Quality Function Deployment (QFD) extended Future Workshop: An Approach for Effective and Enjoyable User Participation

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ABSTRACT
Information technology (IT) has become an essential element in our society that constitutes both possibilities for those who are able to make use of it and a threat to those who are not. The Swedish Trade Union Confederation (LO) collaborates with academia to find out how IT can be useful in unions. The objective of this paper is to present the development of a design model for specifications of information systems used in unions. The model was constructed on the basis of preconditions found in empirical studies of unions and literature. Subsequently the model was applied and evaluated in a union project. It resulted in a model based on PD principles for determining the features that an information system should implement. The conclusion is that this kind of model is useful for development of information systems in trade unions, even though some questions are raised for further work.

Keywords
Information systems, Trade unions, QFD, Future Workshop

INTRODUCTION
Information technology (IT) has become integrated in our daily activities, both in private and work life. Individuals and organizations that have not been able to make use of the new technology risk missing valuable information and, hence, cannot exert the influence they are capable of. However, to introduce an information system in an organization is also to change that organization [1]. Poorly designed information systems can make organizations collapse, even though they technically work well [2]. Hence it is important to capture the social aspects of the requirements to arrive at a design that harmonizes with its context of use [3,4]. In this way the changes information systems constitute can, at least to some extent, be controlled and the unwanted and unexpected changes in the organizations can be minimized. The more sensitive an organization is the more carefully these

changes have to be made. The Swedish Trade Union Confederation (LO) is an example of a politically sensitive organization with several sub-organizations and political views.

The labor market has traditionally been marked by long years of struggles between the employer organizations and unions. In recent decades, new management strategies, often based on IT, have resulted in flattened traditional hierarchic structures [5]. As a consequence, decisions previously taken at higher levels have become decentralized. Negotiations between the employers and union representatives are, thus, made at lower organizational levels. Hence, the local shop stewards gain greater responsibility and, therefore, need more knowledge and information to be able to handle the new situation. As a consequence, it is necessary for them to gain adequate training and access to information they need to be able to perform their duties. However, it is not practically nor economically possible for the unions to provide this by traditional methods of training, e.g. lectures and seminars. Since traditional approaches have become insufficient, the Swedish Trade Union Confederation has initiated a project to investigate how IT can be used to support shop stewards in their duties [6].

The Scandinavian trade unions have traditionally been progressive as regards the design and introduction of new technology at the workplace [7]. It was also Scandinavian trade unions that, together with academia, were the driving force behind the Scandinavian approach to participatory design (PD). It seems, therefore, natural to use PD for the development of information systems used within the trade union movement.

Democratic values have traditionally been highlighted as a major motivation for PD. However, it is not the only reason for using PD. If people involved in the development in some sense have direct experience of the users and the contexts of use, this can lead to simple but genial solutions to important problems [8]. In PD the true experts of the users and the use situation are engaged in the development, namely the users themselves. Several examples of methods to capture the use situation and the users' needs can be found in PD, e.g. ethnological approaches and Contextual Inquiry [9-11]. There are

also several methods for the design of systems, e.g., prototyping and PICTIVE [12]. However, PD lacks methods and techniques that support the middle, creative, part of the design process, i.e., when the design group goes from addressing representations of the present situation and the existing needs to a formal description of the information system that will be designed and implemented. An exception is the Future workshop technique that stepwise goes from generating problem descriptions to design solutions [13]. However, the Future workshop has several weaknesses. For example, it does not provide a prioritization of design attributes or any tractability of requirements to design features or vice versa [14]. The prioritization is important since in development of larger information systems it is not possible to implement all requirements asked for [15]. Therefore, a prioritization of the requirements must be made so that it is the most prominent features that are implemented [16].

The aim of this article is to describe a model based on PD principles for determining with a progressive degree of formalization the IT features that an information system should implement. The model describes which tools and techniques to use and in which order they should be applied. It is constructed on the basis of preconditions identified in the initial phase of a large trade union project, subsequently applied, and finally evaluated. The main contribution of the study is the model that supports the work of determining what features an information system needs. The study is of specific value for trade union organizations, since they share many of the values and features of the setting in which the study takes place.

BACKGROUND

The setting for this study is the project, Distance Supported Learning for Local Knowledge needs (DLK). DLK is aimed at providing an experimental environment at the local trade union level. Local shop stewards with a varying degree of previous experience from and use of IT will use their everyday tasks as a basis for formulating knowledge needs and making educational plans. Different technologies, such as communication and information sharing through e-mail, conference systems, videoconferences and databases are used to meet the needs. In the project several local groups run subprojects at their local level, i.e., workplaces or local union club organizations. Those projects are supported and followed by ombudsmen, teachers from union folk high schools, and researchers from Linköping University.

Even though the use of IT is a vital aspect of DLK, the main objective is to gain knowledge and experience of how to create and implant self-directed learning supported by IT in trade unions. The central trade union participants play a key role in this process. What they learn will influence trade union strategies in this area. If the project is successful, the long-term result will be vitalized trade unions with a clear bottom-up perspective and learning-organization profile. One part of DLK is to design a prototype of an information system that supports local knowledge needs and self-directed learning. For the development of the prototype the choice fell on Action Design, a method that is theoretically grounded and developed on the basis of experience from PD projects [17]. Action Design consists of a rigid administrative framework for arrangement of PD projects and a toolbox. The administrative framework includes outlines for project contracts, initial meeting agendas and an overview design process description. The toolbox consists of descriptions of work procedures and templates for tools, such as video studies, critical-incident-technique-based questionnaires, and Argumentative Design [18]. In recently performed projects, based on Action Design, tools from the Japanese quality method called Quality function deployment (QFD) have also been used [19].

Tools

This section describes the Action Design tools that are used in the model, i.e. the Critical Incident Technique (CIT), the Future Workshop (FW), and the Quality Function Deployment system (QFD).

The Critical Incident Technique

The Critical Incident Technique (CIT) was developed by Flanagan in the 50s as a technique "for collecting observed incidents having special significance and meeting systematically defined criteria" [20, p. 327]. He defined incidents as "any observable human activity that is sufficiently complete in itself to permit inferences and predictions to be made about the person performing the act". Further, he defined being critical thus: "an incident must occur in a situation where the purpose or intent of the act seems fairly clear to the observer and where its consequences are sufficiently definite to leave little doubt concerning its effect".

The CIT does not include a rigid set of rules for its use. Instead, five steps are suggested. (1) Identify the general aim of the studied activity. This step is essential to be able to determine what is critical or not; and further, whether the critical incident contributes to achieving the aim of the activity. (2) Develop plans for the collection and analysis of data. This step includes determining who the observers should be and how the information should be acquired. It is necessary that the observers are familiar with the studied activity. (3) Collect data from the observers. This can be done by interviews, focus groups, questionnaires, and record forms. (4) Analyze data. The analysis means identification of the incidents and clustering the incidents into categories of similar incidents. (5) Interpret and report findings. CIT has been highly appreciated for studying what works well in practical settings and what does not. Thereby, the technique can be used to reveal what needs to be improved [21].

Future Workshop

The Future workshop (FW) technique is well known in the PD community [13]. It can be seen as an instrument for exploring problematic situations and generating solutions to these problems. The technique was originally developed

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to enable citizen groups to take an active part in decision-making processes of public planning. The simplistic way of performing a FW and the low demand on the participants' knowledge of the process beforehand made it an approach of interest for system development where non-professional developers participate in the design process. However, the technique has not only been appreciated for democratic reasons. It also supports a more innovating problem solving approach than several of the other more traditional system development techniques do. A FW can be performed in three phases:

- The Critique phase; aimed at generating an understanding of what is going wrong and not working well, i.e., problems and dilemmas in the studied activity.
- The Fantasy phase; aimed at generating futuristic solutions to the problems and dilemmas identified in the first step.
- The Implementation phase; aimed at generating realistic implementations of the futuristic solutions identified in the previous step.

Quality Function Deployment (QFD)

Quality Function Deployment (QFD) is a quality system aimed at ensuring and maximizing customer satisfaction with developed products, i.e. goods, services, and software [22]. QFD was developed in Japan during the late 1960s and has since been used world-wide in many different application areas [23, 24]. In its general form, the features of the product as well as, for instance, the manufacturing and marketing processes are specified. However, it is common that QFD is just applied to the transformation of customer needs to a specification of design attributes, often by using a matrix called the House of Quality (HoQ) [25]. QFD consists of a philosophy, quality tools, and application models. An essential aspect of the philosophy of QFD is to only design, develop, and produce features of products and services that bring value to the customers. Another essential part of the philosophy is: to do nothing wrong does not mean to do anything right [26] or as stated by Deming [27] — zero-effects are no longer enough. Several different graphical quality tools support the applying of QFD, such as relation diagrams, hierarchy diagrams, tables, and matrices [28]. The models of QFD work as maps for applying the quality tools so that quality creation processes are obtained. In the QFD community, the target group is referred to as the customers. In software engineering the target group is often referred to as the users [1]. In this article, users and customers will be used equivalently in a broad sense, which means people and organizations that will be directly or indirectly affected by the design and implementation of the information system or service.

The Voice of the customer table (VCT)

The motivation for the Voice of the customer table (VCT) is that when asking customers what they need, they will not express themselves only in terms of needs [29]. They will also use descriptions of, for example, problematic situations that they have experienced and technical solutions that they

believe can be useful to them. Therefore, the voice of the customer must be cleaned up, so that the actual needs are identified. The VCT consists of two parts, heron called the VCT(I) and VCT(II). The VCT(I) constitutes an eight-column table. In the first column the expression of the voice of the customers is inserted. The following columns state who asked for something, what they want to do with it, when do they want to do it, where would they like to do it, why would they do it, and how would they do it. The analysis of these columns means that the last column for the customer can be filled in, hopefully expressing a correct understanding of the customers' needs. The VCT(II) constitutes a five-column table: Reworded demands, Demanded Quality, Quality characteristics, Function, Reliability, Other. This table is used to determine what technical requirements are asked for by the customers.

The matrix

The matrix is used to transform the ranking of features in one notation to the ranking of features in another notation, such as the ranking of customer needs to the ranking of technical requirements. The actual transformation is performed by inserting the customer needs to the left in the matrix together with their ranking. The technical requirements are inserted at the top of the matrix. In the middle of the matrix, the degree of how well each technical requirement fulfills each need is inserted, the correlation. The scale $\{1, 3, 5, 9\}$ is the one usually used. A "9" means that the technical requirement to high degree effects the fulfillment of the need. A "1" means that the technical requirement only has a minor effect. An empty spot means that the technical requirement does not contribute at all to fulfilling the need. Then by multiplying the rank of the customer needs with the correlation with the technical requirement and then summarizing each column, the importance of each technical requirement is acquired.
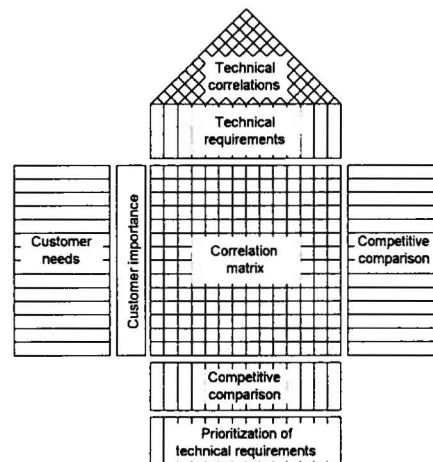

Figure 1: The House of Quality, which is the most famous QFD tool.

The House of Quality (HoQ) is a matrix that has become a common way of applying QFD [25] (Figure 1). It is used for the transformation of the ranking of customer needs to the ranking of the technical requirements. Before the transformation of the ranking of the customer needs, each of them can be adjusted, for example according to how well the competitors succeed in fulfilling the need. After the transformation, the ranking of the technical requirements can be adjusted, for example according to how well competitors fulfill the technical requirements and the difficulties in achieving the requirement. Another feature of the HoQ is displaying how this information interacts in a compressed format. It has been claimed that in many cases, sought for information already exists in different parts of an organization, but is hard to find, understand, and to coordinate with customer satisfaction. QFD contributes to everyone in the providing organization understanding what the customer really wants and how they can help to achieve it.

METHODS

During the entire study a participatory action research approach was used [30]. The participating researchers (NH, SP, MI) collected data through literature studies, interviews, and participatory observations of design work. Each researcher also kept a diary of their personal observations and reflections made during the study.

The preconditions for the method developed included important issues found in the literature on system development, requirements engineering, and the initial studies of the context they should be used in, i.e. information system development and use in the Swedish trade union movement.

On the basis of the preconditions identified the model was constructed and subsequently applied in the DLK project for specifying a prototype. A design group was gathered for the work. It consisted of shop stewards on shop-floor level, representatives from the DLK's leading committee, technicians, and researchers. For a period of eight months, four-hours design meetings were held monthly. During four of these meetings the work on the design related to the model developed. Before these, two initial meetings were used for the formalization of the work procedures and administrative issues according to Action Design. These initial meetings are not included in this study; neither are the meetings used for constructions of prototypes.

The evaluation of the model is based on the video recordings from the meetings, the researchers' participatory observations, and the informal discussions about the work procedures that were held with all design group participants in relation to each meeting.

RESULTS

The results are presented in three parts: the identified preconditions and their implications, the resulting QFW model, and the evaluation of the QFW model.

Preconditions

In this section the issues identified and the measures they led to which were found to be important for the development of the model are presented.

Issue: Several participants, representatives for the user group, in the DLK project stated that they not were at ease with the written language and that the keyboard stood as a barrier to participating in electronic discussions in the project. Further, the knowledge of and experience of IT amongst the persons involved in DLK was diverse.

Measure: A tool that does not require any special knowledge of or skills in using IT, and which at the same time produces commitment is the Future workshop (FW). Therefore it was selected as the core tool for the work in the design group during the analyses of union problems and for generating suggestions for their solutions.

Issue: The Swedish Trade Union Confederation is a non-profit organization, and its power comes from its members and shop stewards. It is thereby important that as many of them as possible can participate in the work, or at least be allowed to provide input to it. However, the FW technique limits the number of participants.

Measure: A technique that makes it possible to collect data from a large group of respondents, through questionnaires, is the Critical incident technique (CIT). The CIT also has similarities with the FW technique. For instance, they both ask the questions of "what problems do you have" and "how can these problems be solved". An additional advantage of CIT is that answering the questionnaire does not require a lot of writing, since the questions are focused, but still not leading. The critical phase of the FW was exchanged with the CIT questionnaire.

Issue: Usually it is not possible to implement all requirements asked for in information systems [15]. Therefore, a prioritization of the requirements must be made so that it is the most prominent features that are implemented [16]. Further, in the software development and requirements engineering literature, the importance of being able to trace requirements from their origin to design features and vice versa is emphasized [14].

Measure: QFD matrices were used to calculate the prioritization of the design attributes, based on the statistical data connected to the problems and needs from the CIT. The matrices were also used to document the correlation between needs, technical requirements, and design attributes.

Issue: QFD matrices require input in a certain form, i.e., a clear and distinct separation of needs, technical requirements, and design attributes. However, the output from the FW and the CIT are not expressed in the required form. Instead, it is a mixture of different verbatim statements [31]. Therefore, the output from the CIT and FW must be cleaned before using it in the QFD matrices.

Measure: To analyze and transform the core answers for the CIT study, the QFD tool VCT(I) was used. To analyze the results of the FW sessions the VCT(II) was used. The output from the VCT(I) and VCT(II) were used as input to the matrices.

The QFW Model

The Quality Function Deployment extended Future workshop (QFW) model can be divided in the same three steps as the FW. The first step in the QFW approach is to collect problem descriptions and analyze them according to CIT (Figure 2). More specifically, CIT questionnaires are sent out to the target group. Besides questions of a background character the questionnaire contains questions such as "What was the most recent problem you have experienced in daily practice?", "Where did it happen?", "How often does it happen?", and "How did you solve the problem?". The responses are read through, interpreted, and categorized. Subsequently core problem descriptions for each category are selected and used as input to the second step. The purpose of the core problem descriptions is that they should represent and illustrate their category. The core problem descriptions are subsequently analyzed in the VCT(I) and transformed to needs. The needs are inserted into the left side of the QFD matrix, called the House of Quality (HoQ). Further, the number of questionnaire replies related to the different categories is used to calculate the importance of each need.
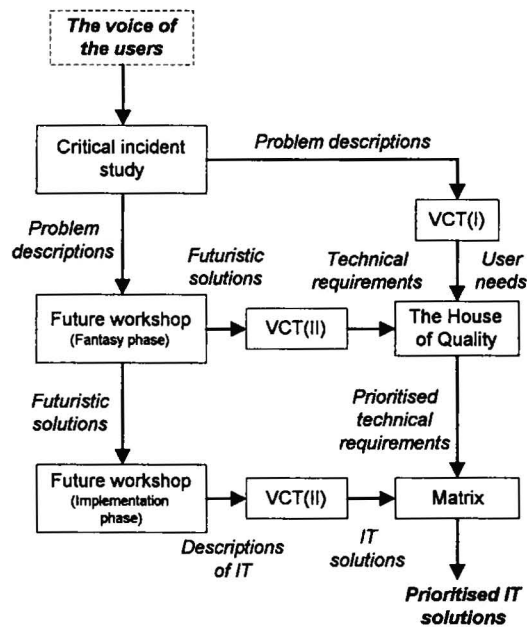

Figure 2. The structure of the QFW model.

In the second step, the core problem descriptions are used as input for the Fantasy phase of a FW session. During this session, the design team participants can freely come up with ideas on how these problems should be solved without considering any limitations, e.g., techniques and organizations. The visionary solutions determined are naturally used as input for the next phase of the FW, but they are also analyzed and transformed into technical requirements in VCT(II). The technical requirements are inserted into the HoQ. Subsequently the correlations between the needs and the technical requirements are determined. Based on the correlations and the importance of each need, the prioritizations of the technical requirements are calculated.

In the third step, the design team identifies practical solutions based on the visionary solutions — the implementation phase of the FW. The practical solutions are the transformed in a VCT(II) into concrete design attributes. The design attributes are inserted into the second matrix, together with the technical requirements and their prioritization. Then the correlations between the technical requirements and the design attributes are determined. The correlation and the prioritization of the technical requirements are then used to calculate the prioritization of the design attributes.

Evaluation Results

In this section the experiences of applying the model in the DLK project are presented and commented on.

CIT: The response rate for the CIT questionnaire was 64%, which is acceptable considering that it is a semi-qualitative method. The rate was also in parity with earlier experience of this kind of questionnaires [31]. The categorization of the problem descriptions was found time-consuming and hard to perform due to the fact that none of the researchers had any long experience of union work. Afterwards, when the design group participants were confronted with the problem categories, it also became apparent that they interpreted some of the problems differently than the researchers. Further, they viewed some problems that the researchers had put in the same category as distinct from each other. For example, a problem that the designers categorised as insufficient access to union training at the workplace (i.e. training), was instead viewed by the union participants as reflecting a lack of interest for union issues and training among members and shop-stewards (i.e. lack of commitment).

Comment: In the analysis and categorization of the answers the researchers found it difficult to interpret many answers and tended to see abstractions were the union representatives in the design group saw concrete problems. The experiences indicate that it is beneficial, if not necessary, to include persons with a similar background as the respondent group in the initial categorization. Further, the work on the categorization of the CIT questionnaire responses can be enhanced and communicated in a suitable notation, e.g. the VCT(I) which has been found to be a useful tool in PD settings [31].

FW: The FW technique is in itself imaginative and engaging, which several of the design-team members also expressed. To avoid the introduction of bias, the problem descriptions gained from CIT and used in the FW session were changed as little as possible, i.e. they were, more or less, directly quoted from the questionnaire answers. The exceptions were only minor changes in order to retain the anonymity of the respondents. The work procedure of the FW was experienced as straightforward and the participants felt that the work proceeded successfully. However, since the participants viewed the CIT problems as very concrete, they sometimes tended to get stuck in a specific problem. In other words, they had a hard time to think about the problem as representative for more general problems and found it difficult to proceed to the solutions. For instance, a problem that the designers considered as related to insufficient access to information in general, instead generated intense discussions about that particular problem, e.g. whether the person reporting the problem actually should have access to information in a certain agreement.

Comment: The FW enhances the active participation of user representatives. Hence, during the FW it was the user representatives' voice that was dominant and they become the leading designers. Further, the FW is suitable for work in PD groups, since it lets participants focus on concrete design, and thus gives them a sense of moving forward in design work. The combination with CIT is useful in that the problems collected can be said to represent an entire user group, not only those of the workshop participants. However, it is essential that the exemplifying problem descriptions used in the workshop are described on a general level, so that participants will not get stuck on them but can move on to generate solutions. Perhaps, the problem descriptions should not have been kept in their original form.

QFD: To use QFD is more of a theoretically demanding kind of work, include reading, analyzing, validating, calculating, and redoing. Hence, the initial QFD analysis was performed by the researchers. The tools in QFD provide a process documentation of the design, including the design decisions. It makes it easy to track the origin of different design attributes and the solutions to different needs. In other words, the notation provides tractability between IT solutions and the user voices. It also focuses on the future work of the design team on the aspects that are most important for the users by providing a prioritization among the design attributes.

Comment: It has been claimed that it is hard for people who lack knowledge of QFD to use it [16]. This comment is, however, more related to using the matrices of QFD than QFD in general. Using the matrices can be hard for persons who not are familiar with QFD. Examples of difficulties include determining what a need is and what a technical requirement is and determining the size of the correlations [35]. However, in the QFW model the FW technique provided an interface between practice-oriented user representatives and the

formal QFD notation.

Further, in PD there are several approaches taking their starting point in the gathering of user data, e.g., contextual inquiry and ethnological approaches [9-11]. However, none of them provide any ranking of the needs and the approaches often conclude by explaining the users' situation. Other approaches start with creating formal descriptions of the design of a system, e.g., prototyping and PICTIVE [12]. QFD can be used as the bridge between these kinds of approaches, by its ability to support and document the transformation of the user needs into technical requirements [32].

The Advantages of the QFW Model

The first source for the design of an information system must be based on the users' acting in their real environment [8]. In this way an information system that exceeds the users' expectations can be designed [33]. Further, it has been claimed that traditional design methods used are insufficient. In particular the early phases have been found to be weak and these are the most critical for successful design [34, 35]. In QFW, CIT is used and has been found to be an effective way of creating a picture of the dilemmas and breakdowns that the target group experiences in the situation that is being studied. It is a self-study technique where target group study themselves and then report what they have found.

Information systems that make a difference to their users are more likely to be accepted by the users and thereby more likely to be successful [36]. However, there is still a need for methods that ensure the features of information systems that meet existing needs. Further, since not all needs are equally important and not all can be realized, it is necessary to prioritize so that the needs that are the most urgent for the users are met. The ranking of the design attributes makes it possible to make the systems less complex since features that do not add any value can be excluded. There are several methods for prioritizing software requirements, such as the analytical hierarchic process and bubblesort [16]. However, it can be argued that applying these prioritization methods to the technical requirements is insufficient since, if the professional designers do it, they will have little opportunity to judge the users' prioritization correctly and if user representatives perform prioritization, they have little opportunity to relate the technical requirements to their work situation. In the QFW model the numbers of questionnaires that are related to needs are used to determine the users' judgement of the importance of the needs. The importance of the needs is subsequently transformed into the importance of the design features, by the use of matrices. The result is a prioritization of the design solutions. In this way the users' prioritization of the design attribute is determined indirectly based on the CIT response and the QFD calculations.

The advantages of the QFW model are thus that it combines an effective way for CIT to collect the users' voices on issues for improvements, QFD's ability to transform these voices into design solutions, and PD ensuring that the social aspects

of the information systems are considered in the design. Further, the use of PD also means that users in the design team can question and validate partial results during the process.

DISCUSSION

The main objective of this paper is to describe a model based on PD principles for determining with a progressive degree of formalization the IT features that an information system should implement. The result, the QFW model, combines the benefits from different areas: from PD, the work procedure of getting design experts and users working together is employed, to ensure that the democratic and social aspects are met; from QFD, two types of graphical notations are used to ensure the traceability of design decisions and to optimize the resulting system according to the users' needs; from CIT, the technique is used to collect data from larger populations, focusing on the needs of improvement.

The motivation for the development of the model is found in that the conditions for trade union activity have changed noticeably during the last decade. This has been especially significant at the local levels. New management strategies not only flatten hierarchic structures and decentralize decision-making, negotiation and information, they also often result in slimmed organisations where time spent on union tasks or education is not accounted for and results in an increased workload for the local shop stewards and/or their fellow-workers. The cut in work-force-numbers resulting in, by Swedish standards, extremely high unemployment figures also affects local trade union work. Much time and energy is spent on negotiating cut-downs and the cut-downs in their turn make union members less willing to accept union assignments. Until 1991 trade union education for members and representatives was considered to be an important part of adult education in Sweden and was partly financed by society. However, in 1991 the financial support was cut by 70 percent and the volume of union education dropped dramatically and has stayed at a comparatively low level. Young trade union members share union values and find trade unions important and needed. However, they do not take part in traditional trade union activities, such as formal meetings, to the same extent as older members. Instead, they ask for untraditional and flexible ways of taking part in union work and decision-making. Hence trade unions have many reasons for trying to find ways to use IT to support local knowledge needs, communication and decision-making.

Need for Improvements

Traditional models for software engineering, such as the waterfall model and the spiral model [37], have been criticized for not being able to prove results [35]. The reasons for this problem have been put forward as the lack of connection between the designers' actions and the concerns of the users, and that the focus has been on the efficiency of the machines instead of human needs [34]. As a response to this failure methods taking their starting point in the use situation become more interesting. However, even though the users'

situation was ensured, these approaches, e.g., PD, have had difficulties in proving their efficiency.

Further, different types of prototyping have been proposed as useful approaches for design of information systems in PD contexts, e.g., PICTIVE [12]. Nonetheless, using prototyping as an approach to requirements means that some assumptions have to be made in advance. One assumption is that a system is needed. In the case of PICTIVE this is illustrated by asking the users to "Think through what you want the systems to do for you." [12, p. 217). This approach will also limit the resulting product, since by asking the users what features they want in an information system, they will only be able to state features that they believe can be provided, which corresponds to the performance requirements in the Kano model [33]. The performance requirements are those which are expressed explicitly by the users. The more they are fulfilled, the more satisfied the user becomes. However, this means that the requirements that Kano called the excitement requirements, will be missed, since the users are not aware of them. Even worse is if the requirements that Kano called the basic requirements are missed. These are unspoken but required. If they are omitted, the users become dissatisfied, but if the requirements are fulfilled, they are taken for granted and barely noticed. However, even users do not know how information systems can meet their needs: they know what problems they have. In fact, they are true specialists on problems and breakdowns that occur in their work. By taking the starting point for the design in the users' knowledge about problems and breakdowns and transferring them into design features, the risk of missing basic requirements decreases and the chance of finding excitement requirements increases.

In this paper, a model that combines PD, CIT, and QFD is proposed. The graphical notation of QFW provides a stable way of documenting the design processes and decisions taken. This approach implies that knowledge gained during one project can be reused. The notation of the matrices displays the needs, the technical solutions, and their relationships in a compact way that is easy to overview. In other words, it provides back and forward traceability between needs and design attributes, a feature that has been lacking and thus viewed as a weakness in several other methods for information systems design [14]. In the DLK project case this means that experience from the project will not only be represented in the completed system and in the memory of the participants, but also the notation will preserve the decisions made together with their background for future use.

In the design of information systems the technical quality is far from unimportant, even though it can not dominate over the users' view. It would be like saying, "Ok, we have an information system that works well, let's see what it can do for the users". Instead, in QFW, the saying is "the users have these needs, let see how we can exceed their expectations with an information system". The notation of the model displays how the technical qualities contribute in meeting the

users' view of quality. In this way the developers' efforts, for instance in creating correct code, can be concentrated on the parts of the system where the users notice it.

It has been claimed that tools used in PD should not require any excessive training since user representatives who are given a large amount of training are alienated from those whom they represent and their ordinary work. In other words, this means that the more trained the user representatives are in performing design, the less is their value in representing the users [12]. The QFW is based on the FW technique that minimizes the demand on specific domain skills of the participants.

Merging PD and QFD
The QFW model can be seen as an attempt to combine the Scandinavian tradition of PD with a Japanese quality process, QFD, for designing information systems in a union setting. The basic philosophies of QFD and PD have several similarities; for example, they put the users' needs before technical quality and they both strongly emphasize the importance of the developers' understanding the context of the use situation. However, there are also several differences between the two. In QFD it is the producer who has the responsibility to see that the product fulfills the needs of the customers, whereas in PD the producers, that is the professional system developers, share this responsibility with the users. Further, in QFD the overall objective is to develop products that bring benefits to the producer, e.g., by selling more of the product [22]. Therefore, the focus is on the ones who pay and the ones who decide on purchasing. These groups should be highly satisfied so that they choose to buy the product. Meanwhile, in PD the democratic issues are central and it is the direct users who are in focus [5]. Their right to participate in the decision making about their own work situation and working-life quality is emphasized. Despite these differences, the findings presented in this paper suggest that the two approaches have much to gain from each other. For example, in QFD it is of importance that the developers have an understanding of the users and the use situation. In PD projects the developing team includes experts on these two topics, namely the user representatives. Further, the importance of capturing the social aspects of the requirements has been emphasized [5]. This is a core issue in PD that could be beneficially adopted in QFD. On the other hand, PD has seldom been committed to time and budget frames [38], while reducing the development time has been claimed to be one of QFD's benefits [39]. QFD can increase the focus of work on the design tasks in PD projects and provide coherent design processes, which make the requirements traceable. Hence, PD and QFD can benefit by taking inspiration from each other.

In this article the work on developing a model for the design of trade union information systems has been described. The model is aimed to be used for formalizing the IT features that an information system should implement. The work has been performed in a major Swedish Union IT project, DLK. The Swedish trade union has, by tradition, been and still is progressive in trying to take advantage of the new technique. There is no doubt that other unions will have to make the same kind of effort towards making the use of modern IT. Since unions world-wide share many characteristics, e.g. in focusing on oral rather than written communication, the use of the QFW model and the experience gained during its development will be useful for them. However, the model can be used in other contexts, too, merging the benefits of QFD and PD, thereby resulting in well-grounded systems.

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APPENDIX: SOME DESIGN DATA[1]

The major needs identified

Knowledge to carry out traditional shop steward assignments (e.g. negotiations and settlements)

Moral support and encouragement

Knowledge to deal with internal conflicts within the union, including with members.

Motivate union actions and decisions for members

Motivate members to engage in union work

Knowledge in stress handling

The major technical requirements determined

Communication with a mentor

Communication with members

Communication with supportive group (e.g. network of shop stewards)

Education

Access to other shop stewards earlier experience

Communication with union ombudsmen

Access to laws and regulation of work life

Access to traditional union information, (e.g. agreements and settlements)

Access to local union information (e.g. agreements and settlements)

The major design solutions determined

Electronic mail

Discussion forum

Mailing lists, including administrative environment for mailing lists

Case database (describing earlier experience)

Electronic address book

Distance education

Education in form of games

Education in form of self-study courses

Videoconference system

Agreements and settlements database

Laws and regulations database

[1]The appendix is intended to provide examples of needs, technical requirements, and design solutions, not to describe the complete design of the prototype.