

## **Collaborative System Building**

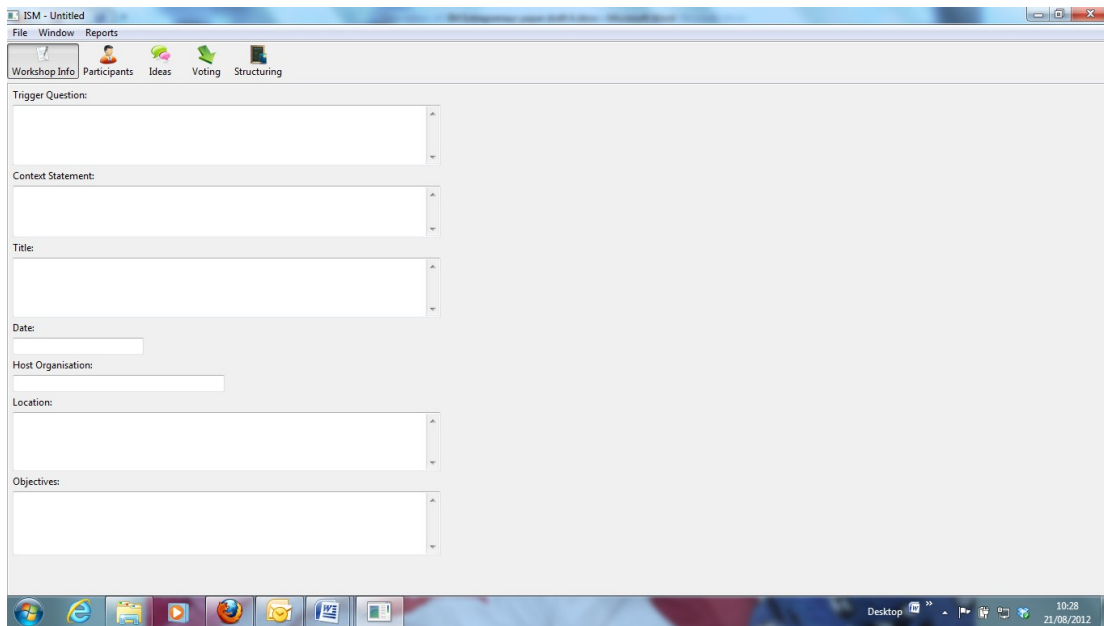
Perhaps the greatest challenge we face in the modern world is the challenge of effective collaboration. In business and educational settings, working groups often fail to solve complex problems because their method of collaborative problem solving is ineffective. Decades of research in social psychology and cognitive science highlight the many limitations of group problem solving, including the tendency to focus on a limited set of ideas, select ideas based on biased 'rules of thumb', and failure to build trust, consensus and collective vision. We have developed a new software tool that helps groups to structure the many and varied ideas that are often generated when a group comes together to 'brainstorm' solutions to problems. Our software tool allows groups to first identify important ideas and next, using algorithms derived from principles of logic and mathematics, develop a model describing how ideas are related in a system. The software and associated methodology is very useful in situations where a group wants to understand a complex situation and design a roadmap for action built upon consensus, trust, and a collective vision.

We have used our new software in a variety of business and educational settings to help groups to understand and resolve complex problems and to build their strength and creativity and team spirit (see below, **Full Technical Description** and attached **Sample Report**). We are currently looking for a business partner to further develop our software and it's applications in a global, online environment.

The following screenshots are taken from our current implementation of this methodology and represent the following interfaces: (1) Trigger Question and working group objectives; (2) Working group members; (3) Ideas generated by the group; (4) Selecting ideas based on group voting; (5) Structuring selected idea to produce a consensus model.

## 5 easy steps

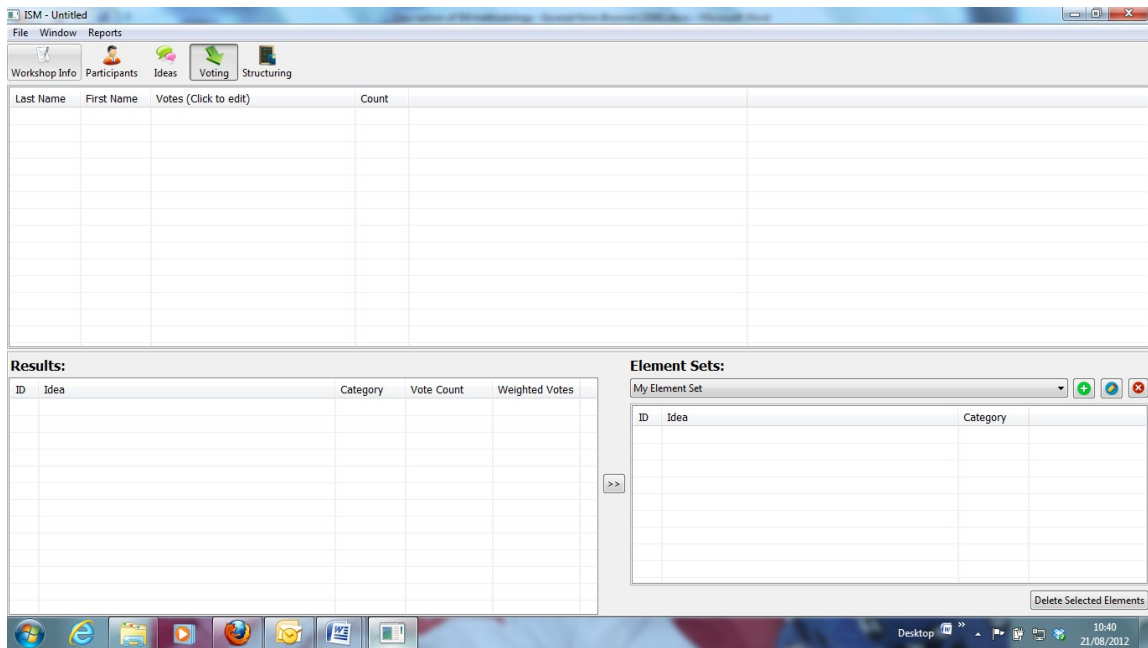
1. **Identify the trigger question that prompts creative ideas from group members**



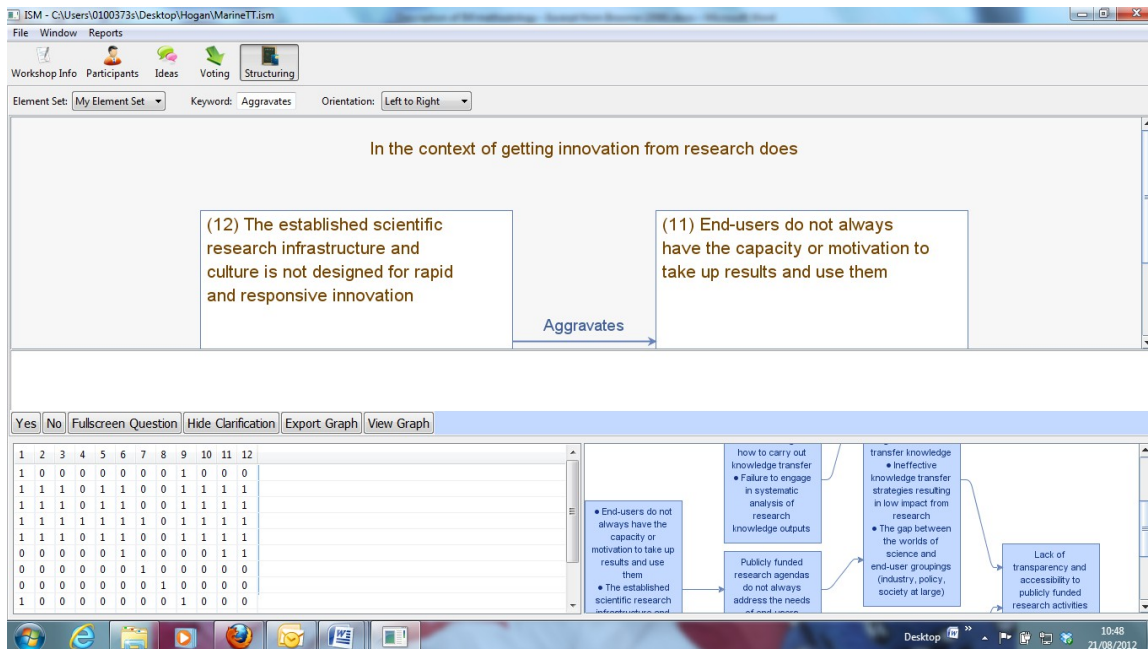
The screenshot displays the ISM software interface. The window title is "ISM - Untitled". The menu bar includes "File", "Window", and "Reports". The main toolbar contains icons for "Workshop Info", "Participants", "Ideas", "Voting", and "Structuring". The "Workshop Info" section is active, showing a form with the following fields: "Trigger Question:", "Context Statement:", "Title:", "Date:", "Host Organisation:", "Location:", and "Objectives:". Each field is represented by a text input area with a small upward-pointing arrow on the right side. The Windows taskbar at the bottom shows the system tray with the time "10:28" and date "21/08/2012".



4. Individual group member vote to select the most important ideas and votes are aggregated across the group to produce a consensus set



5. Structure selected ideas to produce a consensus model



## **Full Technical Description**

Our software builds upon the work of John Warfield, past president of the International Society for the Systems Sciences. Specifically, we are further developing Warfield's Interactive Management (IM) methodology. Based on Warfield's (1994) science of generic design, the IM process is a system of facilitation and problem solving that helps groups to develop outcomes that integrate contributions from individuals with diverse views, backgrounds, and perspectives. Established as a formal system of facilitation in 1980 after a developmental phase that started in 1974, IM was designed to assist groups in dealing with complex issues (see Ackoff, 1981; Argyris, 1982; Cleveland, 1973; Deal & Kennedy, 1982; Kemeny, 1980; Rittel & Webber, 1974; Simon, 1960). The theoretical constructs that inform IM, developed over the course of more than 2 decades of practice, draw from both behavioral and cognitive sciences, with a strong basis in general systems thinking.

The IM approach carefully delineates content and process roles, assigning to participants responsibility for contributing ideas and to the facilitator responsibility for choosing and implementing selected methodologies for generating, clarifying, structuring, interpreting, and amending ideas. Emphasis is given to balancing behavioral and technical demands of group work (Broome & Chen, 1992) while honoring design laws concerning variety, parsimony, and saliency (Ashby, 1958; Boulding, 1966; Miller, 1956). IM has been applied in a variety of situations to accomplish many different goals, including assisting city councils in making budget cuts (Coke & Moore, 1981), developing instructional units (Sato, 1979), designing a national agenda for pediatric

nursing (Feeg, 1988), creating computer-based information systems for organizations (Keever, 1989), improving the U.S. Department of Defense's acquisition process (Alberts, 1992), promoting world peace (Christakis, 1987), improving Tribal governance process in Native American communities (Broome, 1995a, 1995b; Broome & Christakis, 1988; Broome & Cromer, 1991), and training facilitators (Broome & Fulbright, 1995).

In a typical IM session, a group of participants who are knowledgeable about a particular situation engage in (a) developing an understanding of the situation they face, (b) establishing a collective basis for thinking about their future, and (c) producing a framework for effective action. In the process of moving through these phases, group members can develop a greater sense of teamwork and gain new communication and information-processing skills.

IM utilizes a carefully selected set of methodologies, matched to the phase of group interaction and the requirements of the situation. The most common methodologies are the nominal group technique, ideawriting, interpretive structural modeling, and field and profile representations. The first two methodologies are primarily employed for the purpose of generating ideas that are then structured using one or more of the latter three methodologies.

The *nominal group technique* (NGT; Delbeq, Van De Ven, & Gustafson, 1975) is a method that allows individual ideas to be pooled, and is best used in situations in which uncertainty and disagreements exist about the nature of possible ideas. NGT involves five steps: (a) presentation of a stimulus question to participants; (b) silent generation of ideas in writing by each participant working alone; (c) "round-robin" presentation of ideas by participants, with recording on flipchart by the facilitator of these ideas and posting of the

flipchart paper on walls surrounding the group; (d) serial discussion of the listed ideas by participants for sole purpose of clarifying their meaning (i.e., no evaluation of ideas is allowed at this point); and (e) implementation of a closed voting process in which each participant is asked to select and rank five ideas from the list, with the results compiled and displayed for review by the group.

*Ideawriting* (Warfield, 1994) is a method that utilizes relatively small groups of 4-6 persons each, formed by dividing a larger group into several working teams, for the purpose of developing ideas and exploring the meaning of those ideas through open discussion. Ideawriting involves five steps: (a) presentation of a stimulus question to participants; (b) silent generation of ideas in writing by each participant working alone; (c) exchange of written sheets of ideas among all group members, with opportunity for individuals to add ideas as they read others' papers; (e) discussion and clarification of unique ideas; and (f) an oral report of the ideas generated by each working group in a plenary session. In this plenary session, duplicate ideas across the working groups are eliminated from the set and new ideas (if any) are added; the resulting set of ideas is then ready for use in the next stage of the group's work, which might involve one or more of the following methodologies.

*Interpretive structural modeling* (ISM; Warfield, 1994) is a computer-assisted methodology that helps a group to identify relationships among ideas and to impose structure on those ideas to help manage the complexity of the issue. Specifically, the ISM software utilizes mathematical algorithms that minimize the number of queries necessary for exploring relationships among a set of ideas (see Warfield, 1976). ISM can be used to develop several types of structures depicting the relationships among a set of ideas,

including influence structures (e.g., “supports” or “aggravates”), priority structures (e.g., “is more important than” or “should be learned before”) and categorizations of ideas (e.g., “belongs in the same category with”). The five steps of ISM are: (a) identification and clarification of a list of ideas (using a method such as NGT or ideawriting); (b) identification and clarification of a “relational question” for exploring relationships among ideas (e.g., “Does idea A support idea B?,” “Is idea A of higher priority than B?,” or “Does idea A belong in the same category with idea B?”); (c) development of a structural map by using the relational question to explore connections between pairs of ideas (see below); (d) display and discussion of the map by the group; and (e) amendment to the map by the group, if needed.

In the third step of developing a structural map, questions are generated by the ISM software and are projected onto a screen located in front of the group. The questions take the following form:

*“Does idea A relate in X manner to idea B?”*

“A” and “B” are pairs of ideas from the list developed by participants in the first step of ISM and the question of whether they “relate in X manner” is the statement identified in the second step.

For example, if a group is developing an influence structure with problem statements, the question might read:

*“Does problem A significantly aggravate problem B?”*

Using the ISM methodology, the group engages in discussion about this relational question and a vote is taken to determine the group’s judgment about the relationship. A “yes” vote is entered in the ISM software by the computer operator if a majority of the



participants see a significant relationship between the pair of ideas; otherwise, a “no” vote is entered. Another pair of ideas is then projected on the screen in front of participants, another discussion is held, and a vote is taken. This process is continued until the relationships between all necessary pairs of ideas have been explored. The ISM software then provides to the facilitator the information from which a structural map can be constructed, showing the result of the group’s series of judgments about pairs of ideas. The length of time required to complete discussion of all necessary pairs of ideas depends on the total number of ideas in the set, but, generally, the process requires between 3-5 hours of group deliberation. The number of necessary queries also depends on the total number of ideas in the set, but the ISM software is able to infer during the structuring process an average of approximately 70-80% of the judgments involved in relating the complete set of ideas.

The influence structuring work conducted with ISM can be considered an activity in “mapping perceptions” of the group members. Participants are given the opportunity to explore connections and links between ideas in ways that probably would have gone undetected without such structuring work. ISM can, thus, provide participants with useful insights into the relationships between ideas and it generates a product, a structural map of those relationships, which can guide their thinking as they design potential solutions.

*Field representation* (Warfield & Cardenas, 1995) organizes ideas in a way that allows a large amount of information to be worked with effectively. There are different types of field representations that are useful for different types of applications, but, typically, a field representation portrays a significant amount of information organized in a form that (a) is appropriate for use in making decisions and (b) maintains an ongoing,

visible record of intermediate decision making en route to a final portrayal of the total set of choices that has been made. A field representation shows a set of categories and the members of each of those categories. When appropriate, the group might engage in a structuring process (using ISM) to sequence the categories according to agreed-on criteria.

The portrayal of choices in the field representation technique constitutes a *profile representation*. In constructing a profile, a group examines the first category of the field and chooses elements from that category. Each choice is represented graphically by drawing a line from the bullet in front of a selected element down to a “tie line,” a continuous line drawn at the base of the graphic, beneath the full category set. After all choices are made, the selected elements are connected to the tie line; all elements that have not been selected remain unconnected. In this way, the viewer is presented with a graphical portrayal of both selected items and the full set of items considered for inclusion in the final product.

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