

Improving Requirements Elicitation and Synthesis Using Group Decision Support and Virtual Teams

Joseph J. Romano, Ph.D. and Mary E. Crannell¹
Science Applications International Corporation
McLean, Virginia

Abstract. This paper describes a methodology for improving the elicitation and synthesis of systems requirements using group decision support and virtual teams. An approach to implementing this methodology using two of the premiere tools in their respective genres is also provided. Use of the methodology and tools presented in this paper provides the means for improving the speed and cost-effectiveness of requirements development, while achieving greater consensus and more accurately representing the needs of the organization and individual users. This approach is particularly relevant in highly-decentralized and geographically-dispersed organizations.

Keywords. Requirements, decision support, consensus building, virtual teams.

INTRODUCTION

Good requirements are the foundation for building good systems. Likewise, poor requirements are frequently a major factor in the failure of systems development efforts. The problem in achieving good requirements is that elicitation and synthesis (i.e., interpretation, consolidation) of requirements are often very time consuming and expensive efforts; with the final product not truly representing the needs of an organization as a whole or even the majority of the individual users. This paper describes a methodology for improving the elicitation and synthesis of requirements using group decision support and virtual teams. An approach is presented for applying this methodology using CoNexus and Caucus, two of the premiere software tools in their respective genres.

The potential for severe negative impacts from inadequate requirements is an old and

continuing problem that has been extensively documented in scholarly research (Charette, 1986) and reported in the newspapers. Since the inadequacies or errors in requirements propagate throughout the subsequent development activities, it is simple to understand why good requirements are so important. Although this situation is understood by many people involved in systems development, traditional methods of eliciting and synthesizing requirements are time consuming, expensive, and often fail to produce good requirements. The use of the proposed methodology and associated tools provides the means for improving the speed and cost effectiveness of creating requirements. This methodology also produces requirements that possess greater creativity and a consensus that more accurately represents the needs of the organization and its users.

In this paper, the problems and pitfalls of traditional elicitation, interpretation, and consolidation of requirements are first examined. These problems include limited access to the critical personnel resources, manually intensive processes, excessively long schedules, and parochial input. The ways these problems are addressed using the proposed requirements elicitation and synthesis methodology are then presented. This methodology uses an innovative application of current technology for group decision support and virtual team interaction. An approach for implementing this

¹ Mary Crannell is now at **Idea Sciences** and can be reached at Mary.Crannell@ideasciences.com.

methodology using CoNexus software for group decision support and Caucus software for virtual team conferencing is described. Key considerations for increasing the effectiveness of using these types of tools are also provided.

DESCRIPTION OF THE METHODOLOGY

Overview. The traditional method for eliciting and synthesizing requirements typically involves interviewing key personnel and extracting information from existing system documentation. This information is then segregated and consolidated into a draft requirements document that is distributed for review and comment. Resolution of comments for production of the final set of requirements may then be achieved through additional individual interviews with the reviewers, in group meetings, or unilaterally by a single decision-maker.

There are many problems with the preceding process stemming from the face-to-face, one-on-one and serial nature of the activities. Because of work pressures and location differences, access to key personnel needed to develop the initial requirements set can be difficult to achieve in a timely manner or limited because of cost implications. (This problem is a long-standing one, but it is exacerbated by the emergence of today's global economy and virtual organizations).

The review process may also be extended, or inadequately performed in some cases, because of competition from a reviewer's other work or documents on the "stack". Resolution by analysts of difficult-to-understand comments or contrary input from different reviewers may require difficult-to-schedule personal interviews, or may not be achieved at all because of time or cost implications. The result can be a set of requirements that cost a lot, took too long to develop, lacks creativity, is incomplete, or

does not represent a true users' consensus of what the system must achieve.

The proposed group and virtual team methodology for requirements elicitation and synthesis improves on the traditional methodology through the use of processes and tools that facilitate group decision making and virtual team collaboration. The end result of this process is a set of requirements that better represents the needs of the organization, have greater support within the organization, and can be developed in a shorter time and with less cost than a comparable set of requirements using the traditional method.

This methodology first introduces a creative technique to help assess how well existing systems meet individual needs and to identify requirements based on the future goals rather than past problems. Group decision support products can be used in conjunction with this process to frame and focus the needs and priorities of multiple stakeholders in the early stages of the requirements development lifecycle.

The underlying decision support approach is particularly adapted to obtaining results under conditions of problem uncertainty, where significant changes to the *status quo* will be required, and in resolving issues that have no successful precedent. These types of conditions are often precipitated by major changes in the competitive environment or organization. This approach is particularly effective in large and geographically distributed organizations, and it is especially useful with systemic problems that are not easily measured or affect many individuals and/or operating units.

After the requirements elicitation has been performed, the proposed methodology provides the means to efficiently consolidate the requirements set and achieve broader reviews, solicit additional comments, and facilitate consensus building throughout an

organization. These objectives can be accomplished through the use of virtual team collaboration and support processes and tools. Because these tools can be used asynchronously over a network, geographic boundaries and personnel availability limitations can be substantially overcome. However, as described in this paper, exercising the proper techniques in implementing and facilitating the use of this type of software can greatly enhance the results attained.

There are three main steps in the proposed group and virtual team requirements development methodology. These steps, shown in Figure 1, are performed primarily in sequence, although feedback and iterations between steps can be introduced to resolve any particularly difficult issues. As described in the following sections, each step consists of several processes and has basic components that are critical to the success of that step.



Figure 1. Three Primary Steps in the Group and Virtual Team Methodology

Step 1 - Group Requirements Development. In the first step of this methodology, one or more groups of key individuals are brought together to create and give priority to a set of requirements. This session, or sessions, is scheduled at the time and location that is the most convenient and achievable for the most key personnel, within time and budget constraints. At this session, or sessions, a group decision support tool supported by a facilitator trained in the associated methodology is used to develop an initial set of system requirements and priorities.

There are three basic components of the group requirements development step:

1. A facilitator: a trained employee or consultant who guides both the process and use of the technology.
2. A facilitator methodology: a structured process composed of steps and skills. The process leads to a shared understanding of desired results, necessary tasks, and effective relationships
3. A decision-support technology: computer hardware and software to enhance the ability to analyze and visually represent the opinions of the participants.

One methodology and associated technology that is particularly effective for the above purpose is CoNexus, from Leadership 2000. CoNexus is a computer-assisted group decision-making methodology that taps the intelligence of groups, enabling them to be more productive, effective, and creative (Land, 1998). This system, created in 1978 by George Land, increases productivity by enabling groups to take advantage of their collective creativity and to test the practicality and effectiveness of potential innovations quickly and thoroughly. Today, more than 200 major corporations and organizations worldwide are licensed to use the latest generation of CoNexus techniques and products.

The group requirements development session, shown in Figure 2, consists of eight processes designed to encourage participation, foster creativity, and obtain consensus using handheld CoNexus keypads and presented visually in the associated CoNexus software. In this session, the demographics are first collected. Creativity is fostered and the ideal system attributes are identified. Then, the participants evaluate the attributes, creating an x-y axis profile of the ideal system. Once they have established a vision of the ideal system, the group identifies the specific characteristics (i.e. requirements) of the system to be developed.

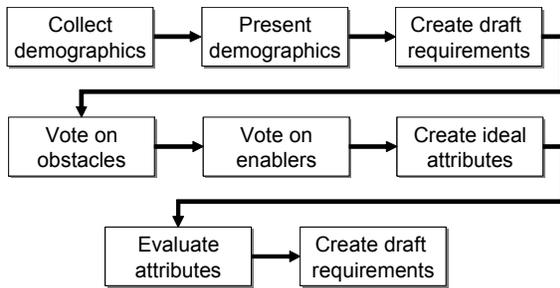


Figure 2. Group Requirements Development Processes

There are four basic principles that serve as the foundation for both the group and virtual sessions.

1. An acceptable picture of complex system needs is best revealed through the group interaction of appropriate people, rather than by piecing together separate versions from individual interviews
2. Identification of complex information or other types of systems requirements resides in many people, not just one person.
3. The end users are the best source of information about needs, even though a facilitator's help in defining them may be required. The facilitator is the best means for guiding these efforts.
4. It is better for the facilitator to ask questions than to give answers. The more ownership established by the group members in the results of this activity, the more willing they will be to aid in meeting them.

The facilitator begins the session by eliciting information about the group to understand its composition, and then sets the stage for the remainder of the activities by reviewing the session objectives. For example, the group may be tasked with creating an executive decision support system for an organization. As part of this process, the facilitator encourages the group to be creative and willing to expand their perspectives of possible needs and solutions.

Creativity is a natural occurrence that uses two distinctly different kinds of thinking: divergent and convergent. Divergence is free and uninhibited thought that produces many alternatives. Convergence is focused and evaluative, and is used to select from among alternatives. Throughout implementation of this group and virtual team methodology, the participants alternate between these two types of thinking. In order to mitigate possible fears of repercussions for unpopular ideas or positions that may be an obstacle to the group's creativity, private polling and anonymity can be used as part of this process.

The next set of processes consists of three series of list-making activities that are aimed at finding potential obstacles, enablers, and the attributes of the ideal system. The first exercise provides a list of answers to the question: "What are all the things that might stand in the way of achieving the ideal system?" The group is also solicited to provide answers to the question, "What are all the resources we have or might get that would help us achieve this objective?" Group input is then used to create an ideal attribute list. In this case, the key question is, "Imagine we have achieved the ideal system. Looking back, what made it so perfect?"

The group then votes to determine importance and satisfaction weights associated with the system attributes derived from the previous set of processes. Participants input their preferences by using handheld keypads and the results are immediately displayed in a four-quadrant profile using CoNexus software. An example of this profile is shown in Figure 3.

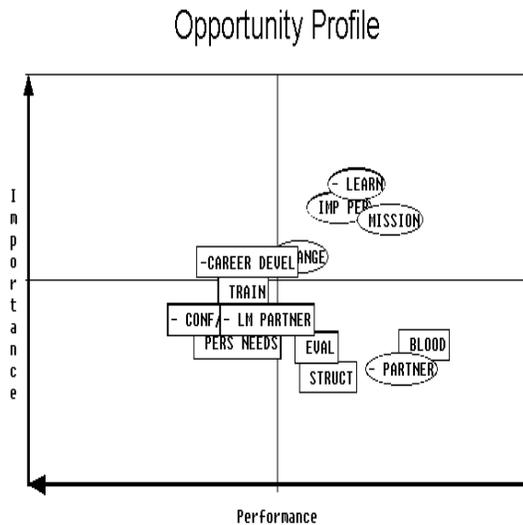


Figure 3. Sample Preference Profile

The first votes are to determine importance: “Imagine we have achieved the ideal information system and have done all of these attributes. The task is to select the attributes that contribute the most to creating this ideal system and assign points (1, 2, or 3) to indicate how much.” The second votes are on satisfaction (e.g. performance): “To what degree do we have these today, on a scale of 1 through 9?” The final step is termed a history vote: “Have we put resources into accomplishing this?” Upon completion of the voting, the facilitator displays the results that include these attributes. These results indicate the current critical user needs, near and long-term future needs, unmet expectations, areas of end-user satisfaction, and areas in which the end-user may be overly satisfied.

The facilitator then reviews the evaluated attributes with the participants and adds new perspectives by asking previously unasked questions and highlighting possible unseen solutions. To accomplish this in the group requirements development sessions, the facilitator must completely enter the perceptual world of the group to get an accurate reflection of the stakeholders's needs. In doing so, the facilitator builds trust and

establishes rapport with the group. Under these circumstances, the group is more likely to make known real problems, priorities, and opportunities. The facilitator may also learn what the group is actually willing to do about the issues, to verify the resources that could and would be allocated, and to confirm how decisions will be made.

Upon completion of the preceding attribute review, the facilitator will identify areas where users indicated critical system features to be included in the requirements set and areas requiring clarification before the requirement draft can be finalized. This process is aided by using the CoNexus methodology and tools, because the facilitator can use group responses to:

1. Rank the importance of the requirements, relative to each other, through computerized voting.
2. Rate each requirement based on how well this requirement is being met with the current system
3. State whether this is a new or old requirement.

Depending on the system complexity, more than one session may be required to completely craft the draft requirements set.

As a result of this set of processes there is a collective, up-front agreement and acceptance within the group of what the system is to accomplish and the associated order of importance. This often includes new, unforeseen scenarios and forms a firm basis for the subsequent review and comment by the broader (virtual) user audience in the next step.

The visual and graphics capabilities provided by the CoNexus software allows immediate presentation of group opinions. This information often promotes discussions and redefinition of the group's needs and resources. Together, these features form a seamless means of exploration and strategic alignment of the group that imbues a sense of personal ownership and commitment to the requirements that emerge.

Use of CoNexus for this application has been shown to reduce the time spent in end-user requirements gathering by an estimated 50 percent and decreases the number of times a redesign is necessary by 30 percent. The quality of the requirements is also improved as evidenced by the comment of one participant in a requirements development session: “I believe we got better insight and knowledge from these than we would have from one-on-one interviews.”

Step 2 - Virtual Review and Comment. In this step of this methodology, the requirements developed in the first step are posted for review and comment on a web site using a virtual conference environment. This environment mitigates geographical, work, and time constraints on the review. The critical component of this step is an ongoing, active dialogue in which the reviewers work together on problems and lead each other (with the help of a facilitator) through relevant topics, issues, and agenda items.

There are four basic components in the Virtual Review and Comment step:

1. A facilitator: a trained employee or consultant who guides the virtual discussion
2. Help desk support: technical person who assists participants and issues passwords for access into the virtual conference
3. Virtual conference design team: a group of individuals who design the virtual conference. The design team takes responsibility for crafting the virtual space and creating an environment that will encourage engaging discussions and creative output
4. Virtual facilitation methodology: an approach and associated virtual conference technology that encourages and records user participation in “open” asynchronous, threaded discussions.

One such facilitation methodology and software system that can be used for this step

is Caucus. Caucus is a service and product provided by Caucus Systems, Inc., a leading producer of management meetings, professional conferences, and virtual events since the mid-1980’s. When hosting a virtual conference Caucus supplies expertise and software allowing organizations to create online versions of their key business processes or other information. This information can then be deployed on a network, making it accessible any time and from any place using any standard web browser. Caucus also provides the mechanism for the facilitator to guide the asynchronous, threaded dialog that is expected to take place.

The virtual review and comment step consists of five processes. These processes, shown in Figure 4, are used to create the virtual conference environment, invite and enroll participants, conduct the asynchronous dialog, and collect the resulting product for input to the final step in the methodology.

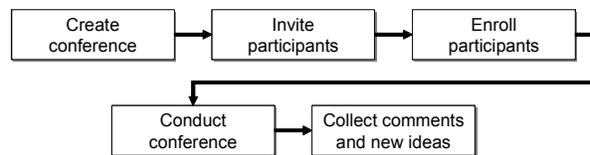


Figure 4. Virtual Review and Comment Processes

To initiate this step, the design team must complete their work, which includes framing the discussion by referencing the results of the face-to-face group requirements development sessions (i.e. Step 1). The facilitator then opens the virtual conference and invites comments by identified stakeholders via email or other means (e.g. voice mail or personal telephone invitation). To join the conference, participants must first contact the help desk to receive a password and, whenever their schedule permits, log into the conference. In addition to providing a secure access to the virtual conference, the password can provide the means to identify each individual’s

dialogue and associated comments made during the conference. This can be useful if subsequent follow up is required.

During the designated dialog period, participants are able to log in to the conference whenever their schedule permits and provide comments (in a virtual manner) on specific requirements developed from the previous face-to-face group session. This virtual environment encourages the divergent creative thought process in which participants have the opportunity to contribute to and become part of the requirements development activities.

By participating in this conference, a broader group of interested individuals can share and shape various discussions. Within the Caucus framework, the virtual conference participants can use all of the capabilities of the web to give presentations, distribute documents, and engage in threaded discussions. They can also use Caucus features to easily include or point to relevant information while they participate in the dialogue's active give-and-take. Although the dialogue in this conference is asynchronous, a facilitator makes a critical contribution by coordinating (but not directing) the dialogue to accelerate the process and keep it focused.

This period of review and comment takes place during a specified length of time that is consistent with the project schedule. Because of the nature of the Caucus tool, dialogue can take place among numerous reviewers (sometimes resulting in resolution of the comments) and the source of unresolved comments can be recorded for possible future individual or group follow-up. At the conclusion of the virtual conference, the comments and new ideas that have been generated are collected for use in the final step of the proposed methodology. In that step, a virtual decision-making tool helps to converge the divergent output developed in the virtual conference.

The virtual conference component of this requirement elicitation and synthesis methodology is advantageous for three reasons:

1. The virtual conference reflects the way the organization works because the end-users' business processes become apparent
2. The social structures and human dynamics of the organization become clear as well as how this structure will impact the success of the system.
3. The conference creates better requirements by extending processes to a larger community of affected and interested individuals.

Step 3 - Virtual Comment Resolution. After the dialogue in virtual review and comment step has been completed, and the resulting comments captured and/or incorporated into the requirements set, the results of the two previous steps can be subjected to virtual group decision making for any needed resolution. The virtual group decision-making environment and session provides all the tools required to resolve any critical issues on content and/or priority raised in the previous steps. This final step converges the prior input of all of the involved individuals and finalizes the requirements for the system into an even higher quality set.

There are three basic components for the virtual comment resolution step.

1. A facilitator: a trained employee or consultant who guides the creative decision-making process
2. Help desk support: a technical person who assists participants and issues passwords for access into the virtual decision making session
3. Facilitator methodology: processes and tools for facilitating a virtual decision-making session

The virtual group decision processes that constitute this step can be implemented using Virtual CoNexion, from Leadership 2000. Virtual CoNexion, is a newly released, web-enabled version of CoNexus that provides a

robust, virtual decision-making tool. This tool was designed to assist in taking advantage of the knowledge resources residing in a group of individuals while minimizing the constraints associated with time and location. By using Virtual CoNexion, disperse groups can hold a global meeting to discuss, debate, and identify any new critical requirements for the system. In addition, the Virtual CoNexion processes and output mirrors those used in CoNexus for face-to-face group decision making. This offers participants in this endeavor a seamless transition from one environment to the other, thereby making the overall process less obtrusive.

The virtual comment resolution step consists of nine processes, shown in Figure 5. These processes are instituted to take advantage of a larger review group to assimilate the input accumulated during the steps, resulting in an enhanced set of system requirements.

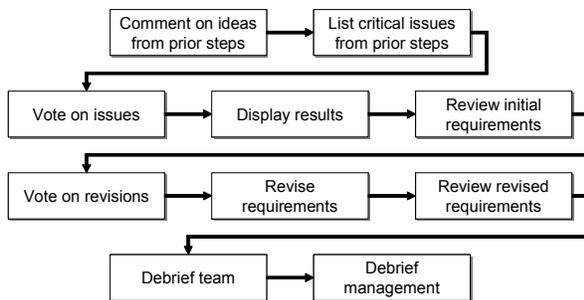


Figure 5. Virtual Comment Resolution Processes

To initiate this step, the facilitator reviews all of the ideas that were generated as part of the previous two steps. The facilitator also identifies and lists critical issues that surfaced during the previous steps (Sometimes a quick poll is required to determine a short list of critical issues).

A vote is then conducted to establish the relative importance of the comments and any unresolved issues. This vote is conducted on a scale of 1 through 9, or using a paired

comparison, raised on the facilitator’s assessment of the most appropriate method. Because of the asynchronous nature of this step, an extended period of time is allowed for this process (e.g. two days) to allow as many as possible of the virtual participants to vote their preferences.

Upon completion of the designated voting period, the results are displayed in the profile format previously illustrated in Figure 3. A facilitated discussion of the results is then conducted in the form of a virtual conference, in a manner similar to the previous step.

The draft requirements set developed in the group session during the first step is subsequently reviewed. If necessary, a virtual vote on the first Virtual CoNexion results is also conducted to determine whether any modifications to the requirements set should be implemented. This virtual vote is similar to the vote conducted in the face-to-face group session. It requires the participants to vote preferences based on importance, current satisfaction, and whether resources should be invested in a requirement as indicated by its position in the profile.

The facilitator again reviews the results in the quadrant profile format and asks questions regarding results to clarify and to surface issues. Any needed revisions to the draft set of the requirements are made and reviewed in relation to the previous profile. This allows the participants to see if there are different requirements needed for different geographical locations or functions. Final output of this virtual session is the new version of the requirements set and a greater understanding by all participants of the requirements necessary to achieve optimum results

At the completion of the previous task, the results are debriefed to the virtual team participants. This debrief can be in the form of a teleconference at a time convenient for most

participants and/or posted on the associated web site. A team of senior managers is also debriefed on overall results, typically in a face-to-face meeting. If the requirements set is acceptable to both teams, it then can be used as input to the next phase of the development lifecycle.

Benefits. In using the proposed group and virtual team requirements development methodology, the focus shifts from “What can be put together within the time and budget constraints?” to “What is most useful for the end users and organization as a whole?” This approach continually asks the questions, “If you had the particular capability you want, what would that do for you?” and “How is that important to you?” This methodology encourages the stakeholders to connect the “what” has to be accomplished with the “why”. It also links how strategies must be implemented with who must take the associated actions, and it pinpoints where and when the actions must be carried out.

By using the proposed methodology, those tasked with developing system requirements can achieve significantly improved, organization-wide identification and agreement on the requirements much earlier in the systems lifecycle. The usefulness and importance of requirements can be decided by a consensus of a broad set of end users and affected individuals, not just by a few available people. This result avoids the problems that can arise from an analyst’s or small group’s misperception of the system requirements, which can lead to disastrous consequences in terms of time, cost, or disruption of operations.

The visual and graphics capability of the group decision support and virtual collaborative processes, software, and hardware allows immediate group presentations of opinions and fosters creativity. This leads to discussions and to the redefinition of the group’s needs and

resources. All this together forms a seamless process of exploration and strategic alignment of the group. It imbues a sense of personal ownership and commitment to the designs that emerge from the process.

Group participation can reinforce and emphasize key organizational values and positively affects beliefs about what can be accomplished. Computer ranking of requirements also ensures that beliefs about what is not important are made explicit. This approach shifts the focus from exploring problems to exploring desired solutions. It leads the stakeholders from the question 'What is wrong?' to the question “What are the most desired outcomes?”

Use of this group and virtual team methodology in support of requirement elicitation and synthesis enables groups to pinpoint opportunities and problems, draw out emerging needs and desires in the end-user community, and obtain instant feedback and documentation of the entire process. The type of tools and specific products discussed in this paper are particularly suited to requirements development because they are fully portable, easy to use, provide robust graphics, and are unobtrusive to the group decision making process.

Summary. This paper describes a group and virtual team methodology that uses state-of-the-art processes, software, and hardware for group decision making and facilitation of virtual teams to enhance the quality of the requirements elicitation and synthesis process. This methodology helps to break down time, budget, and geographical barriers to accessing key personnel that are inherent in traditional approaches and increasingly problematic in today’s highly distributed and decentralized organizations. As a consequence, systems requirements development can proceed in a more efficient and effective manner. For the purpose of this paper, two of the premiere tools for implementing this type of

methodology are described: CoNexus from Leadership 2000 and Caucus from Caucus Systems, Inc.

This proposed methodology incorporates four crucial factors for increasing the effectiveness of the processes and tools being used. First, as many as possible key stakeholders are represented in the initial face-to-face session. Second, as many end-users and affected individuals as possible are involved in the virtual processes. Third, communication feedback loops are built in so that those who participated in one of the steps will be linked to the other steps. Fourth, to ensure that the three-step process is seamless, a champion (facilitator) is appointed who will provide easy transition from one step to the next.

Incorporating these factors into the group virtual team methodology ensures that the development of the system requirements includes a greater number of key participants and considers more of the relevant system attributes. In this way, this methodology creates more accurate, creative, and clearer input and the final requirements set better reflects the needs of the organization as a whole.

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BIOGRAPHY

Joseph J. Romano is the Chief Scientist for the Software and Systems Integration Group of Science Applications International Corporation. Dr. Romano is a member of SAIC's Executive Science and

Technology Committee and is the SAIC representative to the Corporate Advisory Board of INCOSE. He has over 27 years experience in systems engineering and integration in high technology, computer-intensive companies. His doctoral research and dissertation was in the area of requirements engineering.

Mary Crannell is President of Idea Sciences. She was formally President of Leadership 2000 – a wholly-owned subsidiary of Science Applications International Corporation. She is an expert in group decision support applications and knowledge management. Ms. Crannell has led numerous group decision support sessions for industry and government in the United States and in Europe.