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Abstract

Participative design is an effective tool for designing organizational systems where conflicting and diverse goals of users and clients from different organizations must be reconciled. This paper presents a methodology for participative design based on Soft Systems Methodology (SSM). A brief overview of SSM is first presented. The design methodology is then presented within the SSM framework. The design methodology prescribes a set of activities to accomplish participative design, and uses two design tools from the manufacturing and process engineering fields - Quality Function Deployment (QFD) and the IDEF0 functional modeling method. Experiences using the design methodology are also presented.

Introduction

The development of organizational systems is characterized by having both “hard” and "soft" aspects. The hard aspects typically deal with hardware and software systems, while the soft aspects deal with organizational, political, and cultural systems - the so-called human issues. While much has been written about how to address the hard aspect of designing organizational systems, the soft or human aspect has received comparatively little attention. However, the lack of success of many organizational systems has more to do with the failure to consider non-technical factors in design and development rather than technological failings of the system.

Several factors complicate design of successful organizational systems. The systems must obviously perform the tasks and functions that the users require. While eliciting requirements from users in traditional systems is difficult enough, organizational systems typically have a broader and more diverse constituency to satisfy, where the entities involved may be from different functions or enterprises. The design must align the viewpoints, needs, and objectives of the organizational groups. Differences of opinions must be resolved in an amicable fashion if the system is to be accepted and used by those involved (de Vreede, et al, 1997). The design must not only consider the needs of users, but managers, technologists, and all others potentially affected by the system. Again, this requires the integration of diverse and often conflicting interests.

Collaborative or participative design has been proposed as a way to overcome these difficulties. This paper presents a methodology for collaborative design that uses Soft Systems Methodology as its framework. The methodology provides process guidance in the steps to perform for designing an organizational process and incorporates a set of established tools for accomplishing several of the steps.

Soft Systems Methodology

Soft Systems Methodology (SSM) was first introduced by Peter Checkland in 1981 in his book *Systems Thinking, Systems Practice* (Checkland, 1981). SSM has been grouped among the “soft” operations research tools as opposed to the “hard” mathematical and decision models that have traditionally existed in the operations research field. It is a methodology for analyzing and modeling hard to define and complex systems that integrate both a technology (or hard) system and a human (soft) system. The latter system is defined by Checkland as a Human Activity System (HAS) and is posited to be different from natural systems or designed systems due to the introduction of the subjectivity of human desires and objectives into the HAS. A HAS is defined as a collection of activities in which people are purposefully engaged, and the relationships between these activities. Checkland proposes that the same methods used for engineering technology may not work as well for the more unpredictable and complex human side of the system.

SSM addresses fuzzy problems with unclear and multiple objectives and several different perceptions of the problem. SSM recognizes that different individuals will have different perceptions of the situation and different preferable outcomes. It recognizes these differences and explicitly attempts to take these into account from the outset to ensure that the results of the analysis are acceptable to all parties concerned. SSM does not attempt to define a single right method of action but, through an iterative process, defines an acceptable improved path of action. People who are involved in the methodology include not only actors within the designated system, but also clients and owners of the system. Because of these characteristics, it is proposed that SSM can be seen as a valuable framework for participative design activities.

The Participative Design Methodology

Having presented the motivations and some background on SSM, we now present the design methodology we have developed and used in several projects. In all of these cases, the development required identifying a set of requirements from a diverse set of users and clients. In all of these cases teams or groups of users and clients were created for the design activity. We will discuss the design methodology in relation to the steps of SSM, and will discuss pertinent tools and techniques that we have found valuable in accomplishing the steps.

The Soft Systems Methodology consists of a seven stage process: 1) problem situation unstructured; 2) problem situation expressed; 3) root definitions of relevant systems; 4) conceptual models; 5) comparison of conceptual models with the real world; 6) feasible, desirable changes; and 7) action to improve. Stages 1 and 2 are most often combined in descriptions of the SSM. They represent the identification and representation of the problem situation in terms of a “rich picture.” A rich picture is a representation of the problem situation, typically presented in the form of an abstract drawing, which describes aspects of the system that are relevant to the problem definition. We have found Quality Function Deployment (QFD) to be an especially valuable tool in eliciting requirements from a diverse group in Stages 1 and 2. QFD is a means of translating the “voice of the customer” into product, process, and production requirements using a series of matrices. It is a means of translating and prioritizing customer requirements into the appropriate technical requirements for each stage of product, process, and service development and implementation. It has been successfully used in software and hardware development (Haag, et al., 1996) and was easily adapted to our projects.

In Stage 3, a “root definition” is developed. The mnemonic CATWOE is used to guide the development of a root definition: **C**ustomer: people affected by the system; **A**ctor: people performing activities in the system; **T**ransformation: the transformation carried out by the system; **W**eltanschauung: the “world-view” or viewpoints held of the system; **O**wners: the person(s) with the authority to decide how (and if) the system will be carried; and **E**nvironment: the larger system within which the system under consideration exists and operates. The elements of CATWOE emphasize the need to examine the problem from a number of viewpoints. The Root Definition and CATWOE provide the analyst with a framework for ensuring that all points of view and interest are considered in the requirements elicitation. Stage 4 includes the construction of a conceptual model identifying what the system needs to accomplish including its activities and their interactions. These activities describe what has to happen for the system to meet the goals and aims defined in the root definition. Our implementation of the SSM uses the IDEF0 functional modeling method (Mayer, et al., 1992) to complete Stages 3 and 4. IDEF0 is an appropriate tool for SSM for several reasons. All of the elements of the CATWOE can be included in the IDEF0 model with minor modifications. IDEF0 prescribes the identification of specific viewpoint and purpose for the model — the IDEF0 equivalent of the Weltanschauung. Checkland (1981) states that the conceptual model should focus on what is done, not how it is done. IDEF0 was designed to be a functional modeling tool specifically focused on the "whats" of a system without explicit regard to how certain activities are accomplished. Furthermore, IDEF0 is especially well suited for development of a consensus model. It allows for the input from a broad range of individuals who might be affected by the new system. The author-reader cycle for review of the model used in IDEF0 allows for the efficient input of opinions from those holding diverse viewpoints of experts, users, etc., and from a variety of stakeholders. The stagewise development of an IDEF0 model supports the discovery process, as new processes and activities are identified as the model is incrementally created.

In Stage 5, the conceptual model is compared with the real world system to highlight possible areas where changes are necessary. This conceptual model will identify where problems or deficiencies exist between what is happening (the 'rich' picture) and what is desirable (the 'root definition') as defined by the models. In Stage 6, changes to address the ‘disconnects’ or gaps between the conceptual model and the real world identified in Stage 5 are introduced and evaluated for feasibility. These alterations may include changing the way certain activities are completed, or could result in the identification of activities not currently achieved in the real world. The IDEF0 model also supports Steps 5 and 6 through the author-reader cycle as the designer specifies the new system and sends it to the groups for review. Finally, in Stage 7, recommendations for change are implemented. These changes then result in a modification of the problem situation. This new situation may then lead to a new cycle of the methodology.

Applications of the Methodology

The projects (some of which did not use the entire method but selected portions) included the development of a methodology and supporting deployment tools for the strategic justification of investments in enterprise technology; a consulting methodology

for implementing continuous improvement in small companies; a strategic information system to support organizational decision making; and a methodology and decision support system for enterprise performance management.

The most comprehensive use of the development methodology was in the development of a system to assist in the justification of investments in strategic technologies (Presley, et al., 1997). The system in this case consisted of a process for conducting strategic justification and deployment tools to operationalize the process - a workbook and a supporting decision support system. This project required the integration the efforts of three geographically dispersed teams of industry experts. The use of the QFD assisted greatly in the identification, categorization, and prioritization of requirements for both the justification process and tools. Several meetings were held with each of the three teams using trained facilitators who then worked to integrate the results of the meetings. A group decision making technique not mentioned earlier, Analytic Hierarchy Process (AHP), was used for the prioritization of the requirements. The justification process was incrementally developed in IDEF0 by a development team who distributed the model to the expert team along with some identified experts in the strategic justification field. A decision support system to support the process was then developed. Requirements for the information system were developed concurrently with the requirements for the process itself.

In all of projects to which the design methodology has been applied, we found the use of SSM concepts and QFD and IDEF0 to be valuable tools in developing the systems in question. While minor modifications to the original system designs have been needed, we believe the number and magnitude of these have been much less than would have been necessary with more traditional methods.

Conclusion and Future Directions

In this paper, we have proposed that soft systems methodology (SSM) an effective approach for aiding diverse groups of organizations come together to identify requirements for organizational systems. By incorporating customers (not only developers) into the development process, the approach described has potential for the development other organizational systems. Our experiences provide support for the value of SSM for participative design.

SSM is a general methodology to which we have attached three particular tools - QFD, IDEF0, and AHP. We believe that even without these three tools, SSM offers a valuable framework for participative design and that other tools are available to guide and facilitate the process. We also believe that the methodology and tools we use would benefit greatly from the use of automated GroupWare tools to facilitate the collaborative design process. This is one area in which further work would prove valuable.

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