# Participatory Design of Inter-organizational Systems: a Method Approach

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## ABSTRACT
It has been claimed that to gain the most positive effects possible from the adoption of inter-organizational information systems (IOIS), major re-organizations, such as Business Process Redesign (BPR) are necessary. In this paper, a method based on participatory design for developing inter-organizational systems for public services is explored. This is in order to to ensure that traditional values of participatory design are taken into consideration in the design of the inter-organizational information systems. The method builds on the graphical notation of Quality Function Deployment (QFD), to facilitate focus being kept on the customers' needs and to ensure that the design decision is prioritized. The participatory design working methods ensure that the need for innovation in services provided by local and national governments and the availability of modern information technology constitute the basis of the provider.

## Keywords
Inter-organizational information system, Quality Function Deployment, method development

## INTRODUCTION
In the 1970s, the collective resources approach to Participatory Design (PD) was developed in Scandinavia as a response to employers' efforts in computerizing industrial work processes [1,2]. One of the primary aims was to prevent the introduction of computers at the workplace causing worker alienation, by providing them with structural possibilities to influence their own work situation. Subsequently, PD has been applied for its potential to obtain more competitive design solutions than traditional design methods, for example see Mumford [3]. It has also been found that workers who are allowed to influence their own work situation are more efficient and take more responsibility [4]. Recently, service organizations, especially those community-owned ones,

have been forced to perform cut-backs and to re-organize in order to improve their cost efficiency [5]. However, at a certain point, further internal rationalizations cannot be made without decreasing the quality level of the service to below what is acceptable. In such situations, one option is to examine whether it is possible to introduce new or to improve existing inter-organizational collaboration. Today, information technology has made entirely new connections and cross-boundary collaborations possible. It has been claimed that to gain the most positive effects possible from the adoption of inter-organizational information systems (IOIS), major re-organizations such as Business Process Redesign (BPR) are necessary [6,7]. A successful adoption of IOIS has also been shown to be greatly dependent on social issues such as the organizations' cultures and the power relations between them [8].

The aim of this paper is to explore whether participatory design can be used for developing IOIS for public services. The basis is the need for innovation in services provided by local and national governments and the availability of modern information technology. In this situation, it is preferable that the organizations involved are able to participate at an equal level. The starting point for this study is the Medical Software Quality Deployment (MSQD) method [9]. The MSQD method was originally developed for the design of information systems support for a profession or a multi-professional service team within a single organization. Its cornerstones are participatory design methods and the graphical notation of QFD.

### Participatory Design Methods
Since the introduction of PD, several instruments have been developed to help users to participate in system design, for example mock-ups and future workshops. To serve their purpose, the instruments need to be simple to learn and use, and to encourage the participants and help them developing their skills[10,11]. From a technical point of view, one problem with the instruments is that design decisions are not traceable backwards, e.g. there is no simple way to see how a design feature is a result of a specific need. Another problem is that they not prioritize the design features, so that the design that is selected for implementation is the one which corresponds to the main needs. Such features could be useful, for instance when choosing between design options and when a design

decision for sponsors or other users is to be motivated. Another problem when user representatives are included is that after education and initial participation, when design decisions are starting to be made, they are no longer representative of their professions, since they have become trained to a far greater extent than their colleagues [12].

**Quality Function Deployment (QFD)**

Quality Function Deployment (QFD) is a quality system which supports the development of products and services that satisfy customers [13]. In its general form, both the design attributes of the service/product as well as the development process itself are specified. However, it is usual for subsets of QFD to be used just for the specification of the design attributes, for instance the Software Quality Function Deployment [14].

The starting point of QFD is the *Voice of the Customers*, which describes the needs and problems that the customers have or experience. With the support of graphic tools, the Voice of the Customers is transformed to design requirements and then developed further to be a specification of the development process [15,16]. Some of the advantages of QFD are that;

- it provides a prioritization of design attributes,

- design decisions are traceable back to customers needs,

- much information can be visualized in a compact format,

- it provides an arena for discussion for people with different backgrounds and knowledge,

- it helps the design team to focus on customer needs, and

- it focuses on bringing *values* to the customers, not technical solutions.

**METHODS**

The Medical Software Quality Deployment (MSQD) method has been theoretically customized and evaluated in a case study. In the customization, IOIS features are used to adapt the method for inter-organizational use. The case study is an application of the method in a project where an Information-system-supported public service is designed. In the case study data was collected through;

- questionnaires and interviews on a regular basis with the participants,

- video-recordings of design meetings and demonstrations, and

- participator observations by the researchers who noted their observations.

**The MSQD Model**

The MSQD method is divided into four phases (figure 1). The first phase is the pre-study phase, where the developers learn about the customers and their work situation via participatory observation, interviews, and literature studies.

Figure 1. Medical Software Quality Deployment (MSQD)
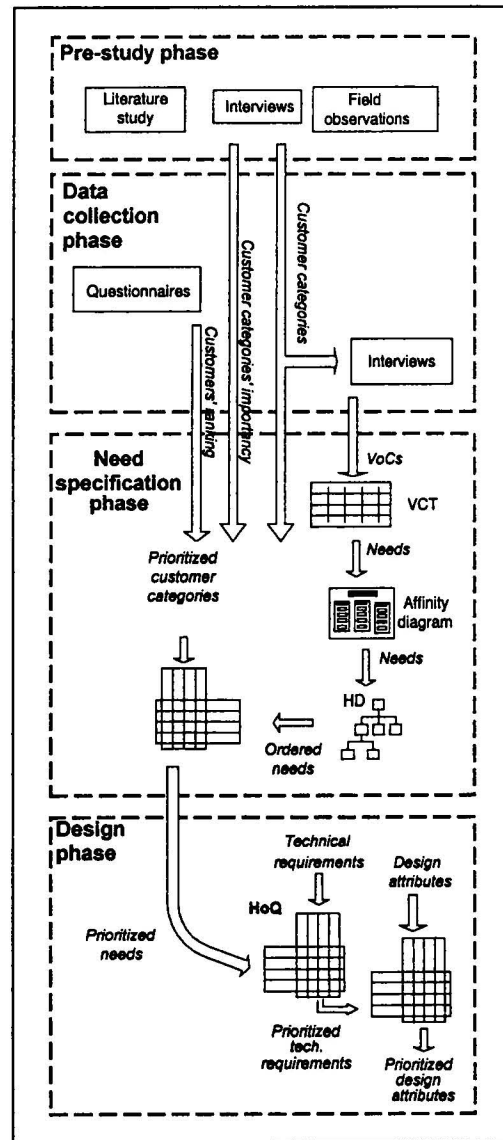


From the knowledge thus gained, customer categories and their power of influence are determined. The second phase is the data collection phase where the customer data (called the 'Voice of the Customer', VoC) is collected through observations, interviews, and/or questionnaires. The VoCs consist of spoken and unspoken information that could reveal customer needs which should be considered in the design. The method(-s) to use depends on the characteristics of the customer population, e.g. size and accessibility. The third phase is the need specification phase, where the VoCs are transformed into a manageable set of mutually independent customer needs. This is necessary since the customers cannot express what they need or even believe that they need, especially not in the language of the provider. Therefore, they try to explain by expressing themselves in metaphors. The metaphors could

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consist of problem descriptions, technical solutions and so on. The Voice of the Customer Table (VCT) is a tool for transforming the VoCs to statements of needs by scrutinizing what has been expressed [17]. This is done by analyzing; why the customers express themselves as they do, why they have the various needs, and so on. Since a large set of needs are usually discovered while tools later in the process require a limited set of needs, they are organized in affinity diagrams [18]. Here the needs are organized in categories and subcategorizes. Multiple copies of needs are removed. However, the affinity diagrams are not the optimal tool to use for the final analysis of the needs. Therefore the affinity diagrams are transformed to hierarchy diagrams (also called tree diagrams or systematic diagrams) [19,15]. In estimating the importance of the different needs, the power of influence of each customer category is considered. For a validation of the needs, a participatory design technique is used. The last phase is the design phase, where the customer needs are transformed into design attributes in two steps. First, the needs are transformed in the House of Quality [20], which is a matrix, into technical requirements. In the second step, these are transformed into design attributes in a second matrix.

customers should have greatest influence on the design, they are ranked. The higher a customer is prioritized, the more effort should be devoted to collecting his/her needs and to fulfilling them.

Figure 2. The customer identification tool



## RESULTS
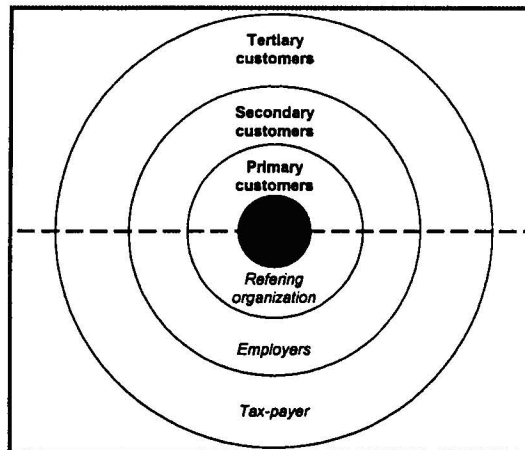### The Customizations of the MSQD Method
An inter-organizational system development method means that each organization involved has to consider needs outside its own boundaries, e.g., third-party needs. One way to provide this view is to introduce a service-customer perspective as a basis for the development. However, since the number of customers can be large and difficult to determine in advance, it is usually not possible to explicitly collect and adjust to all customers. Therefore, the customers must be ranked on the basis of what influence on the design of the service they are judged to have. The method must also include an adjustment of the service to all the collaborating partners' needs. In the first step, it is the service that is (re-)designed and in the second the information system that supports the service.

Objective 1: In MSQD, the users of the information systems inside the organization, were defined as the customers. This meant that a relatively small population need to be considered to determine the customer categories. All customer categories could also be given direct influence over the design. In the new method, customers current as well as potential, had to be identified. This implies that the possible customer population becomes large and not all of them can be given a direct influence on the design. Hence, it must be determined which are the ones who will have influence on the design.

Adjustment 1: To support the identification of customer categories, a graphic tool was included to the new method (figure 2). The tool supports identification of both direct and indirect customers of the service. To determine which

Objective 2: In the MSQD, the objective is to design an information system to supports an existing service, e.g. health care provision. Therefore, the users of the information system are defined as the customers. In the new method, which is concerned with inter-organizational collaboration, the provided service also has to be (re-)designed in compliance with the customers' needs. It should be designed with the assumption that it will be provided through the use of information technology. Hence, the provision of the service harmonizes better with the IOIS. However, it is important to bear in mind that it is the service which provides the customers with what they value. The information system is just one tool used in providing the service.

Adjustment 2: Four new matrices were added to the design phase. They were used to determine the features of the service and the information system. The customers' needs are transformed into the service processes, which in turn lead to a service that satisfies the customers. Then the service processes are transformed into activities and into information system features which support the service processes. However, the activities of the information system should also be supported. Hence, the activities are also transformed to information systems features. This means that the information system is to support the individual care provider in his/her work, the organization's work and the delivery of the service (i.e. inter-organizational collaboration).

Objective 3: In the MSQD, participatory design was mainly used to identify and validate the users' needs. However, in the new method the identification, prioritization and

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selection of customer categorizes are essential, and this is highly suited for PD. Hence, early participation from the users is required for structuring the scope of the service network. Further, the redesign of the service provided is a task which is difficult to manage without the participation of the providers.

<u>Adjustment 3:</u> A design team which includes user representatives works throughout the entire project, from the definition of customers to the identifications of design attributes. This implies that more efforts must be devoted to the training of the representatives in the method and in information technology.

## The Modified Method
### The Pre-study Phase
<u>Objectives:</u>

- to assemble the design team.

- the user representatives are to learn both about the method and information systems

- the developers are to learn about the providers, the providers' environment, and their work practice

- the customers categories whose needs will be taken into consideration for the design are to be determined

<u>Methods:</u> The design team is assembled from service providers, system developers, and group process facilitators. The providers are to represent the professions involved in the service provision, i.e. constitute system user representatives. The user representatives are given lectures on the method. The developers spend time at the workplaces involved, where they observe work practice. During the initial design meetings, a graphical description of the work proceedings is constructed. Then the categories of customers for the service is identified. First, categories of individuals and organizations that have a direct use or possible use for the service are identified. They respond to the question: *Who do we have direct professional contact with?* These are defined as primary customers. Secondly, the categories of individuals and organizations that have indirect use of the service are identified. Indirect means that they have a direct contact with primary customers of the service: *Who are affected by the service, having a direct relationship with the direct customers?* These are defined as secondary customers. Finally, the categories of individual and organization include those who do not belong to the other two categories but are still affected or affect the provision of the service. They are defined as tertiary customers. Examples of the latter type of categories include tax payers and also non-persons such as laws and professional organizations: *Which other institutions, organizations, laws, and citizen categories are affected by or affect our service?*. The customers identified are then roughly ranked on a scale from one to ten depending on the extent of influence on the design they are judged to have. Each of the user representatives makes his/her own ranking. To validate, it a Delphi-oriented method is used

[21,22]. In this way the user representatives are presented with the other user representatives' ranking in a second step. Subsequently they are permitted to adjust their own ranking. The final rank is calculated as the average values of the rankings for each customer. The purpose of the ranking is to achieve a bases for deciding those customers whose needs should be used as a basis for the design. The highest ranked customers are considered and a number of them are selected to directly influence the design. It is also decided which data collection method should be used for each of the customers. (Figure 3).

<u>Outcome:</u> The customers who are selected will have a direct influence on the design. Participants have received basic knowledge about the users, the use environment, the work practice, the method to be used, and the expected result of the design efforts.

### The Data Collection Phase
<u>Objective:</u>

- to collect customer data (the Voice of the Customers (VoCs)) which will constitute the basis for the design

<u>Methods:</u> Several methods are available for data collection, e.g. interviews, participatory observation, questionnaires and written sources. Questionnaires and other quantitative approaches make it possible to collect data from a large population, which implies that a large proportion of the customers can affect the design. Further, the ranking of needs can be based on the questionnaires. The qualitative approaches provides a deeper understanding of the customers' situation. The best is to be able to combine the two approaches. However, the choice of methods to be used also depends on the customer categories and the amount of resources dedicated to the project. Further, the effort required to collect customer data from the different categories is related to the importance of the customer categories.

<u>Outcome:</u> The Voice of the Customers and, in the case when quantitative data approaches have been used, the basis for the ranking of the needs . *The Needs Specification Phase*
<u>Objectives:</u>

- to identify the 'true' needs from the Voice of the Customers

- to determine a manageable set of mutually independent needs

- to rank each of the needs

<u>Methods:</u> In this phase the three QFD tools; the Voice of the Customer table (VCT), the affinity diagram, and the hierarchy diagram are used in order to transform the VoCs into statements of needs. The VCT is used for the identification of the customers' needs from of the VoCs. The process itself leads to achieving a higher understanding of the customers and their needs, since the work requires that the participants penetrate the customers' statements.

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Since the needs are often expressed at different levels of abstraction and are usually too many to be managed, they must be refined by the categorization, renaming, and removal of duplicates. For this purpose the needs are arranged in affinity diagrams. To further analyze the needs the affinity diagrams are transformed into hierarchy diagrams, whose notation provides a better overview of the structure. During this process, the needs can be moved between categories, removed, renamed, or split into two needs. It is also possible to add new needs, if any are found to be missing. These result in three-layer hierarchy diagrams. The needs at the bottom layer are sent back to the customers for validation. If no foundation for the ranking has been obtained from the collection of the VoCs, for instance by questionnaires, the customers are asked to rank the needs. This could be done by asking them to assign a value on a scale of 0-5 to each need, where 0 is not important at all and 5 is most important. Another and more precise method is the Analytic Hierarchy Process, where the needs are pairwise compared [23,24].

Outcome: A manageable set of separate, ranked and validated customer needs.

*The Design Phase*
Objectives:

- to prioritize service processes based on the ranking of the needs (i.e. the service provided to the customers).

- to prioritize activities based on the ranking of the needs (i.e. the building blocks of the service processes).

- to prioritize design attributes based on the ranking of the needs (the features of the information system and generated from technical requirements).

Methods: The first step in the design phase is to transform the customers' needs to service processes by the use of the House of Quality. The second step is to define the individual service provider's work by transforming the service processes to activities in a second matrix. The activities are building blocks, which put together, in a specific order, constitute a service process. To achieve a definition of the information system, both the service processes and activities are separately transformed to technical requirements in one matrix each. Then the technical requirements are transformed to design attributes. The design attributes which are a result of the transformation of the service processes are of a more general character. Meanwhile, the design attributes transformed from the activities support actual work practice.

Outcome: A specification of the service based on the service processes. Activities which in more detail describe how the service should be put together. A design specification of an information system which supports the delivery of the specified service, through supporting the inter-organizational collaboration, the teams' work and the work of the individual providers.

Figure 3. The modified method for design of IOIS
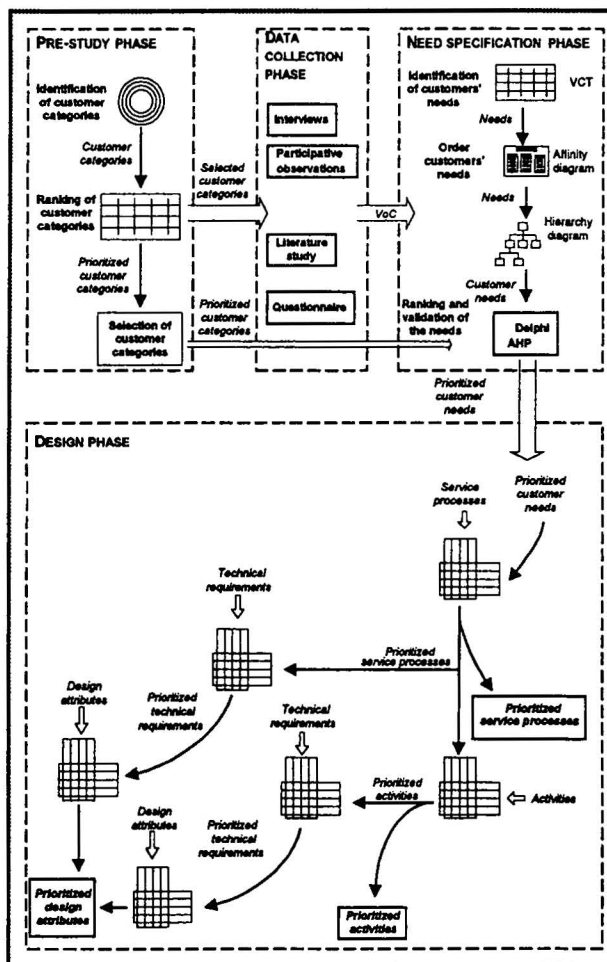


## Evaluation of Pilot Application
In this section some of the preliminary findings of the pilot study are presented.

*Pilot Application Site*
A social medical service is provided by the Pain and Rehabilitation Center in the County of Östergötland, Sweden. The patients are examined and rehabilitated according to a case management program based on integrated teamwork [25]. All patients are sent by referral from other institutions.

Due to changes in the environment and to economic prerequisites, it was necessary to investigate how the service could be provided more efficiently. The ideas which arose were to use information technology to support individual tasks, team work, and above all to develop inter-organizational collaboration with the other rehabilitation actors.

*Experience*
The instrument describing the customers' relationship to the service provider (figure 2), introduced in the pre-study phase, become useful as a model for analyzing the service

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network. The first level of customers was relatively clear to the user representatives, while the instrument was useful as a support to generate customers at the second and third level. However, the identification of needs from the VoCs was found to be more difficult then in the original MSQD case. Two main causes for this were distinguished. First, the design team did not deal with VoCs and needs "owned" by themselves. Second, the background knowledge held by the organizations involved about both the customers and each other varied to a large extent. It was even found that some asked for services which were already offered by the others. It was also found that the number of customers who can have a direct influence on the design, must not be too large, since the number of needs has to be limited. Otherwise the specification of the needs will become too complex.

The initial phases of the project were found to be time-consuming. According to the method, the focus in the early phases should be on the customers' needs. The representatives sometimes found this confusing, since they looked forward to the introduction of computers. Hence, they occasionally started to discuss possible computer solutions. These were taken down to be used in the later design phase. Nothing indicated that the user representatives had any problems with using the new graphical notation as such.

## DISCUSSION

Originally, participatory design was aimed at empowering workers and increasing their ability to influence their own situation [1,2]. But it has been claimed that the democratic ideal of PD has been lost [1] and that PD has become more commercialized, and is now aimed at creating *good* software [3]. The area of IOIS could be the new challenge and provide opportunities for traditional PD in the democratization of the process of introducing IOIS. Cost reduction and competitive advantages have been given as the main reasons for sharing information between organizations [6,26,27].

The aim of this paper is to illustrate how a method built on PD and QFD can support the development of IOIS community-provided services. Even if some technical issues remain to be solved, the information technologies of today provide increased possibilities for sharing information, direct communication and coordination of work, independent of time and space [28,29]. However, to adopt IOIS successfully a work process redesign is demanded, which implies that the adoption will affect work practice and the workers' situation. As a consequence of the fact that virtual organizations are becoming increasingly popular [30], the need for methods that support the development of IOISs will increase. The virtual organizations extend over the traditional organization's border, which become less distinct and consequently demand a working IOIS.

The method presented extends the democratic principles of PD to include the service delivered and the avoidance of problems, conflicts and failures in the introduction of IOIS. By using this method, the actual service providers could both contribute to providing a better service and at the same time protect and develop the quality of their own work. The PD techniques are aimed at ensuring that the social values of the design are taken into consideration. However, most PD techniques do not support the prioritization of design features, nor are they traceable, i.e. from design decisions to needs. Therefore, the graphical notation of QFD was introduced to support the design process. The advantages of QFD are that its tools are relatively easy to learn and use and that it supports communication between individuals of different backgrounds [31]. These features are prerequisites for the instruments of the philosophy of PD [9]. The QFD process is straightforward and assists the design team to keep the focus on the needs of the customers' requirements throughout the whole design process. This implies that the design is grounded in the needs identified. The notation also provides the feasibility of tracing a design attribute backwards to the need it originates from. This could be useful in many respects, such as if a design attribute in an evaluation is found to be useless. Then it is possible to trace this design attribute backwards in the design process to see where the mistake was made. QFD does not introduce or correct mistakes, but its helps find them so that they can be avoided in the future. Another way of using this feature is to motivate a design feature. It is also possible for the staff members to see how their individual tasks relate to customer satisfaction and who the information system is aimed to support. Further, the higher an outcome (service process, activity, or design attribute) is prioritized, the more it is coupled to customer satisfaction. By improving or introducing the highest prioritized outcomes, higher customer satisfaction is achieved. Meanwhile, improving or introducing outcomes with low priority do not lead to such a response in customer satisfaction.

The adaptation of IOIS has not been unproblematic. The literature contains several examples of problems and failures [32,33]. Decisions about inter-organizational collaboration are often taken at the top level of an organization or even higher. Meanwhile, the actual collaboration is performed at lower levels of the organizations. This implies that several types of conflicts can arise, both within the organizations and between them. Conflicts within the organization could be between those at the top level, who have decided on the inter-organizational collaboration and those who perform the actual inter-organizational collaboration. Conflicts between the organizations could be of a cultural nature or be caused by the fact that different business goals and visions lie behind the collaboration. Consequently, major efforts must be made to increase the possibility of achieving an efficient collaboration. It is in line with PD-philosophy that those who are directly effected by the collaborational climate are

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those best equipped to design the collaboration. If collaboration and PD are undertaken at an early point during the development of IOIS, conflicts that arise after the system's implementation can hopefully be eliminated or at least reduced.

The method explored do not include any tools or instruments for the selection of team members or for the creation of an organizational environment in which a PD project can take place. In other words, the presented method should not be used for creating an environment for PD projects. On the contrary, it is assumed that this has already been done. The method should be evaluated for its potential to be used by a participatory design team in their work on the design of IOIS. Correctly applied, it will help determine what service should provided and how the information system support for the service should be design in order to achieve the highest possible customer (collaboration partners) satisfaction.

The method presented needs to be further evaluated and developed. The next step in developing the method will be to orient the method even further towards an inter-organizational perspective by including persons from the different organizations as members of the design team. This will put even more demands on the work process at the design meetings. But it also means taking a step from the customer-provider approach to a collaborative one.

To conclude, the method presented should not be seen as a "stand-alone" one. Instead, it can beneficially be used together with other PD instruments, such as prototyping, future workshops and scenarios.

## ACKNOWLEDGMENTS

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