

A Design Theory Approach to Incorporating Emotional Intelligence into Group Support Systems

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Abstract

Researchers in IS have conducted extensive research into various kinds of group support systems (GSS) over the last twenty-five years. A parallel stream of research in Management has developed an important body of research in organizational Emotional Intelligence (EI), which has been shown to contribute to the effectiveness of group interactions by increasing cooperation and reducing conflict. GSS technologies present a special opportunity to introduce soft management functions such as Emotional Intelligence because they are designed as a channel of interaction between group members. This article utilizes a design theory approach to highlight key features of a plan for integrating EI into GSS.

Background

Information system applications for group support have been described as decision support systems (DSS), group support systems (GSS), executive information systems (EIS), collaboration information systems (CIS) and related project management systems (Nunamaker et al. 2001; Power 2003). These systems have benefited from over two decades of research and development and have been deployed and evaluated in a wide variety of management contexts. In spite of the extensive research and development support for group support systems, they have met with mixed experimental success and limited adoption (Nunamaker et al. 2001).

Over the same period, researchers in Management and Psychology have developed an important body of research in organizational Emotional Intelligence (EI), which is broadly described as “the ability to manage ourselves and our relationships effectively” (Goleman 2000). Claims of benefit for EI stem from its ability to foster “learned capabilities . . . that result in outstanding performance at work” (Cherniss and Goleman 2001). Emotional Intelligence has been shown to contribute to the effectiveness of group interactions by increasing group cooperation and reducing interpersonal and group conflict (Cherniss 2003; Salovey and Mayer 1990). Many studies show a positive relationship between EI and improved managerial effectiveness, and a number of graduate business schools incorporate EI training into their management programs (Cherniss 2003; Cherniss and Goleman 2001; Shinn 2003).

Traditional GSS applications and research do not address soft management approaches such as the EI methods. Yet, GSS applications are dedicated to facilitating information flow and group interaction, two factors shown to improve as a result of EI training and practice. GSS technologies present a special opportunity to introduce soft management functions such as EI because they are designed as a channel of interaction between group members. Considered together, these factors suggest that designing GSS applications that incorporate Emotional Intelligence techniques may yield results that benefit organizations in many ways.

However, the question of how to design GSS applications with EI presents several unique challenges. First, information systems in general, and GSS in particular, have been designed with functions that assume and expect rational and uninhibited information flow by users and systems have not been designed to address the non-rational or emotional motives and behaviors commonly seen in work environments.¹ As a result, existing IS functionality models may be of limited benefit to the task of designing GSS with EI. New design theory must be developed to understand and develop systems that include EI as an integral part of the GSS application.

We are approaching this question with efforts on a number of levels. First, we must acknowledge the need to extend prior theory in group support systems, as

¹ There is clearly a place for functions that enhance computer-mediated group communication with added dimensions of meaning. A simple example is seen in the popular, grassroots practice of adding emoticons to e-mail and text messages.

well as other theoretical elements from IS. In addition, we must incorporate the findings of fields that inform the development of EI research – fields that are outside the traditional boundaries of IS.

An organizing framework for our review and analysis is the Information Systems Design Theory (ISDT) approach (Walls et al. 1992), which guides us in identifying and exploring a body of relevant contributing theories and integrating the results of this exploration into the design. The ISDT approach, as well as related concepts described as Improvement Research, Design Research and Design Science, have been the focus of significant research in Information Science over the last decade (Markus et al. 2002; Vaishnavi and Kuechler 2004; Walls et al. 1992). The design science approach to information systems research “seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts” in the form of information systems applications implemented in computer software (Hevner et al. 2004). In IS design research, increased understanding of the problem area is expected to result from the activities of building the artifact itself (Rossi and Sein 2003; Vaishnavi and Kuechler 2004)

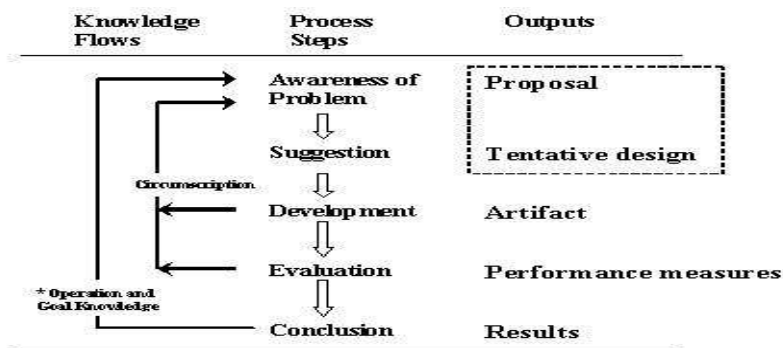


Figure 5. The General Methodology of Design Research

Figure 1: The ISDT Cycle (Vaishnavi and Kuechler 2004)

The following sections introduce several contributing theories, followed by a discussion of our use of the ISDT approach for the design of the system.

Kernel Theories and Disciplines

A key aspect of the ISDT approach is its reliance on incorporating research from contributing, or kernel theories. We have identified several kernel theory areas that can help us understand how a GSS with EI should be designed, and these can be classified into two broad research streams. The first is focused on organizational elements, and this research stream includes kernel theories and concepts from Emotional Intelligence, Organizational Conflict, and Virtual Organization. The second stream is focused on research related to information systems for group support, and these include research from Group Support Systems, Social Presence Theory, and Expert Systems.

Organizational Theory Areas

The past decade has seen significant management research in organizational Emotional Intelligence, which describes a specific set of competencies in the areas of self-awareness, social awareness, and the skills for managing relationships based on such awareness (Cherniss and Goleman 2001; Goleman 2000). The EI qualities and behaviors are believed to improve teamwork, improve employee commitment and morale, improve the ability to cope with change, and improve the ability to deal with large amounts of information (Cherniss 2003; Dulewicz and Higgs 2000). In addition, some researchers believe EI has a place in technology management and suggest that “you must develop your emotional intelligence, particularly social awareness or empathy, if you are to be a new CIO leader” (Broadbent and Kitzis 2005). Large studies of business executive performance indicate that effective leadership behaviors are associated with Emotional Intelligence functions (Goleman 2000). Economic benefits from organizational use of EI principles have been demonstrated in a number of studies over a fifteen year period (Shinn 2003; Spencer 2001).

Conflict is a wide-ranging phenomenon that afflicts most organizations. IT management environments are especially vulnerable to conflict and have been shown in a number of studies to be extensively affected by conflict (Barki and Hartwick 2001). The main elements of conflict derive from the development of opposing interests between individuals or groups, along with the belief or expectation that the opposing party will attempt to assert its interests over those of the primary party (Rahim 1992). Time-pressured IT management environments are especially vulnerable to conflict and a number of studies have

highlighted the extensively effects of conflict on IT projects (Barki and Hartwick 2001).

Three main categories of conflict are relevant to GSS-mediated organizational interactions: Relationship-based conflict, process-based conflict and task-based conflict (Jehn and Mannix 2001). All three are common in organizational environments in which GSS can be used, and recent simulation-based research suggests potential process benefits form use of groupware-based conflict reduction mechanisms for virtual teams (Burkhard and Horan 2005).

Individuals who interact within a GSS can be seen as members of a virtual team, regardless of their physical location, insofar as the interactions are conducted through online channels. A large body of research in virtual organization has addressed many aspects of how co-workers in virtual organizations interact using information technologies to accomplish organizational tasks (Mowshowitz 2002), and several key concepts from this research can inform the design of the GSS with EI. For example, communication efficiency is often reduced in virtual telecommunications that lack the cues provided in face-to-face interaction (DeSanctis and Monge 1998). In addition, interpersonal trust, a concept that is central to EI, has been shown to individually and collectively enhance or inhibit virtual collaboration (Paul and McDaniel 2004).

Group System Theory Areas

Group Support System research within IS has a rich and extensive history that has led to specific application designs (GroupSystems 2003; Nunamaker et al. 1991). Popular GSS applications, such as Groove and MS NetMeeting, are typically confined to pragmatic group communication and decision facilitation, and the functional boundaries of GSS are illustrated by a current classification of these tools as either as communications-focused, data-focused, document-focused, or model-focused (Power 2003). The intended utility of such applications is comparable to what might be accomplished by a co-located team equipped with whiteboards, note-taking devices, and spreadsheets, but with the benefits of greater efficiency and distributed, asynchronous communication.

The concept of social presence as mediated by information technologies has been studied in a variety of environments, beginning with telecom studies in the 1970s (Tu 2002). Social presence is highly relevant to the design of EI-enhanced groupware because of its interpersonal focus on “the degree to which a person is perceived as ‘real’ in a mediated environment” (Gunawardena and Zittle 1997). While integration of simple social presence mechanisms into computer-mediated conferencing environments has been shown to contribute to user satisfaction, other objectives of social presence that may inform the design of groupware include creating co-presence, stimulating psychological involvement and encouraging behavioral engagement (Biocca et al. 2001). Enhanced social presence can increase the effectiveness of groupware-based EI.

Research in expert systems can contribute to group support technologies by providing the means for intelligent advice and increasing overall group synergy (Aiken et al. 1991). For example, a GSS with EI can provide advisory functions that implement EI analysis in unique ways. Such a system can be designed with expert system functions that provide specific advice, based on analysis of the user's textual communication, intended to assist the user in implementing EI-based communication behaviors. A typical approach to applying expert technologies in such systems is to base the design on normative, predictive user models (Carroll and McKendree 1987) that would recommend particular actions, such as communication patterns based on EI.

Information Systems Design Theory as a Framework for Developing GSS with EI

The ISDT framework calls for integration of kernel theories into the design process and design product. In addition, ISDT is particularly appropriate for developing a system such as the GSS with EI because it "involves the analysis of the use and performance of designed artifacts to understand, explain, and very frequently to improve on the behavior of aspects of Information Systems (Vaishnavi and Kuechler 2004)." In the case of GSS/EI, we seek to improve the behavior of both the application and the system user, both of which are elements of the broader information system.

In addition, the ISDT approach is especially useful for GSS/EI research because the researcher applies circumscriptive methods to develop the knowledge base and generate “understanding that (can) only be gained from the specific act of construction (Vaishnavi and Kuechler 2004).” The construction and evaluation of the GSS/EI application will generate new knowledge in the unexplored domain of how information systems for soft management can be made effective (e.g., through functional features) and how organization members will respond to such new types of systems (e.g., a variety response behaviors is expected). In this way, the design of the GSS/EI research will employ the “artifact as an experimental apparatus (Vaishnavi and Kuechler 2004).”

The license to use an artifact as an exploratory, experimental tool is critically important in areas that have limited or no research precedent, such as in our effort to introduce soft management to IS. Using a battery of functional instantiations of EI in a series of test systems is a suitable and expedient way to begin integrating EI in an information system such as GSS.

The outputs of Information Systems Design Research should contain some or all of a number of key elements, including constructs, models, methods, instantiations and better theories (Vaishnavi and Kuechler 2004). These can be further organized into design products and design processes that incorporate meta-requirements, meta-design, kernel theories, and testable hypotheses (Olfman and Ryan 2002; Walls et al. 1992). Figure 2 shows the relationship

between the theory elements needed to inform the design of the GSS with EI, the ISDT Framework, and the instantiation.

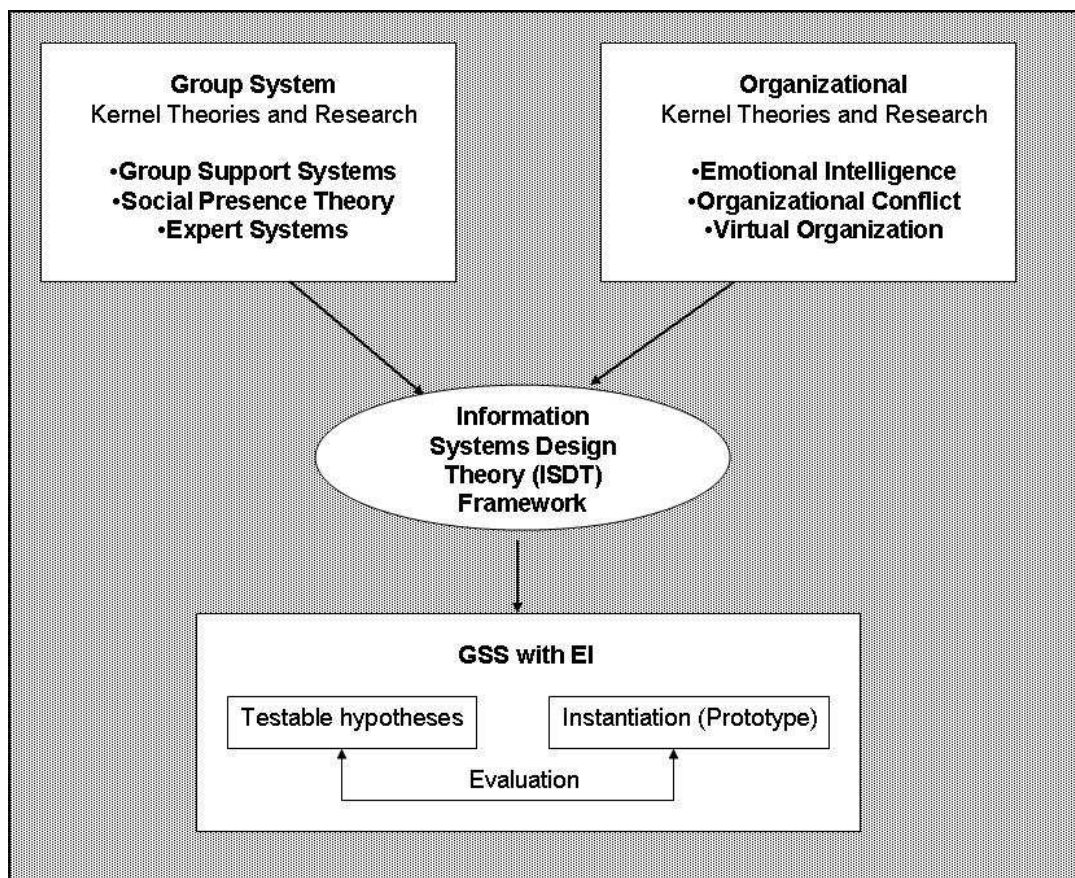


Figure 2: Design framework for GSS/EI

Following Walls, et al. (1991, 2005), and Olfman and Ryan (2002), we break the design plan into product elements and process elements. The product elements are discussed below.

Design Product Elements

First among the design product elements are the meta-requirements, or the goals addressed by the system of the type being designed. These include the following:

1. Ability to collect, store, modify, represent and distribute details of team communications
2. Ability to assist participants in direct application of EI principles to requisite team interoperation on project details, including:
 - a. Interpersonal/organizational conflict resolution
 - b. Adaptation to workplace timing and assignment stressors
 - c. Improved idea generation and information flow
 - d. Constructive communication and harmonious interaction

Next, the meta-design is introduced as the plan to enable the system to meet meta-requirements. The meta-design for the GSS/EI will include a database to store communications, interfaces for project participants, and active scripts and visualization interfaces for application of EI principles to project content.

Guidance for this design is drawn from the kernel theories group support (GSS, Social Presence, Expert Systems) and organizational interaction (Emotional Intelligence, Organizational Conflict, Virtual Organization).

The final elements of the design product plan are the testable design product hypotheses, which are propositions to about the satisfaction of meta-requirements by the meta-design. Our general hypothesis is that inclusion of EI into GSS tools will improve the product's ability to meet the meta-requirements of the design plan in terms of EI functionality and impact on GSS. As the cycle of circumscription informs our understanding of the particular needs presented by our system and its users, these hypotheses will gain increased specificity.

Some Requirements for Evaluating Conformance to Meta-Requirements

The next step in this research was testing and evaluation of a prototype system and the expanded task of deployment in user environment. ISDT calls for iterations of feedback to generate “understanding that can only be gained from the specific act of construction,” which in turn contributes to the “understanding of the always-incomplete- theories that abductively motivated the original design (Vaishnavi and Kuechler 2004).” Following this approach, the evaluation plan is focused on obtaining measures of the performance and effectiveness of the application to provide useful feedback to the design research development cycle and the theory base for applications of this type.

In this context, ISDT calls for the use of testable design product hypotheses. The general hypothesis for this study is that inclusion of EI into GSS tools will improve the product’s ability to meet the meta-requirements; In essence, these meta-requirements address the feasibility and effectiveness of a GSS that incorporates EI. Evaluation of the initial system instantiations will require the performance of the system be systematically compared to the meta-requirements. Table 1 provides a detailed definition of these elements as they are implemented in this GSS/EI research.

Table 1: Design Research Elements, Methods and Deliverables for GSS/E, after (Olfman and Ryan 2002; Walls et al. 1992).

Element	Definition	Implementation in GSS/EI
<i>Design Product Elements</i>		
Meta-requirements	Goals addressed by the system of the type being designed	<ol style="list-style-type: none"> 1. Ability to collect, store, modify, represent and distribute details of team projects 2. Ability to assist participants in direct application of EI and other kernel theory principles to requisite team interoperation on project details, including: <ul style="list-style-type: none"> • Conflict resolution and resistance-

		<p>lowering</p> <ul style="list-style-type: none"> • Adaptation to project timing stressors • Adaptation to project content stressors • Improved idea generation and information flow • Constructive communication and harmonious interaction
Meta-design	Plan for system to meet meta-requirements	The meta-design for the GSS/EI includes a relational database for project details, interfaces for project participants, and interactive scripts and visualization interfaces for application of EI principles to project content.
Kernel Theories	Theories from natural or social sciences that provide a conceptual bridge between meta-requirements and meta-design	The kernel theories for the GSS/EI will include: <ol style="list-style-type: none"> 1. Group Support System research and theories 2. Organizational Conflict research and theories 3. Emotional Intelligence Theories (which includes Sedona Method theories) 4. Secondary support from other IS theories, including Expert Systems, Virtual Organization, and Social Presence Theory
Testable design product hypotheses	Propositions to be examined regarding satisfaction of meta-requirements by meta-design	The general hypothesis is that inclusion of EI into GSS tools will improve the product's ability to meet the meta-requirements described above. A prototype GSS/EI will be constructed and evaluated in a user study for effectiveness and feedback to the design cycle.
<i>Design Process Elements</i>		
Design Method	Procedures to be used for construction of system	The design process specifies GSS/EI requirements and functionality, followed by construction of the database, general interfaces and EI interfaces, resulting in a working prototype of the system. The design process employs Use Cases, Activity, Sequence, Component and Deployment Diagrams as defined in the Unified Modeling Language.
Kernel Theories	Theories that support the design method	The design process uses theory from Information Science in the areas of database design (e.g., Relational Model), interface and network design.
Testable design process hypotheses	Propositions to be examined regarding whether the design method produces an acceptable system	The general hypothesis is that inclusion of IS and HCI kernel theories will result in a more thoroughly specified and functional system than could be designed without such theories.

Linking Kernel Theories to Design: A Nomological Design

Network Approach

A design approach that begins with kernel theories and meta-requirements must eventually proceed to designed artifacts, and continuity of guiding concepts is needed as the design moves from abstraction to realization. The challenge of maintaining this continuity arises in the effort to generate specific, appropriate and useful design hypotheses from general ones, as well as the challenge of defining design classes and instantiations from meta-requirements. These challenges can be approached systematically through a method that can be described as a nomological design network.

The concept of the nomological network was introduced as a method of articulating strict connections between constructs, related constructs, and their measures (Chronbach and Meehl 1955). Although the nomological network approach is often applied in social science to link theory to measurement, the core concept of the network is “an interlocking system of laws which constitute a theory” and these laws can link “theoretical concepts to observables” (Chronbach and Meehl 1955). In information systems design, this approach to traceability can serve as a model for the specification of the conceptual linkages between theoretical levels, such as ISDT kernel theories and general hypotheses, and the realization levels of specific hypotheses and observable design elements.

Figure 3 illustrates the relationship between kernel theories, hypotheses, design classes and design instances as approached in this research.

Figure 3: Concept of the Nomological Design Network

Hypotheses Derived from Kernel Theories

Following this approach, we identify a set of propositions or hypotheses that derive from our organizational kernel theories (Emotional Intelligence, Organizational Conflict, Virtual Organization) and our GSS/IS kernel theories (Support Systems, Social Presence Theories, Expert System Theories). The following list groups hypotheses by kernel theory category.

Propositions (hypotheses) for design of the EI-enhanced GSS:

1. Organizational / Management Kernel Theory: Emotional Intelligence

- a. A Group Support system can effectively incorporate mechanisms for assisting Emotional Intelligence based Self-Awareness (Including self-observation, self-assessment, and recognizing a feeling (such as resistance to an individual or a group) as it happens), as discussed, for example, in (Cherniss and Goleman 2001; Dvoskin 2003).
 - b. A Group Support system can effectively incorporate mechanisms for assisting Emotional Intelligence based Social Awareness (Including empathy and organizational awareness).
 - c. A Group Support system can effectively incorporate mechanisms for assisting Emotional Intelligence based Self Management (Including self-control, initiative and optimism).
 - d. A Group Support system can effectively incorporate mechanisms for assisting Emotional Intelligence based Relationship Management (Including conflict management, teamwork and collaboration).
2. Organizational / Management Kernel Theory: Organizational Conflict
- a. A Group Support system can effectively incorporate mechanisms for addressing Organizational Conflict by providing means to represent incompatibility, disagreement, or dissonance as discussed, for example, in (Jehn and Mannix 2001; Rahim 1983).
 - b. A Group Support system can effectively incorporate mechanisms for addressing Organizational Conflict by providing means to make explicit hidden attitudes about problematic nature of issues, as discussed, for example, in (Baron 1990).
 - c. A Group Support system can effectively incorporate mechanisms for addressing Organizational Conflict by providing means to inform (train) users in conflict-handling methods, as discussed, for example in (Jehn and Mannix 2001).
3. Organizational / Management Kernel Theory: Virtual Organization
- a. A Group Support system can effectively incorporate mechanisms for addressing issues of Virtual Organization by providing means to reduce the impersonal character of technology-mediated interactions, as discussed, for example, in (Straus and McGrath 1994).
 - b. A Group Support system can effectively incorporate mechanisms for addressing issues of Virtual Organization by is providing means for social context cues such as those that are seen in face-to-face interaction, as discussed, for example in (DeSanctis and Monge 1998).
4. IS Kernel Theory: Group Support Systems
- a. A Group Support system with EI can effectively incorporate mechanisms for facilitating group interaction by implementing a set

- of classic GSS functions, as discussed, for example, in (Gopal and Prasad 2000; Power 2003).
- b. A Group Support system with EI can effectively incorporate mechanisms for addressing “risk aversion, (and) how to recognize differences concerning assumptions, goals and understanding (in group decision situations)” as discussed in (Alter 2003).
5. IS Kernel Theory: Social Presence Theories
- a. A Group Support system can effectively incorporate mechanisms for addressing Social Presence by providing means to stimulate psychological involvement and encouraging behavioral engagement , as discussed in (Biocca et al. 2001).
 - b. A Group Support system can effectively incorporate mechanisms for addressing Social Presence by providing means to increase “the degree to which a person is perceived as ‘real’ in a mediated environment,” as discussed in (Gunawardena and Zittle 1997).
6. IS Kernel Theory: Expert Systems
- a. A Group Support system can incorporate mechanisms for providing intelligent advice, as discussed, for example, in (Aiken et al. 1991)
 - b. A Group Support system can effectively incorporate mechanisms for providing guidance based on normative, predictive user patterns, as discussed in (Carroll and McKendree 1987)

Completing the Design Sequence: Specification of Design

Classes and Design Instances Based on Hypotheses

Based on the kernel theories and hypotheses, six design classes were defined, and a total of twenty-one object instances were defined and constructed as part of the testable artifact. Table 2 provides a general description of these design characteristics.

Table 2: Object Classes, Instances and Kernel Theories for EI-enhanced GSS

I T E M	Object Class	Object Instance Name	Description	Kernel Theory Sources: Design²	Kernel Theory Sources: Content	Presentation to Subject (GSS user)
1	Personal Stress Indicator	<i>Stress Meter</i>	Personal stress / emotional intensity indicator; Green, yellow, red temperature gauges	GSS, EI, SP, VO	EI; OC, Horan, ³ Riggio	Active selection by subject
2	Group Stress Indicator	<i>Group Stress Meter</i>	Presents average of group stress level; Large green, yellow, red gauges	GSS, EI, SP, VO	EI; OC, Horan, Riggio	Fixed indicator with automatic status update
2	Wordfinder	<i>Emotion Word Finder</i>	Programmed dynamic word recognition of stress (e.g. fear, anger) words; Total base words = 75 Variants = 15 Total linked variants = 90	GSS, EI, ES	EI, OC, GPL	Linked; Active selection by subject
3	Advisor	<i>* Dissatisfied</i>	Advisory text; requests acknowledgement	EI, ES	EI, OC	Pseudorandom Selection Set
4	Advisor	<i>* Emotions in Others</i>	Advisory text; requests acknowledgement	EI, ES	EI, OC	Pseudorandom Selection Set
5	Advisor	<i>* Stress Signals in Others</i>	Advisory text; requests acknowledgement	EI, ES	EI, OC	Pseudorandom Selection Set
6	Advisor	<i>* Awareness</i>	Advisory text; requests acknowledgement	EI, ES	EI, OC	Pseudorandom Selection Set
7	Advisor	<i>* Emotions are Energy</i>	Advisory text; requests acknowledgement	EI, ES	EI, OC	Pseudorandom Selection Set
8	Advisor	<i>* Responsibility</i>	Advisory text; requests acknowledgement	EI, ES	EI, OC	Pseudorandom Selection Set
9	Advisor	<i>* Go For It</i>	Advisory text; requests acknowledgement	EI, ES	EI, OC	Pseudorandom Selection Set
10	Advisor	<i>* Inner Motives</i>	Advisory text; requests acknowledgement	EI, ES	EI, OC	Pseudorandom Selection Set
13	Advisor	<i>* Listen and Clarify</i>	Advisory text; requests acknowledgement	EI, ES	EI, OC	Pseudorandom Selection Set
14	Advisor	<i>* Signals</i>	Advisory text; requests acknowledgement	EI, ES	EI, OC	Pseudorandom Selection Set
15	Advisor	<i>* Emotion Power</i>	Advisory text; requests acknowledgement	EI, ES	EI, OC	Pseudorandom Selection Set
16	Advisor	<i>* Feedback</i>	Advisory text; requests acknowledgement	EI, ES	EI, OC	Pseudorandom Selection Set
17	Advisor	<i>* Feel and Acknowledge</i>	Advisory text; requests acknowledgement	EI, ES	EI, OC	Pseudorandom Selection Set

² Acronyms: EI = Emotional Intelligence, OC = Organizational Conflict, VO = Virtual Organization, ES = Expert Systems, GSS = Group Support Systems, SP = Social Presence, GPL = General Psychology Literature

³ Personal communication

18	Interactor	<i>Recognizing your feelings</i>	Text based advisor with brief dialogue that incorporates and responds to subject statements	EI, ES	EI, OC	Active selection by subject
19	Interactor	<i>Responding to Others by Communicating Feelings</i>	Text based advisor with brief dialogue that incorporates and responds to subject statements	EI, ES	EI, OC	Active selection by subject
20	Interactor	<i>Handling Resistance in Others</i>	Text based advisor with brief dialogue that incorporates and responds to subject statements	EI, ES	EI, OC	Active selection by subject
21	Releaser	<i>Releaser</i>	Text based advisor with dialogue; Implements Sedona Method	SM, ES	SM	Active selection by subject

Potential Implications for Design Research

This research initiates the development of a new category of socio-technical theory, tentatively described as *theories of soft management through information systems*. This appears to be a broad and fertile area that holds much promise for theory generation and testing, but it is also one that has minimal design precedent. Few information system designs draw as heavily from social science models that have not been applied in computer-based environments.

Nevertheless, our research model suggests that the socio-technical interaction of organizational participants and the information system will yield new phenomena and knowledge that will in turn require unique design approaches to guide further development.

This design challenge presents a number of unique opportunities. Design and evaluation of the GSS/EI application will generate new knowledge in the unexplored domain of how information systems for soft management can be made effective (e.g., through functional features) and how organization members will respond to such new types of systems (i.e., a variety of utilization and response behaviors is expected). In addition, the research will contribute to the emerging area of Information Systems Design Theory by adding to the example applications developed in the context of ISDT.

Finally, we should note that this design has been constructed and tested, and the analysis of the results is currently underway. We hope this analysis will yield useful insights to guide subsequent iterations of the design cycle as we attempt to strengthen the contribution of EI to group support systems.

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