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User Participation and Tailorability in PSN Systems Design

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ABSTRACT

User participation has received significant research attention in the past. Researchers have attempted to understand and demonstrate a link between user participation and system success, but studies have shown the link to be conditional. The purpose of this paper is to propose a type of system design when user participation is not required because the design consists of tailorable functionality, permits exploration through reversibility, and builds trust. In this paper past participation research is examined – including findings casting doubt on the participation-success link. Technology features are then offered to address unresolved user concerns identified in prior research. Future research of a non-participatory design in a Public Safety Network is also described. This paper contributes to IS design knowledge by expanding on the contingency view of user participation and system success. This paper also assists public safety professionals by offering potential design solutions to address user concerns.

Keywords

User participation, user involvement, system success, design, tailorability, reversibility, trust

INTRODUCTION

User participation (and the related concept of user involvement) has received significant research attention over the past several decades[1]. Researchers have attempted to understand and explain the relationship between *user participation* and *system use* – and at times extended that relationship out to information *system success*. While the majority of prior research supports the notion that user participation is consistently associated with increased information systems (IS) use, a number of researchers have called for further research regarding the contingencies of user participation that lead to increased success and how different categories of system *users*, *use contexts*, and *technology features* might affect the relationship between user participation and system success. The purpose of this paper is to propose that user participation is not always necessary for system success and to introduce a user-sensitive non-participatory design. The specific question posed herein is "To what degree might a tailorable, reversible, trust-enhancing system design make user participation in the development process not required?" This paper is motivated by calls for additional research examining effective user participation (Ives and Olson, 1984; Markus and Mao, 2004) as well as the call for additional research on the IT artifact (Orlikowski and Iacono, 2001). Below, the paper describes what user participation is and its suggested relationship to system success. The paper then describes research casting doubt on that relationship. Next the paper looks at unresolved issues in participation research in terms of user, use, and technology characteristics. A theoretical background for future research is then covered – particularly in the context of public safety networks. The paper concludes with thoughts about contributions to IS design as well as public safety practitioners.

USER PARTICIPATION DEFINED IN PRIOR RESEARCH

The meaning of user participation has gone through multiple rounds of refinement and clarification. Over time researchers refined the definition of user participation (distinguishing it from user involvement) and specified some instances where practitioners sub-optimized user participation based upon certain contingencies – such as the degree of user influence and the complexity of the system being designed. Table 1 provides details about key definitions of user participation, the potential benefits of user participation, and findings for the user participation-to-system success link. For definitions of user participation, one researcher qualified it as involving decision-making (Hirschheim, 1985). Another characterized user participation by including the degree of authority, formality, content, and influence (Cavaye, 1995). Others described prior treatments of user participation as typically viewed outcomes like requirements gathering, or as psychological states like buy-in (Markus and Mao, 2004). This current paper focuses on the following definition of user participation: the tasks performed by target end-users in the systems development lifecycle (Barki and Hartwick, 1994). Active user participation (task-centric) is considered one of many antecedents to a more general concept of effective user involvement (perceptions, psychological states).

[1] One Harvard University study examining (in part) user involvement was conducted in 1959 (Ives and Olsen, 1984).

Author	Year	Definition	Proposed Benefits	Relationship Findings
Ives & Olson	1984	User involvement in the systems development process by representatives of target group.	System quality, user acceptance	Inconclusive connection between UP and system success
Hirschheim	1985	Incorporates decision-making for technical *and* social aspects of IS. UP encompasses representative and consensus types of IS efforts.	User buy-in, user-friendly interface, reduction in design errors and implementation time	More complex systems required more UP
Barki & Hartwick	1994	Set of tasks performed by target end-users during development. Highlighted need to distinguish between user involvement and UP.	User satisfaction, user-designer conflict resolution, system use	UP is one antecedent to more general *user involvement*. UP can give rise to increased system use and improved attitudes toward specific systems
Cavaye	1995	Involves six dimensions: user type, degree of authority, content, extent, formality, and influence	System quality, user-designer relationships, system use.	Conditional relationship between UP and system success. Research complexity will increase with increase in inter-organizational systems.
Saleem	1996	Tasks performed by users in cycle of design. Users can participate but not have true influence.	Same as prior, but introduces idea that user expertise is a key variable	User expertise moderates relationship between UP and system success. Frustration arises when users do not have true influence over design outcomes but UP-like activities are performed.
McKeen & Guimaraes	1997	Barki &Hartwick (1994) definition used, and described prior user involvement research as having really attempted to examine UP behaviors.	Same as prior	UP should increase with increased task/system complexity. UP done under the wrong conditions could result in "open warfare" between users and designers
Markus & Mao	2004	Described through outcome concepts of buy-in, system quality, improved design/user relationships	User buy-in, system quality, user-designer relationships	Generally, better UP improves system success measures but prior research is inconclusive. Future tests should include better treatment of non-participating users, system quality, and relational outcomes.

Table 1 – User Participation (UP) in the research literature

Over all, user participation theory has matured to better distinguish user participation from other aspects of the systems design process. The next section describes research of the link between user participation and system success.

USER PARTICIPATION AND SYSTEM SUCCESS IN PRIOR RESEARCH

The concept of system success has had diverse conceptualizations in user participation research. Ives and Olson described the connection between user participation and two measures of system success - system quality and user acceptance (Ives and Olson, 1984). Tait and Vessey described three measures of system success - Increased system usage, improved perception of system quality, and improved satisfaction (Tait and Vessey, 1988). DeLone and McLean described the concept of system success in terms of six components: system quality, information quality, system usage, user satisfaction, individual impact and organizational impact (DeLone and McLean, 1992). Markus and Mao used similar measures but treated information provision satisfaction as a distinct feature - while also noting that antecedents of system success are moderated by other factors such as task complexity and system complexity (Markus and Mao, 2004). This current paper focuses on the

following elements of system success: system quality, perceived usefulness, user satisfaction, and system use (Sabherwal, Jeyaraj and Chowa, 2006).

Over time more attention has been given to the contingencies that moderate the effectiveness of user participation. For example, Saleem argued that functional expertise is a key variable to consider when examining user participation and system success (Saleem, 1996). Other findings include the notion that user participation can occur without influence (Saleem, 1996); and the notion that designing more complex systems requires more user participation (Hirschheim, 1985). Cavaye and McKeen & Guimaraes also identified system complexity as a key factor moderating the effects of user participation, and Cavaye argued that the increasing prevalence of inter-organizational systems would add complexity to user participation research (Cavaye, 1995; McKeen and Guimaraes, 1997). Cavaye also identified organizational commitment to participatory designing in general as moderating user participation's effectiveness in driving system success.

Research Casting Doubt on the Link Between User Participation and System Success

IS researchers have recognized the limits of past research examining user participation. Ives and Olson suggested that a lack of grounded theory, poor methodologies, and a lack of empirical data casted doubt on the strong claims being made regarding user participation's unmediated influence on system success (Ives and Olson, 1984). In addition, Hirschheim used exploratory interviews to highlight negative outcomes for user participation in system development projects (Hirschheim, 1985). For example, Hirschheim highlighted differences in the way trade unions view participation - particularly when the new system would involve changes to work tasks. This finding demonstrated the reality that the combination of certain types of users (high expertise, high expectations of influence) and certain circumstances (requirements could not be fully incorporated into system features) resulted in frustration and poor relational outcomes. Hirschheim highlighted the reality that costs and risks associated with user participation must be justified by an adequate return on investment. The costs of user participation included: user time, extension of the design phase (due to additional deliberating and synthesizing user and designer views), and project-level coordination. The risks of user participation included: the potential to introduce users too early or too late in the development lifecycle; heavy reliance on facilitator skills to synthesize conflicting user/designer views (on more than just technical dimensions); and the potential to increase post-implementation user-driven system change requests due to enhanced comfort level on the part of users perceiving themselves as empowered.

Other studies casting doubt on user participation's role in system success include the following:

- Even *user-led* design efforts resulted in not meeting users' expectations of representation (Lawrence and Low, 1993)
- User participation found to be counter-productive and at times results in "open warfare" in user-designer relations (McKeen and Guimaraes, 1997)
- User participation is neither necessary nor sufficient for successful systems outcomes (Markus and Mao, 2004)
- General user perceptions of information systems have more effect on their view of a particular system than the user's participation in the systems development effort (Sabherwal et al., 2006)

UNRESOLVED ISSUES IN USER PARTICIPATION RESEARCH

Although the weight of evidence supports the user participation-to-system success link under certain conditions, outstanding issues still require resolution. Markus and Mao identified user, use, and technology-related gaps in prior user participation research (Markus and Mao, 2004). *User characteristics* must be examined to provide a better understanding of the conditions allowing for non-participatory designing. Prior research has been inattentive to how designers account for the perceptions and usage requirements of those users that do not have an opportunity to participate in system design (Markus and Mao, 2004). Another characteristic not fully addressed in prior IS design research is a user's capability to perform sensemaking. Sensemaking refers to the cognitive ability to be productive in the face of novel situations by marshalling internal and external resources and getting an overall sense of "what is happening" (Weick, 2001). In addition, sensemaking represents cognition that is context-aware and group-identity sensitive (Weick, Sutcliffe and Obstfeld, 2005). Users who effectively make sense of a system's components and information might not need to participate in designing in order to effectively utilize the system.

Use characteristics must also be examined to provide a better understanding of the conditions allowing for non-participatory designing. Focusing on use allows researchers to better distinguish between different types of outcomes. Prior research has made inadequate distinctions between functional outcomes like system quality, and relational outcomes like user-designer conflict resolution (Markus and Mao, 2004). In addition, the higher degree of change introduced by system use, the less likely users are to look favorably upon the system in question (Levy, 1986). Questions remain like what type of use

conditions might be conducive to a user effectively using such a system regardless of the procedural change it introduces? Understanding when users show signs of becoming resistant to degrees/types of change would provide criteria for understanding at what point they might begin to exhibit resistant behavior toward non-participatory designing.

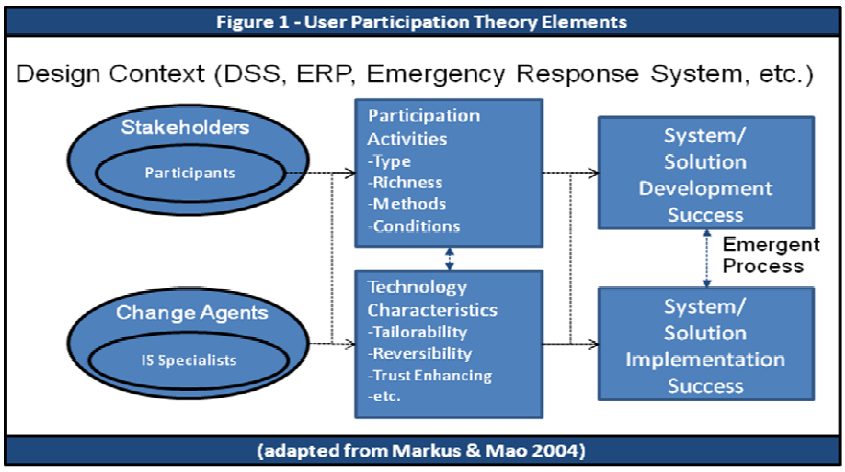
Lastly, t*echnology characteristics* must be examined to provide a better understanding of the conditions allowing for non-participatory designing in light of concerns regarding the possible discrepancy between user requirements and eventual system implementation quality. Some research has shown that new features can emerge after implementation if users are provided tools to facilitate end-user development, and that this type of end-user development can lead to increased user satisfaction (von Hippel and Katz, 2002). Further research is required to understand what role *tailorability* (in this case meaning empowering users to customize applications) plays in allowing for user involvement after the initial implementation. This concern is particularly salient in light of the increased prevalence of software package implementations (Wagner and Newell, 2007). For example, further research is required to understand the threshold at which personalization – filtering data flows to prevent information overload (Liang, Lai and Ku, 2006) - can overcome the user's need to participate in design and deployment activities. Another line of research requiring further investigation is the effect of the degree of *reversibility* designed into the system on system success. Reversibility signifies the system's ability to track and "undo" the outcomes of a user's system-related activities (Norman, 1990; Cass, Fernandes and Polidore, 2006). For example, in Microsoft Word the user has the ability to unwind actions performed, and in SAP enterprise systems a "sandbox" environment enables harmless user experimentation. Systems that make undoing a series of performed tasks more difficult might give rise to user frustration when the inevitable human mistakes occur (Norman, 1990). In addition, reversibility allows exploration and scenario analysis on the part of the user. This concept's measurement will require further elaboration prior to any case study or survey work, but research consideration must be given to the possible link between the degree that a system is forgiving, and the users' willingness to allow for non-participatory designing. Lastly, while the role of *trust* has been examined from many perspectives – including the role of information systems in mediating trust between individuals and groups (Jarvenpaa, Shaw and Staples, 2004), additional research is required to specify how trust enhancement capabilities (meaning those features that increase interpersonal trust between users) influence user satisfaction regarding non-participatory designing. Inter-personal trust enhancement might be a means to induce users to increase system adoption and use based upon a user's affinity with other users of that system (i.e., building an online community) and well as building a group identity essential for sensemaking (Weick et al., 2005).

Summarizing, there are three technology characteristics requiring further investigation in the context of non-participatory designing: tailorability, reversibility, and trust-enhancement. The next section will discuss the theoretical basis for examining these three system characteristics.

THEORETICAL BACKGROUND

As mentioned above, participation theory has undergone refinement over the past few decades. Markus and Mao developed a model highlighting the roles IS specialists and participants play in influencing both system development and implementation success (Markus and Mao, 2004). Figure 1 below shows an adapted version of the Markus and Mao model – highlighting the importance of the use context, the actors involved in the designing interaction, and design process contingencies (e.g., the type of participation in which users are engaged).

Figure 1 - User Participation Theory Elements



(adapted from Markus & Mao 2004)

The model was modified to include *technology characteristics* as part of the drivers for system development and implementation success. The addition of these specific technology characteristics attempts to address several of the unresolved issues of past participatory design research. This paper proposes that designing systems with tailorability, reversibility, and trust-enhancement features in mind can decrease the need for user participation. Table 2 summarizes how each of these feature sets is meant to address particular instances of unresolved issues in user participation literature.

Technology Characteristic	Unresolved Issues
Tailorability	• Higher degrees of organizational change introduced by system use and its affect on user satisfaction • Usage requirements in light of prevalence of software packages (i.e., gap between user requirements and eventual system quality) • Degree personalization in reducing information overload that would negatively affect user satisfaction and sensemaking
Reversibility (including enabling exploration and experimentation)	• User's capability to perform sensemaking in face of complexity, novelty, and error • Higher degrees of organizational change introduced by system use and its affect on user satisfaction
Trust-enhancement (interpersonal, inter-organizational)	• User's capability to perform sensemaking in face of complexity, novelty, and error (group identity) • Distinguishing between relational outcomes and functional outcomes

Table 2 – Technology Characteristics and Unresolved Issues in User Participation Literature

TECHNOLOGY CHARACTERISTICS – FEATURES AND PROPOSITIONS

The three capabilities of tailorability, reversibility, and trust-enhancement were briefly defined above, but require some elaboration. These capabilities were selected in an attempt to identify system functionality that would assist users in sensemaking and counteract user feelings of disenfranchisement. First, tailorability represents the system's capability to allow users to create or enable new configuration of functionality as well as control information provision. Tailorable systems are designed to encourage user modification and provide users with a means of personalizing appearance, functionality, and information provision (Germonprez, Hovorka and Collopy, 2007). Personalized information provision processes employ user profiles to intelligently filter and push specific content to individuals. Personalization decreases user information overload and thereby improves the user experience (Liang et al., 2006). These capabilities include not just turning on latent capabilities, but also using building blocks or tool kits to create new capabilities. In their treatment of the user-modifiable artifact, Germonprez and colleagues specified nine principles of designing levels of tailorability into a system. Tailorability is seen as particularly important for users who value user representations within the system based upon expectations of repeated exclusive use of a personal artifact and based upon users facing unanticipated situations (Germonprez et al., 2007). Users can be empowered to make significant modifications to systems and will do so if the demands for customization are significant enough (von Hippel and Katz, 2002). To extend the concept, this paper further proposes that users will respond favorably to non-participatory designing if those users have the ability to tailor the system for themselves.

> *Proposition #1: In the context of non-participatory designing, system success will increase as tailorability increases.*

Second, reversibility represents the system's capability to allow a user to unwind/undo user triggered transactions. This capability includes reversing user actions when either an error (due to inattentiveness) or mistake (due to misunderstanding) is made. In this context, reversibility also includes the capability for the user to harmlessly try out scenarios and unwind them as needed. Design researchers have identified the importance of designing systems for the inevitable human error (Norman, 1990). Also the process of "trial and error" can be viewed as a significant building block of learning a new system (Weick, 2001). In addition, researchers have identified the benefit of selective undo capability in triggering user satisfaction as part of both individual and collaborative work (Prakash and Knister, 1992; Cass et al., 2006). As well, if user participation is limited

then opportunities for learning during the design phase will be limited. Therefore, learning must occur while the system is in production. This learning requirement calls for exploration and experimentation made possible via reversibility features. To extend the concept, this paper proposes that users will respond favorably to non-participatory design if the system demonstrates reversibility.

> *Proposition #2: In the context of non-participatory designing, system success will increase as reversibility increases.*

Third, trust-enhancement represents the system's capability to build reliance and confidence between users in the face of uncertainty and vulnerability. Relational issues are key elements of user satisfaction to attend to in participatory design (Markus and Mao, 2004). The proposition is that trust-enhancing features can address relationship-related concerns between groups that arise from non-participatory design. This current paper assumes three types of trust – commitment, companion, and competency (Newell and Swan, 2000). Genuine trust is built incrementally as commitments are explicitly made, monitored, and kept. Interpersonal trust can be enhanced by the system through documenting negotiations and commitments, as well as by enabling more frequent and multi-directional feedback (Kumar and Becerra-Fernandez, 2007). There is also a sensemaking component to the trust-building process - actors explicitly convey meanings through the system in an attempt to create social order (Kumar and Becerra-Fernandez, 2007). Trust is also seen as improving performance in teams that form around temporary episodes (Paul and McDaniel, 2004) and facilitated by computer-mediated communication (Jarvenpaa and Leidner, 1999). This current paper proposes that users will respond favorably to non-participatory design if the system enhances trust between users. The assumption inherent in this proposition is that as trust increases so does community through a sense of group identity and meaning, and that increasing a sense of online community positively affects system use. This assertion looks to address user concerns regarding non-participatory design that limits "affiliating" human interaction (i.e., interaction that allows workers to better make sense of the issues they face) by encouraging feelings of trust required to sustain online collaboration (Weick, 2001).

> *Proposition #3: In the context of non-participatory designing, system success will increase as trust-enhancement increases.*

These three feature sets are intended to counteract user concerns about their non-participation in system design. Tailorability could address user concerns about the non-participant design not meeting requirements. Reversibility could address user concerns about a lack of understanding in the face of system complexity and change. Trust-enhancing features could address user concerns about a lack of offline group identity (caused by non-participation concerns) by enabling online group identity with the system. The next section proposes research aimed at examining the effect of these features on system use and user satisfaction. Due to space constraints, a detailed methodology is not included in this paper, but a research overview is described below.

FUTURE RESEARCH

This section proposes research to examine non-participatory design that examines the efficacy of the above described technology characteristics in the context of public safety networks. Public safety networks (PSNs) are government-sponsored interagency collaborations focusing on emergency management and ongoing safety operations, and are enabled by interorganizational information and communication technology (Williams, Sawyer, Fedorowicz, Markus, Dias, Jacobson, Tyworth and Vilvovsky, 2008). PSNs consist of multiple agencies at multiple levels of government, but at least one member agency must be a policing unit. Fire Departments and Judicial agencies can also be members of PSNs, but the systems must support policing work. The designers and users of PSN-related systems face all the unresolved issues mentioned above. Designers face target user identification and requirements specification challenges and users face complexity and inter-organizational challenges due to the multifunction and multilevel nature of PSNs. Complexity is also increased due to the need to form temporary teams to address crisis public safety events like offender searches and natural disasters. Complexity and inter-organizational issues moderate the degree and manner in which user participation affect system success (Cavaye, 1995; McKeen and Guimaraes, 1997). Personal artifacts are also prevalent – particularly in-car technologies – and these artifacts can trigger user expectations of customization (Germonprez et al., 2007). Along these lines, researchers have noted the reality that information systems traditionally have been fitted to the structure and processes of policing organizations (Manning, 2003). Examining PSN collaborative information systems provides fertile ground to investigate how technology features influencing functional and relational outcomes affect user satisfaction in the wake of non-participatory designing. Table 3 below summarizes the research approach.

Method Element	Description
Data Source	• NSF-funded research project examining PSNs
Data Gathering	• Case Study (multi-PSN sample) • Experiment (technology characteristics used as variables in controlled interventions) • Survey (perception of user satisfaction)
Data Analysis	• Case Study: identify themes of software package use and scenarios when tailorability is permitted / encouraged • Survey : compare perceptions of user satisfaction before and after interventions to identify effect of each technology characteristic

Table 3 – Research Approach Summary

The research will move iteratively from descriptive investigation to prescriptive evaluation – starting with case studies of technology-in-use in PSNs and moving to experiments and surveys. Case studies can be conducted scientifically, and with the appropriate considerations for internal and external validity, they can provide researchers with rich data gathering for theory extension (Lee, 1989). Experiments will provide opportunities for more controlled analysis. Proposition testing will follow the conceptual model adapted from prior research (Markus and Mao, 2004) as well as guidance for design science researching (Hevner, March, Park and Ram, 2004). The outcome of interest will be considered system success as determined by individuals – and evaluation criteria again based upon literature (Sabherwal et al., 2006). These success criteria will be subjective measures at the individual unit of analysis as suggested by other tailorability and participation studies (Germonprez et al., 2007; Wagner and Newell, 2007). User satisfaction perceptions will be evaluated via survey instrument.

CONCLUSION

This paper discussed certain gaps in the IS design and user participation research literature that require further examination. IS design theory calls for specific attention to different types of systems used in different types of contexts by different types of users (participation theory has evolved similarly). The position of this paper is contrary to conventional wisdom regarding the necessary role user participation plays in system success and proposes to examine non-participatory design in the context of PSN-related systems based upon the use and user challenges these interagency collaborations face. This paper contributes to literature by offering a more contingent view of the participation-system success link. This paper also sets the stage for practitioner contributions by identifying possible design principles – tailorability, reversibility, and trust-enhancement – that can overcome challenges like the requirements-quality gap as well as user frustration. The important work performed by PSNs (which require high quality ICTs that satisfy functional and relational requirements) provides an additional incentive motivating this research.

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