search engine.

Search engine	Studies identified
Engineering Village	182
Scopus	475
ACM Digital Library	41
Web of Science	82
Total	780

3.3 Analysis

The 17 articles were read multiple times in full by the first and second or third authors. To form a better understanding of the context of the studies, key study characteristics were extracted from the full-text articles, in addition to any challenges pertaining to the scaling of PD. A description of the extracted characteristics is provided below:

- *Research questions/objectives* denote the study's research questions or research objective, as described in the original article. For studies that did not explicitly state a research question, a specified research objective was provided.
- *Context/domain* describes the application areas or the domains that the study addressed in its investigation of participatory methods.
- *Project goal* states the goal of the design or development project that the study either followed or was a part of. Typically, the project goal corresponds to what the IT solution being designed or developed was envisioned to achieve.
- *Location* refers to the geographic location in which the project took place.
- *Duration* specifies the duration of the project and its phases (if details in the original paper were provided).
- *Stakeholders* describe the groups and/or organizations that formed the main stakeholders in the project, including those consisting of people affected by the IT solution being developed without being direct users.
- *User groups* specify the groups formed by the users of the IT solution being designed or developed through the design/development projects that the study followed or had been part of.
- *Participatory methods* list the participatory methods and techniques employed in the project. In most cases, the applied participatory methods and research methods were entwined (see below).
- *Research methods* describe the research methods employed by the researchers in the study to gather empirical evidence. In studies in which the researchers were part of the project, there was generally a large overlap between research methods and participatory methods. This contrasts with studies in which the researchers observed participatory activities applied in the project without actively taking part.

General characteristics of the included studies are presented in Section 4, while a detailed overview of the characteristics of each study can be found in Appendix A.1.

The challenges of scaling PD, as described in the individual articles, were iteratively coded for themes (i.e., the nature of the challenges described in the study). This involved labeling identified challenges (i.e., extracted phrases of text from the original articles) with a suitable code, and constantly checking for consistency against existing codes. In the case of inconsistencies, new codes were created, renamed, removed, or rearranged. In cases where different codes described the same challenges, we selected the code that provided the most accurate description. The articles were read multiple times during the coding process to ensure that new codes included all the studies in the review. The identified categories of challenges are described in Section 5.

4 CHARACTERIZING THE REVIEWED STUDIES

The final set of studies included in the review comprised 17 studies published in the period 2004–2020. Ten of the studies were published in scientific journals, while six were published in conference proceedings. One of the studies was published as a book chapter.

Fourteen of the 17 studies presented empirical findings from projects that took place in or were initiated in Scandinavia. Four of these projects were initiatives targeting developing countries. The most dominant contexts or domains addressed by the projects described in the studies were health care (9 studies) and education (4 studies). Two studies drew on findings from multiple projects. The project length was not explicitly specified in most of the studies, but several projects lasted from approximately four years to more than two decades.

Most of the studies described projects in which researchers (including the authors) had been involved in participatory project activities. One of the included studies [54] addressed a project in which the researchers had taken on an observatory role in participatory project activities and in which empirical findings concerning user participation and impact were assessed using PD methodology as a conceptual lens.

While all the articles brought attention to the problem of scaling PD, they varied considerably in focus, presentation style, and the type of scaling issues addressed. Several articles (e.g., [13, 41]), focused primarily on scaling issues associated with PD and typically reflected this in the stated research question or research topic. These articles tended to present identified scaling issues in an orderly fashion, offering a clear statement of the challenge, as well as elaborate descriptions. In other articles, scaling issues were discussed as one of a number of other challenges pertaining to PD. For example, Bødker and Kyng (2018) consider the upscaling of PD one of five significant challenges PD needs to deal with in order to remain a relevant methodology in the development of future IT systems.

5 IDENTIFIED CHALLENGES TO SCALING PARTICIPATORY DESIGN

Based on the iterative coding process described in Section 3.3, the identified scaling issues were sorted into seven categories: (1) *Involving users*, (2) *Ensuring continuous user engagement*, (3) *Handling user heterogeneity*, (4) *Capturing and utilizing insights*, (5) *Applying participatory methods*, (6) *Acquiring appropriate project conditions for PD*, and (7) *Maintaining democratic control*. Table 4 provides an overview of the types of challenges that were given significant attention in the reviewed studies. Each category is explained and elaborated on with findings from the reviewed corpus.

Table 4: Overview of the challenges discussed the reviewed studies.

	Oostveen and V.d Bessalaar [38]	Pilemalm and Timpka [41]	Simonsen and Hertzum [45]	Obendorf et al. [37]	Titlestad et al. [52]	Dalsgaard [12]	Braa and Sahay [3]	Dalsgaard and Eriksson [13]	Iversen and Dindler [24]	Mogensen and Wollsen [34]	Madrid et al. [32]	Dindler et al. [15]	Bødker et al. [4]	Roland et al. [44]	Bødker and Kyng [6]	Smith and Iversen [48]	Zahlsen et al. [54]
Involving users		•				•		•	•		•					•	
Ensuring continuous user engagement		•						•		•	•						•
Handling user heterogeneity	•	•	•			•		•		•		•					
Capturing and utilizing insights						•	•	•						•			•
Applying participatory methods	•		•	•	•	•		•									•
Acquiring appropriate conditions for PD			•						•			•	•				
Maintaining democratic control							•								•	•	•

5.1 Involving users

The first category of challenges pertaining to the scaling of PD concerns user involvement. Large IT projects generally develop systems that have a big population of potential users. For example, the Urban Media Space Aarhus project [12, 13] intended to produce a solution targeting Aarhus' entire population of approximately 300,000 citizens. The public health informatics project described by Pilemalm and Timpka [41] aimed to develop a system for 175,000 users. In terms of participatory project activities, the direct involvement of large user populations—or even of large portions of such populations—is not practically feasible [41]. Similar challenges were also echoed by Smith and Iversen [48], who discussed the problem of moving from user involvement to the involvement of entire communities in a shared and extended space of exploration. Instead, participatory projects, such as those described in the reviewed articles, tend to rely on representative participation, that is, the involvement of individuals who have been appointed or selected as representatives of a user group (e.g., [13, 32]). Representative participation, however, can be considered a potential threat to the empowerment of the individual user (i.e., non-participants). For example, Madrid et al. [32], who discussed their experiences in a large-scale project involving people with disabilities, considered representative user participation problematic, as the full range of the user groups' needs and preferences is likely omitted in such circumstances, potentially leading to suboptimal solutions.

The unsystematic manner in which the involvement of user representatives often occurs in large-scale projects is another relevant aspect in this context [12, 13]. Dalsgaard [12], considered the failure to involve the appropriate participants a risk related to the challenge of raising awareness of a participatory project among large user populations—especially in cases in which future users and stakeholders might not recognize the immediate personal relevance of the participatory process or even how they can become involved.

Iversen and Dindler [24] discussed the importance of recruiting a core group of users and stakeholders who have been provided resources (e.g., dedicated project time) and who possess the ability to reflect on their own practice and to communicate and possibly introduce PD initiatives to other stakeholders. In order to achieve this, the authors emphasized the need for intimate dialogue with the stakeholder organization and its management in the process of involving users.

5.2 Ensuring continuous user engagement

The second category of challenges concerns the problem of ensuring stability in participating user groups throughout a large-scale IT project. The complexity of large information systems typically implies that their development projects may extend over several years. For example, the Urban Media Space Aarhus [13] lasted from 2001 until 2015. Having users commit to a project and its participatory activities over long periods, however, is a recurring problem described in several articles.

In some cases, the involvement and continuous engagement of certain user groups (e.g., marginalized user groups) mean that a significant amount of time and resources must be put into building a sufficient level of trust among the group members [32]. Individual input may also seem trivial in a large-scale project with many stakeholders and distant project goals [13]. Time-consuming pre-design group procedures (e.g., user participation in administrative tasks) can also result in perceived inefficient use of time among participants and thus risk decreasing users' motivation to stay involved [41].

Turnover or discontinuity in participating stakeholder groups as user representatives leave the project and are replaced by new ones can make it particularly challenging to maintain a shared understanding among group members as a project progresses [41, 54]. Zahlsen et al. [54] described how a central part of the group discontinuity problem is that the knowledge and understanding of the (group) discussion that led to the current status of a particular subject, and that are "knowledge in the head" for regular participants, are not easily transferred to newcomers or substitutes via shared sources, such as project documents. When a participant stops following a series of associated project activities, this form of implicit knowledge disappears with the person.

Although replacing user representatives involved in a participatory process may have negative effects on constructive group discussions, Mogensen and Wollsen [34] argued that participants oscillating between being deeply involved and being more peripheral in project activities may be beneficial, as such shifts can cause participants to shift between being contributors and learners in the activities.

5.3 Handling user heterogeneity

The third category concerns the heterogeneity characterizing the different user groups often involved in large participatory IT projects and the challenge of giving, especially, disempowered or marginalized groups a say in design decisions. This heterogeneity generally reflects the wide variety of user groups that form the user population of large information systems. For example, Dindler et al. [15] described how participants can have different understandings of the participatory process, diverse backgrounds for entering a project, and different expectations regarding the project's main results. Oostveen and Van den Bessalaar [38] pointed out that users may come from different countries with different cultural backgrounds, opinions, norms, and values, all influencing the requirements, expectations, evaluation, and acceptance of the new technology. Similarly, Dalsgaard and Eriksson [13] highlighted that project partners can have different ways of expressing themselves and have somewhat different agendas or sets of ideals, which again makes it challenging to align different paradigms of practice and inquiry. One factor that may further complicate the situation is

that the needs of various user groups are also likely to change throughout the timeline of a large IT project as new project results become available to the user population [12]. This suggests that the manner in which user groups are heterogeneous may also change as a project progresses.

For PD, aspects such as those described above raise the problem of fostering participatory activities that are experienced as constructive and of value for participants, where various voices are heard, different motivations are aligned, and diverse perspectives are integrated [13, 34, 41, 45]. However, as pointed out by Mogensen and Wollsen [34], diverse needs and perspectives among different user groups may also give rise to new opportunities. For example, new communities of practice may emerge from participatory work as different user groups, representing different practices, engage with one another.

5.4 Capturing and utilizing insights

The fourth category of challenges concerns the capturing and utilization of insights from multiple participatory activities in large-scale IT projects. Each participatory activity may produce a substantial amount of data that needs to be analyzed [13], and connections between data, analysis, and decisions need to be clarified for generated insights to become easily accessible for other participating project groups (ibid.). Synthesizing multiple sources of knowledge to inform the development process, both in terms of technology and organization, thus stands out as a key challenge [12]. To mitigate problems related to synthesizing insights from multiple groups and activities, Dalsgaard and Eriksson [13] highlighted the need for an improved and more structured way of capturing insights emerging from participatory activities.

The challenges of utilizing insights across multiple groups and activities are also likely to increase when the groups and participatory activities are distributed, for example, located or taking place in different regions or countries [3, 44]. In particular, Roland et al. [44] discussed how physically distributed participatory activities also change the nature of participation compared to small-scale PD, potentially reducing the possibility for those involved in the project to engage intimately in participatory activities not occurring locally.

Zahlsen et al. [54] brought attention to the temporal aspects of utilizing insights in large-scale projects. In particular, the study describes how the handover of undocumented process insights from one project phase to another may raise issues.

5.5 Applying participatory methods

The fifth category of challenges concerns the adoption and application of participatory methods in large-scale IT projects. Adopting a participatory approach in large-scale IT projects can be time and resource demanding, as the partners likely need to continuously develop new methods and techniques that match the participatory agenda (e.g., finding ways to support communication and understanding between different stakeholder groups and help generate insights that can move the design process forward) [13]. In addition, project partners may also need to develop the skills needed to carry out participatory activities [12, 13]. As participation becomes more distributed, this also raises the need for alternative participatory methods than those typically used in settings where participants are collocated [37, 52]. Some studies have also argued that the application of participatory methods in a large-scale IT project requires regular co-reflection on the participatory methods and the process in which they are used to enable constructive adjustments [54].

Drawing particular attention to evaluations of early design solutions in large participatory projects, Simonsen and Hertzum [45] discussed the problem of conducting large-scale experiments to evaluate prototype systems as part of real work—especially how limited time frames and precautions against errors, which may potentially affect ongoing work, can impede such efforts. Simonsen and Hertzum (2018) also highlighted the challenges of managing individual PD

experiments in combination with a stepwise implementation process, as opposed to a "design first then implement" process. Referring to the challenges of evaluating the impact of technologies emerging from participatory projects, Oostveen and Van den Bessalaar [38] discussed the limitations of direct observation, pointing out how the indirect and long-term effects of technology (in their case, an e-government system) cannot be accounted for by such means.

5.6 Acquiring appropriate conditions for participatory design

The sixth category concerns challenges related to the wider context in which the large participatory project is conducted and how the success of such projects can depend on initiatives targeting stakeholder organizations, political arenas, or practical arenas. For example, Simonsen and Hertzum [45] argued that to set the stage for PD in a large project, it is important that project partners (e.g., vendor and customer organizations) accept that PD is an improvisational and relatively open-ended process.

However, acquiring appropriate conditions for PD (i.e., circumstances in which genuine user participation and empowerment can realistically be achieved) goes beyond the preparatory phases of a project. Bødker et al. [4] described how setting the stage right requires continuous efforts that often can involve the use of activities not traditionally associated with PD. The authors described how they, in an educational PD context, saw the need to engage with a wider set of stakeholders at various levels of authority in the Danish school system through "backstage" PD activities, such as panel debates, steering committee partnerships, counseling, and lectures to realize the goals of the project.

As a means of obtaining appropriate conditions for PD, Iversen and Dindler [24] and Dindler et al. (2016) drew attention to the importance of dissemination initiatives targeting future users and stakeholders who are not directly involved in the project's participatory activities. Creating visibility, accessibility, and interactivity of PD activities in the general user population, for example, through prototypes that have emerged from PD activities, can be an important measure in this regard. Dissemination activities targeting the wider organization or user population are also an opportunity to open the PD process and outcomes to general critique [24]. Failure to inform non-participants about the ongoing PD work risks, in the longer run, that they develop a negative attitude toward the project [24].

5.7 Maintaining democratic control

The seventh category describes challenges that can arise when PD faces the "corporate world" (i.e., commercial interests and values) or other settings in which there are values that may be inconsistent with PD's democratic and emancipatory ideals. Smith and Iversen [48] found that although PD is increasingly used in different settings across the public and private sectors, PD's political dimension and values are often neglected in search of pragmatic and short-term gains. Bødker and Kyng [6] problematized the ownership of major commercial platform technologies, which often play a central role in large IT projects. In particular, Bødker and Kyng (ibid.) discussed the challenge of retaining democratic control in settings where platforms are owned by private big-tech companies that users have little power to influence (the platforms are used by many but owned by a few). Braa and Sahay [3] saw a similar risk for PD in relation to the development of better health IT systems in developing countries. In particular, Braa and Sahay (ibid.) raised the concern that business models associated with platform technologies can deprive developing countries of possibilities for growth, for example, by outsourcing software-based services to industrialized countries. The authors also pointed out the political challenges that can arise in large-scale PD work targeting developing countries—for example, that the deep involvement of local communities in PD efforts is not necessarily in the interest of health workers, managers, or the political class.

The reviewed studies also illustrate how the challenges of maintaining democratic control in a large IT project may manifest in ongoing participatory project activities. For example, Zahlsen et al. [54] described how contractual discussions disrupted participatory activities in a health IT project, thus moving the focus of the activity to a topic in which participants' work competence was irrelevant, and they had no real decision power. The researchers also discussed how a project's decision-making structure can potentially move the power to make decisions on important matters from users to management levels.

6 DISCUSSION

This review presented a multifaceted picture of the types of challenges that can arise when PD is applied on a large scale. The challenges concern different aspects of a participatory project, such as planning, preparing, and running participatory processes, and can be logistical (e.g., involving users and ensuring continuous user engagement) or political (e.g., acquiring the appropriate conditions for PD and maintaining democratic control). Challenges related to involving users in design processes is not exclusive to PD, applying also in, for example, user-centered design [19, 50, 53] and service design [51]. However, in the case of PD, the challenges identified in this review could be viewed as a threat to PD's methodological integrity – rooted in ensuring democracy and empowerment by highlighting heterogeneities and complexities [25] – and thus particularly relevant to take into further consideration.

An interesting question that emerges in this context is the extent to which PD is capable of scaling without compromising its core values. To facilitate a discussion of this question, we apply Kensing and Greenbaum's [26] guiding PD principles, or "heritage," described in Section 2.2, as conceptual lenses to assess the identified challenges.

6.1 Equalizing power relations

Finding ways to give those who are marginalized and often disregarded a voice in the design of technology that affects their lives is at the heart of PD methodology. The findings related to handling user heterogeneity (Section 5.3) suggest that, with the involvement of more user groups, challenges related to asymmetric power relations are more likely to arise—this is especially due to the potentially more complex totality of power relations that upscaling of participation can bring about. Instead of negotiating a solution between one weak part and one strong part, which could likely be a scenario in a small-scale project (e.g., [11]), a large-scale project potentially demands negotiations between multiple parties with various levels of power. In the face of increased heterogeneity, we envision the future of PD to involve the emergence of new sensitivities and efforts to pay more attention to and equalize asymmetries between the parties involved. Studies suggest that equalizing power relations in practice, however, is by no means trivial. Discussing lessons learned from a small-scale project, Dahl and Svanæs [11] problematized how issues related to power asymmetries can easily pass "under the radar" of PD facilitators managing participatory activities and thus not addressed appropriately.

Settings where democratic control is challenging to achieve and maintain may raise the bar for equalizing power relations even higher. As described in Section 5.7, this especially applies to large-scale projects that involve stakeholders and authorities that hold values that may conflict with PD's emancipatory ideals.

6.2 Democratic practices

Involvement is a key component of all democratic practices. Given its democratic underpinning, user involvement is an integral part of PD. The issues associated with user involvement in large-scale IT projects (Section 5.1) and ensuring users' continuous engagement throughout the project (Section 5.2) are, in many ways, challenging traditional democratic practices in PD. In particular, the *direct* involvement of users often appears to be compromised due to the logistical and

practical problems of involving large portions of the user population. As described in Section 5.1, several large-scale projects tend to rely on the involvement of user representatives who supposedly act on behalf of large user groups. While representative democracy in many ways can be seen as a pragmatic solution to scaling democracy, such a shift in PD's democratic practices potentially weakens the voice of those who are marginalized or otherwise disadvantaged, as they are not actively involved in design processes. In particular, the construction of empathic relations between participating users and designers, which is a central component in many PD projects [10], may become more challenging when there is discontinuity in participating stakeholder groups. The reviewed literature [41, 54] also revealed how group discontinuity may raise problems when it comes to maintain a shared understanding among group members throughout a project. The ad hoc ways in which the involvement of user representatives reportedly takes place in large-scale projects and the challenges of keeping users actively engaged in projects that may last for several years, further question the extent to which PD can scale without compromising democratic practices.

As noted in Section 5.6, a large-scale project may raise the need for "touch points" with stakeholders who are not directly involved in participatory project activities to obtain the appropriate conditions for PD. Such efforts can certainly be considered democratic practices that emerge as a consequence of a project's scale and will likely become more prominent in future PD projects.

6.3 Situation-based actions

Traditionally, PD has emphasized working directly with people—either in their homes or at work—to help form a better understanding of people's existing situation-based actions, and how new technology can be designed to accommodate existing practices by allowing users to benefit from their experience-based knowledge. This emphasis on understanding and designing for situation-based actions in many ways reflects PD's deep mistrust of abstract representations of practice. In this regard, capturing and utilizing insights from physically or temporally distributed PD activities (Section 5.4) represents a potential problem, as it likely implies developing new approaches to communicate such representations of practice to other participatory groups located at other sites. From a traditional PD perspective, then, the nature of participation in "distributed PD" contradicts the principle of situation-based actions.

6.4 Mutual learning

The design process itself should be experienced as rewarding, not only for designers and developers but also for involved users, which is a hallmark of PD. Embedded in the principle of mutual learning is the idea that users and designers should learn from each other, and that the knowledge users obtain by participating is a key component of their empowerment. The reviewed studies generally provided little insight into the concrete challenges that may impede mutual learning. As noted in Section 5.3, however, the studies indicated that in large-scale projects that involve multiple user groups, the way mutual learning occurs can be different vis-à-vis more traditional (small-scale) PD settings. In particular, user groups may, to a greater extent, learn from each other, as opposed to learning only from designers or other project affiliates who have technological competence [34].

6.5 Tools and techniques

Tool and techniques in PD have traditionally played a key role in helping stakeholders involved in the design process express needs and visions. In large-scale projects, as described in Section 5.5, learning how to use tools and techniques within stakeholder organizations and tailoring them to a specific project can be resource demanding. Such costs need to be planned for in large-scale participatory projects in order for participatory methods to realize their potential. For PD

applied in distributed contexts, costs are likely to increase further as traditional tools and techniques (i.e., those that have been made for settings in which participants are collocated) will not be adequate.

6.6 Alternative visions about technology

Finally, PD, with its focus on equality and democratic practices, has often produced design solutions that build on visions of technology differently from conventional commercial solutions. In this regard, commercial platform technologies, which often form the basis for large-scale IT systems, frequently come with built-in values that may contradict traditional PD values. Similarly, realizing alternative visons of technology may be challenging in regions that lack democratic traditions. In practice, then, challenges related to maintaining democratic control (Section 5.7) risk compromising the last principle that defines PD's heritage. However, the political sensitivity that lays at the core of PD should remain an important sensitizing tool for researchers and other involved stakeholders to surface and problematize design situations that threaten ideals of democratic control [2].

6.7 Can participatory design scale?

With respect to the question motivating this discussion (the extent to which PD can scale without compromising its core values), the assessment above yields a less hopeful answer. We consider the challenges described to contradict several of the guiding principles described by Kensing and Greenbaum [26]. As the principles are interlinked (one principle being integral or forming the basis for another), breeching even one of the principles might have negative spillover effects on the realization of other principles. Using the principles as yardstick to assess PD's capability to scale might arguably not account for the new and diverse ways by which participation can occur in contemporary participatory projects (e.g., [4, 14, 44]). However, if one accepts the principles as defining for PD, one could also question the extent to which large-scale projects such as those described in the studies included in this review can be considered genuine PD projects, or if they are projects with elements of PD.

Our somewhat pessimistic appraisal of PD's ability to scale while maintaining its methodological integrity, however, should not be interpreted as a warning against applying PD methods in large-scale projects. As the findings also showed, several of the studies reported that the application of PD methods had positive and even user-empowering effects. To remain a vital design approach in the era of large-scale IT systems, PD arguably also *needs* to face "big issues" such as scaling [6]. Thus, we consider the identified categories of challenges to form important opportunities to explore the plurality of participation in the context of applying PD on a large scale. Fulfilling the principles that have traditionally defined PD is unrealistic in many ways when PD is applied in large IT projects. Having the ambition to do so can nevertheless still yield results that are fruitful from a democratic and emancipatory perspective. The HISP initiative [3] serves in many ways as a good example of how PD ideology and methodology may yield positive results in such regard, in spite of being applied in settings with weak democratic traditions. The methodological implications of the argument above, however, are that there are limits to how large an IT project can be and yet be capable of accommodating Kensing and Greenbaum's [26] guiding PD principles. As such, there is a risk that *user participation* in large-scale project becomes a rhetorical cliché in which the empowering potential is reduced to participatory tokenism. Given the challenges of realizing *all* the principles in a large-scale project, specifying in the planning phase of a project what elements of PD should adopt as key objectives and how those objectives should be realized and later verified may be important measures.

7 LIMITATIONS

Drawing on a systematic review of relevant studies, the present study provides an overview of the challenges of scaling PD. As with all systematic literature reviews, the emerging picture of the addressed topic is colored by how the method was applied. Therefore, it is relevant to reflect on some methodological aspects and how they may have affected the results. First, we cannot be certain that we, through the initial search query (Section 3.1), were able to identify all relevant articles, as the results produced by the databases ultimately depend on the search terms used to form the query. For example, the decision to focus exclusively on large-scale projects (i.e., studies in which the addressed projects have initially been conceptualized as large scale) could potentially preclude consideration of issues from studies of smaller projects and why such projects may be challenging to upscale. Likewise, studies that may have discussed challenges related to user involvement and participation in large-scale projects, without explicitly relating the work to PD, could not be identified thorough the initial query. We tried to compensate for the issues mentioned above by building the search string iteratively and checking the reference lists of included articles for relevant studies (see Section 3.2). Nevertheless, it is possible that the review may have omitted literature of potential relevance. Our decision to discard shorter publications from the review has also reduced the number of studies included.

Second, it should be taken into consideration that the categorization of identified challenges was based on our (the authors') interpretation of qualitative studies. To ensure consistency, the categories were constantly reassessed, as they were gradually expanded with findings from the reviewed studies. However, as the seven resulting categories are ultimately a result of our understanding of the reviewed material, we acknowledge that the same corpus may also be interpreted differently (thus leading to other categories and potentially other insights).

Third, we need to reiterate that the goal of this review is to provide an overview of the types of challenges that PD faces when applied in large-scale IT projects. The objective of a structured review is generally to summarize existing evidence as opposed to presenting details. Thus, the present study provides little insight into the sometimes highly diverse circumstances under which the scaling issues described in the individual studies manifested and their project-specific effects. For example, Dalsgaard and Eriksson [13] reported on findings from a participatory project taking place in a Scandinavian democratic setting, while Braa and Sahay [3] described challenges related to applying PD in developing countries often with weak democratic traditions. While we in this review applied project scale and PD values as conceptual lenses, our intention is not to trivialize the context in which PD is applied as participatory approaches are emanations of specific projects, people, and cultures. Nor does the present study do justice to the rich reflections offered in several of the articles included in the review.

8 SUMMARY AND CONCLUSION

In light of the increasing attention that the scaling of PD has received in HCI and related fields in recent years, this review identified the challenges that PD faces when applied in large-scale IT projects. A total of 17 articles of the initial 780 retrieved references were reviewed. Seven categories of challenges were extracted from the reviewed studies: (1) Involving users, (2) Ensuring continuous user engagement, (3) Handling user heterogeneity, (4) Capturing and utilizing insights, (5) Applying participatory methods, (6) Acquiring appropriate project conditions for PD, and (7) Maintaining democratic control.

The seven categories provide a complex picture of the issues that PD faces when applied in large-scale settings, consisting of challenges that are logistical and political. Assessing the challenges through the lenses of PD's guiding principles [26], as we have argued, raises serious concerns about PD's ability to scale and remain true to its heritage.

Given the nature of the challenges, there is a considerable risk of watering down the principles while scaling up to a point where the PD ideology in a project is no longer recognizable.

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A APPENDICES

A.1 Characteristics of the studies included in the review

Study	Research questions/ objectives	Context, project goal and duration	Stakeholder organization/groups	User groups	Methods for user involvement in the project	Research methods
Osteveen and Van den Besselar [38] (2004)	What PD issues arise in ICT projects involving complex and large-scale network technologies? What methods can be used for user participation? What are the implications for PD strategies?	E-government systems (Germany, the UK, Netherlands, Belgium, Denmark, Italy and Switzerland) Designing and building an internet and smart card-based system to support mobile Europeans with administrative transactions between countries.	Municipalities (management of the and clerks). Political leadership and strategic management of participating cities. Local public services.	Citizens of EU countries (including end-users of services, clerks, administrative technical and strategic management; politicians, smart card producers and providers, and providers of other public or private services.	Interviews, survey, workshops and scenario-based evaluation in combination with social research and technology assessment.	Case study (including the methods described under *Methods for user involvement in the project*)
Pilemalm and Timpka [41] (2008)	Examine which modifications are needed in order to make PD of health information systems applicable in large health service organizations, and to integrate modifications in a third generation PD method for user in this context.	Public health informatics (Sweden) Develop a modern information infrastructure that allowed local shop stewards to address their local problems, and to support them in dealing with and improving	Representatives from the Swedish Trade Union Federation and educators from a trade union folk high school; project management; researchers from Linköping University	175 000 shop stewards	Participatory action research (action design)	Case study (participatory action design; individual interviews)

		employee work conditions				
Simonsen and Hertzum [46] (2008)	What are the challenges that PD must face when engaging in design and implementation of large-scale information systems?	Health care (Zealand region, Roskilde, Denmark) Implement an electronic patient record module intended to support clinical documentation and decision making.	Vendor organization, Customer organization (The Zealand healthcare region – in particular Zealand's EPR unit and the neurological stroke unit at Roskilde Hospital)	Clinical staff (physicians, nurses, therapists)	A four-step iterative participatory process to identify and specify change, implement prototype and expose it to real use, evaluate, and to foster new desired change.	PD workshops (with mock-ups drawings, non-interactive PowerPoint prototyping, and prototype demonstrations) prototype implementation, testing, reconfiguration, training, trials, observations and analysis, interviews, questionnaires, diaries, response times analysis, seminars, report writing

Obendorf et al. [37] (2009)	How can PD approaches be carried out in a distributed setting, when one system is developed for and within several different contexts of use? Which traditional PD methods prove difficult in distributed context and what new problems arise, respectively? What kind of new approaches are necessary to carry out participatory design processes in distributed settings?	Community building, learning science Development of an open source webbased educational groupware system 1999-2009	Software developers, moderators, evaluation staff and users from different contexts. Commercial partner	Post-secondary university level, secondary schools, and vocational communities, industry, public as well as private sector	Mix of established PD methods such as paper prototyping, user workshops, interviews and scenarios	Case study (Participatory action research)
Titlestad et al. [52] (2009)	Explore challenges to distributed participation within and across countries, and describe efforts at addressing these	Healthcare management in developing countries Development of a distributed IT-system for health management in developing countries 1994 - 2022	Health workers, administrators, public health experts, graduate students (master and PhD candidates who also are developers and key project members), project leaders, technical staff and trainers in the various sites where the system is introduced	Health information officers and health staff involved in management	Prototyping and intensive face-to-face interaction between users and designers, such as close observation of the work practices of users, joint workshops, and scenarios	Case study (participatory action research)

Dalsgaard [12] (2010)	How are new information and communication technologies impacting what participation means and how it can be enabled? What are the roles of participation?	Public knowledge institutions (Aarhus, Denmark) Development of new multi-use media library 2001–2015	Principal developer (municipality), project board steering committee, sub-committee, strategy group, idea group, and project management	Library employees and the public	Conventional events for involving stakeholders (e.g., public hearings), established and new PD techniques (e.g., workshops)	Case study (PD activities and interviews with project management and stakeholders, including citizens, architects, contractors, library staff and management, and others)
Braa and Sahay [3] (2013)	Discussing various trends and questions within the context of the ongoing globally Health Information Systems Programme (HISP) initiative.	Healthcare management in developing countries Development of a distributed IT-system for health management in developing countries 1994 - 2022	Health authorities in various developing countries, software developers, NGOs, UiO.	Health information officers and health staff involved in management	Participatory and exploratory prototyping, meetings.	Case study (participatory action research)
Dalsgaard and Eriksson [13] (2013)	How to make large-scale participation work in practice? How to align different paradigms of inquiry and practice in a large-scale project? How to capture and anchor the insights from participatory events to inform the ongoing design process?	Public knowledge institutions (Aarhus, Denmark) Development of new multi-use media library 2001–2015	Principal developer (municipality), project board steering committee, sub-committee, strategy group, idea group, and project management	Library employees and the public (approx. 300 000 local citizens)	Workshops and other (unspecified) methods	Case study (structured interview with three stakeholder representatives; informal interviews with library staff)
Iversen and Dindler [24] (2014)	Illustrate how a nuanced conception of sustainability may be a resource for discussing the means and ends of PD activities. To suggest that concerns for sustainability may be	Learning sciences Design of educational technology for the Country primary school 2012-13	Researchers (computer science, anthropology, architecture, pedagogy), two commercial partners, children, teachers, school management	Sixth grade students	Participant observation, workshops, collaborative prototyping, and storyboarding. Activities often considered outside the core PD repertoire, such as dissemination of results and political	literature review and case-study

	transformed into concrete PD activities.				engagement	
Mogensen and Wollsen [34] (2014)	Formulate principles and insights of relevance for the application of PD in a complex, large-scale commercial context.	Health care (Denmark) Development of a national IT-solution for pre-hospital sector	Paramedics and medics from ambulance services, nurses and doctors from emergency departments, ambulance center staff, acute medical coordination staff, management from different organizations and levels.	Pre-hospital practitioners	PD workshops (involving incident games, prototyping with mock-ups, case stories, prototype evaluations, group discussions, plenary discussions, and generation of principles for technical design and future practices.	Fieldwork and PD workshops
Madrid et al. [32] (2015)	Investigate strategies for managing the participation of people with disabilities in large-scale R&D technology projects	Accessibility (Europe) Development of digital solutions supporting accessibility to ICT products and services AEGIS project: 2008–2012; Cloud4All project: 2011–2015	People with disabilities, tutors, relatives, educators, rehabilitators, and staff in user organizations	People with disabilities	Co-design sessions, focus groups, and other user-oriented methods.	Same as listed under Methods for user involvement in the project.
Dindler et al. [15] (2016)	Explore how a design process based on design thinking principles is experienced from a participant perspective	Knowledge institutions, design of public spaces (Aarhus) Conceptual transformation of the library; design of a thinking tool for libraries; creation of interactive installations.	Two librarians, a pedagogue, a journalist (all working at Aarhus library)	Children and families and the other focusing on IT	Design thinking	Single case study (data collection: interviews, observations; project documentation analysis)

		2013-15				
Bødker et al. [4] (2017)	Explore theoretical work as a basis for understanding: How participatory processes play out vertically in different arenas. How the backstage design activities unfold between workshops The reach of participatory processes as they tie into existing networks.	Develop an educational environment that encouraged teachers, students, and schools to integrate new digital fabrication technologies 2014-17	The whole hierarchy of the Danish School, Stanford University, Danish Industry Foundation, MD's of 3 municipalities, a steering committee, various researchers,	Teachers, students, educational staff	Workshops, design game, a public hearing, survey/questionnaire, keynote speeches, project applications, lectures, observation studies	Case study (Participatory action research)
Roland et al. [44] (2017)	What role does architecture play in large-scale PD?	Healthcare management in developing countries Development of a distributed IT-system for health management in developing countries 1994 - 2022	Universities, ministries of health, global regulatory agencies like WHO, international development funders, emergent regional implementation partners	HISP: Health information officers and health staff involved in management	Not specified	Case study (Participatory action research)

Bødker and Kyng [6] (2018)	Considering possibilities for a new PD.	HISP: Healthcare management in developing countries; FabLab: Public sector: education; 4S: telehealth HISP: Development of a distributed IT-system for health management in developing countries; FabLab: Introduce emerging digital technologies in Danish primary and secondary education; 4S: Govern open-source software applied for telemedicine in Denmark HISP: 1994 – 2022; FabLab: 2013 – 2017; 4S: 2013-2022	HISP: Health authorities in various developing countries, software developers, NGOs, UiO. FabLab@school.dk: students, teachers, schools, politicians on local and national level, administratively involved stakeholders in the Danish educational system 4S: Board of managers, health forums, patient organizations, researchers , government, hospitals, municipalities, grants, health providers, software developers	HISP: Health information officers, Health staff involved in management FabLab@school.dk: students. teachers 4S: ": Telehealth users	Not specified	Case study (Participatory action research)
Smith and Iversen [48] (2018)	Design for sustainable social change	Public sector: education Introduce emerging digital technologies in Danish primary and secondary education. 2013 - 2017	Students, educational staff, local politicians and international researchers	Upper primary and lower secondary school students	Pilot workshops, ethnographic filed studies, baseline survey, design experiemnts, teacher training, online survey	Integration of partcitipatory design and anthropological reserch
Zahlsen et al. [54] (2020)	How is participation shaped and user impact constrained by influential factors that are external to the participatory activities in large-scale IT projects.	Health care (central Norway) Implement a shared electronic health record system for regional health care services. 2012–2022	Regional public health authority; municipality; primary care physician offices; client project organization; EHR vendor	Health care professionals in in the region (approx. 40 000).	Scheduled project meetings with representatives from the stakeholder organizations.	Case study (document analysis, semi-structured interviews with eight stakeholder representatives)