**Association for Information Systems**
**AIS Electronic Library (AISeL)**

AMCIS 2007 Proceedings

Americas Conference on Information Systems (AMCIS)

12-31-2007

# A Dynamic Voting Wiki Model

Connie White
*NJIT*

Linda Plotnick
*NJIT*

Murray Turoff
*njit*

Starr Roxanne Hiltz
*New Jersey Institute of Technology*, roxanne.hiltz@gmail.com

# A DYNAMIC VOTING WIKI MODEL

**Connie White**
**Linda Plotnick**
**Murray Turoff**
**Starr Roxanne Hiltz**
Information Systems Department
http://is.njit.edu
New Jersey Institute of Technology
Newark, NJ USA
Email: connie.m.white@gmail.com, linda.plotnick@gmail.com, turoff@njit.edu, Roxanne.hiltz@gmail.com

**Abstract**

*Defining a problem and understanding it syntactically as well as semantically enhances the decision process because the written agenda and solutions are understood on a token level. Consensus in groups can be challenging in present web based environments given the dynamics of types of interactions and needs. Larger virtual communities are beginning to use wiki based decision support systems for time critical interactions where the quality of the information is high and a near real time feedback system is necessary. Understanding the meaning of the problem and group consensus can be improved exploiting a voting enhanced wiki structure implemented into select parts of the decision making process. A decision support model integrating a wiki structure and a social decision support system (voting) is presented. Findings from a pilot study describe differences of idea generation between groups. Other issues are identified requiring further research.*

**Keywords**: wiki, social decision support system, voting, communities of practice, leadership, feedback, real-time

## Introduction

Accuracy of communication can be a challenge in non face-to-face group decision making. In virtual environments, text is one of the most common forms of communication for problem solving. The written problem and possible solutions can be unclear and misleading when words are not clearly defined or when there are multiple interpretations possible which can lead to misunderstanding. This can cause poor performance, thus increasing the probability of implementing a poor solution. Groups also have a difficult time reaching a consensus or maintaining a neutral point of view (NPOV). Voting can help groups understand their differences and thus help them to produce a better outcome in terms of group consensus especially where it concerns problem solving, domain knowledge building and collaborative authoring.

A wiki is a computer mediated communication site that allows groups to interact in a common web environment conducive for collaborative authoring using hypertext features. Wikis allow for the editing and creation of content by users, often not requiring registration. Problems arise due to the open editing in a wiki community that can make the information biased or wrong, and thus not mirroring the interest of the majority. Reflecting a NPOV or obtaining a group consensus is problematic under an open wiki environment.

Wikis are not only gaining in popularity, but are becoming increasingly more important as a tool for interest groups, demanding quality information from knowledgeable individuals. Based on the Technology Acceptance Model (Venkatesh, 2000) as well as the present growth rate of wiki usage, virtual communities are projected to use them extensively in the future (Viegas, et al. 2004) for they will benefit most from a 'group memory' for collaborative interaction.

The initial research questions for this exploratory study were: What will imposing a majority vote structure do to a wiki discussion? How does this relate to a group understanding of the terminology being discussed? Will groups using a dynamic voting wiki produce better quality answers? How will a dynamic voting wiki affect idea generation and evaluation?

The remainder of this paper is organized as follows: In the literature review, some existing problems with group decision support systems and wikis are described. The concept of *communities of practice* (COP) is introduced and its potential when using a wiki is considered. A voting enhanced wiki model is proposed as a solution. We then describe a pilot study that was conducted, some preliminary results are discussed, and numerous research issues are identified. We conclude by indicating further research considering a wiki's potential as a near real time feedback system, using dispersed teams interacting as a virtual organization together with time critical information, in an emergency response environment.

## Literature Review

As we enter the 21st Century, technology has revolutionized how we communicate and collaborate. One major change from this is how we work together. Global organizations have employees dispersed throughout the world; universities are providing eLearning courses and degrees, hiring the teachers from near and far; while online shopping has never been easier, more accessible or more competitive. More organizations interact over longer distances and larger groups of individuals are working as global virtual teams (Mowshowitz, 2002).

### Group Decision Support Systems

Virtual communities use group decision support systems (GDSS) to aid and benefit in the collaboration and organization of information content, management, and problem solving. Prior research confirms that distributed groups can benefit from collaborative ubiquitous systems in the aforementioned areas (De Sanctis and Gallupe 1987, Hiltz, et. al. 1996, Majchrzak 2006). Problems faced in the virtual world reflect a global economy which is complex and volatile. Computer Mediated Communication (CMC) systems need to incorporate capabilities to support complex decisions that may have to be reached quickly, due to critical circumstances environmentally and restricted time allocations (Fuchs-Kittowski, et al. 2005).

Studies show that larger groups of people create not only more ideas when working together collaboratively, but also, ideas of higher quality (Dennis and Valacich 1994, Hiltz, et al 1996, Turoff et al. 2004). This is a direct consequence of the old adage 'two heads are better than one' but in today's context, is it 20, 200, 2000, or even 20,000? The collaborative effect of large groups networked together creates a synergistic effect with a desired end result of collective intelligence (a decision better than any individual could have made on their own) (Hiltz and Turoff, 1978). Early experiments demonstrated that such collective intelligence is due to the interactions amongst group members during discussion of issues, which increases the overall understanding of the problem and hence, increases the quality of decisions produced (Hiltz and Turoff 1993). Organizations can unleash this potential as well as tap into a knowledge base generated by the professionals to create an organizational memory and intelligence (Majchrzak, et al. 2006).

**Problems with Group Decision Support Systems**

Two problems in current GDSS that decrease effectiveness are that information is often misinterpreted or misunderstood (McDermott, et al. 1978, Savage 1987, Robinson and Bannon 1991, Schmidt 1991, Davenport 1994, March 1991); and that obtaining group consensus maintaining a neutral reflection by the group without various group biases such as "group think" and other biases in group consensus is challenging (Turoff, et al. 1993, Brennan 1997, Viegas 2004).

When individuals work together, defining the problem and understanding it syntactically as well as semantically enhances the decision process because the written agenda and solutions are understood on a token level. Key terms can be domain specific in their interpretation (Schmidt 1991, Savage 1987). As Gerson and Star (1986) note: "No representation ..... is either complete or permanent. Rather any description is a snapshot of historical processes in which differing viewpoints, local contingencies and multiple interests have been temporarily reconciled."

Many current GDSS systems do not address this dynamic nature of such processes. There have been some attempts to surface the differing assumptions and perspectives among group members and make them visible and malleable ( e.g. the cognitive mapping work of Eden and his colleagues, and the work of Boland and his colleagues (1992) on software to represent different participant's perspectives; and the Policy Delphi Method (Linstone and Turoff 1975)). Understanding the meaning of the problem can be increased with a continuous feedback structure implemented into phases of the decision process (Li, et al. 2003). A decision support model integrating a feedback structure can be a useful tool to increase user communication in the textual content and to attain group consensus. For example, Turoff et al. (2002) describe the concept of a Social Decision Support System (SDSS) which focuses on large groups of knowledgeable individuals holding numerous diverse and opposing views, working collaboratively on complex problems. This system utilizes dynamic (continuous) voting to extrapolate issues of conflict, which helps the members to know where to focus their efforts and if need be, maintain a NPOV. With an SDSS, Turoff explains that "all participants can come to respect and understand the differences caused by diverse values and interests of

the contributing population" (1993).

## Why Communities of Practice?

Groups will work harder on problems that they perceive to be interesting, unique and/or important. Also, groups will work with a greater intensity and dedication if they know that they are working with other knowledgeable individuals (Majchrzak, et al. 2006). Defined by Wenger, (2000) "Communities of practice (COP) are formed by people who engage in a process of collective learning in a shared domain of human endeavor. Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly." Since COP by nature share a common interest, it stands to reason that they will work harder than a group that does not share a common interest and will thus have higher quality solutions. (Hiltz, et al. 1987, Venkatesh 2000, Majchrzak, et al. 2006).

Shared information through interaction is central to the success of a COP. Larger groups of people interacting need a structure to aid in the reduction of information overload. An SDSS would be useful for a COP whose interest is unambiguous and domain specific. This helps them collaborate more effectively since they share common goals and would be more interested in working through their differences for the greater good of the group.

COPs, including professional associations, desire an easily updated Web-based resource for their members as well as other CMC that are conducive to their efforts (Chawner, et al. 2006). It is reported about wikis that "such dynamic properties have implications for the design of other online communities where collaboration and consensus are critical" (Viegas, 2004). This is favorable for an environment where time is of the essence and updated and quality information is invaluable in order to increase the probability of implementing the best solution available.

It is suggested that the combination of wiki community with a COP produces a synergistic effect such that together they create a more powerful tool than had either been used separate from one another (Fuchs-kittowski, et al. 2005). A wiki can be created satisfying the needs of a COP considering the context in which they are used (Di Iorio, et al. 2006).

## Wikis

The original wiki concept was conceived by Tim Berners-Lee who foresaw opportunity in having a collective memory space where people could collaborate online, having the ability to edit content utilizing a simple browser (Berner's-Lee and Fischetti 2000). However, it was Cunningham who implemented the first wiki in the mid-1990s for the Portland Pattern Repository (Leuf and Cunningham 2001). In 2001, two ambitious designers, Jimmy Wales and Larry Sanger, launched Wikipedia , not the first wiki, but the one that has most demonstrated a wiki's power and numerous possibilities. Although wikis are new, their popularity is gaining and Leuf and Cunningham have created an almost cult-like community adhering to 'The Wiki Way' (2002).

"Corporations, education and other entities, both public and private, are embracing wikis for their knowledge management and collaboration capabilities," (Viegas, et al. 2004). Wikis can be extended to suit the most dynamic social environments demanding the most knowledge-intensive processes for

knowledge generation of COPs (Fuchs-kittowski, et al. 2005, Reinhold, et al. 2006). Currently, the groups using wikis to support work projects are numerous: software developers, eLearning environments, project management, ad-hoc collaboration, research and design as well as COPs (Majchrzak, et al. 2006). Research suggests that "wikis are the best solution for COPs" (Fuchs-kittowski, et al. 2005). Potential benefits from using a corporate wiki include enhanced reputation, making work easier and helping the organization improve its processes (Majchrzak, et al. 2005).

### Problems with Wikis

Open editing has potential drawbacks. Not only in COP settings, but in other environments, the wiki's content credibility is increasingly relevant (Di Iorio, et al. 2006). These range from a novice user's honest mistake to a hacker's annihilation of an entire page and even WikiSpam (Viegas, et al. 2004, Chawner, et al. 2006) and "edit wars," which have been defined as "interactions where two people or groups alternate between versions of the page" (Viegas, et al. 2004). Edit wars create the problem of the survival of authorship, which basically means "the last person to edit, wins." This is not a good reflection of a group's interaction, but an outcome of the most persistent group member.

As Di Iorio (2006), observes:

> "Wikis are frequently updated, rich and continuously improved, but also under controlled and flawed. We noticed that wiki pages improve their correctness and clearness when a set of rules are enforced by the community or by the wiki system. These rules cannot be strict prohibitions that prevent users from freely expressing their ideas and comments, rather they should help them in doing work that would be otherwise done later or never."

Wikis can be classified by their availability, or vulnerability, to others. There are open wikis which are open to the public and closed wikis, which are closed to all but group members. A COP would use a closed wiki and have it open only to the COP members. Imposing structure, or "constraints," on behavior is one way to solve the open editing problem (Reinhold, et al. 2006). QwikiWiki, PmWiki and TikiWiki are wikis which have been implemented for Web content management.

Constraints are defined as either *Hard* or *Light* where a *Hard Constraint* must adhere to real time reflection upon change. Opposite of that is a *Light Constraint* which means that an information constraint on a wiki page can be temporarily violated without disturbing the wiki (Di Iorio, et al. 2006). Lightweight constraints have been a proven method for the authoring process, implementing enough restriction to keep a group organized without destroying the editing freedom in a group memory (Di Iorio, et al. 2006, Reinhold, et al. 2006).

## Social Decision Support Systems and Wikis

One of the criteria of an SDSS concerns dynamic voting where the "voting process must be continuous and it must be of such a nature as to help filter and organize the resulting material." (Turoff, et al. 2002). This is one means of using a group vote to organize information easily with a system and reflect a NPOV. Other studies suggest that voting aids as a tool for group consensus and collaboration (Li, et al. 2003, Turoff et al. 2004). Voting and scaling tools are for group reflection and can be implemented a number of ways

depending on the preference measurement requirements.

We introduce a concept to strengthen the wiki by using an SDSS in order to implement light constraints to deal with the present problems discussed. This more specifically applies to large groups of knowledgeable individuals communicating and working towards a common goal. Through visual feedback from the voting, we satisfy the first criterion of light constraints which states, "helps the editing work of authors giving visibility to constraint violations" and to the second criterion, "helps the work of tailors (the users who coordinate the collaboration on set of pages) enabling the description of constraints and their association to pages" (Di Iorio, et al. 2006). This is achieved by controlling the content by a democratic voting process where one uses a majority vote by those concerned with the given topic. The system provides a visualization of the uncertainty in the results due to those who did not wish to vote on the given item and the votes may be changed by anyone at anytime. This method may be utilized in wikis or any other form of group communications.

Our premise is that the understanding of a given agenda is increased by an open collaborative environment, and with the ongoing discussions within a wiki community, building syntactical structures together, will result in an increased understanding of the meaning of items defined within a decision process. This will produce even better solutions than had they used just either a wiki or an SDSS. In the next section, we propose a solution in the form of a model reflecting the aforementioned SDSS wiki.

## A Dynamic Voting Wiki Model

This is a dynamic model and is flexible in terms of voting techniques. Human moderators, rule based expert systems, conditional programming, or intelligent agents could be considered as methods for implementation. The model is also dynamic in the decision structure where alternative processes may be used to fit the desires of the organization. The key objective is to implement structure in areas where a reservoir of critical information is vital.

For this particular problem, five processes are identified: (1) problem definition; (2) intelligence gathering; (3) argumentation; (4) idea generation and finally (5) implementation. However, once initialized, the problem can be cyclic and adapt as time or merit dictates. The problem can sit dormant, only to be brought back to life by circumstances or to select another solution for implementation.

### A Walk Through

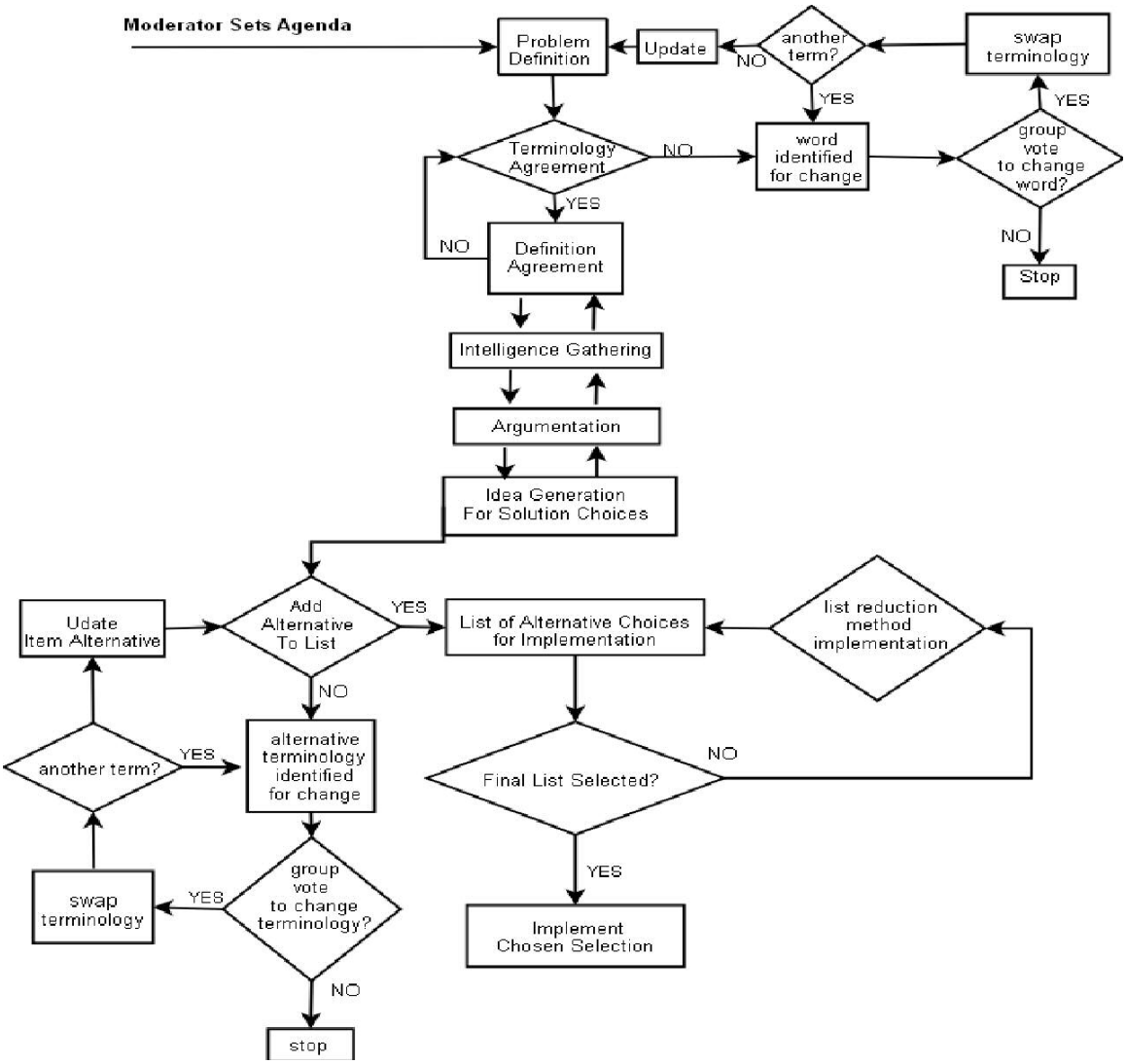


**Figure 1. Dynamic Voting Wiki Model**

The model begins with a moderator who sets an agenda, for example, a problem definition. Initially, the problem is posed in a wiki for discussion to increase understanding of the problem, a critical part of solving any problem. Sometimes it can take many exchanges before a full understanding and comprehension of a problem is understood, especially when large groups are solving complex problems crossing cultural and linguistic boundaries. This cycle can consist of the entire problem being redefined, or fragmented parts or a single word posed for interpretation or dispute.

Intelligence gathering and argumentation follow. Asynchronous interaction is conducive to experts contributing valuable information when it comes to them naturally and they can present this to the group at anytime from anywhere as long as there is Internet connectivity. Note that there are arrows pointing in both directions for each process. This is to better represent the human cognitive process as the continuation of ideas and processes best reflecting the way the human thinks. Ideas are not forced at a certain time and place, which can induce such dynamics as *group think*. A dynamic structure better reflects the human mental process in that it's flexible in respect to time and cognitive ability.

Once a member has an idea, it is put to a group vote for acceptance or rejection. In our pilot, this was a filtering process to separate perceived good from bad ideas. Ideas are accepted by the group via a yes/no vote. This is a dynamic model and different voting methods can be implemented for flexibility to reflect the needs of the group. Once an item is accepted, it is put before the group as a potential solution. This is to aid the group in working collaboratively to derive a solution. Many solutions may be voted by the majority as viable.

Problems that could arise in the system are that a larger population of less qualified experts could outvote a smaller group of more qualified experts. There are a few ways this could be handled. One way is to give group members more weight in certain areas of their expertise.

## Research Methodology

An experiment with two conditions was conducted with two groups of 15 subjects each: one, the Blue Team, was the control group, the other, the Red Team, was the experimental group. The subjects were graduate university students and were randomly assigned to the groups. Leaders were not designated in either group. The task developed as a classroom exercise and used in this study was to generate a list of ideas in answer to the question, "What are the ten most significant emerging technologies that will influence how we work in the future, interacting globally?" The students were also asked to generate a glossary of terms and definitions for any words that might not be understood or might be confusing to those unfamiliar with either the technology or the telecommunications field.

The wiki used by the experimental group was identical to that used by the control group except for the addition of voting. The instructions given to both groups were also identical except for the addition to the experimental group's instructions of voting to reach consensus at three steps during the task process: (1) in the problem definition which is the initial phase setting the agenda by a moderator, (2) in the definitions of the glossary and finally (3) ranking the list of items accepted by a majority vote. A moderator managed the voting for the experimental group.

The students were randomly assigned to either the control (no voting) or experimental (voting) group and given a link to their assigned wiki. On the wiki home page were links to pages with the problem definition and instructions, a wiki page for building a glossary, an idea generation wiki page for suggesting items, then a wiki page for the final list of top ten emerging technologies was produced. Intelligence gathering and argumentation were supported using a forum with post/reply structure. The main distinction between the two wikis was that the control group had open access to all pages and moved candidate items to the final list page themselves, and were under normal group situations in an open edit wiki page, while the experimental group voted on items to include in the final list and the moderator moved the items voted for inclusion to the final list page.

The group with the voting wiki used a voting tool to either vote for or against items suggested during three stages of the task. Discussion lasted two weeks, and subjects were allowed to change their vote based on incoming information. The students, although anonymous, could see the running tally of votes. Three experts then independently graded the deliverables.

## Discussion

As with most pilots, problems were many. Both groups encountered the same technical difficulties. The experiment took twice as long as originally planned to execute in full because extensions had to be given to make up the time for the unforeseen problems. Wiki experiments are prone to problems during all phases of the experiment. Education, teaching novice users to use a wiki properly, is a challenge. A summary of the results is shown in Table 1.

**Table 1. Summary of Results**

| | Ideas | Words | Glossary | Repetition of Information | Bad Answers | Best Ideas |
|---|---|---|---|---|---|---|
| **Wiki Only** | 21 | 3112 | yes | 15% | 3 | 7 |
| **Dynamic Voting Wiki** | 30 | 4886 | no | none | 2 | 8 |

The group with the voting wiki had 57% more discussion than the non-voting wiki. This was deduced from a word count comparing both groups, removing duplicated (pasted) information. In total, the voting wiki group generated 42% more ideas. The voting produced a process structure that distinguished the items agreed upon from those that had disagreements, to encourage more discussion and more ideas. This could also be stated as, the '*voting wiki'* increased collective intelligence more than the '*non-voting wiki.'* The voting wiki definitely gave structure to the management of content when compared to no vote. In the initial phase of the problem description, there was only one difference, the voting group clearly defined the critical term 'emerging'. Both groups interacted to clarify in both a forum discussion and on the wiki to help understand the problem better. Evidenced from the group's interactions, the students knowing what the voting outcomes were in real time proved to be a great stimulus for more discussion. The results were calculated and also indicated how many subjects had not voted yet. A real time bar chart giving visual feedback and numbers was presented. Figure 2 shows a screen shot of the voting feedback that was provided to the students.

The students would view the votes on items and then if they disagreed, would start posting in the forum again. The voting gave the subjects a feedback system mirroring the groups' opinions. The voting wiki both increased the meaningfulness of the problem and acted as a guide towards a group consensus. From the forum discussion interactions, it was inferred that voting on items stimulated group interactions in the forum creating a better understanding of the given problem. Also, a few individuals had insightful interactions that benefited other group members.

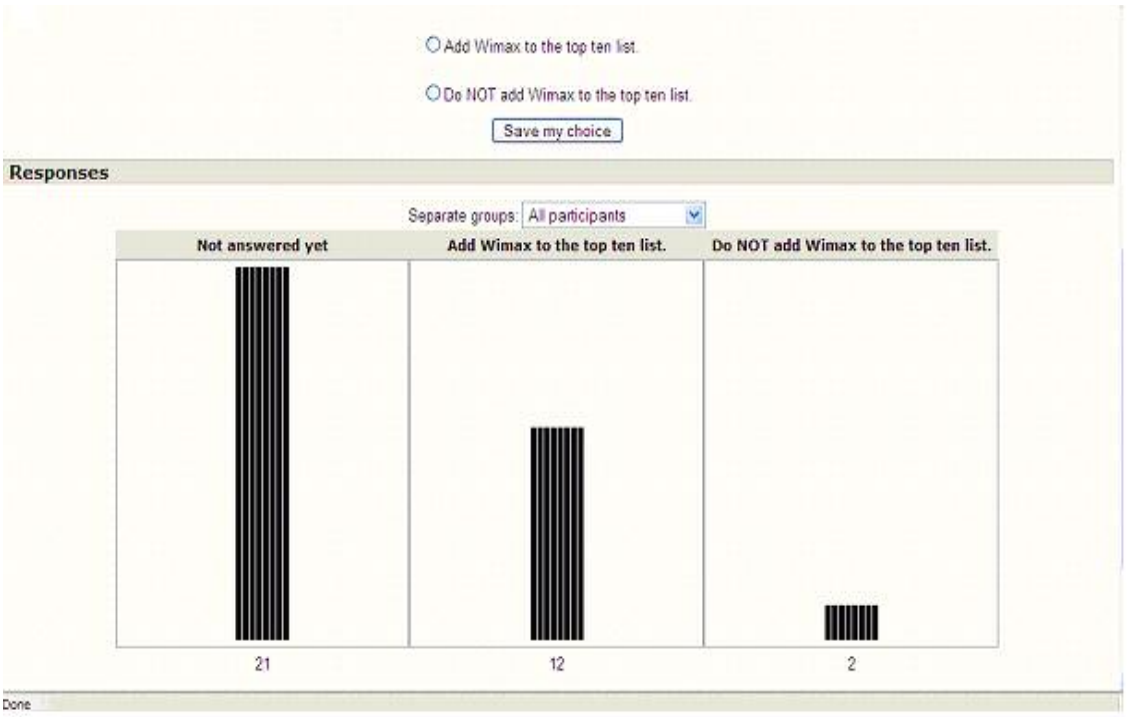


**Figure 2. Voting Feedback**

Concerning the construction of the glossary, the team with no voting actually created a much better glossary. It could be that they felt they had more control, while the voting group grew dependent on the moderator coming in and editing issues based on votes. This was their attempt to produce a task structure, but the glossary task structure was not as effective as the voting process.

The groups did not have assigned or elected leaders but were self-managed teams. It has been suggested that there is no such thing as a truly "leaderless" team (Misiolek and Heckman 2005). In a functional perspective, leaders will emerge in self-managed teams as participants enact leadership roles. Interestingly, in the control group (no voting) leaders emerged. In that group one participant volunteered for and did integrate the postings in the wiki into one post listing the technologies the group had proposed for the "top ten" list. Another student in the control group did the same for the glossary. In both cases, therefore, individuals enacted the leadership role of "integrator" (Yoo and Alavi 2004). An inspection of the wiki discourse for the experimental team did not show similar emergent leadership behaviors. However, it has been suggested that communications software can take over leadership roles in virtual teams (Avolio and Kahai 2003). The moderator's actions, transparent to the participants in the experimental group, may have substituted for emergent leadership in the experimental group. That is, the participants may have relied on the organization by the moderator instead of engaging in organizational leadership behaviors themselves.

## Conclusions

Recently in a Public Briefing sponsored by the Office of the Director of National Intelligence, a ‘wiki-like’

environment was suggested as a way to improve group performance (Hastie, 2006). The Defense Advanced Research Projects Agency recently engaged in a Request For Information indicating such needs for 'Strategic Collaboration' that is well within a wiki's potential (DARPA, 2007).

Wikis are going through the same evolution as previous forms of CMC where attempts were made to extend these systems to large numbers of users. It requires more content structure, communications protocols and human roles to insure the contributions among a large group can in fact, be understood and kept somewhat consistent. It is the same evolution that face to face groups go through in moving from small group discussions to face to face meetings of hundreds and structures such as Roberts Rules of Order to make the meeting coherent (Hiltz and Turoff, 1978, 1993).

Whether or not the difference in pattern of emergent leadership found in this study will hold in future studies comparing voting and non-voting wikis needs to be investigated. It is also possible that emergent leadership vs. the reliance on an external leader influenced the differences in performance seen in this study. For example, the reliance on the voting mechanism may have increased idea generation while at the same time reducing collaborative efforts at understanding the importance of the items. That is, the voting may have proceeded without adequate discourse interleaved between individual voting rounds. This may be useful to investigate in future studies that structure the voting to promote discussion during the voting phase.

## Future Research

Organizations can benefit from a form of risk analysis that supports continuous adaptation through feedback. As new information comes in, including the updating of current threats, it is preferable to respond immediately rather than waiting for a predetermined length of time to assess and react. This requires a change in organizational procedures that can be difficult to institute (Gerd Van Den Eede, Bartel Van de Walle and Anne-Francoise Rutkowski, 2006, Gerd Van Den Eede and Bartel Van de Walle, 2005). However, the goal is a worthy one.

In an emergency, uncertainty and ambiguity are critical problems, especially when teams are large heterogeneous groups from different professional and management areas. In that case, ambiguity can be an especially onerous problem. Communication can help to reduce uncertainty, but it cannot be completely mitigated in an emergency situation. During the events of 9/11, massive resources were sent to rescue people from the collapsing buildings, but some who had survived the attack and aftermath still died, However, communication cannot reduce uncertainty if there is ambiguity in the communication. For example, the phrase, "help is on the way" can mean different things to different people in a complex situation. It is critical that the definitions in the working lexicon be understood the same way by all.

It is proposed that this type of system will reduce ambiguity by focusing people's attention on disagreements that are a result of both uncertainty and ambiguity. A pilot wiki (***www.emergenciWiki.com***) is under development to be used in future studies to test this proposition.

## REFERENCES

Avolio, B.J. and Kahai, S.S., Adding the "E" to E-Leadership: How it may Impact Your Organization, Organizational Dynamics, 31, pp. 325-338, 2003

Bannon, Liam, J., Group Decision Support Systems: An analysis and critique In Proceedings, 5th

European Conference on Information Systems , Cork (1997) vol. 1 pp. 526-539.
Chowner, B. and Lewis, P., WikiWikiWebs: New Ways to Communicate in a Web Environment. Information Technology Libr no, 1, 2006.
Connolly, T., Jessup, L. and Valacich, Effects of Anonymity and Evaluative Tone on Idea Generation in Computer-Mediated Groups, Management Science, pp. 689-703, 1990.
De Iorio, A. and Zacchiroli, S. Constrained Wiki: an Oxymoron?, Proceedings of the 2006 International Symposium on Wikis, WikiSym?'06.
Dennis, A.R. and Valacich, J.S., Group, sub-group, and nominal group idea generation: new rules for a new media? Journal of Management, 20, 4, pp. 723-736, 1994.
DeSanctis, G. and Gallupe, R.B., A Foundation for the Study of Group Decision Support Systems *Management Science*, Vol. 33, No. 5, pp. 589-609, 1987.
Defense Advanced Research Projects Agency. Request for Information(RFI): Strategic Collaboration. SNO7-28. http://www.darpa.mil/baa/SNO7-28.html, April, 2007.
Fuchs-Kittowski, F. and Kohler, A. , Wiki Communities in the Context of Work Processes. Proceedings of the 2005 International Symposium on Wikis, WikiSym?'05.
Hastie, Reid., *Making Groups Wiser*. Office of the Director of National Intelligence. Public Briefing, Sept. 26, 2006. *http://www.apa.org/ppo/issues/1006Hastie.pdf*
Hiltz, S.R. and Turoff, M., *The Network Nation: Human Communication via Computer*, MIT Press, revised edition, 1993 (original 1978 Addison Wesley).
Hiltz, S.R., Dufner, D., Fjermestad, J. , Kim, Y., Ocker, R, Rana, A. and Turoff, M. , Distributed Group Support Systems: Theory Development and Experimentation. Book Chapter in Coordination Theory and Collaboration Technology, Hillsdale NJ: Lawrence Erlbaum Associates, 1996.
Leuf and Cunningham, The Wiki Way, 2001.
Li, Z., Design and Evaluation of a Voting Tool in a Collaborative Environment, PhD dissertation, 2003, IS Dept of NJIT. http://www.library.njit.edu/etd/index.cfm
Linstone, H. and Turoff, M. (editors) *The Delphi Method: Techniques and Applications*, Addison Wesley Advanced Book Program, 1975. (Online version can be accessed via http://is.njit.edu/turoff)
Majchrzak, A., Wagner C. and Yates, D., Corporate Wiki Users: Results of a Survey. Proceedings of the 2006 international symposium on Wikis, WikiSym?'06.
March, J., How decisions happen in Organizations. Human - Computer Interaction, 1991.
McDermott, R. , Gospodinoff, K. & Aron, R., Criteria for an ethnographically adequate description of concerted activities and their contexts. Semiotica 24, 3, 4, 245-275, 1978.
Misoliek, N.I. and Heckman, R., Patterns of Emergent Leadership in Virtual Teams, 38th Hawaii International Conference on System Sciences, Hawaii, USA, 2005.
Mowshowitz, A., Virtual Organization: toward a theory of societal transformation stimulated by information technology, Quorum Books, 2002.
Reinhold, S. WikiTrials: Augmenting Wiki Structure for Collaborative, Interdisciplinary Learning. Proceedings of the 2006 International Symposium on Wikis, WikiSym?'06.
Robinson, M. & L. Bannon, Questioning Representations. In Bannon, L., M. Robinson, & K. Schmidt, (editors). Proceedings of the Second European Conference on CSCW Dordrecht: Kluwer. Pages 219-233, 1991.
Turoff, M. Hiltz, S.R., Bahgat, A.N.F. and Rana, A., Distributed Group Support Systems, MIS Quarterly, pp 399-417, 1993.
Turoff, M., Hiltz, SR., Cho, H., Li,Z. and Wang, Y., Social Decision Support Systems (SDSS). *Proceedings of the 35th Annual Hawaii International Conference on System Sciences (HICSS 2002)*
Turoff, M., Hiltz, S. R., Li, Z., Wang, Y., Cho, H., Yao, X., Online Collaborative Learning Enhancement through the Delphi Method, Proceedings of the OZCHI 2004 Conference, November 22-24, University of Wollongong, 2004.

Gerd Van Den Eede, Bartel Van de Walle and Anne-Francoise Rutkowski, Dealing with risk in incident management: an application of High Reliability Theory, the 39th Hawaii International Conference on System Sciences HICSS39 (Hawaii, January 2006), 10.

Gerd Van Den Eede and Bartel Van de Walle, "Operational risk in incident management: a cross-fertilisation between ISCRAM and IT Governance", in Proceedings of the Second International Conference on Information Systems for Crisis Response and Management ISCRAM2005, Brussels, Belgium, April 2005, pp. 53 – 60.

Venkatesh, V., Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. Information Systems Research, 2000, 11(4), 342-365.

Viegas, F., Wattenberg, M., and Dave, K., Studying Cooperation and Conflict between Authors with history flow Visualizations. CHI 2004, ACM.

Wenger, Etienne, Communities of Practice and Social Learning Systems. 2000, Vol. 7, No. 2, 225-246, SAGE Publications.

Yoo, Y. and Alavi, M., Emergent leadership in virtual teams: what do emergent leaders do? Information and Organization, 14, pp. 27-58, 2004