# Varieties and Issues of Participation and Design

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**Abstract**

Participatory design is the antithesis of traditional design in which designers are expected to exhibit their expertise. The right to participate in design is often ignored and even when it is accepted, many obstacles including perceived pragmatic/economic deficiencies and organizational concerns, impede participation. This paper criticizes the foundations of traditional design and elaborates some features of participation in various design disciplines particularly in the context of architectural design and urban planning. An approach to participation founded on widening communication channels among participants is presented. Finally, the potential applications of computer tools for supporting participation is discussed.

**Keywords:** Design Theory, Communication, Computer-Supported Cooperative Work, Design Quality.

Participatory design has been discussed, off and on, at least since the 1960s [1, 2, 3]. However, the still prevalent view of design is that active involvement of users is not useful and in most cases avoided. According to this view, it is the responsibility of design professionals to know what is best when it comes to design [4]. Even when participation is politically demanded, as in the case of public housing design, it is often allowed to be ineffective with different interest groups canceling each other out [5, 4]. While the traditional view has been challenged, recently, for example, with respect to high-tech or economically powerful customers [6, 7] and in certain countries [8, 9], it still continues to have considerable influence over the practice of design. In what follows we examine some practical and methodological assumptions, analyze them, and suggest a set of issues that are involved in extending participation in design.

We interpret the terms "design" and "participation" broadly. Design is any purposeful activity aimed at creating a product or process that changes an environment or organization. We see participation as a *prima facia* right of all people potentially affected by a design. Additionally, since design often creates needs rather than simply stemming from them, participation must be legitimated independent of the origin of the needs themselves. For example, the development of a new business district will immediately create additional transportation and related needs. Hence, in many cases this will require that the traditional asymmetry in responsibility and decision making between users/customers on the one hand and designers/experts on the other be modified.

On the other hand, the right to participate is limited by a given participant's experience, understanding, motivation, and the pressing need to get things done. This implies that certain negotiations, which can become widespread and intense, have to be brought to, at least, a relative and temporary close. Unfortunately, the need to get things done coupled with constraints on finances may overshadow any benefit from user involvement. Therefore, participatory ideals must confront designed environments, institutions, policies, design codes and standards that resist extending participation [5]. In any given situation, such resistance can never be completely overcome, nor should it be: compromises must be made if practical effects are to be achieved. Participation brings with it the need to navigate between the expansiveness and dynamism of open systems and the decisiveness and maintenance associated with closed systems.

While the ideal participation is located at the open system end, most real participatory experiences do not achieve this ideal being often limited to some authoritative (e.g., management) choice.

Nevertheless, the restrictions on the form of participation can be informed by a collective judgment that can benefit from experience with previous participatory projects [10]. Therefore, recording previous participatory situations – especially, their rationale and outcomes — is a critical source for advancing the understanding and practice of participation.

Section 1 criticizes the received view of design and discusses some of the alternatives developed in the past. Section 2 analyzes what is missing from this traditional view of design as well as from the alternatives: the acknowledgment that design knowledge is not possessed by one homogeneous consciousness (e.g., the designer), but is essentially social and maintained through negotiation and reconciliation of many different perspectives (e.g., those of designers, customers, manufacturers). Section 3 summarizes key characteristics of artifacts and properties of participation projects that can help organize other participation projects. With an eye toward extending the scope of participation projects, Section 4 discusses how their properties can be supported by tools and what are some of the issues that are important in operationalizing these supports. These issues serve as an important thread in the development of a design support infrastructure at Carnegie Mellon University.

## 1 A Critique of Traditional Design

In the "traditional" design situation, user needs are "thrown over the wall" to the designers whose response — the design — is then "thrown over the wall" to downstream experts (e.g., manufacturers, sellers) till it reaches the customer or the end-user. An assumption of traditional design is that active user involvement comes after the design process is over. From this point of view, a producer creates a product and the success or failure of the product in the market transfers to the design process. Users of products are assumed to be essentially consumers of products and have very little or no direct role in creating the products themselves or even communicating their own needs. Product realization is then used, or so it is thought, as a means to make explicit the needs that are often not articulated by the users themselves. In effect, in industrial societies, the manufacturers often articulate user needs without necessarily involving users or create needs users accept as their own [11].

In traditional design, participation is often side-stepped by reducing the user to a databank.

This is manifest in disciplines such as human factors or ergonomics that enable "representing the user in the design process" [12]. In this case, the best designers can achieve is by creating building blocks that allow users to adapt the product to their specific needs.

Such situations result in the designer's demanding an objective evaluation of need as an integral part of the design process. However, it may not be possible to get objective needs using traditional social science techniques such as surveys, interviews, or questionnaires. Rather, useful information about needs could be obtained by allowing users to become involved during the design process thus obtaining, at least, face validity and inter-subjective data. This is the starting point for our suggestion that extensive participatory design may be a fruitful alternative to views which underemphasize the active role of the user in the design process. This opens the way to more emphasis on participatory methods in understanding the development and use of designs (e.g., software) and to what has been called participatory action research [13]. See Konda et al. (1992) [14], Monarch et al. (1993) [15], and Reich (1992) [16], for additional discussions of the notion of participatory action research with respect to design theory and practice.

In the case of sophisticated (i.e., complex) products and processes, user needs are either not known or are, at best, inchoate. In these cases, not only is user participation necessary, but also more sophisticated means may be needed to support this participation. Research on group decision support systems [17], multi-party communication [18], and the various forms of prototyping with users [8] may provide insight into, and facilities for, computational support of participatory design.

Finally, in the market-based approach to participation, users "participate" via their purchasing decisions. However, if the product in question is successful, the total cycle time between versions (or models) based on this approach will take longer and, hence, is potentially more expensive. Obviously, if the product is a failure, anything that leads to either the discovery of the failure potential or the information required to prevent the failure in the first place ought to be considered. Internalizing as much of this iterative process during design is one of the consequences of participation and, hence, could operate even in the absence of competitive markets.

A design proposal, while possibly meeting user needs, could raise a host of issues related to usability and other factors. That is, obtaining requirements from user needs is a cascading process [19]. By extension, user needs evolve through the use of related or previous versions of products [20]. Thus, any static technique for uncovering user needs will be inadequate.

We believe that evaluating user needs on a continual basis through the entire product life-cycle demands user participation. Hence, focusing on extracting needs from users must be changed to a dynamic ongoing activity where the central purpose is continually evolving a design on the basis of the multi-lateral participation of all relevant actors. This requires the acceptance of the legitimacy of multiple, perhaps incompatible, and certainly incommensurate perspectives, and the sympathetic adaptation of multiple perspectives to enhance or improve personal contributions — that of the designer *qua* designer and the user *qua* user.

There is also a problem of enabling all people potentially affected by a design outcome to be an effective part of the design process. Even in cases where these needs are considered and, to some extent, addressed, those affected may still become alienated if they do not believe they have been effective participants in the process [21]. There is considerable evidence that user participation leads to more general, acceptance of both the process itself and its consequences [22, 13].

## 2 Beyond the Traditional View: Multiple Perspectives

It might be thought that an ideal way for involving users in the design process is for the designers to *be* the users. When the designers are the users, they understand perfectly the needs of the users better than anyone else *could*. Since their ideas and values are the users' as well, designers are subject to no external influences and can proceed from their own, subjective ideas and values and can be as artistic as they are personally capable. The users do not need to communicate needs to the designers because designers-as-users already know them. However, the perspectives of others can give insights that the designer-as-user does not have: users are not without bias or blindness on their own behalf.

It is the avoidance of communication in the case of users-as-designers that is also at work in the idea of design expertise. Here, not only are designers ideally situated to understand the technical requirements of a design, they are also ideally situated to understand the needs of users; i.e., what the needs of users *ought* to be. The ideal of participatory design challenges the notion of an expert understanding of users of artifacts. As with a user, no expert is without bias or blindness; assuming otherwise has led to design failures [23, 24].

Both these ideals entail a classic Platonic move by assuming that perfect knowledge can be had by one consciousness transparent to itself without bias or blindness.

We offer an alternative conception of knowledge in which it is essentially social and maintained through being shared and contested by many different consciousnesses and perspectives [15, 25]. Knowledge is thereby instituted in the face of many different perspectives and for this reason is always subject to change, even radical change. This conception of knowledge is not new having been expressed by Peirce [26] and more recently by Feyerabend [27]. The acceptance of this new ideal encourages increasing participation as much as feasible but also requires organizational, and may benefit from computational, support to reconcile these contesting perspectives.

This conception, pragmatically, depends on the creation of communication channels among designers and users which can facilitate the largest feasible bandwidth — the actual bandwidth to be determined contextually and dynamically by all the participants in design. Communication is thus seen as a continuous process of perspective, conceptual, and information exchange, always requiring interpretation and translation of both designers and users who are learning, building, and evolving shared meanings of the design situation [14]. The designers need to learn about the users' needs, about the context in which the problem is posed and about what may be a solution that will suit users' needs and "personality;" while the users need to learn about what is possible to achieve thereby potentially modifying their needs as initially perceived [28, 20]. In this ideal, each participant traces, follows, influences, and is influenced by the evolution of views of others, while all influence the progress and direction of the design process.

This conception of design knowledge resulting from participation requires changing some traditional divisions of design responsibility between the expert (the designer) and the non-expert (the user). We hasten to add that our use of term 'non-expert' is with considerable hesitance since it is our contention that such labeling is inherently antithetical to effective participation. Furthermore, we maintain that the different participants are equally important, and therefore, must have equal legitimacy in the process of design. Legitimacy of participation may be a prerequisite for the success of participation programs [29]. Our contention is that a social norm in which all design responsibility is expected to be assumed by the designer alone will inevitably lead to poorer designs than a social norm which calls for extending participation throughout design activity [23]. Examples do exist of course in which relative responsibility is more equally distributed, for instance, the interaction between Boeing and Rolls-Royce [6] and scientific instruments manufacturers and customers [7]. However, the success of these interactions where participants were equally recognized as "experts" in their respective fields is in contrast to housing design. Experience in the latter suggests that acknowledging the right to participate is insufficient to cause change [5], when economic issues govern the consequences of participation [30].

In keeping with the cascading nature of design, participatory design cannot be a one-shot affair. Rather, one-time participation may lead to benefits weakening over time [31]. Hence, effective participation requires continuous commitment. Moreover, two issues must be addressed continuously: the content and form of participation. The content, which refers to the issues discussed, change as all participants learn. The form also may evolve and must be determined based on the changing context of the design activity and experience accumulating from participatory projects [32]. Though the form should be managed, it should be done participatively; otherwise power differences will be maintained hindering cooperative work.

There is a gap between the *perception* of design participation efficiency and its *experienced* outcome. The issue of the efficiency of participatory design cannot be addressed without clarifying what is meant by efficiency. If we mean the rate at which the design phase is completed, the case for the usefulness (as opposed to the correctness) of participation, may be weak. However, if we mean the rate at which *successful* products reach the market, then a strong argument for participation can be made since in the long run significant inefficiencies could result from the failure to address real needs despite the short run potential for inefficiency of extensive participation. Thus the issue of the inefficiency of participation is directly circumscribed by the time-horizon one brings to the issue of design [33] and the resources initially spent.

As for the effects of participation on design quality, studies report positive, negligible, or no significant effects. By and large, cases with no significant effects are characterized by differential power between management and users, or between planners and citizens, or by the lack of legitimacy of participation groups [29]; i.e., by a distorted type of participation. Note also that failure may result from interpreting quality in a non-participatory manner. The fundamental question is whether the purpose of design is to satisfy customer requirements or user needs as they evolve. As long as the focus is not on the long term viability of the product, all issues of the efficiency and efficacy of participation in design are essentially moot if not irrelevant.

## 3 Varieties of participation

We can observe that participatory design manifests itself in different disciplines depending on particular dimensions that characterize them. The following list of dimensions may be incomplete and its items have some overlap. The list is divided into two broad categories: dimensions that characterize the *artifact* being designed and those that characterize the participation *activity*.

**Artifact characteristics** come in a large variety.

The *lifetime* of an artifact can range from short-term (consumer products) to long-term ( buildings). Typically, the longer the duration, the greater the opportunities for failures due to unforeseen circumstances and the more critical the success of the project because it has a long term impact. The higher stakes of a longer life-time can create an atmosphere in which more participation seems desirable.

The *risks/cost* of an artifact ranges from low for many consumer products to high for buildings or large artifacts such as airplanes. High risk/cost artifacts require special attention and careful design. Risk, especially technical risk, may require special measures to enable the non-technical to participate effectively.

*The trace of an artifact* is the mark left on a community by an artifact. A new shaver design may potentially impact a large portion of the target population, while a building project in a small town leaves a trace on a limited community. For a risky project, a large trace is a problem; however, for a simple product, a large trace relieves the need to satisfy specialized needs or requirements. The opposite often holds for small-trace projects.

*User-artifact interaction* captures the type of interaction a user may have with an artifact. Users will rarely be admitted to a hospital (where they may stay for a non-negligible period of time), but usually, live in a house for many years.

*Salience* of a product to participants reflects the importance or meaning the participants assign to the artifact. It ranges from minor for some consumer products to major for urban planing (or even for hospitals).

*Nature of design knowledge required* always includes both formal and informal technical knowledge as in the case of scientific instrument design or "informal" technical as well as social knowledge as in architecture or workplace design. Elsewhere, we challenge the traditional view that engineering activities are mainly formal and demonstrate that the informal aspects of engineering comprises the majority of design [34]. The knowledge required and the knowledge of participants influence the role they can assume. Special efforts will be required to ensure that non-technical participants are not disenfranchised. Without pro-active training or special efforts to provide comprehensible information, participants without technical knowledge cannot be effective when technical knowledge is necessary.

Artifact characteristics often impose constraints on participation. For example, it is clear that the lifetime of the artifact limits the duration of the participation activity. The type of artifact also determines the *motivation for participation.* Participation in consumer product design typically ranks low in contrast to achieving commercial viability. Participation in software design can be initiated by the customer in an attempt to ensure an effective workplace. Finally, participation in a housing project may be initiated by the sponsor to gain political acceptance and rarely for achieving better quality of design.

The following **participation characteristics** are influenced by all the dimensions of the artifact being designed.

*Duration of projects* range from months for small consumer products, to years for complex technology-based artifacts such as cars or airplanes, and to decades for buildings (assuming that design includes the life cycle concerns, such as renovation). This is different from the lifetime duration of the artifact. For example, a building may change its function and occupants over time, while a power station is unlikely to do so. While the lifetime of both artifacts is long, the duration of the project is different.

*Duration of participation* may be independent of the duration of the project and is driven by the resources different participants are willing to expend. Duration may range from short to long term depending on who is in power or who initiates the activity. Duration of participation also depends on the salience dimension. Products with low salience such as a razor will at best elicit short participation, whereas highly salient products such as housing or hospitals may elicit willingness to engage in extended participation even if the user-artifact interaction is relatively short-term as with most interactions between people and hospitals.

*The epistemic limits on participation* ranges from the participation of "non-experts" with "experts" to the participation of experts alone. The former is more common, but the latter has also been demonstrated (e.g., the interaction between Boeing and Rolls-Royce [6] and scientific instruments manufacturers and customers [7]). An equally salient product to all participants, such as scientific instruments, may help break power relationships based on expertise, and may even lead to transferring a major part of the participation activity from manufacturers to customers.

*The form of participation* determines who participates in a design and is influenced by the trace dimension of the artifact. If all those potentially effected by an artifact can participate, two problems surface. First, there may have to be a limit on the number of participants that can viably interact in a particular design situation, noting that this can be different from one situation to the next. The second problem is whether those who "ought" to participate will in fact chose to do so when given the opportunity. This dimension ranges from representative to direct participation.

*The role/responsibility of customer participants*, independent of epistemic limits, can vary from subjects of studies by behavioral scientists to designers who assume responsibility for making decisions [9]. Though a distinction can be drawn between *co-design*—where customers have access to some of the technical knowledge or *dialogue*—where customer have the social and informal knowledge but lack the technical knowledge, we advocate increasing access to technical knowledge and its translation for equal participation in a dialectical process.

The status of participation can change during the evolution of a design. In particular, the trace of the artifact, the user-artifact interaction or the salience of a product may be unclear at the beginning of a project. If one of these is perceived to increase later on, the demand for participation may be increased as happened in the evolution of nuclear power plants.

Table 1 briefly summarizes how five typical classes of participatory projects (i.e., urban planning, scientific instruments [7], airplane engine design [6], software design [8], and workplace design [13]) would rank along all the dimensions discussed. Architectural design and urban planning emerge as activities with significant cost and lifetime, presenting opportunities for participation due to their often relatively small trace. This may change if participation is considered for the entire life-cycle of an artifact since, then, the future participants are unknown. Long durations enable appreciation of the critical role of capturing and analysing design and participation history.

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Based on the foregoing discussion, extending participation involves supporting the recording of decisions, asynchronous communication, the articulation of informal knowledge, and the provision of improved educational material; these requirements are elaborated in the next section.

We have mentioned some plausible relations between the dimensions while discussing them, but any generalization seems superficial and premature. Experience is too scarce and failures are rarely recorded for the purpose of improving participation (although they may be recorded by those attempting to dismiss the potential of participation). We do not claim to have exhaustively enumerated the dimensions of participation. Such an elaboration requires the collection of historical data on design and participation. Nevertheless, in spite of our hesitance to generalize, there is a striking dichotomy between the classes of projects in the table: those involving technical issues and equal epistemic level of participants tend to be successful whereas the fate of others — socio-technical projects with different epistemic levels of participants — are less consistent ranging from bad to good.

We believe that much of the difficulty in exercising equal participation is rooted in the platonic view of knowledge. We intend to examine this more fully in other places. For now, we turn our discussion to how equal participation can be supported.

## 4 Critical issues in realizing Participation

The effect of participation on design efficiency and quality may not always be positive. This is a practical and empirical question. Clearly artifact characteristics provide context to, and constraints on, the nature of successful participation activities. Practically, participation is initiated either by the "designers" side as a means to improve design quality or future acceptance, or it is initiated by the "users" side as a means to control and influence the project outcome. In either case, the participation activity and its design can benefit from an infrastructure that supports (1) the recording of historical data on participation activities including design decisions, projects' progress and outcomes; (2) the provision of improved educational material on various technical issues for future participants; (3) the articulation of informal knowledge possessed by users or customers as well as designers; and (4) asynchronous communication between participants. These supports are intertwined with four properties of participation activities whose scope we wish to extend: form of participation, epistemic level of participants, role of customer participants, and duration of participation.

### 4.1 Broadening the form of participation

In our previous discussion of the form of participation, we noted two problems that surface when all those potentially effected by an artifact can participate.

The first problem uncovers some very deep issues with respect to participation in all contexts — the most significant being, arguably, civil governance itself. We obviously cannot tackle this problem here, though we do wish to point out: the existence of computers enable us at least to question the cognitive bases underlying one of the conventional answers — representative participation for large scale societies. Insofar as representative participation addresses the issue of information volume, i.e., the difficulty in a practical sense to involve everyone, the solution has been some form of *source reduction*. Today, however, with radically different technologies available which can incorporate not source reduction of information but a contextualized selection and use of information generated, a new solution may be available. Our contention is that the confluence of high-speed computers, vast storage capacities, and the deeper understanding of computational linguistics and machine learning techniques coupled with the development of environments realizing their *flexible adaptation and interactive* use, provide support for greater direct participation on the basis of handling information volume via the selection and organization of information.

We note here that conferences on design participation emphasizing computer support for participation go back to 1971 [1]. In the 1990's we are less sanguine and more skeptical about: (1) changing social norms — the problems surrounding participatory design are not a simple matter of a universal inverting of the structure of responsibility between, for example, designers and users; and (2) assuming the existence of sophisticated computer installations for supporting design participation in the near future. However, by focusing on specific design contexts, each of which exhibits its own particular problems of interpretation and translation of varying user and expert perspectives, and by honing computer support tools in a participatory atmosphere responsive to differing design circumstances, evolutionary developments are possible. In this respect, we also differ with more recent proposals for computer-supported participatory design [35] or group decision support systems [17].

We might add here that this perspective has relevance for the second problem raised above since people may be *disinclined* to participate when the amount of information required to participate is not manageable. Our contention is that the appropriate way to resolve the issue of whether those who ought to participate will, is by collecting empirical data on people's choices when they are allowed to participate in a variety of forms and contexts. Note that it is particularly critical to investigate those who did not participate in order to discover the underlying reasons for their decision, so that new forms and support of participation can be developed.

### 4.2 Extending the role of participants and supporting differences in epistemic level of participants

The ideal participation involves customers as co-designers. Clearly, such a situation is not feasible today especially in the way the term 'designers' is perceived. The impediments may include lack of suitable technical knowledge as reflected by one of the properties of the artifact, or power differences between participants. There are however means to improve the role of customer participants. The provision of educational material in a highly usable presentation format can allow customers to appreciate the issues involved and also bridge the gap between their language and the technical jargon. We note that such a bridge is a major concern of much work in the area of quality function deployment.

Claiming a particular role in a participation project requires an understanding of what such role entails and how such role may influence the desired outcome of a design project. This understanding can be improved by recording previous participation projects and their presentation in a form that can be studied by potential participants. Analyses of these records can make an impact on the larger community of potential participants.

The accumulation of educational materials and records of previous participation projects can give rise, through the infusion of computational systems, to generation and accumulation of data not possible in computerless organizations. Such data can be widely disseminated given that the right computational and organizational support acts to loosen traditional hierarchical structures that increase opportunities for participation. There are risks embedded in this scenario [36]. First, users may initially be attracted to programs that do not require their active involvement. They may prefer to rely on a tool rather than exercising their own judgment. Second, data containing participation records can be used to monitor and control users/designers. We argue that such factors can be minimized by involving users as much as possible in the development of computational tools for participation and by providing tools with enough flexibility for their evolution as participants see fit. Since we view the developers of tools for participation as participants in future design projects, we do not restrict tools for participation to those embedding a pre-defined set of mechanisms for adaptation. Rather, we allow for and accept the possibility that the computational tools for participation may become obsolete and be replaced by others.

There are a number of ways of looking at the relationship between computation and participation. From one point of view the relationship concerns whether and to what extent computational products are developed through participation. For example, although Winograd and Flores [37] have correctly pointed out that system breakdowns must be graceful, such a requirement cannot be formulated and satisfied by careful anticipation and designing as Winograd and Flores contend [28]. A formulation and its solution can be meaningful to practitioners only if it is obtained and maintained through participation. Such questions can lead to a wider view of participation as the democratizing of work [38]. Thus participation in all kinds and phases of production is at issue, including tools for *supporting* participation. That is, it can be asked *whether* and *how* the use of computational tools can increase the level of participation itself in all phases of production.

### 4.3 Supporting long term participation

In the case where customers assume the role of subjects, their participation activity is very short and no new means are required other than those mentioned above. In order to support participation in long term projects or when designing artifacts with long lifetimes, different means are required. These means are required even if the participants are only designers, that is, in any multidisciplinary design project. Diverse information, formal and informal, needs to be recorded, made persistent, and organized as a shared memory [14] so that it can be accessed and used over a long period of time [34]. Whereas in a very short term project, synchronous communication between participants may answer most concerns, in a long term project, asynchronous communication becomes mandatory [39]. The hypothesis that computer tools can provide support for building such persistent and organized shared memory is the driving force of a computer tool called *n*-dim under development at Carnegie Mellon University [40].

## 5 Summary

Starting by arguing against an objective inclusion of users in design, we arrived at an alternative approach whereby designers (now, technical professionals as well as users/consumers) may use strategies to continually construct a social reality out of multiple perspectives that are best appreciated and understood through actual participation and feedback into practice. Following a survey of participation projects, we extracted several characteristics of artifacts and several properties of participation activities in an attempt to better understand how the context of the design influences the success of participation projects. We identified four key issues: (1) the recording of historical data on participation activities; (2) the provision of educational material; (3) the articulation of informal knowledge; and (4) the support of asynchronous communication among participants; as key for extending participation activities. These issues can be supported by computational tools.

The issues discussed in this paper such as designing quality artifacts that will match customers needs or supporting multidisciplinary design of designers situated in different locations is also the concern of other approaches such as quality function deployment or concurrent engineering. The former is concerned with bringing the 'voice of the customer' into the design process and the latter in bringing down stream concerns into the design process. Clearly, participatory design subsumes these efforts.

The collaborative work of designers in a concurrent engineering project is part of the collaborative work of customers and designers in a participatory design project. The differences in technical skills, technical jargon, skills in the use of computational and other tools, make the latter much more complex. Similarly, the capture of the customer voice in QFD is part of capturing it, reconciling the terminological differences between the participants, admitting continuous revisions of this 'voice', and communicating back to customer participants the ramification of the requirements. Therefore, we see all tools developed in these disciplines as potential for inclusion into a computational support tool for participatory design provided that they can be extended and prove useful empirically.

In the future we will test tools under development in various design settings, some of which are participatory in nature. We intend to evolve them continually as more experience is collected about their use.

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## Table Caption

1. A comparison of five participatory design activities

Table 1:

| **Dimension** | **Participatory project** | | | | |
|---|---|---|---|---|---|
| | urban planning | instrument design | airplane engine design | software design | workplace design |
| **Artifact characteristics** | | | | | |
| *Lifetime duration of artifact* | very long | short | long | medium[1] | medium |
| *Risks/cost of artifact* | high | medium | very high | medium/high | medium/high |
| *Trace of artifact* | small—medium | small[2] | large | small—large | small—medium |
| *User-artifact interaction* | large | small | small[3] | medium | large |
| *Salience of product to participants* | high | high | high | high | high |
| *Nature of design knowledge required* | social technical | technical | technical | social technical | social technical |
| *Motivation for participation* | political—ideological economical | economical | economical | work effectiveness well being | work effectiveness well being |
| **Participation characteristics** | | | | | |
| *Duration of project* | decades | months | years | months—years | months |
| *Duration of participation* | medium—long | short—medium | long | medium | medium |
| *Epistemic level of participants* | different | equal | equal | different | different |
| *Form of participation* | representatives | most | representatives | representatives | representatives |
| *Role of customer participants* | subjects—co-design | co-design | dialogue | subjects—dialogue | subjects—dialogue |
| *Experience* | bad—good | good | good | bad—good | bad—good |

Notes:

[1] The consequences of using the software in an organization may have long duration.

[2] This is true for scientific instruments and where the customers are the scientists.

[3] If the customer is the airplane manufacturer.