THE EFFECT OF SHARED DYNAMIC UNDERSTANDING ON WILLINGNESS TO CONTRIBUTE INFORMATION: DESIGN AND ANALYSIS OF A MEGA-COLLABORATIVE INTERFACE

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DEDICATION

To my husband, who has supported my efforts with great patience.

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Collaborative helping via social networking conversation threads can pose serious challenges in emergency situations. Interfaces that support complex group interaction and sense-making can help. This research applies human-computer interaction (HCI), computer-supported cooperative work (CSCW), and collaboration engineering in developing an interactive design, the Mega-Collaboration Tool (MCT). The goal is to reduce the cognitive load of a group's growing mental model, thus increasing the general public's ability to organize spontaneous collaborative helping.

The specific aims of this research include understanding the dynamics of mental model negotiation and determining whether MCT can assist the group's sense-making ability without increasing net cognitive load.

The proposed HCI theory is that interfaces supporting collaborative cognition motivate contribution and reduce information bias, thus increasing the information shared. These research questions are addressed:

1. Does MCT support better collaborative cognition?
2. Does increasing the size of the shared data repository increase the amount of information shared?
3. Does this happen because group members experience 1) a greater sense of strategic commitment to the knowledge structure, 2) increased intrinsic motivation to contribute, and 3) reduced resistance to sharing information?

These questions were affirmed to varying degrees, giving insight into the collaborative process. Greater content did not motive group members directly; instead, half of their motivation came from awareness of their contribution's relevance. Greater content and organization improved this awareness, and also encouraged sharing through increased enthusiasm and reduced bias. Increased commitment was a result of this process, rather than a cause. Also, MCT increased collaborative cognition but was significantly hampered by Internet performance. This challenge indicates MCT's system

components should be redesigned to allow asynchronous interaction. These results should contribute to the development of MCT, other collaboration engineering applications, and HCI and information science theory.

Davide P. Bolchini, Ph.D., Chair

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CHAPTER ONE: INTRODUCTION

The Phenomenon of Mega-Collaboration

We live in a time of tremendous technological and social growth, continually engaged in an effort to understand the changing world around us (de Vreede, Antunes, Vassileva, Gerosa, & Wu, 2016). Though many of these changes are positive, sometimes their effect manifests itself most clearly during tragedies. One such change is a phenomenon characterized by the mass spontaneous collaboration of ordinary people, who are both demographically diverse and geographically dispersed, but who are striving to achieve a common goal. This phenomenon has been termed *mega-collaboration* (Newlon & Faiola, 2006); and it is often found in times of crisis. The dynamics of mega-collaboration and its potential effects, both good and bad, can be illustrated by looking at an example.

On April 16, 2007, a lone gunman, with a history of mental illness, killed 32 people on the campus of Virginia Technical Institute (Virginia Tech). This terrible act triggered a frantic effort by family, friends, fellow members of the Virginia Tech community, and uninvolved and widely dispersed strangers, to share information about what had happened. Much of this activity occurred on social networking sites. Ongoing posts to such places as the Facebook group Prayers for VT, helped ease (or confirm) the fears of those who could find no other source of information. By the time an official list of the deceased victims was released, a day and a half later, the names of all 32 had already appeared on at least one of the various compilations created by this public effort (Vieweg, Palen, Liu, Hughes, & Sutton, 2008).

This is not an isolated phenomenon. The expansion of social media, such as Facebook and Twitter, has been accompanied by an upsurge in *collaborative helping*, a form of collective social action characterized by an altruistic response to those in need (i.e., de Vreede et al., 2016; Palen & Liu, 2007). The correspondence between improved "social interfaces" and increased collaborative helping via mega-collaboration suggests that the success of such activity is directly influenced by the quality of the communication tools that are available.

A feature of the collaborative response is the gathering and filtering of information to ensure its completeness and accuracy. The self-organized groups of the Virginia Tech response were serious about the work they were doing, and determined that

their lists should be as accurate and complete as possible. While no single list contained all 32 of the victims' names by the time the official list was released, none of them contained incorrect names (Vieweg et al., 2008). This indicates a dedication to the jointly developed pool of information that each list represented.

The Importance of Supporting Mega-Collaboration

Potential Benefits of Collaborative Helping

This sort of collaborative activity can be a positive development, both in terms of collective advantage and in terms of increased individual competence. One result of the growing venue for collaboration provided by social media is an increase in the ability of members of the general public to take collective action. In the Virginia Tech case, even the simple compilation of victim lists may have helped thousands of people cope with the disaster. There are many other examples of collaborative helping bringing material benefits to society at large. Some of them are listed in Chapter Two.

Beyond social benefit from overt action, there is also cognitive benefit from online collaboration. This cognitive benefit falls within a subset of Vygotsky's (1978) *zone of proximal development* that is known as the *zone of reflective capacity* (Tinsley & Lebak, 2009).[1] Tinsley and Lebak showed that peers mentoring each other can expand their capacity to reflect on the subject at hand through the sharing of insights, feedback, analysis, and evaluations, based on the diverse backgrounds of the group members. This effect is further enhanced through the growth of trust and mutual understanding.

The dynamics of the Virginia Tech Facebook group, Prayers for VT, appeared to follow this pattern. Vieweg and colleagues (2008) documented exchanges among members that established standards for the listing of sources, reached agreement on which sources were reliable, provided insights into the believability of the information, and built trust among members. If the findings of Tinsley and Lebak (2009) held true for the Virginia Tech groups, not only did they increase in capability as a group, but the

[1] The zone of proximal development, a measure of learning readiness, describes the difference in the level of skill that an individual can demonstrate with no help, versus the level of skill that same individual can demonstrate with just a bit of help from a mentor. It is highly predictive of the set of skills the individual will soon master (Vygotsky, 1978). Within this zone, those particular skills that are cognitive in nature comprise the zone of reflective capacity.

capacity for self-reflection of the individual members also expanded, leading to individuals who could think more critically about the information available.

Potential Problems of Collaborative Helping

This type of socially-driven remedy is not necessarily good for everyone, however, as it can be chaotic, ephemeral, and based on potentially fallacious information. Technology-empowered volunteers present serious management issues. Vieweg and colleagues (2008) did not examine what was happening behind the scenes at Virginia Tech while the list-building activity took place on the social networks. However, it might have helped if there had been a way for the university to coordinate with these groups as part of the overall response. Even if the university staff did not yet know who had perished, if they had at least known immediately what names were being placed on the Facebook lists, they could have been more prepared for phone calls. In this way, the ongoing mega-collaboration would have been more likely to reduce the chaos of the recovery effort rather than add to it (Denning, 2006; Newlon & Faiola, 2006).

Another potential issue is the limited attention span of the crowd (Cebrian, Rahwan, & Pentland, 2016). There are currently few ways to ensure long-term participant engagement in ad hoc Internet collaborations (Nguyen, Tahmasbi, de Vreede, De Vreede, & Oh, 2015). If someone who lost a loved one had become dependent on the Prayers for VT site, watching its participants drift away after the event would have been heartbreaking. This lack of long-term incentives is one reason mega-collaborations rarely continue long enough to generate lasting social change (Cebrian et al., 2016; Link, Siemon, de Vreede, & Robra-Bissantz, 2015).

A third issue to consider is whether the information submitted to a group website accurately reflects the available information. As noted, in the case of the Virginia Tech websites all the information on each site's list was accurate, but no list had all the information, even though every victim's name had appeared on at least one website and was, therefore, available (Vieweg et al., 2008). This issue is discussed by Brodbeck, Kerschreiter, Mojzisch, and Schulz-Hardt (2007) and Wittenbaum, Hollingshead, and Botero (2004), who describe subtle biases on the part of group members that affect their choices about what information they are willing to share. For example, people tend to share information that is consistent with their own preferences, so if a Virginia Tech

group member had a source site she was fond of, she might have been more likely to share the information from it, even if more accurate or complete information were available elsewhere.

This sort of bias can also affect the evaluation of information by the group. For example, if several Virginia Tech group members brought the same information from the same favorite site, the simple repetition from multiple group members might have added to its perceived validity in comparison to information from a possibly more accurate or complete site that was brought by only one person. In addition to the effect of simple repetition, because individuals tend to perceive information they have contributed as more valid than information submitted by others, the repeated information would have had multiple sincere advocates (Brodbeck et al., 2007). This is why information is more likely to be accepted as the number of people who know it increases (Wittenbaum et al., 2004).

Problems such as this can be compounded by the tendency to *self-censor* if an individual thinks their information or opinion won't be acceptable. This may prevent the group from even receiving information that a member has. The *willingness to self-censor* has been studied by Hayes, Glynn, and Shanahan (2005b), revealing it as an individual characteristic that is separate from such factors as the issue at hand, the individual's gender, and any dispositional shyness the individual exhibits. Because this phenomenon varies from person to person, it can result in group access to information that is somewhat erratic. Self-censorship can both exacerbate and be exacerbated by *negotiation bias* (Brodbeck et al. (2007). When in the grip of a negotiation bias, the group will focus on discussing and negotiating the members' opinions and preferences, trying to identify the dominant or majority position, instead of attempting to gather and pool new information. This creates an atmosphere in which the introduction of new information can seem like an unwelcome diversion, thus increasing the tendency of the members to self-censor.

In many cases, the fact that the information received by a group can be skewed by these individual biases and characteristics is of no consequence. If there is sufficient shared information for the group to make correct decisions (a situation termed *manifest profile*; Brodbeck et al., 2007) the fact that some information is missing from the decision-making process doesn't really matter. Of particular concern is when publically

shared information leads to one conclusion, while private information could have led to a better conclusion. This is known as a *hidden profile* situation (Brodbeck et al., 2007). One or more information biases might possibly have prevented information in the various Virginia Tech lists from being fully shared among all of them. In fact, it is possible that information biases and the resulting hidden profiles may be a limiting factor, in general, in the sense-making of mega-collaborating groups. Information biases are discussed in more detail in Chapter Two.

What We Need to Learn about Supporting Mega-Collaboration

The issues discussed above highlight the need for more knowledge about how to best support a mega-collaboration. There are two interrelated areas where additional information is needed. The first involves the dynamics of the collaborating group, while the second involves graphic user interface (GUI) and human-computer interaction (HCI) requirements, principle, and practices.

Understanding the Dynamics of Large-Scale Collaboration

Given the dramatic appearance and activities of these mega-collaborating groups, there are surprising gaps in the understanding of their dynamics. For example, in addition to simple trust that develops from increased familiarity, two different dynamic processes appear to be driving effectiveness as the mega-collaboration forms. The first is the development of shared mental models. A *mental model* is a cognitive image of the issue at hand that describes its various states and dynamics (Mohammed, Ferzandi, & Hamilton, 2010). To successfully collaborate, group members must combine individual mental models of the problem into a group mental model (Mohammed et al., 2010). This *common ground* (Convertino et al., 2008) allows the group to develop communal goals and coordinate actions that address those goals. Formation of a group mental model involves the *convergent* sub-processes of *information pooling* and *cognitive consensus* (Mohammed & Dumville, 2001). However, the second dynamic process in the forming mega-collaboration is the development of a system of *transactive memory*, in which group members come to know about each other's areas of expertise (and/or voluntary specialization), and refer new information to the appropriate specialist for handling. The sub-processes of *specialization* and *transmission of information* to the appropriate expert are *divergent*, rather than convergent (Mohammed & Dumville, 2001).

According to Wildman and colleagues (2011) both group mental model formation and transactive memory specialization have a positive association with group performance. However, in theory, because one depends on similarity in knowledge among group members while the other depends on differences in knowledge among group members, as the shared mental model increases, specialization would be expected to decrease, and vice versa. This doesn't appear to match any described phenomenon, however. DeChurch and Mesmer-Magnus (2010) and Wildman and colleagues (2011) established that group knowledge enhances group coordination processes, behavioral processes, motivation states, and performance, while Mohammed and Dumville (2001) demonstrated that transactive memory increases group efficiency. Because of this, Wildman and colleagues (2011) call for research to determine whether there are particular types of knowledge that need to either be shared or be specialized to improve group performance.

One factor that hasn't been considered in this puzzle, however, is the group's development of a shared data repository. The group's mental model depends on a repository of pooled data that must be cognitively processed by the group's members to create the knowledge upon which decisions can be based. The growth of such a repository was evident in the Virginia Tech groups, in the form of the list of names that was continually reprinted and expanded, and the agreed upon standards that were discussed as needed (Vieweg et al., 2008).

Wildman and colleagues (2011) point out that prior research on group cognition assumed, perhaps incorrectly, that cognition was the same thing as knowledge. They suggest that making such an assumption might be missing the full picture of how the dynamic works. It can be argued that the inconsistency between information pooling and information specialization may represent the difference between data and knowledge, with distributed cognition being the intermediate factor. When a group member routes incoming information to a specialist in that type of information, and then defers to that specialist's judgment of the information's content, the intent is certainly not to deprive the group of the information's benefit. The development of specialization becomes a more effective way to add information to the common pool. This allows the complexity of the group mental model more unfettered growth, because it can be based on a shared

data repository that is larger than any individual member's ability to cognitively convert it into knowledge. In other words, the information specialists become curators of parts of the pooled repository, and their expertise is depended upon for the group's mental model to produce its collective knowledge through distributed cognition.

One advantage of this process is that it appears to encourage the contribution of additional information to the shared repository. According to Wittenbaum and colleagues (2004), there is empirical evidence showing that groups with members who know each other's areas of expertise are more likely to discuss unshared information, making it easier to resolve hidden profile situations. This would make sense, because if group members become more confident in contributing their expert individual information, and in actively retrieving expert information from each other, it could be expected to reduce the group's tendency toward a negotiation bias (Brodbeck et al., 2007). In fact, having group members specialize in different areas might also reduce the distortion from having multiple members who contribute (and advocate for) the same piece of information. The validation of expertise thus replaces the validation of repetition (Brodbeck et al., 2007).

Wildman and colleagues (2011) have noted that little research has been done on the affective, behavioral, and cognitive processes surrounding such constructs of group knowledge. Of particular interest is this apparent positive feedback loop, wherein a growing pool of information encourages specialization, which then encourages the contribution of more information. This implies a growing obsession with the group's shared data repository that was certainly observed in the Virginia Tech case (Vieweg et al., 2008). If the amount of information each group member is willing to share with the group is a function of the increasing intrinsic reward provided by improvements of both the shared mental model and the group's transactive memory, this implies that a group member will develop increased motivation to improve the knowledge structure as it grows in both content and organization, based on the increased level of self-efficacy it provides. Not only do the conversations surrounding the shared repository become more affirming for the member, but a sense of value in the repository itself begins to grow. Clearly, this process warrants examination. Group cognition is discussed in more detail in Chapter Two.

Designing More Supportive Interfaces

The GUI and interaction design strategy for mega-collaboration must both convey the knowledge of the collaborating group, and support the interactions of the group members. Currently, collaboration on social networking sites is primarily managed through online conversation threads, such as comment windows and email (Maver & Popp, 2010), as was certainly the case for the Virginia Tech Facebook groups (Vieweg et al., 2008). Such social-computational systems are primarily meant to support people's informal text-based chat instead of their formal conceptualization of the situation. The simplest chat windows list each newly posted comment in the order in which it is received, with no attempt to record its contextual relation to prior comments (Darie & Brinzarea, 2006). More capable systems allow people to specify the comment to which they are responding, with each new response listed hierarchically under the original comment. While this preserves the parent-child context of the comment, it is easy to lose the temporal context, because successive comments tend to be separated on the display as the trail of responses grows (Ramachandran, Jensen, Bascara, Carpenter, & Denning, 2009).

The inability of these chat formats to represent complex relations among data elements is a major problem, one basic aspect of which was demonstrated by the *Prayers for VT* site (Vieweg et al., 2008). Each time another decedent was identified, it was necessary to reprint the list in its entirety to add the new name to it. This is a simple example of the inefficiency of trying to maintain a shared data repository within a conversation stream. However, the drivers of mega-collaboration effectiveness, these being information pooling and transactive memory, present much more complex issues. The pooling of data during the building of a shared mental model requires the incorporation of information from other collaborators into each individual's existing set of definitions and concepts. This often requires creation of a higher-level abstraction to link concepts from other collaborators that are similar, but not identical, to one's own (Newlon, de Vreede, MacDorman, Patel, & Pfaff, 2009). This process of building information classes leads to the development of information networks, as various class hierarchies become cross-linked with each other. Finally, on top of whatever level of complexity the resulting data pool exhibits, one must then add the framework of specialization developed by the transactive memory system (Mohammed & Dumville,

2001). It is simply not possible to efficiently represent this amount of complexity in a chat GUI.

The problem of representing the shared data repository is only one of the two mega-collaboration interface requirements. The other issue involves interaction support. Understanding user interaction is required, both to manage activity and to encourage the unbiased contribution of information. As has been noted, while they have tremendous potential for generating support and remedy, mega-collaborations can be hard to manage, especially in a crisis situation. A trade-off must be made between command-and-control requirements for the efficient delivery of services and the need to respond creatively to unforeseen problems and coordinate spontaneous volunteers (Harrald, 2006). If not carefully thought through, the effort to enforce a command structure on a mega-collaborative response could siphon critical resources away from the recovery effort. One can imagine, for instance, what would have happened if the authorities responding to the Virginia Tech shootings had tried to stifle the communications on Facebook to prevent the unauthorized release of names. Even though an effort such as this would probably have been ineffective, it could have distracted those critical to management of the situation. An interface that provides organizational structure to the mega-collaborating groups could alleviate such problems. It could provide more predictable forums of communication and patterns of growth (Newlon et al., 2009), and allow better ability to comprehend what can be controlled centrally and what can only be managed by response.

In addition, interaction support must be provided to encourage an unbiased contribution of information to avoid hidden profile situations. GUIs that support the development and tracking of specialization will aid in this, because specialization encourages contributions (Wildman et al., 2011). Also, interfaces that provide a specific time and place to put new information into the common pool seem likely to reduce the amount of self-censorship. GUIs that support brainstorming, directed discussion, and turn-taking imply that all contributions are welcome, thus encouraging even the hesitant to speak up (Newlon et al., 2009).

Therefore, there is clearly a need to investigate the design and impact of GUIs that represent the complexity and support the interactions that a developing mega-collaboration requires. One source of such GUIs is collaboration engineering. Past

research in this field has produced a number of collaborative interface elements, known as *thinkLets*, which may help to address these requirements (Briggs & De Vreede, 2009). To date, however, there are only a few examples of GUIs that have been developed and tested using thinkLets (Hoppenbrouwers & van Stokkum, 2013; Seeber et al., 2015). Research in this area is described in Chapter Two.

Summation of the Issues and How this Research Addresses Them

As noted, the tools of mega-collaboration, including their functionality, usability, and impact on group work, must be examined together. Interfaces that are explicitly designed with knowledge of human behavior and cognitive and social factors, required for collective sense-making, are needed to support efficient large-scale collaborative helping. For these tools to be effective, however, better understanding is needed of collective sense-making, as shared understandings are negotiated within the group (Mohammed et al., 2010). In particular, a better understanding of the power of the growing shared data repository as an intrinsic motivator for increased contribution could significantly support progress in this area.

Therefore, it is the aim of this research to examine the dynamics of the mental model negotiation process. As the group mental model grows, it will eventually be based on a shared data repository that is larger than any individual member's ability to cognitively convert it into knowledge. In this situation, an interface that is designed specifically to support collective sense-making, via the building of the shared data repository and its attendant knowledge structure, should increase the amount of information shared and the effectiveness of its use.

It expected that the amount of information each member is willing to share with the group increases with the growth of the shared data repository and the shared mental model. It is proposed that this happens because the group member develops increased intrinsic motivation to improve the knowledge structure as it grows in both content and organization, based on the increased level of self-efficacy it provides. If the theory is correct, it is expected that the ability of the proposed GUI (noted below) to describe and share complex data and to facilitate negotiation will be a predictor of both the information contributed to (and the intrinsic rewards provided by) the model, and that the

correlation between these factors will explain most of the variation in willingness to share.

On the other hand, the act of sense-making, by definition, creates its own cognitive load. This must be balanced against the cognitive load created by the burgeoning data repository. If the sense-making interface is not intuitive enough, it could magnify the cognitive load of each additional unit of data, rather than reduce it. This is especially true when users are confronted with a learning curve for a new interface (Link et al., 2015). Therefore, it is important to measure the effect of the proposed tool against the effect of a traditional chat-based interface to examine the trade-offs.

Expected Contribution of this Research

This research is expected to make two overarching contributions. The first is an increased understanding of the behavioral factors discussed above, which must drive future Mega-Collaboration Tool (MCT) development. This includes an examination of whether the current interface is progressing in a direction that is compatible with the behavioral constraints observed during the study. Because it requires taking a close look at actual group cognition as it develops in a controlled, collaborative setting, the study is also expected add to the general understanding of cognitive theory.

The specific deliverables expected are an answer to the question of whether MCT adequately supports group cognition, an understanding of the overall effect of the group data repository on sharing behavior, and a clearer picture of which intervening factors mediate that effect. The findings in this area are overviewed below, laid out in detail in Aims 1 to 3 of Chapter Four, and discussed throughout Chapters Five and Six.

The second overarching contribution from this study is expected to be a practical examination of the performance of various interface components. Because it involves testing the workability of several thinkLets, the study is also expected to add documented, hands-on case material to the field of collaboration engineering.

The specific deliverables expected are answers on the usability and usefulness of the topic-generation function, the relation-development and categorization functions, and the matrix-sort function. In addition, the results of category development and matrix sorts are expected to provide useful insights into how to support structure in inter-group

settings with future MCT versions. The findings in this area are overviewed below, laid out in detail in Aim 4 of Chapter Four, and Discussed in Chapters Five and Six.

Overview of Methodology and Findings

In conducting this research, the focus of the study was the application of information theory in examining the cognitive effects of a simplified version of MCT (Newlon et al., 2009). This MCT prototype captured individuals' mental models and supported the negotiation of team models, allowing an examination of both the development and use of the shared data repository.

To conduct this study, we recruited 12 groups of three individuals each to play roles in a collaboration (development of a charity art auction) that was performed across the Internet. Each individual was given a certain amount of private information that could be shared with the group, or not, based on that individual's own decision-making. Half of the groups used a chat-only interface for their collaboration, while the other half used the simplified version of MCT, which helped them build explicit group mental models. The resulting sharing behavior was examined in detail, as well as the mental models developed by MCT-based groups.

Based on the results of the study, it was determined that group cognition can be enhanced by a supportive interface. But it was also determined that interfaces and HCI requiring abstract thought must be more supportive than those requiring only chat. This is due to the additional cognitive load involved. When faced with Internet functionality issues, group performance using such interfaces degrades more rapidly than performance using chat interfaces.

It was also determined that sharing behavior increases as the data repository increases as long as the growing data repository helps the group members determine the relevance of the information they hold. However, the pattern of that sharing over time is unpredictable, because it is based on the detailed needs of the ongoing conversation.

Finally, it was confirmed that there are intervening factors in the effect of data repository size on sharing. These are intrinsic motivation (as indicated by behavioral expressions of enthusiasm) and resistance to information bias (as indicated by honesty and trust in sharing information that is inconsistent with personal or group preferences). Regression analysis determined that the growing size of the data repository increases

trust, honesty, and enthusiasm, each of which, in turn, increases the amount of information shared.

One of the operational findings of the study was that the various Internet-based thinkLets developed for the interface performed adequately, though several possible improvements were noted. It was demonstrated that thinkLets of this nature can be designed to successfully operate without a moderator in an Internet-based setting.

An examination of the data structures produced by MCT-based groups made it clear that preconceived categories would always be too restrictive, and that the category definition process itself is an important part of the group's cognition. However, group members did appear to be comfortable with the predefined types of mental models. This could enable tool developers to make useful predictions about the structural needs of the group's growing data repository.

One unexpected finding, was the realization that thinkLets need to be asynchronous if they are to be effective in an Internet setting. While this finding may not speak to information theory, it will definitely help future developers.

Organization of this Document

Chapter Two examines prior research in this area, the current state of knowledge, and the research questions this study addresses. Chapter Three describes the specific aims of this particular study, and explains the methodology used to examine the research questions. Chapter Four describes and illustrates the findings of the research. Chapter Five discusses the implications of the various findings, in light of the aims of this particular study. Chapter Six summarizes the study's contributions, discusses the conclusions to be drawn, considers the limitations of the study, and suggests potential directions for future research.

CHAPTER TWO: BACKGROUND

Related Research

The design for a tool to support mega-collaboration drew from a number of different considerations. Therefore, prior research on this topic falls into several areas. Various studies are described below on the benefits achieved by large-scale collaborative helping and on the issues that can arise from it. Research into the dynamics of collaboration is also reviewed, with a discussion of collective mental models, transactive memory, collaborative cognition, and motivation states. Finally, the HCI design of interfaces that support collaborative helping are discussed. These include both interfaces that support group models and decision-making, derived from research in Computer-Supported Collaborative Work (CSCW), and interfaces that support the HCI process, derived from research in Collaboration Engineering.

The Issues Surrounding Mega-Collaboration

The Rise of Large-Scale Collaborative Helping

Without question, the way we live is being transformed by the public's access to new communication media and tools, including wikis, social networks (such as Facebook and Twitter), crowdsourcing, tagging plugins, and mashups (de Vreede et al., 2016). This media is known variously as information and communication technology (ICT) or social-computational systems (Soc-CS). While these platforms are being used in many different ways, it is the phenomenon of mega-collaboration (exemplified by the amplification of spontaneous collaborative helping) that is the topic of interest in this research. A review of the literature reveals that such activity has profound implications, both good and bad, for society. It follows that the forces driving it are important considerations in designing a CSCW tool to support it.

As we have seen, the issues surrounding public response to a crisis or disaster are driven by the dynamics involved in mega-collaboration. The above-noted, analysis of the public's use of social networking after the Virginia Tech shooting showed that ordinary folks (many operating from remote locations) performed a significant amount of spontaneous work to connect people with worried relatives and compile an accurate list of the victims (Vieweg et al., 2008). The example above is not just an isolated incident. Crisis response via contemporary social media has been studied in a number of contexts.

Similar activity has been shown in other recent crises, including grassfires in Oklahoma, the Red River floods in the Dakotas (Vieweg, Hughes, Starbird, & Palen, 2010), forest fires in France (De Longueville, Smith, & Luraschi, 2009), the World Trade Center attack, the Hurricane Katrina recovery, the London Tube bombings, wildfires in California, the SARS epidemic, the Hurricane Sandy recovery (Kogan, Palen, & Anderson, 2015), and various earthquakes around the world (Palen & Liu, 2007). Such behavior has become the rule, rather than the exception.

Examining the Potential for Benefit

Supporting the benefits of mega-collaboration will require an examination of how such benefits accrue to targeted groups, to society as a whole, and to the individual participants. The crisis responses listed above provide a good illustration of the ways in which mega-collaboration can benefit a targeted group. However, there are also other scales, both large and small, on which mega-collaborative benefit may be achieved. Many of the world's problems are of a type formally defined as *messy* (large, complex, intractable situations that no one person can solve, i.e. drug abuse) or *wicked* (where people can't even agree on what the problem is and the solution will entail disruptive innovation, i.e. global warming). These types of problems can only be solved through collaboration (Denning, 2009). Denning and Yaholkovsky (2008) list existing manual processes currently in use to facilitate this type of collaborative problem-solving, including such things as charrettes and structured workshops. However, these methods can only accommodate a conversation space of 50 to 200 participants, while some of the messy and wicked problems to be resolved affect millions (even billions) of people. Mega-collaboration that allows coherent communication to happen on a global scale could address problems such as these, potentially providing material benefit that is also global in scale.

The benefit of mega-collaboration must also be measured on a small-scale, however. This benefit is manifested on the level of the individual, or it would not be considered beneficial. It is not the charitable organization one is attempting to benefit with one's contribution, but the individuals that the charity will subsequently assist. Appropriate incentive structures must also be in place to maintain participant engagement if the collaborating group is to succeed (Cebrian et al., 2016; Nguyen et al., 2015).

Therefore, measurement of the benefit to individual participants must be an important part of studying mega-collaboration.

This makes the cognitive benefit that accrues to the individual particularly relevant. As discussed above, exposure to the ideas of others can increase an individual's reflective capacity. This cognitive benefit for the individual can have a return effect, however, in that group members with greater reflective capacity create a more competent group. Tinsley and Lebak (2009) provided one example of this feedback loop when they described a study group of school teachers who were taking graduate courses. While individual members of the study group had trouble applying learning from the graduate courses to their own classrooms, they had no trouble sharing insights pertaining to a fellow group member's classroom. As a result, each group member received critical feedback from multiple other group members on matters that lay beyond his or her capacity for self-reflection, with the result that each group member became a better teacher and also a better facilitator, able to offer more insight to the group. If a similar feedback loop could be supported by a collaborative interface, it would supply an incentive structure to help maintain participant engagement.

The design of this study (described in Chapter Three) does not include a scale component simulating benefits that accrue to society as a whole. It does, however, include the ability to examine the benefits accruing to the targeted group, and also to the individuals, via conversation analysis of the group's communications.

Examining the Potential for Problems

Even with so much capacity for good ensuing from collaborative helping behavior, there are also potential problems to consider in a venue this powerful. In particular, the three problems discussed above are the difficulty of controlling a large-scale spontaneous collaboration, the difficulty of incentivizing crowdsourced work, and the difficulty of ensuring the quality of the information that is used in its decision-making.

Returning to crisis response as an illustration of mega-collaboration dynamics, the issues surrounding command and control are an example of a potential for harm. Palen and others have found that ordinary citizens are almost always the true first responders to a crisis, and do not necessarily relinquish control when government authorities arrive (Harrald, 2006; Palen, Hiltz, & Liu, 2007). However, even though collaborative helping

can play an important positive role in crisis response, the massive amounts of information and resources and the widely divergent points of view provided by the public can place a strain on the centralized authority structures that the government has implemented to manage such situations (Harrald & Jefferson, 2007). A study of one of these centralized authority structures, over nine different disasters, yielded unexpected results. It was concluded that the federal government's Incident Command System (ICS), far from being a solution to unanticipated disaster situations, works best when those using it are responding to routine demands with little requirement for social or cultural negotiation (Buck, Trainor, & Aguirre, 2006).

Thus ICS is revealed as a mechanism for inter-organizational coordination of entities that are already familiar with each other, giving rise to the prediction that efforts to use ICS for comprehensive disaster management will not succeed as intended. This finding has fueled an emerging debate on the proper way to manage a disaster response in an ICT-enabled society (Mendonca, Jefferson, & Harrald, 2007; Palen & Liu, 2007). Because information is situated (i.e., context sensitive), full understanding requires acquisition of not only its data component but also a perception component and a meaning component that are based on its original source. As a result, *sense-making*, rather than data, is the factor that most limits knowledge, a circumstance which hampers centralized control (Harrald & Jefferson, 2007).

At the same time, the stakes are high in a crisis situation; and failure to take advantage of information and resources provided by the public can cause a politically disastrous loss of public trust. For example, Kweit and Kweit (2004) conducted a retrospective study on the recovery from a severe flood of two communities on opposite sides of the river (Grand Forks, North Dakota and East Grand Forks, Minnesota). In both communities, the physical outcomes were largely the same: a successful rebuilding program. But the communities differed in the extent to which they recruited community involvement in the recovery decisions versus leaving such decisions to the city's administrative department heads. The resulting difference between the communities was that the citizens who perceived greater citizen involvement were more satisfied and continued to support their elected government, while the citizens who perceived less

citizen involvement were more dissatisfied and subsequently voted most of their officials out of office in the next election.

Mega-collaborative helping can present this type of "Catch-22" situation. People in authority can be easily overwhelmed by the need to integrate public resources into the recovery effort and vilified if they fail to take advantage of these resources. In another example, a 2007 expose by The Washington Post disclosed that most of the $854 million in Hurricane Katrina aid offered to the government was never collected. Only $40 million of it had been spent two years after the hurricane (Solomon & Hsu, 2007). When faced with problems such as these, more formal structure for the shared data repositories built by mega-collaborations could reduce the chaotic nature of the information the central command structure must process. For instance, if every agency in charge of Katrina recovery had been able to draw from a comprehensive database of the proffered aid that included how to collect it and account for it, spending that money would have been much easier. Of course these problems are mild compared to some of the uncontrolled mega-collaborations that are happening overseas. Tahmasbi and de Vreede (2015) have been studying the role that spontaneous organization via social media played in the Egyptian uprising.

These cautionary examples suggest that improvements to interface and the overall HCI design for the mega-collaborative data collection and sense-making processes are vital in the support of more robust dialogue between ordinary people and central authorities. One key is the ability to add formal structure to the situated data without overburdening the cognitive load of the conversation. The current study specifically tests a method for doing this. This version of the MCT prototype is designed to allow its users to define their own categories and action plans, but sort them into specific knowledge types, based on situation, strategy, tasks, and team characteristics. In the future, cross-team comparison and coordination methods can be built on such a structure. By comparing the results of using the interface in a predefined situation with results of using only chat, we can determine whether it met its goals at an acceptable level of cognitive load.

The other two problems to be considered are need for a better understanding of the incentive structure behind the sharing of information, and the potential for

information sharing biases. Not only might biases affect the quality of the information that a mega-collaboration could share with a central command structure, they could pervasively damage the decision-making results of any mega-collaborative effort. Brodbeck and colleagues (2007) provide an extensive description of the biases discussed above. Whether we are biased against information that challenges our preferences, or giving more weight to information that more people know about, the bias interferes with our sharing of new information and leads to diminished quality in the group's decisions concerning hidden profile situations.

This is complicated by the fact that information context and member's goals affect not only what information is shared, but also how it is shared and who it is shared with. Wittenbaum and colleagues (2004) expand on the emergence of information biases, contending that the decision to share or withhold information in decision-making groups is a deliberate process that supports members' goal attainment. Even when members do share information, it may be misrepresented or framed in a way that is congruent with the goals of the sharing individuals.

This is a type of *selective sharing*, where a member of a decision-making group selects those other members with whom he or she is willing to share information, thus forming a subgroup within the original group. As a result, information sharing in decision-making groups depends on the situated goal structure, which varies both within and between groups. The effect of this is unpredictable, because as discussed above, the relative importance of the shared or unshared information depends on the content of the information, as well as the distribution of the information among members and the group members' goals. This could add to the chaotic nature of a mega-collaborative effort.

One potential solution for information bias is the provision of a more formalized negotiation strategy. Wittenbaum and colleagues (2004) found that structuring the discussion and having the members rank alternatives in order of preference were two successful techniques for increasing the amount of information that was shared. As mentioned above, the development of a system of transactive memory and the resulting growth of expertise also encourages the sharing of information. This suggests that a GUI that supports more formalized pooling of information and agreement on goals could have

a beneficial effect on mega-collaborative decision-making and provide a more stable partner for a centralized command structure to work with.

The MCT prototype, used for the current study, was specifically designed to encourage more formalized negotiations through the use of collaboration engineering components. The differences in sharing behavior between the two interfaces were compared.

Summary of Issues

While there is a growing body of ethnography surrounding mega-collaborative responses such as those described above, there has as yet been little attempt to establish the basis of such activity, in relation to theories of cognition, psychology, and sociology, or to determine the best methods for supporting it. In particular, the benefits of mega-collaboration for individual participants and recipients, as well as the individual's resulting contribution back to the group, are of interest. This calls for a better understanding of the dynamics affecting mega-collaborative activity.

Also, based on the problem areas, both observed and theorized, the effect that the MCT interface has on mega-collaborative results is of interest. To support the dynamics of mega-collaboration, the GUI was specifically designed to support data collection, sense-making, pooling of information, and agreement on goals. The following sections discuss in greater detail existing research pertaining to both collaborative dynamics and collaborative interfaces.

Mega-Collaboration Dynamics

There has been a tremendous amount of research conducted on the dynamics of collaborating teams, or groups. But there has been little research that covers the specific large, spontaneously forming, ICT-based groups that participate in mega-collaboration. In theory, the same principles should apply, however. Effective group collaboration is driven by three distinct dynamic processes, these being *group cognition* (the knowledge architecture of the group), *motivational states* (such as emotional attraction to the group, dedication to the group's practices, and belief in the group's ability to succeed in its goals), and *behavioral processes* (such as attention, information sharing, situation assessment, decision-making, synchronization of joint actions, and provision of backup support). Each of these processes provides a unique contribution to the performance of

the group (DeChurch & Mesmer-Magnus, 2010). The discussion below examines in detail the various processes, and the methods of measuring them. This information was instrumental in developing the methodology of the current study.

Measuring Collective Mental Models, Transactive Memory, and Collaborative Cognition

The general area of group cognition covers several related sub-processes. These include the development of group mental models, the development of a transactive memory structure, and the cognitive process, itself (DeChurch & Mesmer-Magnus, 2010; Wildman et al., 2011). Shared mental models and transactive memory represent two distinct methods of handling knowledge within a group. The literature on shared mental models describes them in terms of composition. Their specific descriptors are *cognitive similarity* and *cognitive accuracy*, or the degree to which the group members' mental models match each other, and the degree to which they match some index of reality (DeChurch & Mesmer-Magnus, 2010).

Transactive memory, on the other hand, is more of a compilation than a composition. Rather than shared sets of knowledge, a transactive memory system contains different individual knowledge sets linked by shared knowledge about who is responsible for each set (Wegner, 1986). The specific descriptor for transactive memory is the degree to which the members' knowledge sets complement each other (DeChurch & Mesmer-Magnus, 2010). These various models and knowledge sets are used for the group's collaborative cognition, which drives its HCI and subsequent behaviors. The group's knowledge can influence and/or be influenced by the group's cognition; but the knowledge structures are distinct from the cognitive process itself (Wildman et al., 2011).

DeChurch and Mesmer-Magnus (2010) comment on the discrepancy between the shared versus complementary nature of these knowledge structures. However, their discussion of the degree of synergy fails to cover the role of distributed cognition by a collaborating group via its shared data repository. The members of a group hold little knowledge directly in memory; most individual cognition depends on the external artifacts by which group members supplement their recall abilities (Artman & Garbis, 1998; Hutchins, 1995). It follows that the shared data repository of the group is an important component of the group's cognition.

If one starts with the data repository, it makes sense that some amount of the group's cognitive process depends on knowledge in the repository that is accessed and processed by all the group's members; but that, as the repository becomes larger and more complex, the group's members also split the task of accessing and processing some parts of the repository to distill the information in it, thus adding only the distillation results to the group's cognitive process. Therefore, one can reasonably assume that group cognition is a complex balance between the shared mental models that determine the emerging identity of the group, and the transactive memory system that allows the group's collaborative cognition to be larger than the cognitive abilities of any individual member.

The discussion to this point concerning group mental models has somewhat oversimplified the dynamics of collective models. According to the comprehensive review of research on group cognition conducted by Wildman and colleagues (2011), there are several different kinds of group mental models. These are *taskwork models* (containing process-related knowledge), *strategic models* (containing goal-related knowledge), *situation models* (containing situation background and awareness knowledge), and *teamwork models* (containing knowledge about other group members). These models are formed in an emergent manner, not only by the pooling of information from the group members, but also by the group members' interactions (Wildman et al., 2011). The knowledge within each of these models can be either static (changing slowly) or dynamic (changing rapidly).

Transactive memory can also be divided into several conceptual components. These are *group knowledge stock*, *degree of specialization*, *knowledge location consensus*, and *knowledge location accuracy* (Austin, 2003). The type of content in the group knowledge stock mirrors the type of content in the group mental models. There are potentially taskwork content, goal-related content, situation awareness content, and teamwork content. The difference is that, instead of mental models that the entire group share, the transactive memory knowledge stock contains knowledge that is divided among the group's members.

It has been shown that increasing the degree to which individual group members specialize in their particular portion of the knowledge stock reduces repetition of effort,

thus freeing the group to access a wider range of knowledge (Austin, 2003). The group's consensus on, and accuracy about, knowledge location within the knowledge stock is the degree to which the group's members agree upon, and are correct about, who has what knowledge. If these measures seem like the *cognitive similarity* and *cognitive accuracy* of shared mental models, it is because this part of the transactive memory system is, indeed, a collective teamwork model. In this way, the group's mental models and its transactive memory structure are linked.

The cognitive processes of the group represent the use of these knowledge structures to drive the group's strategic behavior, which can also include the processes of agreeing on the pooling of knowledge and agreeing on who should specialize in what knowledge (Austin, 2003). As mentioned above, it is the focus of these cognitive processes (driven by the group's goal model) that may lean either toward negotiation of the group's dominant opinions and preferences (a negotiation bias), or toward gathering and pooling information for the group (Brodbeck et al., 2007). This focus, in turn, affects the behavior, and the performance of the group.

There are a number of different elicitation methods by which these various components of group cognition can be measured (Wildman et al., 2011). Methods that look at *perceptual cognition* are interested in the group members' values, attitudes, perceptions, beliefs, and expectations. However, they don't emphasize causality, relations, or explanations. On the other hand, *structured cognition* looks for the pattern of organization for the group's knowledge but doesn't examine the details of its content or perception. Perceptual cognition is usually measured with ratings scales, while structured cognition is often measured through multidimensional scaling, pairwise comparisons, or Pathfinder network analysis (Wildman et al., 2011).

According to Wildman and colleagues (2011), when examining collective mental models, the elicitation method can depend on how quickly the knowledge in the model changes. In general, the cognitive similarity of a model is assessed by measuring the agreement among the group members' answers to questions, while cognitive accuracy is measured by the overall accuracy of their answers. More specifically, the static segment of the taskwork model (i.e. the extent to which group members share static knowledge of a task) is measured by scoring the similarity of group members' answers when they are

questioned about the key pieces of information in the task. The dynamic segment of the taskwork model can be measured during task execution with interruptive questionnaires asking the group members to report on the present status of the task situation.

The elicitation methods for measuring the strategic model are similar. A pre- or post-test questionnaire can be used to determine if the group has a shared understanding of the (static) overall goal, and a series of interruptive questionnaires can be used to assess their agreement on the (dynamic) progress being made toward that goal. It follows that the situation model can also be studied with a pre- or post-test questionnaire to measure the similarity in the members' understanding of the situation background, and with interruptive questionnaires to measure the level of agreement in their dynamic situation awareness.

The final type of group mental model, the teamwork model, is much more complex because it involves interactions among people. To study the group members' understanding of teammates' abilities and potential future actions, verbal communications among the group members can be analyzed, along with recorded group member behavior (Wildman et al., 2011).

It was not the goal of this study to examine the different types of mental models in detail, merely whether the participants were able to structure their data based on their mental model structure. The study did, however, use some of these methods to look at overall mental model building. In particular, a quiz over key pieces of information was administered afterward, and interruptive questionnaires were used to examine the sharing behavior.

According to Austin (2003), the transactive memory structure of the group also requires several different elicitation methods. The group knowledge stock may be best studied by directly examining artifacts, such as the shared data repository, and by eliciting mental knowledge through questionnaires. The quality of the knowledge stock is measured through network analysis or via some comparison of efficacy. For many laboratory studies, the same information inputs are provided to each group, and the resulting knowledge stock is then examined (Austin, 2003).

The degree of specialization can be measured by quizzing the group members on the information in the knowledge stock. If different members score well on different

areas, it indicates a high degree of specialization. If these areas are contiguous, but not overlapping, the degree to which the knowledge sets complement each other is high.

As mentioned above, the measurement of a group's transactive memory structure also involves one type of group teamwork model, the shared understanding of who in the group has what knowledge. A method that has been used to examine this is to have group members predict their fellow members' scores on the quizzes covering the various areas of the group knowledge stock. The results are then compared to the members' scores. If the members all make similar estimates, they have high cognitive similarity; if the scores they predict are close to the actual scores, they have high cognitive accuracy (Austin, 2003).

These were the specific methods used in the current study. The scenario provided the same information to each group, with each of the above-mentioned measures being gathered from the quiz administered after each session. This quiz both asked for the individual's own knowledge of key information, and asked the individual to predict the accuracy of teammates' answers on each item.

Measuring Motivation States and Behavioral Results

There are a number of ways a group's collaborative cognition can be examined, but basically each method involves studying the effect of the cognitive process on some aspect of the other two dynamic processes of collaboration, these being motivation and behavior (DeChurch & Mesmer-Magnus, 2010). Motivation and behavior, of course, are also linked with each other, because behavior is affected by motivation as well as by cognition, and motivation is affected both by cognition and by behavior. Several standardized scales (described below) are available to measure various aspects of motivation. These were adapted into a post-test survey used by the study, which is shown in Appendix E.

One situation in which cognition affects motivation, which affects behavior, which affects cognition, is the link between transactive memory and information bias. Part of the de-motivation for sharing information is that people don't want to look stupid if the information they share is not accepted by the group due to doubts about its validity. As the group's shared data repository grows, its transactive memory structure also grows, because the group's members develop specialties and begin to respect each other's areas

of expertise. This specialization reduces the risk that information a group member shares won't be accepted by the group. As a result, group members are more likely to share information, which then increases the size of the shared data repository still more (Brodbeck et al., 2007).

Information bias as a de-motivator. Given the potential danger of information bias to the success of a mega-collaboration, this relation is particularly relevant. Studying this set of motivations and behaviors allows the group's cognitive process to be examined via its relative success at information pooling. Can the group achieve a process that motivates the sharing of knowledge, or does information bias de-motivate such sharing? The classic method for testing this is to manufacture a hidden profile scenario, with a pre-defined set of information to feed into the knowledge stock, and to then examine the information-sharing behavior of the group members, under various test conditions, to see whether the group's decision-making process allows it to find the optimal solution to the scenario (Austin, 2003; Brodbeck et al., 2007; Wittenbaum et al., 2004). The current study was set up in exactly this way.

While this may seem simple, there are a number of HCI design issues that must be taken into account to ensure a valid test. Wittenbaum and colleagues (2004), in their discussion of information bias, delineate several possible confounding factors for which controls may be needed in examining whether previously unshared information is more likely to be discussed. These may be summarized as follows:

1. The number of members who know a piece of information (which is positively correlated with discussing it);

2. The font face of the information (bold face increases the likelihood it will be mentioned);

3. Whether it is negative or positive information (negative information is likely to be discussed more thoroughly);

4. The total amount of information versus the amount unshared (if the percentage of unshared information is high in an information-poor environment, unshared information is more likely to be discussed);

5. The amount of pre-discussion disagreement (which is positively correlated with discussing unshared information);

6. The group size (larger groups tend to be better at pooling information than smaller ones);

7. The number of alternatives (which is negatively correlated with the amount of information discussed);

8. The length of the discussion period (because shared information tends to be discussed first, the length of the discussion period is positively correlated with the amount of unshared information discussed);

9. A member's status (which correlates positively with the amount of unshared information discussed), and

10. A member's innate willingness to self-censor (which may be negatively associated with the amount of unshared information discussed) (Hayes et al., 2005b; Wittenbaum et al., 2004).

For the most part, these potential confounding factors are controlled through standardization of the presentation variables and by statistical management of the contextual variables. A detailed discussion of how these factors were addressed by the current study can be found in Chapter Three.

As discussed above, however, in addition to the context-related inhibition of contribution that arises from information biases, there is willingness to self-censor, a more innate inhibitor, that may factor into an individual's behavior (Hayes et al., 2005b). Self-censorship is specifically defined as withholding one's true opinion from an audience perceived to disagree with it. This assumes that the individual has an opportunity to express that opinion and can perceive the opinion of the audience, and that the audience's opinion differs from the individual's opinion.

Willingness to self-censor is a personality trait that has been shown to be distinct from the traits of social shyness, conformity, and opinion inhibition. It is inversely correlated with individuation and self-esteem, and directly correlated with public self-consciousness. These are all stable traits that don't change with social context, but spring from differences in people's innate fear of social isolation (Hayes, Glynn, & Shanahan, 2005a; Hayes et al., 2005b).

Because we are considering inhibitors of contribution, the individual's "opinion" may include any sort of information in the individual's possession that has not been shared with the group. This can include not only a person's beliefs but also whatever

unshared information these beliefs are based upon. Because people differ in this self-censorship characteristic, they might behave differently when given the same test situation, potentially invalidating the test result (Hayes et al., 2005a).

To measure willingness to self-censor, Hayes and colleagues (2005b) created the Willingness To Self-Censor (WTSC) Scale. They validated their scale by showing a statistically significant correlation between the WTSC score and the participants' willingness to give their true opinion when they knew their audience disagreed with it, compared to their willingness to give their opinion when they knew the audience agreed (Hayes et al., 2005a). Their methodology also differentiated between willingness to self-censor and shyness by showing that people who differ in dispositional shyness do not differ in the effect the climate of opinion has on their willingness to speak out. Willingness to self-censor is more than discomfort in social situations (Hayes et al., 2005a, 2005b). It predicts willingness to discuss one's unshared information, given the climate of opinion. This measure was found to be independent of both the issue under discussion and the gender of the participant (Hayes et al., 2005a). An example of the self-report questions of the Willingness to Self-Censor Scale are shown in Table 1 (Hayes et al., 2005b), with the full scale shown in Appendix E.

Table 1. *Excerpts from the Willingness to Self-Censor Scale (Hayes et al., 2005b)*

1. It is difficult for me to express my opinion if I think others won't agree with what I say.
2. There have been many times when I have thought others around me were wrong but I didn't let them know.
3. When I disagree with others, I'd rather go along with them than argue about it. (p. 306)

By administering a version of this scale as part of the post-test survey, it was expected to be possible to examine whether willingness to self-censor had a confounding effect on the current study.

Sense-making as a motivator. While the previous discussion indicates that it may be possible to reduce the de-motivational effects of information bias through the growth of transactive memory, this leaves open the question of what is motivating the sharing of information. According to Brodbeck and colleagues (2007), one motivator might be the

increase of status that results from being able to contribute information to the group, thereby demonstrating competence. People don't like to look stupid because their information is rejected, but they do like to look smart because it is accepted. However, while this might explain why group members begin to share information, it doesn't seem sufficient as an explanation of the intense focus on the completeness and accuracy of the shared data repository that has been evident in past mega-collaborations (Palen & Liu, 2007; Vieweg et al., 2008).

One possibility is that building the shared data repository is self-motivating through its intrinsic reward as a sense-making activity. The act of building a shared data repository during a mega-collaboration seems likely to give everyone involved a greater sense of situation awareness and a greater capacity for reflection. Sense-making is a natural human response to uncertainty (Ravid, Shtub, & Rafaeli, 2008). It seems reasonable, for instance, that learning about a disaster situation introduces uncertainty into an individual's worldview, causing the individual to try to make sense of what is happening. In this context, cooperating with others to get an understanding of the situation that is superior to what could be achieved individually will bring its own reward.

One possible tool for measuring the intrinsic motivation of an activity is the Intrinsic Motivation Inventory. This is a multi-dimensional device that measures the individual's subjective experience of the activity in question. A list of example inventory self-report questions is shown in Table 2 ("Intrinsic Motivation Inventory," 2011), with the full inventory shown in Appendix E.

Table 2. *Excerpts Adapted from the Intrinsic Motivation Inventory*

	What is Measured	Why Measure?	Rated Statement
1.	Participants' interest/enjoyment	Considered the self-report measure of intrinsic motivation	"I enjoyed doing this activity very much."[a]
2.	Perceived competence	Positive predictor of self-report and behavioral measure of intrinsic motivation	"I think I am pretty good at this activity."[a]

What is Measured	Why Measure?	Rated Statement
3. Effort	Relevant to some motivation questions	"I put a lot of effort into this."[a]
4. Value/usefulness	Used in internalization studies because people internalize and become self-regulating with respect to activities that they experience as useful or valuable for themselves	"I believe this activity could be of some value to me."[a]
5. Felt pressure and tension	A negative predictor of intrinsic motivation	"I did not feel nervous at all while doing this."[a]
6. Perceived choice while performing a given activity	Positive predictor of self-report and behavioral measure of intrinsic motivation	"I believe I had some choice about doing this activity."[a]
7. Experiences of relatedness	Used in studies having to do with interpersonal interactions, friendship formation, and so on (Validity of this subscale has yet to be established.)	"I felt really distant to this person."[a] (R)

[a]("Intrinsic Motivation Inventory," 2011, pp. 4-5).

These are not hidden methods of measurement, however, so they have the common self-report problems that they may be influenced by ego, self-presentation tendencies, and other individual and contextual factors. Frequently the correlation between behavior and self-report is only around 0.4. Therefore, behavioral measures should be added for confirmation ("Intrinsic Motivation Inventory," 2011).

It should also be noted that the value/usefulness subscale does not refer to the relevance of the task, even though the concept of relevance is often used when the activity involves sharing information. While it is tempting to use it for information-sharing activities, the problem with relevance as a measure is that there are so many different kinds of it. González-Ibáñez and Shah (2010) lists 1) system or algorithmic relevance, 2) topical or subject relevance, 3) cognitive relevance or pertinence, 4) situational relevance or utility, and 5) affective or emotional relevance. These types of relevance are typically studied via conversation analysis. In the case of affective relevance, it can be judged based on whether statements about the information object are positive, negative, or neutral. Because of this vagueness and complexity, however, it

seems much more reasonable to ask directly about the value that an information object is judged to have.

The current study used both conversation analysis and interruptive questionnaires in examining the effects of relevance. It turned out to be a key driver, because the increased status from contributing information to the group was a prime motivator within the context of the study.

Sense-making and Flow State. An additional way of evaluating the level of motivation is to determine an individual's *flow state*. The term *flow* was first coined by Csikszentmihalyi (1975) to describe a particular type of enthusiasm people can experience as they perform an engaging activity. It develops when the activity is not done to get a reward, but because the work itself is rewarding (also called *autotelic*). People who experience flow during online information-seeking have been shown to experiment and explore more, and to achieve a higher level of skill in their area of interest (Csikszentmihalyi, 1990, 1997; Csikszentmihalyi & Csikszentmihalyi, 1988; Ghani & Deshpande, 1994; Ghani, Supnick, & Rooney, 1991; Katz, 1987).

While flow can be quantified in a number of different ways, it is easiest to use self-report questionnaires. A representative set of Likert-scale questions has been adapted from a flow scale originally developed by Jackson and Marsh (1996). It can be used to measure the level of flow state an individual has while using a web-based Application. Examples from this scale are shown in Table 3, with the full scale shown in Appendix E.

Table 3. *Excerpts Adapted from the Flow State Scale*

What is Measured	Rated Statement
1. Challenge	"I was challenged, but I believed my skills would allow me to meet the challenge."[a]
2. Awareness	"I made the correct moves without thinking about trying to do so."[a]
3. Goals	"I had a strong sense of what I wanted to do."[a]
4. Feedback	"I had a good idea while I was performing about how well I was doing."[a]
5. Concentration	"My attention was focused entirely on what I was doing."[a]

What is Measured	Rated Statement
6. Control	"I felt in total control of what I was doing."[a]
7. Loss-of-self	"I was … concerned with what others may have been thinking of me."[a] (R)
8. Time perception	"Time seemed to alter (either slowed down or speeded up)."[a]
9. Autotelic	"I really did not enjoy the experience."[a] (R)

[a](Jackson & Marsh, 1996, pp. 34-35).

Summary of Mega-Collaboration Dynamics

Based on this information, we decided to study the dynamics of mega-collaboration by creating a scenario that included one or more hidden profile situations, creating a different information set for each group member's role, and studying the group's cognitive processes, motivations, and behaviors as they pooled their information, specialized in parts of it, established goals and shared mental models, and searched for the optimal solutions to the hidden profiles. Pre- and post-test questionnaires were used to gather the parameters needed in the study, including each participant's general knowledge of information in the original knowledge sets, and in the final shared data repository (as well as their estimates of their fellow group members' knowledge).

At each point during the group's activities where a group member decided to share information, an interruptive questionnaire was used to determine what value (either positive or negative) the individual thought the group would place on that information, and thus determine if there were differences in willingness to share.

The characteristic of willingness to self-censor was judged by including questions from the Willingness to Self-Censor Scale in the post-test questionnaire, and the intrinsic motivation provided by the information pooling activity was judged by including questions from the Intrinsic Motivation Inventory. Questions from the Flow State Scale were also included in an attempt to validate the Motivation Inventory. These quantitative measures were supplemented through conversation analysis and other indicators of behavior.

Of course, it was not just the various dynamics of mega-collaboration that needed study, but also the effect that interface and HCI design improvements might have on

those dynamics. This led to the use of A-B testing to compare the differential results of the dynamic features under study. Background research on the various interface features that might improve a mega-collaborative outcome are described in the next section.

Mega-Collaboration Interfaces

The Implications of Collaboration Issues in Designing Supportive Interfaces

As discussed above, the quality of the GUI for the social and computational communication is a driving factor in collaborative helping. The presence of the new social networking venue has fueled an increasing need for collaboration tools that members of the public can use to find other people who share their interests, and to achieve common goals. Denning (2006) notes that there is broad agreement on the need for ICT-enabled interface mechanisms to support emergent collaborations among *adhocracies*, or *hastily formed networks* that develop among responders to a crisis. Such interfaces are needed to filter out duplicate and unessential information and link resources to response activities (Denning, 2006; Mendonca et al., 2007). To do these things, the interface and HCI design must have the ability to support collective sense-making, or shared dynamic understanding, during the collaborative process (Mendonca et al., 2007).

How can an interface help a forming group of collaborators work effectively? Research into information biases has made it clear that such a group must be guided away from an early focus on negotiating its opinions, and instead toward a focus on pooling the information held by its individual members to gain a true understanding of the situation (Brodbeck et al., 2007). To reduce the members' reluctance to mention information that is inconsistent with the group's dominant preferences, the group's discussion forum must be guided toward welcoming all information and away from any early judging. When evaluating information, the group must be encouraged to consider each piece of information on its true merits, rather than by how well it fits with what the group wants to believe, who submitted it, or how many of the group's members already know it. Each of these interface requirements is challenging in itself, and an effective group needs all of them simultaneously (Brodbeck et al., 2007).

Based on Brodbeck and colleagues (2007), an interface can potentially help to accomplish these things in several ways. By stepping the group through a structured HCI process, the interface can explicitly ask the group's members to share their information in

a non-judgmental manner. The interface can also provide step-by-step instructions that separate the task of gathering information from the tasks of evaluating it and of making a decision. The interface's enabling of effective HCI can also structure the evaluation task to ensure that all information is considered, for instance, by requesting that the group develop and rank order all decision alternatives. In addition to the interaction process, the interface can directly support the required tasks. By providing appropriate input mechanisms, the interface makes it easy for group members to share what they know and provide cross-links to their information sources. By providing appropriately structured storage mechanisms, the interface can make it easy for the group to create a shared data repository to serve as a memory aid during discussion. By providing appropriate access methods to this shared repository the interface can make it easier for group members to specialize in different parts of it, and to remember who the expert is in each part (thus helping to build the group's transactive memory structure). Finally, the combination of both the interaction process and the necessary data management tools can encourage the group to take the time it needs to fully discuss the situation, set appropriate goals, and make the right choices.

A Survey of Tool Research

Given the dramatic need for tools to support collaboration, it is not surprising that significant research is already underway in this area. The design of a social-computational collaborative interface involves social, psychological, and technological research elements. Two particularly relevant fields in this regard are collaboration engineering and computer-supported cooperative work (CSCW). Both of these are broad fields. Therefore, this quick survey of examples is intended to represent only those topics most relevant to this discussion.

Supporting HCI – collaboration engineering.

One of the relevant areas of research, given the need for a structured interaction process, as discussed above, involves the field known as collaboration engineering, which attempts to codify human interactions into defined, repeatable components (Kamal et al., 2007). This field is an outgrowth of research on manual processes used to facilitate collaborative problem-solving, such as charrettes and structured workshops (Denning &

Yaholkovsky, 2008). This methodology has the potential to provide underlying structure to a developing collaboration without introducing unwanted rigidity.

Collaboration engineering is used to design and deploy repeatable collaboration processes for groups working on high-value collaborative tasks. Group modeling is one example of such a task (Briggs, de Vreede, & Nunamaker, 2003). Collaboration engineering facilitates group problem-solving by constructing a negotiation process from a sequence of individual process segments, or interactive thinking patterns, called thinkLets (Briggs, de Vreede, Nunamaker, & Tobey, 2001; de Vreede, Kolfschoten, & Briggs, 2006). According to de Vreede and colleagues (2006), a thinkLet is "a named, packaged facilitation technique captured as a pattern that collaboration engineers can incorporate into process designs" (p. 1). ThinkLets produce predictable, repeatable interactions among the people who are collaborating. They serve as a pattern language for designing and executing technology-supported collaboration. Each thinkLet supports a pattern of the group negotiation process, these patterns being *divergence, reduction, clarification, organization, evaluation, and consensus-building*.

By breaking the group activity into process segments, each with one of these pattern goals, it is possible to match each segment to a thinkLet. This allows the HCI design of a collaboration process sequence that captures all the ideas contributed while allowing participants to build a formal structure and focus quickly on what is important.

Successful collaborative processes tend to include a number of these patterns arranged to build on each other. Each formally defined thinkLet is composed of a specification that includes the tool used, its configuration, and the script of sequenced events or instructions given to produce a particular thought pattern within a group. For example, one brainstorming thinkLet (*FreeBrainstorming*) gives group members each a page with someone else's idea on it, and allows them to critique it, elaborate on it, or ignore it and add a new idea of their own (evaluation/clarification/divergence). In a facilitated collaboration, this thinkLet might be combined with a preceding type of thinkLet that produces the idea pages (divergence) and a subsequent type of thinkLet that consolidates the results (organization/reduction).

Collaboration engineering research has created a library of thinkLets to serve as a collection of reusable building blocks for collaboration process design. These building

blocks have been used in numerous domains by facilitators and collaboration engineers (de Vreede, Briggs, & Massey, 2009; Kolfschoten & de Vreede, 2009; Seeber et al., 2015). The growing directory of such components allows collaborative processes to be designed on the fly, appropriate to the needs of the moment, yet yielding more predictable results than could be obtained from simply throwing people together.

Although collaboration engineering is still primarily a facilitated process, the potential for automation and distributed participation is clear. Research is already underway on whether a facilitator is needed (Appelman & van Driel, 2005; Seeber et al., 2015). In a simulated incident at the Port of Rotterdam, Appelman and van Driel (2005) were able to demonstrate that a pre-scripted series of thinkLets could be successfully performed under emergency conditions without a facilitator. Seeber and colleagues (2015) found that an un-facilitated brainstorming thinkLet (*SelfSifter*) supported shared understanding better when compared with two other facilitated brainstorming thinkLets (*FastFocus* and *TreasureHunt*). This implies that thinkLet-driven collaboration scripts could be incorporated into ICT systems to provide support for groups that have to get up to speed in a hurry.

Collaboration engineering has thus far focused on the generation of information in the form of dialogue. However, Hoppenbrouwers and van Stokkum (2013) have described an expanded type of thinkLet, called an *m-ThinkLet*, that is potentially useful in the collaborative development of models. The models in question are formal in nature, such as predicate logic or Petri nets, but Hoppenbrouwers and van Stokkum propose to use thinkLet-based collaboration scripts to solve the problem of lost knowledge by preserving the dialogue surrounding the creation of the model. This dialogue includes such things as eliciting, conceptualizing, expressing, discussing, negotiating, and validating the concepts in the model. Without a historic record of this dialogue, the situational context of the model could become lost, making its application much more difficult.

The m-ThinkLet attempts to solve this problem by incorporating concepts from discourse theory to create a *dialogue game* interface. This interface treats models as sets of propositions that are elicited, evolved and negotiated through a formalized set of interactions. The interactions are small formal bits of dialogue, such as *propose*, *agree*,

disagree, *accept*, *reject*, and *argue*. These interactions are directed by rules for such things as syntax, content, and procedure (Hoppenbrouwers & van Stokkum, 2013). The goal of such an interface is to capture these thoughts in a structured fashion that can be stored and recreated later.

One question that arises, however, is whether restricting the dialogue will choke of the conversation required for full understanding. Seeber and colleagues (2015) found that the un-facilitated *SelfSifter* thinkLet performed better than the similar facilitated thinklets because its dialogue was relatively unrestricted. The extent to which a collaboration can succeed without free dialogue is not yet clear.

While the m-ThinkLet represents a use of collaboration engineering for formalized modeling, no record was found of any attempt to extend thinkLets to the sort of ad-hoc mental models that a collaborating group would generate as it worked on a problem. Yet if these informally generated models can be represented in a relational database it will greatly expand the potential size of the mega-collaboration dialogue. With this in mind, it seemed useful to try using thinkLets in the MCT interface, combined with the CSCW approaches described below, to capture individuals' mental models and support the negotiation of group models.

Supporting group models and decision-making – the potential of CSCW.

The other relevant area of research, given the need for a supportive and user-friendly interface, involves the field known as CSCW. This field attempts to identify best practices in the integration of computer technology into the workplace. Unlike the customized designs of collaboration engineering, many current CSCW-oriented interfaces tend to be static rather than dynamic (Crapo, Waisel, Wallace, & Willemain, 2000). Several different areas of on-going CSCW-based research into interface and HCI design are relevant to mega-collaboration. They are as follows:

1. Research on group mental models. As discussed in earlier sections, it is of overarching importance to the design of collaboration tools that they support the essentials of teamwork, and the development of group mental models, if they are to enable effective group collaboration. Mohammed and colleagues (2001; Mohammed et al., 2010) identified shared mental models, closed-loop communication, and trust as the three coordinating mechanisms required to support successful teamwork. They also

determined that similarity and accuracy can serve as standard measures of whether the mental models of group members have merged into a group mental model.

Other studies have found that a user-friendly interface is crucial to the effective capture of a user's mental model. The interface must support users in converting their thoughts into representations that can be compared with those of other group members to build common ground (Convertino et al., 2008; Crapo et al., 2000). The formation of mental models is a dynamic process that depends on both the individual and the situation. Capturing such models requires a flexible interface capable of representing many different types of entities and relations (Crapo et al., 2000). Another important requirement is the ability of the interface to facilitate the model-negotiation process in a dispersed and heterogeneous group.

Limited testing on a number of different interfaces has indicated that it is possible to guide individuals through the definition of their mental models by helping them to structure their concepts into a series of entities and relations that can be categorized as *events, goals, tasks, roles, actors,* and *resources* (Farnham, Chesley, McGhee, Kawal, & Landau, 2000; Newlon & Faiola, 2006; Newlon, Faiola, & MacDorman, 2008; van der Veer & van Welie, 2000). The information in this structure can be represented in various ways, depending on need (e.g., data tree, log book, calendar, or map). In addition, the online conversation surrounding this process can be captured and preserved in its context (Newlon, 2007). However, the results of testing such a GUI indicated that the predefined categories of entities and relations were too rigid to be useful to the collaborators. Therefore, a different, and more intuitive organizational principle is needed.

In sum, the foregoing research into mental modeling support provides guidance as to why a collaboration tool should use explicitly developed group mental models as a collaboration support mechanism. It also provides suggested methods for measuring and judging the results of the mental-modeling process.

2. Research on mash-ups and potential resources. One noticeable trend in the development of these ICT-based tools is the move toward mash-ups, or tools that are assembled from different sources. There are tools under development to support the process of mash-up assembly (Zhao, Huang, Huang, Liu, & Mei, 2008). Mash-ups are

one potential way in which the members of a mega-collaborating group could share and validate the information they have with the rest of the group.

One example of a potential mash-up candidate that is relevant to collaborative helping is the distributed trust system, described by Adams and Davis (2006), that could be used to manage security by allowing each node in the collaboration to develop trust levels for the other nodes, based on experience, and then share those trust levels with all the nodes, leading to a cumulative reputation score for each node. Another example is the disaster-related templates Bui and Tan (2007) have developed (following a *what, where, why, who,* and *when* format) that could be used to specify what information should be input for collective sense-making. Any number of the relevant databases and ontologies currently under development on such things as disaster decision support (Asghar, Alahakoon, & Churilov, 2005), emergency response planning (Haynes, Schafer, & Carroll, 2007), response grids (Hu, Qing, Ming-Hui, & Qi, 2008; Jaeger et al., 2007), or humanitarian logistics (Tomaszewski, MacEachren, Pezanowski, Liu, & Turton, 2006) could provide information content for collaborations.

The existence of these resources suggests that a collaboration tool should be designed in a fashion that will support easy integration with other software, rather than acting as a stand-alone system. A recent example of such a tool is the EmergencyPetMatcher System, which is designed to work in concert with other social media services (Barrenechea, Anderson, Palen, & White, 2015).

3. Research on decision-support tools. Another general area of endeavor centers on experimental work establishing the importance of improvisation to decision-making in ad hoc collaborations and on the decision-support tools needed to bolster it (Mendonca, 2007; Mendonca, Beroggi, & Wallace, 2001; Mendonca & Wallace, 2004). For instance, risk and time constraints have a major effect on group information "foraging" in the aftermath of a disaster (Gu & Mendonca, 2006). Therefore, researchers are looking for ways to support decision-makers in this situation.

One failed attempt was designed to elicit knowledge from remote experts quickly via the Internet during an emergency response (Mendonca, Rush, & Wallace, 2000). This tool used an automated analysis technique, called a multiple expert influence diagram, which was substituted for direct communication among the experts in the hope that it

could be used as a method to coordinate efficiently among larger groups of decision makers. The process was only marginally successful even as a small implementation, however. It was impeded by differences in definition that the experts could have easily worked out if they had been able to talk to each other. Thus, this failure represents a manifestation of the situated nature of information. The lesson learned here is that a collaboration support tool should never fail to support conversations among the collaborators. Therefore, this research both highlights the decision support that a collaboration tool will need to provide, and also serves as a cautionary warning.

A more recent effort at supporting such conversations involved the use of *anchored discussion* by an application designed to support group mental model development (Link et al., 2015). While this method of tying each new comment to a specific prior comment seemed promising, the tool used to implement it added too much cognitive load to the conversation, and failed in comparison to a chat-only interface.

A somewhat similar area of research into crisis decision support involves the use of autonomous software agents. One example is a tool that creates a collaborative human-agent team architecture, where the human components of the team enter gathered information, and the agent makes recommendations on which decision should be made, drawing from a database repository of inferential, experiential, and procedural knowledge (Zhu et al., 2007). A similar example is provided by a number of studies of teamwork among autonomous software agents in simulated emergency situations (Scerri, Farinelli, Okamoto, & Tambe, 2004a, 2004b, 2005; Scerri, Xu, Liao, Lai, & Sycara, 2004; Schurr et al., 2005). This series of papers describes the development of a methodology by which a virtual team can scale to unprecedented size, while maintaining a reasonable amount of situational awareness, through the use of overlapping group memberships and a small-worlds network.

A more recent series of papers examines, in mathematical detail, the contextual effectiveness of various types of agent networks in transmitting the information necessary for situational awareness (Glinton, Scerri, & Sycara, 2010; Lewis, Wang, Velagapudi, Scerri, & Sycara, 2009; Scerri & Sycara, 2010; Scerri, Velagapudi, & Sycara, 2010; Velagapudi, Prokopyev, Scerri, & Sycara, 2009). The findings from this research are potentially relevant for development of a scalable collaboration tool, given that

collaboration among autonomous software agents, and among agents and humans, has shown much promise for use in disaster response (Tate, 2006). However, these studies were somewhat theoretical, in that they used autonomous software agents to represent human actors.

Another related area of research in decision-support involves the creation of tools specifically designed for using geographical information in crisis situations. For example, NEOCITIES is a tool developed to dynamically simulate disaster situations by generating geographically contextual events to which the simulation participants must respond (McNeese et al., 2005). It is potentially a source of inspiration on how to generate the disaster simulations needed to test a collaboration tool. Another example is the GeoDAT tool, which provides GeoDeliberative Annotation Technology, allowing spatial annotation objects to be added to a map and used as deliberative artifacts. It manages these annotations via a spatial data model, enabling the tool to represent both geographic, and other relations among the annotations, such as visual contexts, discussion threads, spatial referents, and the cognitive states of users (Cai & Yu, 2009). This tool is particularly relevant to collaboration-support in that, unlike earlier tools, GeoDAT is specifically aimed at aiding groups of collaborators in their sense-making process. The latest development in this area is the use of publicly-available participatory mapping software, such as OpenStreetMap. A recent study successfully used this tool in facilitating a large disaster planning exercise (White & Palen, 2015).

4. Field study of a mega-collaboration tool. One final example of tool development to support collaborative helping involves the field test of such a tool during the Haitian earthquake crisis (Epatko, 2010). Kate Starbird and Leysia Palen from the University of Colorado Natural Hazards Center launched a Twitter initiative, called *Tweak the Tweet*. Their idea was to repurpose tweets by giving them a syntax structure to connect those who needed something specific with those who could provide it. This project attracted dozens of volunteers, who monitored tweets concerning the Haitian earthquake and rewrote them in the correct syntax, both in English and French. The Sahana and Ushahidi disaster websites imported the repurposed tweets and used them to map aid requests for non-governmental organizations. This allowed tracking of the requests that were made and the needs that were answered. This tool is an example of a

mash-up using a combination of ICT-based components and human components to produce a real result. As such, it comes closest of the research projects described here to solving the problem of support for collective sense-making.

It should be noted, however, that the sense-making component was external to the group of people with the problem. As such, it was vulnerable to the situated-information trap. Without being in the context of the people creating the tweets, the people translating them could only guess at what they really meant. Also, beyond the experience of launching such a tool, the results of the study were not definitive. Because the tool was launched into a real and chaotic disaster situation, there were many collaborative helping initiatives simultaneously underway. So, while it was possible to track the meeting of the needs that were communicated via Twitter, it was impossible to determine if *Tweak the Tweet* was responsible for the success in meeting them (Epatko, 2010).

Measuring Interface Success

As discussed above, one of the issues to be examined is the effect that proposed interface and HCI improvements might have on the dynamics of a mega-collaboration. To measure this requires A-B testing of the improved interface against a more standard interface, to compare the differential results of the improvements. However, this raises the question of what should be measured in testing one interface against the other.

Some of the items to be measured have been discussed in previous sections. These include the dynamics of the collaboration, such as sharing of information, building of models, motivational factors, etc. Another set of measurements can involve success of the mission, whatever it might happen to be. A third set of measurements involve the interface and interaction sequencing. One methodology evaluates interface acceptance. These parameters are based on the Unified Theory of Acceptance (Sundaravej, 2006), and can be used to measure the comparative likelihood of future use between the two systems. An example of this instrument is shown in Table 4. The complete scale can be found in Appendix E.

Table 4. *Excerpts Adapted from Acceptance Scales (Sundaravej, 2006)*

What is Measured	Description	Rated Statement[a]
Performance expectancy (PE)	The degree to which an individual believes that using a particular system would improve his or her job performance (independent)	PE1: I find MyApp useful in my work.
Effort expectancy (EE)	The degree of simplicity associated with the use of a particular system (independent)	EE1: My interaction with MyApp is clear and understandable.
Attitude toward using technology (AT)	The degree to which an individual believes he or she should use a particular system (independent) [drops out when usage is utilitarian?]	AT1: Using MyApp is a good idea.
Social influence (SI)	The degree to which an individual perceives that others believe he or she should use a particular system (independent) [drops out when there is no social pressure for use?]	SI1: People who influence my behavior think that I should use MyApp.
Facilitating conditions (FC)	The degree to which an individual believes that an organizational and technical infrastructure exists to support the use of a particular system (independent) [drops out when infrastructure support isn't in question?]	FC1: I have the resources necessary to use MyApp.
Self-efficacy (SE)	The degree to which an individual judges his or her ability to use a particular system to accomplish a particular job or task (independent)	SE1: I can complete a job or task using MyApp, if there is no one around to tell me what to do as I go.
Anxiety (AX)	The degree of anxious or emotional reactions associated with the use of a particular system (independent)	AX1: I feel apprehensive about using MyApp.

What is Measured	Description	Rated Statement[a]
Behavioral Intention to Use the System (BI)	The degree of intention for information technology usage (dependent)	BI1: I intend to use MyApp in the near future.

[a]Adapted from pages 6 and 7.

Questions from this scale were also incorporated into this study's post-test survey which can be found in Appendix E.

Current Understanding

The Mega-Collaboration Tool

Any discussion of attempts to build better tools would not be complete without a description of prior work on this particular research track. To date, several cycles have been completed in the iterative construction of MCT for large-scale collaborative helping—particularly, the interface and interaction design. The design process for MCT began with an initial set of user profiles and use cases, which led to a preliminary set of specifications and a concept prototype (Newlon & Faiola, 2006). This was followed with a more detailed paper prototype and a series of focus group sessions. The set of specifications developed from these sessions led to the first interactive prototype of MCT (Newlon, Faiola, et al., 2008). The initial concern was to refine the team-building interface and explore the effect that negotiation of mental models had on the group decision process. The interactive prototype was successfully tested, and the results were used to design and test a modified user-input screen for MCT (Newlon et al., 2009; Newlon, Faiola, et al., 2008; Newlon, MacDorman, & Scerri, 2008). This screen is shown in Figure 1.

Figure 1. The Mega-Collaboration Prototype Interface

Because this is the research track that has led to the current study, a more detailed description of the prior studies seems appropriate. The Phase 1 trials of the interactive prototype compared test teams building collective models using MCT against control teams negotiating common ground using a chat interface. The goal was an examination of the test method itself, which was intended to determine which of the group's behaviors were of value in studying the effect of the interface. The trials used 23 participants, divided into four test teams and four control teams. Both the problem scenario given to the groups and the time spent at each stage of the negotiation process were varied, but one test team and one control team completed each testing setup, and each trial was conducted over a period of about two hours. Two of the test runs were conducted in a laboratory setting, and two were conducted across the Internet with widely dispersed participants (Newlon, Faiola, et al., 2008).

Normally, members of a spontaneously forming team would have had to find each other online and discover their common interests. However, these volunteers were brought together and each of them was given a role-playing scenario involving either volunteering to help tornado damage victims or planning a nursing curriculum.

Therefore, these trials assumed, for experimental purposes, that the participants had already undergone the process of finding a common interest. This allowed the random assignment of participants to the test and control teams instead of self-assignment. In addition to the gathering of standard usability data through the post-test questionnaire and post-test focus groups, conversation analysis was performed on the participant communications generated during the course of each trial. The individual and group models and the action plans developed by both test and control groups were also analyzed in detail.

The initial concept was that the participants would develop their own mental models first, and then combine them to form a team model. Accordingly, participants were first given a fixed period of time during the model-development process, in which they could see only their own models, then a period where they could compare their models with their teammates' models, then a period where they each took turns making additions to a common model. The relative lengths of these time periods were varied based on our experience from prior tests. At the end of each round the participants were asked to vote on whether to take another round. Once they voted to move on, the team was asked to elect one of their members as a team representative. This representative then created a team action plan, which was supposed to be based on the developed models and on the verbal support the representative got from teammates through chat. A chat window was always available for intra-team communication, and a view window was available to give participants additional ways to visualize their data.

The control teams ran through the same process as the test teams, including the action plan step. But instead of using the model-building component of the interface, they were expected to negotiate their common ground solely through the chat window (Newlon, Faiola, et al., 2008).

Phase 2 of testing concerned MCT's graphical data-entry interface (Newlon et al., 2009) and took place in two stages. The first stage of observation was performed as part of a requirements-gathering exercise for the tool. Ten participants worked with the previous version of MCT (Newlon, Faiola, et al., 2008). A scenario was created involving a minimal business proposal to garner capital funding. The participants' primary goals were to specify the means of production, the supply chain, and a marketing plan for a

new product; this loosely defined task allowed observation of a nonemergency collaboration. Participants communicated using only MCT's features.

The second stage of Phase 2 was a scripted crisis-response performance test and questionnaire using a second group of ten participants. The previous version of the interface was compared to a version that was developed to match the requirements gathered in the first stage of Phase 2 (Patel, 2008). (This new interface was the version shown in Figure 1.)

Both stages were conducted in a controlled local setting. The first stage was performed in two uninterrupted sessions on consecutive days with different groups of people. The second stage took place in one-on-one sessions with each participant attempting five basic data entry and manipulation tasks within a post-disaster scenario using one of the two interfaces (randomly assigned).

While these two stages of Phase 2 testing yielded a more effective interface and HCI, the major behavioral findings of the research to date came in Phase 1, using the original interface design. Conversation analysis of the original tests revealed that teams with emergent leadership tended to produce successful action plans (Newlon, Faiola, et al., 2008). A difference in the complexity of concepts between the test and control teams was also observed. Entries to individual models on the test teams tended to be unorganized lists of ideas, but the act of consolidating these ideas into the group model tended to force hierarchical organization, resulting in a more complex group model. This complex organization carried over to the action plans of the test teams, while the action plans of the control teams continued to be unorganized lists of ideas.

Factors identified as affecting usability included data input capabilities and the ability to categorize and visualize the data. Both the Phase 1 testing, and Phase 2 testing with the more advanced entry screen, indicated that the categories of events, goals, tasks, roles, and resources were too rigid. In some cases, the users wanted to use a temporal organization of the data. Users wanted cut-and-paste capabilities, the ability to enter large pools of existing data, and the free-form manipulation of the data after entry. Post-test interviews in the follow-up study revealed a desire to reorganize, attach, and detach partial data hierarchies (Newlon, Faiola, et al., 2008).

Implications for the Building of Better Tools

In light of the trend toward creating mash-ups, it is significant that the above review of the collaboration tools currently under development indicates that they are potentially complementary to each other. The concept of networking autonomous agents, described by the team at Carnegie Mellon University, could potentially provide a management method for human networks (Newlon, MacDorman, et al., 2008; Scerri, Xu, et al., 2004). Collaboration engineering with thinkLets, (de Vreede et al., 2006), has the potential to provide customizable processes for collaboration (Newlon et al., 2009), possibly even by adding some formal structure to the dialogue (Hoppenbrouwers & van Stokkum, 2013). The tools proposed by a number of other researchers, as described above, could also be used in mash-ups combined with such a developing interface. The potential clearly exists for cooperation among these various efforts, both in research and in practice.

There is an unrelated collaboration-interface mash-up effort already underway. Palen's EPIC Project attempts to enlist the public's collective intelligence to respond to crises in a self-organized manner. It has many different modules, each of which could come from a different source (Palen et al., 2010). What is missing from Palen's plan, however, is a specific supporting interface for the deliberative process, such as the one described by Cai and Yu (2009) for their GeoDAT tool. It is this process of collective deliberation that would be best supported by de Vreede's thinkLets (2006), or Denning's charrettes (2009; 2008), which are the concepts behind MCT.

Therefore, the ultimate goal of MCT research is to explore ways in which these various theories and tools might be combined. It should eventually be possible to build an agent network, populate it with nodes of a collaboration engine, and drive it with collaboration engineering thinkLets arranged according to pre-existing templates, with security managed by a distributed trust system. As such a tool, MCT could help to leverage the disaster-related databases and ontologies currently under development.

The testing of the initial MCT prototype indicated that it is possible to support individuals in the definition of their mental models via a three-tier application HCI design (Newlon, Faiola, et al., 2008; Newlon, MacDorman, et al., 2008). As flexible architectures for software development have matured, it has become easier to capture the users' concepts and route them to a back-end database through a process mediated by

middle-tier business logic. This allows these concepts to be grouped into categories, as suggested by van der Veer and van Welie (2000), making them easier to compare and manipulate. The online conversation surrounding this process can also be captured, structured, and preserved in its context (Newlon, 2007). In this way, an interface can harness the data-crunching power of a modern database to support users in converting their thoughts into representations that can be compared with those of their teammates.

The results of experimentation with the initial MCT prototype highlighted a dramatic increase in structure that mental models undergo when the people creating them are forced to compare their individual ideas. This dovetails, both with the findings from collaboration engineering (Briggs et al., 2003; Briggs et al., 2001; Kamal et al., 2007), and with the findings on reflective capacity (Tinsley & Lebak, 2009). However, to move to the next level, the data categorization and manipulation abilities of the prototype MCT needed to be improved to make it more flexible.

Continued design of the interface has been guided by the usability results from the interactive prototype, but it is the behavioral observations made in the original study that have had the most influence on the current design. The role of MCT in supporting development of mental models within the group is a topic of interest for the current study's interface design and testing. The difference in conceptual complexity between the original study's test and control groups provided an indication of what dynamics should be measured in the current tests of MCT. The ability to categorize and manipulate concepts is expected to have a major impact on the success of negotiation among members of large and dispersed groups.

It is these considerations that have caused attention to focus on the emerging field of collaboration engineering for enhancements to the design theory behind MCT. The previous mental model and action plan collaboration and negotiation sequences could be viewed as a series of primitive computer-driven thinkLets. This raised the possibility that computer-driven versions of other, better-established thinkLets could be substituted to add support for functions such as brainstorming, categorization, and consensus building. Instead of requiring a rigid sequence of activities, with the only choice being how much iteration to perform, it should eventually be possible to allow each group to build its own

computer-driven collaboration and negotiation sequence by assembling it from a menu of available thinkLet segments before beginning the model-building process.

Therefore, these results imply that a combination of these technologies can facilitate the model negotiation of a dispersed and heterogeneous group. It is anticipated that the application of thinkLets to complex mental models represented in a relational database and supported by a social network will enhance MCT's capabilities. While a tool such as this would have the potential to satisfy the calls for an interface to support global-scale disaster response collaboration, it could also be useful in resolving many other wicked and messy problems that will take collaboration on a massive scale to solve (Denning, 2009; Denning & Yaholkovsky, 2008).

Summary of What Is Still Unknown About Support for Collaborative Cognition

Ideally, a spontaneously-forming group of people who come together on a social networking site would identify their common interests and find ways to collaborate while traversing the classic team-building stages of forming, storming, norming, and performing (Tuckman, 1965). They would establish common ground by combining their individual mental models of the problem into collective models. And their activities would exhibit both the convergent processes of information pooling and cognitive consensus, and the divergent processes of specialization and transmission of information to the appropriate expert (i.e. transactive memory; Birnholtz, Finholt, Horn, & Bae, 2005; Convertino et al., 2008; Mohammed & Dumville, 2001).

There is much about this process that remains unknown. According to Wildman and colleagues (2011) the individual constructs of group knowledge have been examined extensively, but much less is known about how these constructs work together in allowing the group's success. In particular, more research is needed to determine what processes are influenced by the group's knowledge, and how this affects performance. DeChurch and Mesmer-Magnus (2010) showed that group knowledge affects group behavior, group motivation, and group performance. In general, shared mental models should improve the coordination of a group, leading to improved performance. More specifically, strategic consensus should improve group performance by improving the group's goal clarity and commitment to strategic goal attainment (Wildman et al., 2011). However, more research is needed on each of these linkages.

Furthermore, it is not a foregone conclusion that group members will share information they have with their group. Stasser and Titus (1985), Brodbeck and colleagues (2007), and Wittenbaum and colleagues (2004) observed that often group discussion only encourages contribution of information that group members already hold in common, or information that supports group members' existing preferences. Therefore, even though collective sense-making may be needed, it may not happen spontaneously in an effective or efficient manner.

Considering the urgent need for collaboration support, and the fact that the people supplying situated information should be involved in making sense of it, the news that people cannot be relied upon to share what they know seems like bad news, indeed. However, because prior research on the Mega-Collaboration concept has indicated that the incorporation of information from collaborators into a group mental model results in a dramatic increase in structure as the negotiated content grows, this gives rise to the possibility that the increase in the content and structure of the group mental model might be a motivation in itself. If so, it could potentially be used to overcome this resistance to sharing.

The fact that members of a spontaneously formed group become committed to the information structure they are building has been a casual observation in the past. As discussed above, the hastily formed network that responded to the Virginia Tech shooting (Palen et al., 2007; Vieweg et al., 2008) could have offered a substantial amount of help concerning those people they found out about as authorities released the names of victims. They did not need a complete list of victims to act. However, they became obsessed with the completeness and accuracy of their victim list, and spent a substantial amount of time and effort to compile it.

In general, as the amount of information that is contributed by all parties increases, the complication of the model must also increase. This raises the cognitive processing cost, which includes the cost of determining both what information to contribute and what information to retrieve. However, adding logical structure to any given amount of information decreases the model's complication as individual items of information are placed in categories. This can potentially decrease the cognitive processing cost of sharing information, both by giving the information contributors pre-

defined categories into which they can place their information, and by giving the information users a better idea of where to find what they are looking for. Therefore, the structured group model offers benefits both to the contributor and to the user, these being validation to the contributor (who discovers the contributed information is relevant to the model), and reduced frustration to the user (who discovers the desired information is easy to find). This process of structural elaboration can be observed not only in task work information but also in the teamwork behaviors, such as emergent leadership and specialization (Newlon et al., 2009).

This hoped for effect, however, is potentially balanced by the additional cognitive load of the supporting interface. A simple chat interface generally offers the lowest possible cognitive load, because it simply supports conversations in the way people are used to conducting them. Any interface that requires information to be categorized and sorted is bound to require more thought, and therefore a greater cognitive load. So, it is a critical question whether an interface can be designed that facilitates the building of group model structure without overburdening the communication process. This hinges on the success of the structural template offered by the interface. If it is intuitive, its cognitive load will eventually be balanced by reduction of the cognitive load of the growing model. If not, then as the model grows larger, the cognitive load (caused by the interface) will increase.

The commitment of the group members to the group's mental model, as represented by this complex data structure, seems likely to offer insight into the underlying mental process of the group. The ability of the interface to support formation of a dynamic understanding of the situation faced by the group should affect the level of this commitment in a measurable way. This ability should be facilitated by a tool that helps the group member link similar concepts to higher-level abstractions (Newlon et al., 2009; Pfaff, Newlon, Patel, & MacDorman, 2010). Because, as they collaborate, group members must combine individual mental models of the problem into a collective mental model (Mohammed et al., 2010) this should result in the observable processes of information pooling, cognitive consensus, specialization, and transmission of information to the appropriate expert (Mohammed & Dumville, 2001). Changes in the intrinsic motivation to contribute, and to use, the information in the shared data repository should

also be measurable. It should also be possible to examine the effect of the additional cognitive load imposed by the tool, itself, and determine whether it will help or hinder the group model formation process as the model grows.

In summary, the theory proposed for the current study is that an interactive tool (such as MCT) supporting better collaborative cognition across a group (by facilitating the formation of collective mental models and a transactive memory structure) will increase the amount of information that the group's members share with each other because: 1) each member develops a greater sense of strategic commitment to the resulting knowledge structure as its acuity grows, 2) each member becomes more intrinsically motivated to contribute information to it as the member's reflective capacity and sense of efficacy is increased by access to the knowledge within it, and 3) each member's resistance to sharing information is reduced by the shared data structure's effect on information bias.

Research Questions

To test this theory, the study examined the following research questions:

1. *Does the MCT interface support better collaborative cognition?*

   That is, to what extent does a collaboration-support interface (a simplified version of MCT) promote collective mental model and transactive memory negotiation and group decision-making, when compared with that permitted by a simple online conversation thread? How does the cognitive load of the MCT interface, itself, affect this?

2. *Does increasing the size of the shared data repository increase the amount of information shared?*

   That is, how does the amount of information shared with the group by each group member vary over time, compared with the changing size of the shared repository?

3. *Does this happen because the group member experiences: 1) Greater sense of strategic commitment to the resulting knowledge structure, 2) Increased intrinsic motivation to contribute to the resulting knowledge structure, based on greater content and organization, and 3) Reduced resistance to sharing information?*

That is, how do these factors correlate with the amount of information shared? How does the evidence of reflective capacity and sense of self-efficacy a group member gains from the group's growing data structure vary, based on the size of the shared data repository? How do these factors correlate with the measured intrinsic motivation?

CHAPTER THREE: METHODOLOGY

Overview of Research Study Aims and Experimental Design

The Study's Major Aims

First Aim – Determine the Efficacy of the Collaboration-Support Interface

The first aim of this study was to examine the independent concept – the extent to which the supportive interface increases the effectiveness of a group's collaborative cognition. We had already examined differences in the resulting mental model structure as a laboratory experiment (Newlon, 2008), so this time examining the effects of the mental modeling process in the field, using typical hosting servers, was a major part of the aim. During the planning stage, the two treatment interfaces were thought to be the only variation in interface supportiveness, but the behavior of the Internet (observed in the field) was added later, using conversation analysis.

Collaborative cognition was reflected by quantitatively measuring the group's collective mental models, transactive memory structure, and decision-making. The groups' mental models and transactive memory structure were measured by comparing each group member's knowledge level about items in the resulting shared data repository; and the effectiveness of the groups' decisions was rated based on coverage of issues and avoidance of hidden profiles. Correlation analysis of the data gathered for the first research question addressed this aim.

Second Aim – Theory of Collaborative Information Sharing

The second aim was to test the dependent concept – the hypothesis that as a forming group's shared data repository grows the amount of information the group's members contribute to the repository also grows. This required a comparison between changes in the size of the data repository over time and in the amount the individual shared over the same periods. This was measured by comparing the cumulative number of action comments during each session segment to each individual's sharing behavior during that segment. Correlation analysis of the data gathered for the second research question addressed this aim. However, additional post hoc analysis was also performed, because the results were not what was expected.

Third Aim – Characteristics of Three Intervening Factors

The third aim was to examine the intervening factors. Collective cognition literature suggests three factors that are expected to influence the amount of information members share with the group: 1) strategic commitment, 2) intrinsic motivation, and 3) information bias effects. Each is expected to be influenced in turn by the perceived size of the shared data repository.

The sense of strategic commitment was measured by each member's overall number of suggestions generated or thoughts created discounted by the degree of negotiation bias they represented. The intrinsic motivation was measured by use of the Intrinsic Motivation Index. Because intrinsic motivation is a self-reported variable, it was validated by examining flow state, and analyzing the chat history for behavioral evidence of reflective capacity and sense of self-efficacy. The effect of the interface on information bias was measured by determining what percentage of the information that could be shared actually was shared, and by examining how honest individuals were in sharing information that was inconsistent with their own preferences, and how trusting they were in sharing information they believed to be inconsistent with the group's preferences. This allowed examination of whether differences in the perceived size of the shared repository helped to overcome resistance to sharing information by reducing information bias.

Fourth Aim – Characteristics of the Emergent Data Structure

The fourth aim was to examine the resulting artifacts. One area of interest was the abstract categories that emerged during the model-building process. Prior work (Newlon, 2008) had shown that the categories of events, goals, tasks, roles, actors, and resources, originally suggested by van der Veer and van Welie (2000), were too rigid. As discussed above, an intuitive structural template is required if the cognitive load imposed by the interface is to be kept under control as the mental model grows. So, we hoped to gain insights that would help us increase the flexibility of MCT's modeling support by examining the ad-hoc structures created by the participants using the collaboration-support interface.

We were also interested in examining how well the various thinkLets performed, and how well a new structural template (organized around mental model types) performed. A visual examination of these artifacts addressed this aim.

Most of the measures listed for these aims could be quantified, allowing the use of parametric analysis. If the theory was correct, it was expected that the use of the collaboration-support interface over a well-performing Internet would be a predictor of the group's collective cognition, of the amount of information shared by group members, and also of the

1. Degree of strategic commitment to the growing knowledge structure,
2. Level of intrinsic motivation provided by interaction with the knowledge structure, and
3. Degree to which resistance to sharing information was overcome by the knowledge structure.

Lastly, the expectation was that the correlation between size of the shared data repository and the three intervening factors would explain most of the correlation between use of the interface and the amount of information shared.

Experimental Design

The Two Interfaces

The design for this experiment required two different randomly assigned treatment groups, each divided into several three-member sub-groups. The first group captured information through a test interface that supported formalized modeling and a managed interaction process, producing hierarchical sets of concepts, categories, and facts, the structure of which, at any given point in the development process, could be displayed and examined. The second group shared information through a traditional chat interface and stored it in traditional message and reply threads.

By providing the equivalent sub-group members of both treatment groups with exactly the same information and capturing how much of that information each group's individual sub-group members shared with each other, we could measure whether there were differences in sharing behavior. Although a single-test design was used, this experiment also had a longitudinal aspect: Differences in sharing behavior were measured within each sub-group's session for set task segments during the collaborative sense-making process, and could be compared, both between the groups and within each group.

The Test Scenario

To answer the research questions, it was necessary to have a standard activity against which everything could be measured. The only major requirement was that this activity be an engaging problem that provided plenty of opportunity for discussion, modeling, and collaboration, and for which a fixed set of input information could be used. Therefore, it was necessary to develop a test scenario that required collective sense-making and collaborative problem-solving for both treatment groups. The particular scenario used involved development of an art auction by the participants. While the scenario didn't involve any overt disasters, it did involve collaborative helping and potential community threats. It also called for creative thinking.

Past research with this concept has been conducted using a problem-solving period of about two hours. Based on the research questions, the goal for this research was to use a similar period of time for each session. This scenario used a similar methodology to that used in the prior work (Newlon, 2008), but extended the methodology with a more well-established set of thinkLets that supported a brainstorming, categorizing, ranking, and decision-making sequence (Briggs & De Vreede, 2009).

Each of the three members of each sub-group was assigned to play a specific role. Each role was defined by the role character's given name, and a specific and unique set of information pertaining to the problem. This was provided to the member as the sub-group formed as a simulated set of the character's stored emails. Both test groups were provided the same information.

In attempting to avoid random events and make the test conditions more comparable, a specified set of tasks that unfolded throughout each session was used. A potential hidden profile scenario was manufactured (accomplished by giving each participant the different pre-defined set of information to feed into the knowledge stock). The information-sharing behavior of the group members could then be examined to see whether the group's decision-making process allowed it to find an optimal solution to the scenario.

The test design attempted to control for the potentially confounding issues discussed above to achieve a valid test. These potentially confounding issues included 1) the number of members who knew a piece of information (which was controlled by

making all private information available to only one person); 2) the font face of the information (which was controlled by making sure it was uniform); 3) whether the information was negative or positive (which was measured through an interruptive survey); 4) the total amount of information versus the amount unshared (which was measured as part of the trial); 5) the amount of pre-discussion disagreement (which was measured through conversation analysis); 6) the group size (which was controlled by making the group size as uniform as possible); 7) the number of alternatives (which was controlled by using the same standard scenario for all sessions); 8) the length of the discussion period (which was measured as part of the trial); 9) a member's status (which was controlled through randomly assigned roles that were of roughly equal status[2]), and 10) a member's innate willingness to self-censor (which was measured using Likert questions on the self-censorship scale).

Participants

IRB Human Subject Clearance

The required investigator coursework in human subject testing was completed by everyone involved in conducting the study. All relevant documents in the approved IRB protocol can be found in Appendix A.

Recruitment and Sample Size

Given that any person age 18 or older was a potential participant in this research, it was not necessary to target any particular population during recruitment. Therefore, a sample of convenience was used. Recruitment was done through advertisement, using mailing lists from within Indiana University, from the Indiana CTSI INresearch voluntary registry, from the neighborhood Nextdoor application, and from a researcher's church group.

The design of the current study was influenced by the findings of Farnham and colleagues (2000). Their study demonstrated that the decision-making method a team uses during its forming stage becomes ingrained in its culture, changing the subsequent behavior of the team (a carry-over effect), and that progression through the team

[2] The different roles were of roughly equal status. Of the three roles, one was the president of the neighborhood association, one was the head of the neighborhood crime watch, and one was the liaison for a local minister.

formation stages causes natural differences in team efficiency over time (a maturation effect). The Farnham study used a 2x2 crossover design to yield both within-groups and between-groups results, but some of these results had poor external validity because of carry-over effect. Nevertheless, because Farnham's tool had some slight similarity to MCT, at least in intended effect, and their study had many more participants than prior research on MCT, its published results were still the best source from which to estimate effect sizes for this type of interface (Farnham et al., 2000; Newlon, Faiola, et al., 2008).

The three dependent variables for the Farnham study can be described as degree of consensus reached, rigor used in the decision-making process, and quality of the decision. The between groups effect size for these measurements was large for consensus and rigor (d=1.39), and medium for quality (d=.55), as estimated from the Farnham paper during prior research on MCT (Newlon, Faiola, et al., 2008). It was the magnitude of this primary between-groups result that was of interest, because the within-groups result was too distorted by the carry-over effect to measure the initial effect of the tool. Because the goals of the current study were to measure similar variables, the minimum observed effect size (d=.55) was initially assumed in conducting an a priori power analysis. The sensitivity of various assumptions was then examined.

The sample size requirements for measurements in the current study were based on the individual, because all the required measurements were looking at individual characteristics. Given these considerations, a statistical tool named G*Power (Faul, Erdfelder, Buchner, & Lang, 2009; Faul, Erdfelder, Lang, & Buchner, 2007) was used for the power analysis. Table 5 describes the results.

Table 5. *A Priori Power Study*

Sample Size Required Based on Various Assumptions (Faul et al., 2009)					
Effect Size Assumption	Parametric Assumption	Tails	Alpha	Power	Sample Size Required
.55	parametric	2	.05	.95	174
.55	parametric	2	.05	.80	106
.55	parametric	1	.05	.95	146
1.39	parametric	2	.05	.95	30

Sample Size Required Based on Various Assumptions (Faul et al., 2009)					
Effect Size Assumption	Parametric Assumption	Tails	Alpha	Power	Sample Size Required
.50	parametric	2	.05	.95	210
.50	parametric	2	.05	.80	128
.55	nonparametric	2	.05	.95	182
.55	nonparametric	1	.05	.95	152
1.39	nonparametric	2	.05	.95	32
.50	nonparametric	2	.05	.95	220

If we assumed that a successful demonstration of a new tool's utility required at least a moderate effect size, it was apparent from Table 5 that the individual participant measurements (if parametric assumptions were used for the Likert rankings) would require a sample size between 30 and 210. Therefore, we understood that it might not be possible to answer some of the research questions if fewer than 30 participants were recruited. However, we were prepared to recruit as many as 300 participants. We got good initial responses to our recruitment efforts, In the end, however, due to unexpected difficulty with coordinating schedules for three-person groups, the final tally of successfully scheduled participants was 36, several of whom dropped out before completing major parts of the protocol, leaving 31 usable sets of individual results.

The participants ranged in age, with three under 24, ten between 24 and 30, eighteen between 31 and 60, and four over 61. There were twice as many females (24) as males (12). Fifteen of the participants were students; four each were in business, education, and healthcare; one was in manufacturing, and seven listed their occupations as other. Only one participant had an ethnic background of Hispanic or Latino, but there was a racial mixture of blacks (5), whites (23), and Asians (8). One participant was located in Asia, with the rest being in North America. There were only three participants who had been using computers for less than ten years, and Internet usage also tended to be high, with twice as many (24) spending six hours a day or more online as those spending less than six hours a day (12). Use of social networks was more evenly divided, however, between those visiting such sites less than three times a week (9), those visiting

sites between three and ten times a week (13), and those visiting sites eleven or more times a week (14). Most of the participants had current volunteer experience, as only three had not worked for a volunteer group in the past two years, with nine working less than one hour over the past three months, sixteen working between one and ten hours, and ten working eleven hours or more. Current team experience was also quite high, as only two participants had not been on a team within the past two years. The details of the demographic information about these participants are shown in Appendix B.

Procedures and Interventions

The trials for this research were conducted entirely on the Internet, using volunteers connecting from their own computers, with the researcher monitoring the process remotely as needed. Once participants electronically acknowledged the required online consent form, each individual completed the online pre-test questionnaire (see below), and was randomly assigned a role in a group of three members. Each group was alternately assigned to one (and only one) of the treatment interfaces described above. The group then attempted to solve the simulated problem (planning an art auction) while generating the artifacts described above. At completion, each session was followed immediately by the online post-test instruments described above. A final online chat group session was conducted at the end of the first couple of trials to make note of any problems that needed to be corrected for subsequent trials. The plan for this design is represented as follows: C="chat only interface" M="MCT interface", O="observation" (via questionnaire), and F="follow-up chat (if applicable)":

O-M-O-F

O-C-O-F

Based on the effect-size considerations discussed above, the plan was to attempt at least 6 and at most 42 iterations of the design. In the end, however, due to repeated scheduling difficulties, there were only 12 sessions run, including six of each treatment type. Therefore, the design had a total of six iterations.

Materials and Instruments

Based on the design, as described above, a specific set of materials and instruments was developed. The first in order of use were various recruitment materials, these being email cover letters for each type of recruited population, a flyer to be attached containing an

advertisement, a web document with more details about the study, and an informed consent form covering both of the two treatment groups. These are included in the IRB materials shown in Appendix A. Next were various testing materials, including (1) a demographic questionnaire to be completed before each trial began, (2) the scenario to be used in the test, (3) the simulated information supplied to each individual, and (4) the differing interfaces used by each treatment. As each trial was run, a number of information storage artifacts were generated (5), and an interruptive questionnaire was administered at the point that each sharing decision was made (6). Once each trial was finished, a final interruptive questionnaire was administered on any unshared information (7), a quiz testing knowledge of all the supplied information was administered (8), and a detailed post-test questionnaire was completed (9). Each of these testing materials is described in detail below.

1. Pre-Test Questionnaire

Initial demographic data was gathered on the participants using a pre-test questionnaire. A representation of it, and a listing of the results obtained from it can be found in Appendix B.

2. Test Scenario Details

As discussed above, to answer the research questions, it was necessary to have a standardized, but engaging activity against which to measure, providing plenty of opportunity for discussion, modeling, and collaboration, and for which a fixed set of input information could be developed. The scenario chosen involved an art auction sponsored by the participants. The fixed information set contained items that were supposed to be public knowledge, and also items that were given privately to participants based on their assigned role, and which they could choose to share, or not. An excerpt from the public information given to every participant is shown in Table 6. A full listing of this information can be found in Appendix C.

Table 6. *Test Scenario – Example of Public Information*

Synopsis
You are a member of a restored urban neighborhood, inhabited by a mixture of young upwardly-mobile professionals, and longer-term residents, who tend to be lower income working-class. A young woman

Synopsis
from one of the working class families has recently auditioned for, and won a place on, a new reality show called "Who Wants to be an Artist?" Now, after having watched all the canned episodes that were filmed six months ago, many of the neighborhood residents are gathered to watch the live finale that determines who will win the ultimate prize, an artist-in-residence scholarship at a prestigious art school. Much to the delight of the neighborhood, your young neighbor is declared the winner! As you and your fellow neighbors celebrate at the viewing party, a call comes to the cell phone of the young woman's best friend. It is the winning contestant herself! When she can make herself heard over the shouts of congratulation, she explains to her friend that the show's producers have made her an additional offer. They will sponsor a 1-day charity auction of all the artwork that has been produced during the competition with the proceeds going to fund an outreach art program for low income children in her hometown. The catch is that she has to find local volunteers to plan and host the event. Until the winner was determined, the producers had no idea where this auction would be held, so they have some funding for it, but no pre-planning done. Due to the production schedule of the show, the event must be held live in one weeks' time. In the heat of the moment, you are part of a group of neighbors who offer to help her plan and stage this event. Once you have volunteered, you then have a planning session, working with your fellow volunteers and using a planning tool supplied by the reality show production company to tack down plans for this event.

3. Simulated Information Supplied to Each Individual

By providing each equivalent role in both treatment groups exactly the same private information and capturing how much of that information each group's individual subgroup members shared with each other, we could measure whether there were differences in willingness to share. This private information was carefully designed such that some items would be more likely to support a manifest profile (where the subgroup made a good decision even if they didn't know all the information), while some items would be more likely to support a hidden profile (where the unshared information would have changed the subgroup's decision if they had known it). A sample of the private information given to each role is detailed in Table 7. A full listing of the private information to be shared can be found in Appendix C.

Table 7. *Examples of Private Information for Each Role*

Chandler Smythe's Private Information
Email from a month ago: Chan, I have exciting news for those of you on the neighborhood board. The Foundation has finally been given title to the old School 9 property over on Park Avenue. Now the street's name has come true, because the old school grounds will make a wonderful neighborhood park. There's plenty of room, and even a playground! As you recall, the main school building was demolished several years ago after we complained about its condition, and the city removed the foundation and closed the hole with fill and topsoil. They even put in grass and flowers as part of the maintenance we requested back then, so our new park already has a good base of established plantings. The city offered to tear down the old gymnasium building before the property transfer. But, since it's still in fairly good shape, we've decided to keep it and convert it into a community center. It has a good roof and intact windows, but it's very dirty inside. It will need a lot of volunteers and several days of cleaning before it can be used for community events. We did buy the event insurance for it, though. One idea the Foundation has is that we could offer use of the building for free to the first event sponsor, with the building clean-up being their rent. Do you know of anyone who might be interested? I know the neighborhood association sometimes sponsors events, so be sure to keep us in mind if you are planning anything. *Terry*
Marley Winters' Private Information
Email from last week: Marley, Isn't it wonderful to watch Bell on TV? Her grandfather worked so hard to teach her his craft. She sure is making us all proud now. It's like a miracle to watch the beauty springing from her hands. I hate to even think what direction she might have gone if he hadn't stepped in to mentor her. She and her brother really had us scared for a while. Now he's in college and she's on TV! Do you suppose her fame might finally bring her grandfather some recognition? He's a wonderful artist himself, but no one has ever seemed to notice. The church has bought so many of his works to support him over the years that our attic is full of them. Do you think we could raise money for charity by selling them? *Reverend Clark, Mt. Hope Church*

Taylor Jones' Private Information

Email from three months ago:

To CrimeWatch Captain Jones:
We want to pass along some information that was developed by our local gang taskforce concerning a youth gang that has been operating in your area. The gang "Young Devils" formed about five years ago with members that were then pre-teens. Its members have been periodically arrested for the following activities: 1) Graffiti (tagging activities significantly diminished over the past two years), 2) Assault (charges involved fights on public school property), 3) Illegal use of fireworks (last offense two summers ago).

None of these cases was referred to adult court, but several of the gang members remain on probation as juveniles. Community intervention work two years ago, by Reverend Clark of Mount Hope Church, resulted in a significant (and continuing) reduction in incidents; but the passage of these young people into adulthood as they reach the age of 18 has initiated renewed scrutiny by our gang taskforce. Some attrition of the original gang composition has been noted as members move on, but many original members remain involved. It is the opinion of our gang experts that this gang has a high potential for generating hardcore criminals as its members leave high school and fail to integrate with society. We would appreciate hearing about any problems, issues, or changed circumstances that you become aware of as a concerned neighbor.
Bud Stevens, CrimeWatch Liaison, Police Department

4. Test Interfaces

General Test Bed

A website was developed to support this testing. It stepped each participant through the consent process; gathered contact information and demographics; supplied all of the instructions for the session; created each group, based on whether there were at least three unassigned participants present; guided the group through the sequential steps of the session using a specified timeline; provided entry boxes, storage, and appropriate representation for the data each participant entered; and gathered information on each participant's thought processes, knowledge levels, and individual characteristics. The different parts of this progression were represented on different tabs.

The interface was designed to present each new activity in sequence without allowing participants to jump ahead. Once they had completed an activity, however, they were allowed to return to that tab if they wanted to look at the information there, or

change something. An example screen from the Treatment 1 version of this test bed is shown in Figure 2. The darkened tabs show that the user has already passed the introduction screen, the informed consent screen, the contact information screen, and the background survey, and is now on the MCT screen. The greyed-out tabs are for session phases yet to come – specifically, the wrap-up quiz, the post-test survey, and the conclusion screen.

On the upper left of the MCT screen can be seen the collaboration area, containing a thought card. It shows the thought title, an edit button, and a view button. The card for this particular thought is grayed-out at this point in the brainstorming sequence, so the edit button won't work, but the view button can always be clicked to open a window showing the thought title and the conversation thread that describes (and comments upon) this thought. There is also a button to create a card for a new thought.

To the upper right on the MCT screen is a countdown timer, showing how much time is left in this particular part of the brainstorming sequence. There is also a slider button the participant can use to indicate readiness to move on, even though the timer hasn't counted down completely. If all three participants are ready to move on, the timer can be cut short. There is also a button that opens a tutorial screen. The participants are presented with this tutorial in scrolling form when the MCT screen is first opened, and if they want to review something later they can press the Tutorial button.

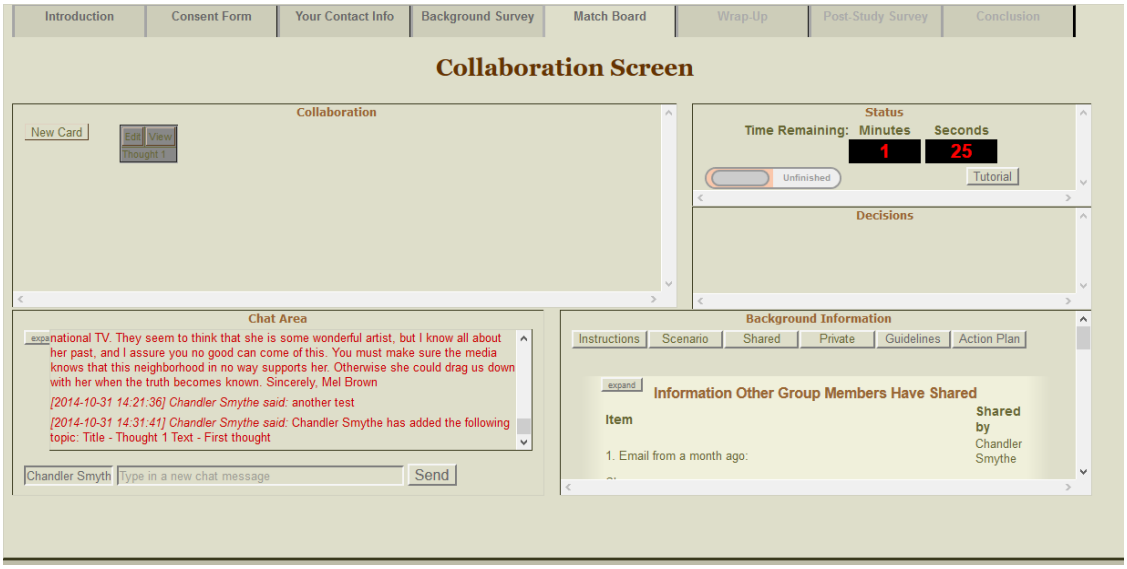


Figure 2. Typical Test Bed Screen

Below the timer section, is a section labeled "Decisions," which is currently empty. Whenever a vote is taken during the session, the vote tally or result is shown here.

To the lower left on the MCT screen is a chat area that shows the running conversation among the participants. It also has an input area for new chat posts, and a marker next to the input area reminding the user what role he or she is playing. A small "Expand" button on the upper left of the chat area allows the conversation stream to be opened in a larger pop-up window.

To the lower right on the MCT screen is an area showing the various items of background information the participants have been given. The participants are presented with this information in scrolling form when the MCT screen is first opened, and if they want to review something later they can press the appropriate button to show the current instructions, the scenario, their own private information, or the guidelines. The "Shared" button shows private information that other participants have decided to share with the group. (This shared information also appears in the chat window in temporal order as part of the conversation.) The "Action" button remains inactive until the final part of the MCT sequence, when the chosen group leader uses it to enter an action plan that the others can view. The screen section showing the various information also has an "Expand" button, in case the users prefer to view the information in a larger pop-up window.

The entire session using this test bed generally took about two hours. A representative screen sequence from Treatment 1 is shown in Appendix G.

Treatment 1

The first treatment group used the MCT prototype. It captured information through a series of thinkLets (see Chapter Two) to support a formalized interaction process. This scenario used a similar methodology to that used in the prior work (Newlon, 2008), but extended the methodology with customized adaptations inspired by the following well-known thinkLets:

1. LeafHopper to support divergence
2. RichRelations to support convergence
3. ThemeSeeker to support organization
4. PopcornSort to support evaluation (this was changed to a matrix sort)

5. BucketWalk to support evaluation

These customized thinkLets were combined to create a brainstorming, categorizing, ranking, evaluation sequence.

Treatment 2

The second treatment group shared information through a traditional chat interface and stored it in traditional message and reply sequences. To make the two treatments as similar as possible (varying only in the collaboration method), the exact same screen was used as shown in Figure 2. However, instead of a collaboration area, the chat window (showing the running conversation) covered both the upper and lower left-hand side of the screen. The timer, decision, and information areas all remained the same.

5. Artifacts Generated by the Collaborative Process

A number of artifacts were generated by each group during the course of each session. These were gathered and used in the subsequent analysis. A description of each is as follows:

Chat History

One such artifact was the chat history, with all the entries to the session chat window. In addition to the ad hoc conversation thread that was posted by each group member, the posts to the chat window included notifications containing the content of any private emails that were shared, any thought cards that were created or updated, any relations that were created, and any changes made to the sort matrix. Examples of the chat history can be found in Chapter Four and in Appendices H and I.

Thoughts/Relations/Categories/Mental Matrix

In place of a single artifact representing the group's mental model, a series of data structures were built by each group using the MCT interface. These included a number of *thought cards*, each with a topic title, and one or more thoughts on that topic contributed by one or more people. There were also a number of *relations*, each identifying two of the entered thoughts and assigning a name to the relation between them. The *categories* were relations generated within the session that were chosen by the participants for use in sorting the thoughts. Finally, there was s *sort matrix*, within which the generated thoughts were sorted into mental model categories and relations, and within which each cell was

potentially expanded upon. Examples of these are shown in Chapter Four. A full listing can be found in Appendices J, K and L.

Action Plan

In addition to the artifacts described above, each group generated some plan of action. These were to be entered into a separate section, but that part of the interface proved so difficult to use that most groups followed the instruction they were given to use the chat window as an alternative entry area. Therefore, the overall action plans have been compiled from an analysis of the chat histories. The complete action plans for two representative groups are compiled in Appendix I.

6. *Interruptive Questionnaire for Shared Information*

Beside each piece of individually-provided information, the interface offered a button for "share with group" to capture the participant's decision about whether to share the information. Whenever a participant pressed the button, the interface would add the item to the shared information window that everyone could see, and also insert it into the chat stream to make doubly sure everyone saw it. Before doing this, however, the interface would interrupt the sharing operation with the questionnaire shown in Table 8.

Table 8. *Interruptive Questionnaire for Shared Information*

Information Context	
1.	Please rate how consistent this item of information is with your preferences, goals or desires for the situation as you understand it right now.
2.	Please rate how consistent you think this item of information is with the group's preferences, goals or desires for the situation as you understand it right now.
	1=Very Inconsistent 2=Somewhat Inconsistent 3=Neutral 4=Somewhat Consistent 5=Very Consistent

7. *Interruptive Questionnaire for Unshared Information*

After each trial session ended, a final interruptive questionnaire was administered, covering all items of private information that were not formally shared. It is shown in Table 9.

Table 9. *Interruptive Questionnaire for Unshared Information*

Information Context
1. Please rate how consistent this item of information is with your preferences, goals or desires for the situation as you understand it right now.
2. Please rate how consistent you think this item of information is with the group's preferences, goals or desires for the situation as you understand it right now.
0=Didn't Notice It 1=Very Inconsistent 2=Somewhat Inconsistent 3=Neutral 4=Somewhat Consistent 5=Very Consistent

8. Post-Test Quiz

A sample question asked in the quiz over the supplied information set is shown in Table 10. The entire quiz can be found in Appendix D. The quiz covered all the information, both public and private. The version administered to the subgroup participants playing the Chandler Smythe role is shown as an example. The versions for the other two roles had identical questions, but asked for predictions about differing partner roles.

Table 10. *Excerpt from the Post-Test Quiz*

Potentially Available Resources			
Question	Your answer (T/F)	Marley Winters would know this (Y/N)	Taylor Jones would know this (Y/N)
The following venues are known to members of your group to be potentially available for the art auction:			
Neighborhood park	T		
County fairground	F		
Neighborhood community center	T		
Frey Lewis House	F		
Ellingham mansion	T		
Walmart parking lot	F		

Potentially Available Resources			
Question	Your answer (T/F)	Marley Winters would know this (Y/N)	Taylor Jones would know this (Y/N)
Mount Hope Church	T		
Local masonic lodge	F		
Neighborhood café	T		
Hotel banquet hall	F		
Rented tent	T		
Convention center	F		

9. Post-Test Questionnaire

Rating data was gathered using a series of summative Likert-type scales in a post-test questionnaire, excerpts from which is shown in Table 11. The full post-test questionnaire, along with the scales it was derived from, can be found in Appendix E, along with the Cronbach's Alpha for each scale calculated from the study data. The scales used in this questionnaire measured willingness to self-censor, intrinsic motivation, flow state, and acceptance. They were drawn from the Willingness to Self-Censor Scale, the Intrinsic Motivation Inventory, the Flow Scales, and the Acceptance Scales (based on the Unified Theory of Acceptance) that were discussed in Chapter Two (Hayes et al., 2005a, 2005b; "Intrinsic Motivation Inventory," 2011; Jackson & Marsh, 1996; Sundaravej, 2006). All constructs were measured on a 5-point Likert scale and adapted in their wording to fit the experimental context.

Table 11. *Excerpts from the Post-Test Questionnaire*

The following questions (all using a 1-5 Likert-type scale of agreement) were presented on the post-test questionnaire in randomized order:
1. Willingness to Self-Censor Scale (to be used to control for this individual personality trait that may be a confounding factor in willingness to share information.)

The following questions (all using a 1-5 Likert-type scale of agreement) were presented on the post-test questionnaire in randomized order:

a. It is difficult for me to express my opinion if I think others won't agree with what I say.

b. There have been many times when I have thought others around me were wrong but I didn't let them know.

2. Intrinsic Motivation Inventory (to be used to measure intrinsic motivation both as an outcome, and as a factor in willingness to share information.)

    a. Interest/enjoyment questions:

        i. I enjoyed doing this activity very much.

        ii. This activity was fun to do.

        iii. This activity did not hold my attention at all. (Reverse)

        iv. I would describe this activity as very interesting.

    b. Competence questions:

        i. I think I did pretty well at this activity, compared to others.

        ii. After working at this activity for a while, I felt pretty competent.

        iii. I am satisfied with my performance at this task.

        iv. This was an activity that I couldn't do very well. (Reverse)

3. Unified Theory of Acceptance and Use of Technology Model (to be used to measure how well the interface supports collaboration, both as an outcome, and as a factor in willingness to share information)

    a. Performance questions:

        i. I found the interface useful in solving the problem.

        ii. Using the interface enabled me to accomplish tasks more quickly.

        iii. Using the interface increased my productivity.

        iv. Using the interface increased my chances of success.

    b. Ease-of-use questions:

        i. My interaction with the interface was clear and understandable.

        ii. It was easy for me to become skillful at using the interface.

The following questions (all using a 1-5 Likert-type scale of agreement) were presented on the post-test questionnaire in randomized order:

iii. Learning to operate the interface was easy for me.

4. Flow State (similar to intrinsic motivation, to be used to measure interface efficacy both as an outcome, and as a factor in willingness to share information.)
    a. Challenge questions:
        i. I was challenged, but I believed my skills would allow me to meet the challenge.
        ii. My abilities matched the high challenge of the situation.
        iii. I felt I was not competent enough to meet the high demands of the situation. (Reverse)
    b. Awareness questions:
        i. I made the correct moves without thinking about trying to do so.
        ii. Things just seemed to be happening automatically.

Methods of Analysis

A number of methods were used to determine whether the interface supported sharing behavior as the group responded to its simulated problem. All of the chat window conversations, particularly the action-oriented contributions of the groups, were evaluated on whether the group was effective in capturing the necessary facets of the problem. The sharing behavior of the participants was quantified. Qualitative data was gathered on the experiences of the participants. The levels of complexity in each mental model data structure were also examined.

Variables Collected

The theory this study was testing (that MCT will support sharing) was based on a series of interlinked research questions. The independent concept's research question was whether a collaboration support interface, such as the MCT, could capture the group's cognition without adding unduly to the cognitive load. The dependent concept's research question was whether the group's members would share more information as the group's collective data repository grew. The intervening concept's research question that linked the two was whether better group cognition, by increasing the size and usefulness of the

group's data repository, would drive commitment and motivation, and reduce resistance, resulting in an increase in sharing. Each of these research questions had its own independent and dependent variables. These are described in detail below.

While the sample size was small in terms of individuals, and even smaller in terms of design iterations, the amount of information collected on each individual was enormous. This was deliberate, because a small sample size was anticipated, based on recruiting difficulties encountered in the prior study. Significant aggregation was necessary to create most of the measures described. These measures were intended to be somewhat redundant. We attempted to obtain actual performance data wherever possible to use if the self-report data was not sensitive enough for the sample size.

Independent Concept

The first aim of this study was to examine the independent concept – the extent to which a supportive interface could capture and support a group's collaborative cognition, versus the effect of the resulting cognitive load. Therefore, the supportiveness of the interface represented the concept's independent variable. Initially, the two treatment interfaces were planned to be the only variation in supportiveness. However, the fact that the study was deliberately conducted under normal Internet conditions introduced another independent variable, the supportiveness of the Internet on a given night and for a given participant, measured via conversation analysis[3].

Internet problems sometimes caused multiple complaint comments, and sometimes caused a complete crash, with the session just going silent for an extended period, or for good. Therefore, a value of 0 was assigned to perfection, and 1 was added to the score for each complaint. The highest number of complaints by a participant (11) was used to determine the score assigned for complete Internet failure by adding 1 to obtain a complete failure score of 12. That wasn't the highest score, however, because some people were having a hard time even before the Internet went down. So, the individual's number of complaints was added to the total failure score to differentiate between these experiences. Finally, the individual scores were totaled for the group score. The scores were based on complaints made to the chat window, so the problems each

[3] While this introduced more complexity into the study, it also gave greater insight into variations in the dynamic relation between the interface, and the host platform.

person experienced became part of the group experience, which is why a sum was more appropriate than an average for the aggregation method.

Collaborative cognition, the concept's dependent variable, was reflected by the group's collective mental models, transactive memory structure, and decision-making.

The specific descriptors for collective mental models are *cognitive similarity* (the degree to which the group members' mental models match each other) and *cognitive accuracy* (the degree to which they match the information originally given). Therefore, the cognitive similarity of each group's mental models was assessed by measuring the agreement among the group members' answers to the questions on the post-test quiz (the level of consistency among the group's members in knowing these items). The group's cognitive accuracy was measured by the overall accuracy of their answers (the gross number of accurately recalled items in the knowledge base).

Transactive memory is measured in terms of *group knowledge stock* (the total content of the group's knowledge that is divided among the group's members), *degree of specialization* (the amount by which the group members' areas of expertise differ), *knowledge location consensus* (the degree to which the group members agree upon who has what knowledge), and *knowledge location accuracy* (the degree to which they are correct). The quality of the knowledge stock was measured by providing the same information inputs to each group and totaling the number of questions that were answered correctly by at least one group member on the post-test quiz. The degree of specialization was measured by comparing the group members' scores for each question of the post-test quiz to see whether the quiz questions answered correctly were contiguous but not overlapping.[4] The knowledge location scores were determined by having the group members predict their fellow members' scores on each question of the post-test quiz. The results were then compared to the fellow members' actual scores. Knowledge location consensus was based on whether the members all made similar estimates. Knowledge location accuracy was based on whether the scores they predicted for their fellow members were correct.

[4] The different members were expected to score well on different questions, because they were each given specialized knowledge.

The decision-making support provided by the interface was measured both by rating the group action plans that resulted from the session (based on number of issues addressed and whether the plan overcame hidden profiles), and by examining the overall self-reported acceptance (determined by the Likert rating items of the Unified Acceptance Scales on the post-test questionnaire).

Because each of these measures was quantitative in nature, it was possible to conduct ANCOVA analysis of the behavior of the dependent variables, controlling Internet performance, for each of the treatments. Most of these variables were measured at the end point of each session, so this single point was used to indicate overall performance for the cognition measures.

The basic assumptions required for ANCOVA analysis are addressed as follows:

1. All of the dependent variables and the Internet performance were continuous, as they were either direct measurements, or taken from summative scales.

2. The z-score for each of these variables was less than 2.0, well within an acceptable range for a normal distribution.

3. All samples were drawn independently.

4. The assumption of independence of observation was a possible issue with this data, due to the fact that it was a multi-level situation. Most of the group cognition measures were for the group as a whole. Only the acceptance scores were by individual. Each person's Internet connection was different, so their experience with it was individual, but on some nights the entire system crashed, which was a group experience. Because the small sample size ruled out multi-level modeling, a choice had to be made whether to give each individual the same group scores, or to aggregate the data into a group-level data set. Aggregation was the solution chosen, because it avoided issues of independence and interclass correlation. The resulting data set had a substantially reduced *N*, but running the tests both ways revealed that the overall results were the same.

5. There were a few places where removal of an outlier or two might have resulted in a tighter distribution, but no justification was evident for treating those cases differently.

6. Levene's test on each ANCOVA resulted in acceptance of the null hypothesis that the error variance of the dependent variable was equal across groups.

7. The scatterplots for each of the dependent variables are shown in Chapter Four. Inspection revealed that any relation between the dependent variable and the covariate (Internet performance problems) was linear.

8. An analysis evaluating the homogeneity-of-regression assumption was performed on each dependent variable. None of the relations between the covariate (Internet Performance Problems) and the dependent variables were found to differ significantly as a function of the independent variable (Treatment).

9. One issue of importance was the existence of a significant treatment effect between the independent variable (Treatment) and the covariate (Internet performance problems). The MCT interface was more demanding of bandwidth than the chat-only interface, which caused the test groups to experience more Internet performance problems than the control groups. It is generally accepted that this situation will occasionally arise when the variable is an observation from the field, rather than designed as part of the test. Because the variable cannot be left out of the analysis without distorting the situation observed, the accepted practice is to leave it in and explain that the treatment effects are observed at any given value of the Internet performance (Grace-Martin, 2012). This relation is also shown in a graph in the results section.

Dependent Concept

The second aim of this study was to test the dependent concept – the research question was whether as a forming group's shared data repository grows the amount of information the group's members contribute to the repository also grows. The independent variable for this hypothesis was the changing size of the data repository. The cumulative amount of available information in the data repository was obtained by counting the cumulative number of action comments for each segment of the session. The dependent variable was acts of sharing. This was measured by counting the instances of sharing (both formal and informal) during each segment of the session. The context of sharing was also collected, measuring whether the information shared was apropos of the current conversation, or was shared out of context or in response to an interface instruction. Each of these variables was quantitative in nature. The relations among these variables were examined with linear regression analysis.

Intervening Concept

The third aim of this study was to look at the intervening factors. The research question here was whether the positive effect of group cognition on the size of a group's data repository resulted in increased willingness to share because of 1) increased commitment to the knowledge structure as the group's collective strategic model was more detailed, 2) increased intrinsic motivation to interact with the knowledge structure as it was better able to increase the reflective capacity and self-efficacy of the group members, and 3) reduced resistance to sharing information as a larger information pool, and increased specialization among the group's members, reduced information bias effects.

The independent variable for this research question was the size of the group's data repository. The measure of each individual's perceived size of the group repository at the end point of the session was different from the group's knowledge stock (all information known by anybody). It was the percentage of correct answers the individual got on the post-test quiz that depended on information from others, rather than from the individual's private store of knowledge. This was measured by scoring the subset of questions that couldn't be answered by that individual based on the private information for the individual's role.

The sense of commitment was measured by the total number of action comments by each individual for the entire session. Conversation analysis was used to tally each member's overall number of suggestions generated or thought cards created. However, these comments were also rated for degree of *negotiation bias* (the phenomenon where the group focuses on trying to identify the majority position, instead of trying to get new information). Because negotiation comments didn't add new information to the knowledge structure, they were subtracted from the tally.

Intrinsic motivation was measured by the Likert ratings of the Intrinsic Motivation Index. Because intrinsic motivation was a self-reported variable, it was validated through a couple of more direct measures. The first measure was the flow state of the individual, as reflected by the Likert ratings of the Flow State Scale. The second measure was behavioral evidence of reflective capacity and sense of self-efficacy as indicated by the overall level of enthusiasm expressed, that is, the number of *like* statements posted.

The effect of data repository size on reduced information bias (i.e., sharing only information that is consistent with one's own preferences, or with the group's preferences), and the resulting effect of reduced bias on lowering resistance to sharing, were measured by examining the sharing score (percentage of the information that could be shared that was shared), the honesty score (sharing of information that was inconsistent with one's own preferences, goals, or desires), and the trust score (sharing of information one believed to be inconsistent with the group's preferences, goals, or desires) to see how they were affected by the interface, and by group cognition, repository size, commitment, and motivation.

These measures were determined by examining the formal sharing choices for each person; by examining the chat postings for informal sharing; and by Likert rating of items shared and not shared on the various interruptive questionnaires. This allowed examination of whether differences in the size of the group data repository helped to overcome resistance to sharing information by reducing information bias. The original intention was use the Willingness to Self-Censor (WTSC) rating as a control variable. However, the Cronbach's Alpha score for this study's data was unacceptably low (.609), which made it of little use as a control variable.

Because several of the measures used in the intervening concept section were collected at the end point of the session, a single measurement at the end point was used for all of them.

In addition to the overall effect of each factor, the relative strengths of each factor, and whether there were interactions among them, were also of interest. This was examined through cross-correlations, and by looking at relative effect sizes.

The basic assumptions for regression analysis for all these variables were addressed as follows:

1. Linear relation – Scatter diagrams were examined to make sure all identified relations were linear.

2. Multivariate normality – Histograms were examined, along with z-scores to check for normality.

3. Multicollinearity – The correlation matrix was examined to look for any significant correlations between the two independent variables. The tolerance was also checked by subtracting R^2 from 1 to look for extreme effects.

4. No auto-correlation – Durbin-Watson's d tests were run on all significant regression results where time-series data might have caused one result to influence the next. Most results were measured post-test, however, so there was little chance of auto-correlation.

5. Homoscedasticity – The scatter diagram was also checked for this.

Other Variables of Interest

The fourth aim of this study was to examine the resulting artifacts. In particular, the abstract categories that emerged during the model-building process were of interest. Prior work had shown that the categories of events, goals, tasks, roles, actors, and resources were too rigid. However, an understanding of participants' abstract data structures will eventually be necessary for the design of MCT's business logic and its database of screen components. By examining the categories created and chosen by the participants using the collaboration-support interface, we hoped to gain insights that would help us increase the flexibility of MCT's modeling support.

Another area of interest was the creative use of thought cards by participants. This mechanism was intended to support dialogue threads that were presented by topic, while also being simultaneously inserted into the temporal conversation thread. Conversation analysis was conducted to determine if such a method encourages the participants to share their thoughts.

A final area of interest was the sorting matrix. Variables of interest for this area were whether participants were willing to use this artifact, whether they used the various types of mental models in the way expected, and the extent to which each cell's contents had been expanded upon in an organized and useful manner.

Treatment of Missing Values

One issue of particular concern for this study was the treatment of missing values. The software for the test bed was designed to only allow a session when three unassigned participants were present to be formed into a group. So, theoretically, each group had three members. However, it was apparent from analyzing the conversations for each

group that in a couple of cases one member dropped out immediately during the preliminary reading stage, and never made any contribution to the group cognition. There were several other cases where a group member completed the entire session, having all the normal influences on the cognition of the group, but failed to complete one or more of the final questionnaires. There were also a number of cases where participants missed individual questions on the questionnaires.

Specific situations are discussed in Chapter Four, but in general, the treatment of missing values varied for these different circumstances. In the case where one group member dropped out immediately, that group was treated as having two members. Any values from the third member (i.e. demographic) were simply dropped from any calculations. In the case where a group member contributed to the group cognition, but failed to provide the ending data, that data was input where possible, either by crediting the individual with values imputed from the behavior of the group as a whole, or by imputing a mean, or by inseting a randomized answer.

The goal in each case of input data was to capture true variations in group behavior without letting the missing values distort the result. Sensitivity analysis was performed in each case to see how sensitive the findings were to changes in the imputation assumptions. In the case of individual missing values, these could usually be treated as a wrong answer because they were an indication that the participant didn't know the right answer.

There were usually several individual types of measures gathered to evaluate each section. So, in the case where one of them wasn't sensitive enough, as was the case for some of the self-reported measures, a more sensitive measure, generally based on performance, was used.

CHAPTER FOUR: RESULTS

Introduction

There were four aims in this study. First, to determine the efficacy of the collaborative support interface in comparison to a regular chat interface. Second, to test the hypothesis that growth of the group's shared data repository increases willingness of the group's members to contribute to it. Third, to examine the effects of commitment, motivation, and information bias on this process. And, fourth, to examine the characteristics of the emergent data structure. The study's findings are listed below, organized into sections based on which aim they addressed. The numbers used in the calculated findings are given, as are the statistical results, and a discussion of any issues.

Specific Findings

First Aim – Determine the Efficacy of the Collaboration Support Interface

A number of different measures were used to try to gauge the collaborative cognition of the group. They are described below. Some of these measures were based upon performance, either during the trial or afterwards on the quiz. Other measures were based on self-reports in the final questionnaire. The measures for this section were results for each group as a whole. The descriptive statistics for the various measures are shown in Table 12.

Table 12. *Descriptive Statistics for Group Cognition*

Variable	N	Min	Max	Mean	SE	SD	Skew	Z-Score
Treatment	12	0	1	.50	.151	.522	.00	0.00
Internet Problems	12	0.00	41.00	13.92	4.38	15.18	.97	1.52
CogSim	12	0.19	0.75	0.50	0.05	0.19	–.46	–0.72
CogAcc	12	0.46	0.75	0.63	0.02	0.09	–.39	–0.61
KnowlStock	12	0.79	0.94	0.88	0.01	0.04	–.76	–1.19
DegSpec	12	0.16	0.48	0.28	0.03	0.10	.85	1.33
LocCon	9	0.39	0.63	0.51	0.03	0.08	.33	0.46
LocAcc	9	0.28	0.61	0.44	0.03	0.10	–.12	–0.16
ActionPlan	12	0.13	0.65	0.43	0.04	0.15	–.39	–0.62
Accept	12	0.31	0.70	0.50	0.04	0.14	.20	0.32

Independent Variable: Supportiveness of the Interface

The supportiveness of the interface had two components.

1. *Treatment:* The chat-only interface was assigned a value of 0, while the collaboration support interface was assigned a value of 1.
2. *Internet Problems:* The scores were based on complaints made to the chat window, and whether the Internet (or the server) completely cashed.

Dependent Variable: Collaborative Cognition

There were eight components to collaborative cognition

1. *CogSim:* Cognitive similarity, the degree to which the group members' mental models matched each other, the agreement among the group members' answers to the questions on the post-test quiz (the level of consistency among the group's members in knowing these items).
2. *CogAcc:* Cognitive accuracy, the degree to which the group members' mental models matched some index of reality, the overall accuracy of their answers (the gross number of accurately recalled items in the knowledge base).
3. *KnowlStock:* Group knowledge stock, the total content of the group's knowledge that was divided among the group's members, total number of questions that were answered correctly by at least one group member on the post-test quiz.
4. *DegSpec:* Degree of specialization, the amount by which the group members' areas of expertise differed, comparing the group members' scores for each question of the post-test quiz to see which areas complemented each other as determined by whether the quiz questions answered correctly were contiguous, but not overlapping (at least one member knew the answer, but not more than one).
5. *LocCon:* Knowledge location consensus, the degree to which the group members agreed upon who had what knowledge, whether the members all made similar estimates when predicting their fellow members' scores on each question of the post-test quiz

6. *LocAcc:* Knowledge location accuracy, the degree to which the group members were correct, whether the scores they predicted for their fellow members were close to the actual scores.
7. *ActionPlan:* Group action plan rating, based on number of issues addressed and whether the plan overcame hidden profiles.
8. *Acceptance:* Overall self-reported acceptance, determined by the Likert rating items of the Unified Acceptance Scales on the post-test questionnaire.

Issue: Treatment of Missing Values

While viewing these findings, one should bear in mind that there were shortcomings in the data for specific participants, which were handled differently, for the reasons discussed in Chapter Three. Participant 1 dropped out immediately, so Participants 2 and 3 were treated as a two-person group. However, Participant 3 failed to complete the final questionnaires. To best represent the data from Participant 2, two opposing randomized sets of answers were input for Participant 3 to test for sensitivity in the final calculations. Where possible (i.e. rating of the action plan, etc.), the performance data for the group as a whole was credited to participant 3. Participant 9 also dropped out before the session got underway, so Participants 7 and 8 were treated as a two-person group. Participant 19 also dropped out at the beginning, so Participants 20 and 21 were treated as a two-person group. However, Participant 22 contributed to the group's work and failed to complete the final questionnaires, so randomized answers, sensitivity testing, and group-appropriate answers were used as input for Participant 22 instead.

Another issue that had to be treated in different ways concerned the part of the questionnaire that asked participants to guess whether their fellow participants would have known an answer. In the case where participants otherwise answered questions, but skipped answering some or all of these, the unanswered ones were treated as a "don't know", which was scored as a failure to guess the answer correctly. In the case where participants failed to complete the entire questionnaire, randomized answers were input instead, and subjected to sensitivity testing.

Results of Analysis

Part of the analysis was intended to gain a better understanding of the context in which the study took place. The dynamics of the actual group cognition were examined, as were

the differential effects of Internet performance problems on the two interface treatments. Based on this contextual information, the effect of the interface treatment on group cognition was examined while controlling for Internet performance problems. These various results are discussed below.

The different measures of group cognition had a somewhat complex relation with each other. Simple regression analysis was run for this study's data set to explore these interrelations in the study setting. Cognitive similarity (CogSim) and cognitive accuracy (CogAcc) are both indicators of successful information pooling by the group as it forms a group mental model. In this study, CogSim predicted 65-68% of the variation in CogAcc, while CogAcc predicted CogSim by the same percentage. These measures didn't behave in the same way, however, even though they seemed identical. CogAcc predicted 95-96% of the variation in perceived size of the data repository (DataPercept), while CogSim predicted only 75-78% of the variation in DataPercept. CogAcc predicted 54-73% of the variation in the completeness of the group action plan (ActionPlan), which is an indicator of group decision-making. CogSim didn't significantly predict ActionPlan, though it did predict 26-33% of the variation in acceptance (Acceptance), which is an indicator of individual decision-making. While CogSim and CogAcc both predicted about half of the variation in flow state (Flow), an indicator of motivation, CogSim also predicted 26-33% of the variation in the self-report from the Motivational Index (Motivation), while CogAcc predicted 38-44% of the variation in measured commitment (Commitment).

Finally, ActionPlan predicted 49-54% of the variation in CogAcc, while the degree of specialization (DegSpec) inversely predicted 44-49% of the variation in CogAcc. Of the other measures of group cognition, 41-46% of ActionPlan was predicted by DataPercept, while 67-70% of Acceptance was predicted by Motivation and 39-44% of Acceptance was predicted by Commitment. The results of these regression analyses are shown in Table 13.

Table 13. *Regression Analysis of Group Cognition*

Independent/Dependent	R^2 (Adj.)	F(d.f.)	p	β
CogSim/CogAcc	.68 (.65)	21.36 (1, 10)	.001	.83
CogAcc/CogSim	.68 (.65)	21.36 (1, 10)	.001	.83

Independent/Dependent	R^2 (Adj.)	F(d.f.)	p	β
CogSim/DataPercept	.78 (.75)	33.70 (1, 10)	<.001	.88
CogAcc/DataPercept	.96 (.95)	214.04 (1,10)	<.001	.98
CogSim/ActionPlan	.19 (.11)	2.30 (1, 10)	.161	.43
CogAcc/ActionPlan	.73 (.54)	11.607 (1,10)	.007	.73
CogSim/Acceptance	.33 (.26)	4.89 (1,10)	.051	.57
CogAcc/Acceptance	.23 (.15)	2.99 (1, 10)	.115	.48
CogSim/Flow	.52 (.47)	10.85 (1, 10)	.008	.72
CogAcc/Flow	.51 (.46)	10.52 (1, 10)	.009	.72
CogSim/Motivation	.37 (.31)	5.86 (1,10)	.036	.61
CogAcc/Motivation	.18 (.10)	2.21 (1,10)	.168	.43
CogSim/Commitment	.24 (.16)	3.15 (1,10)	.106	.49
CogAcc/Commitment	.44 (.38)	7.80 (1,10)	.019	.66
DegSpec/CogSim	.27 (.20)	3.78 (1, 10)	.080	–.52
DegSpec/CogAcc	.49 (.44)	9.55 (1,10)	.011	–.70
ActionPlan/CogSim	.19 (.11)	2.30 (1,10)	.161	.43
ActionPlan/CogAcc	.54 (.49)	11.61 (1,10)	.007	.73
DataPercept/ActionPlan	.46 (.41)	8.59 (1, 19)	.015	.68
Motivation/Acceptance	.70 (.67)	22.92 (1, 10)	.001	.83
Commitment/Acceptance	.44 (.39)	7.91 (1, 10)	.018	.67

The following representative scatterplots (Figures 3-10) resulted from an examination of group cognitive function under differing interface conditions. The interface differences were caused both by alternative treatments and by varying Internet performance.

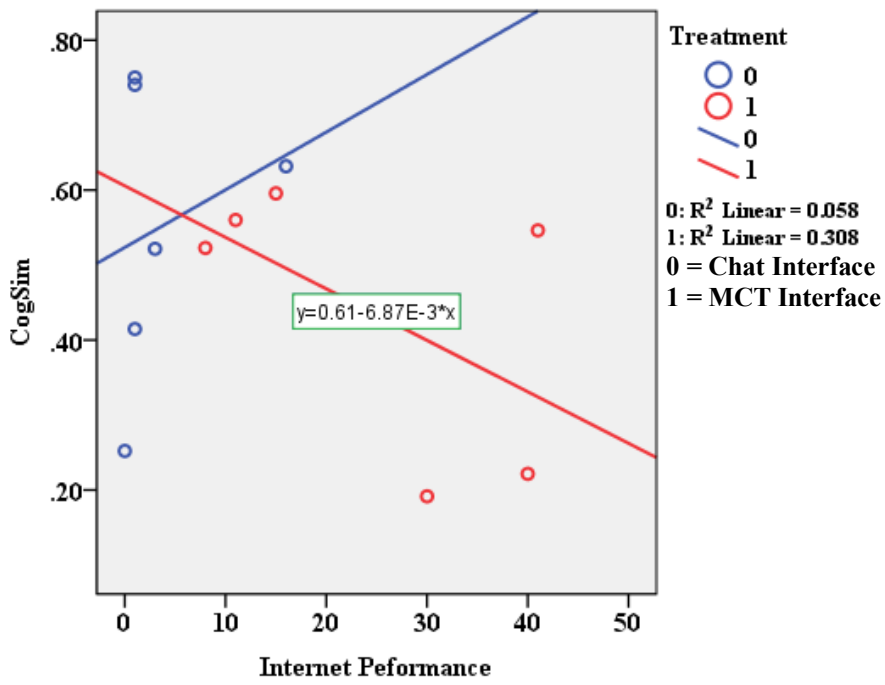


Figure 3. Effect of Internet Performance on Cognitive Similarity (CogSim)

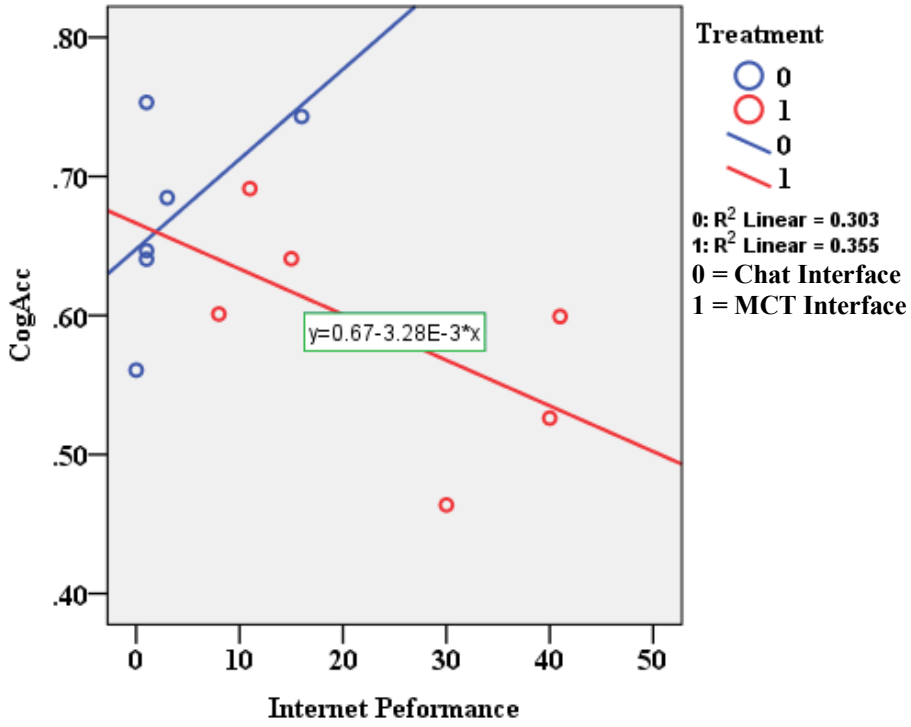


Figure 4. Effect of Internet Performance on Cognitive Accuracy (CogAcc)

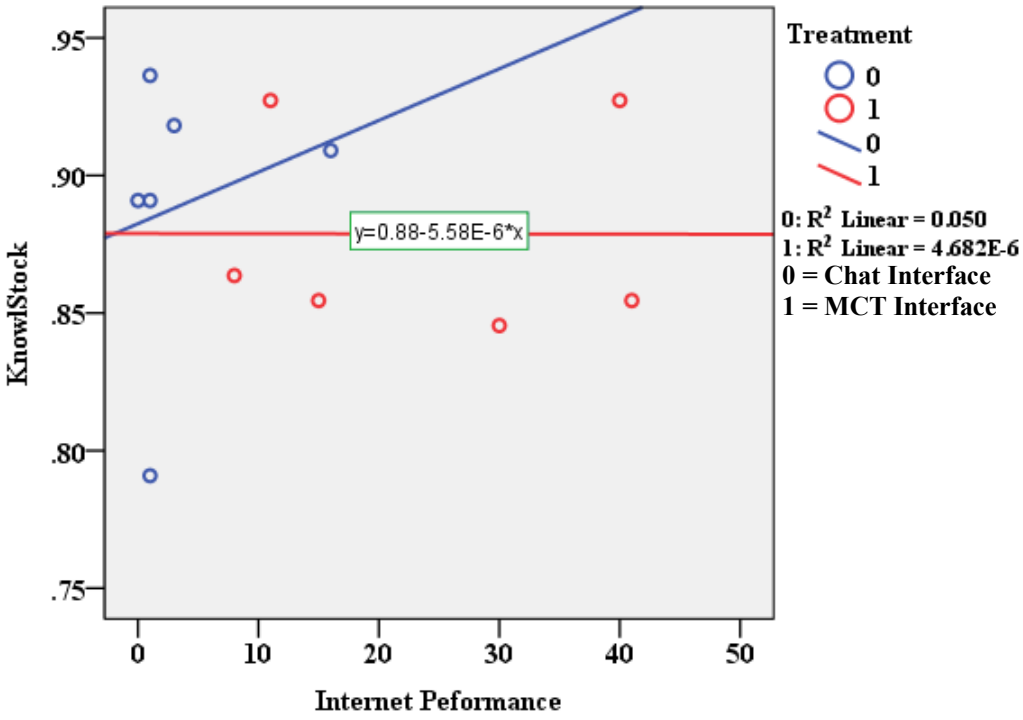


Figure 5. Effect of Internet Performance on Knowledge Stock (KnowlStock)

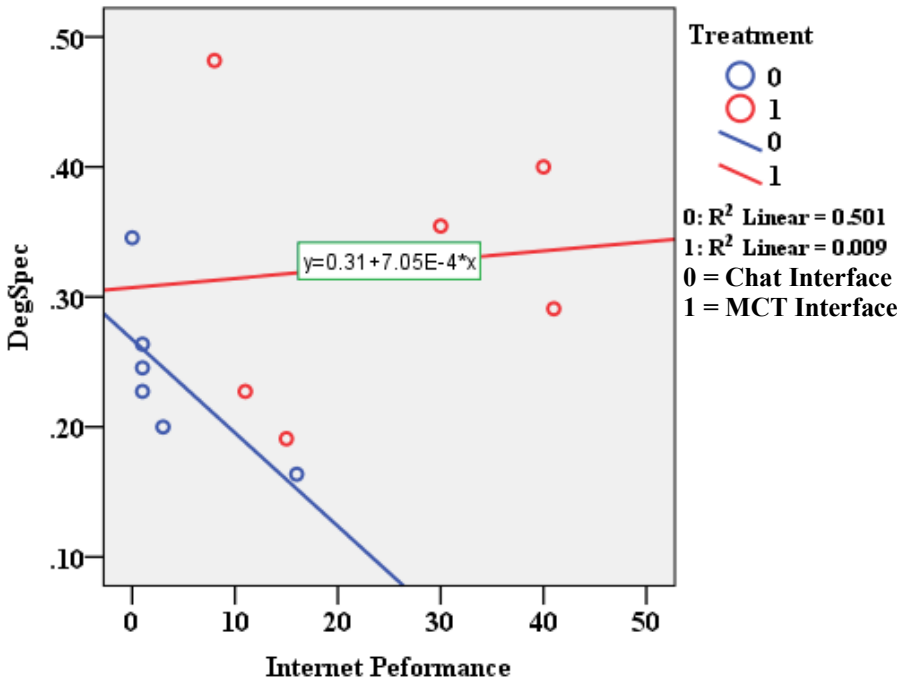


Figure 6. Effect of Internet Performance on Degree of Specialization (DegSpec)

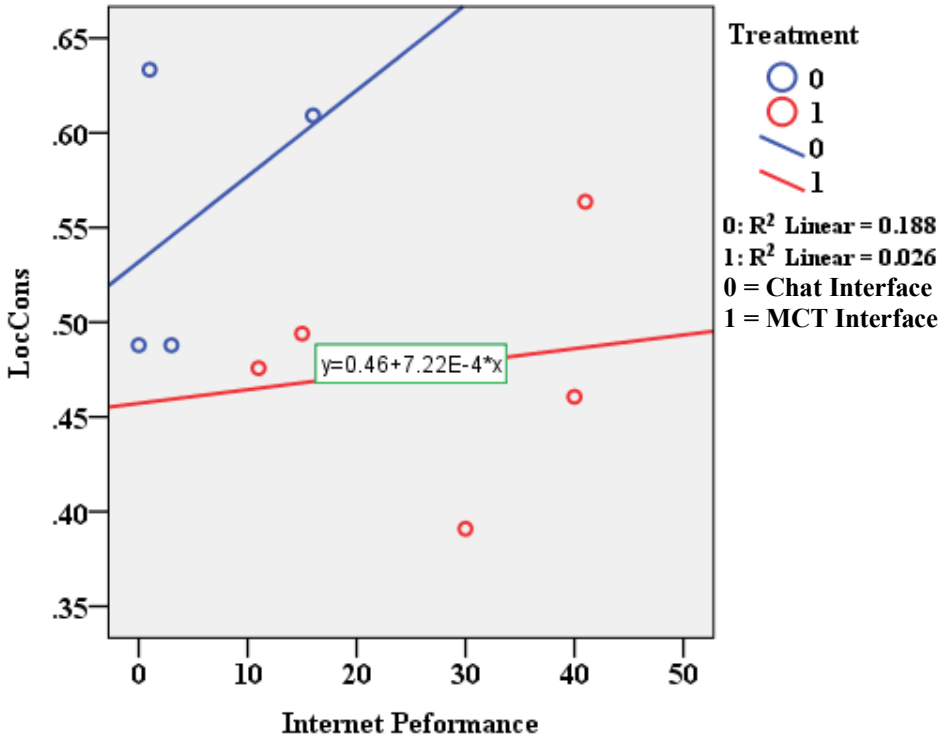


Figure 7. Effect of Internet Performance on Location Consensus (LocCons)

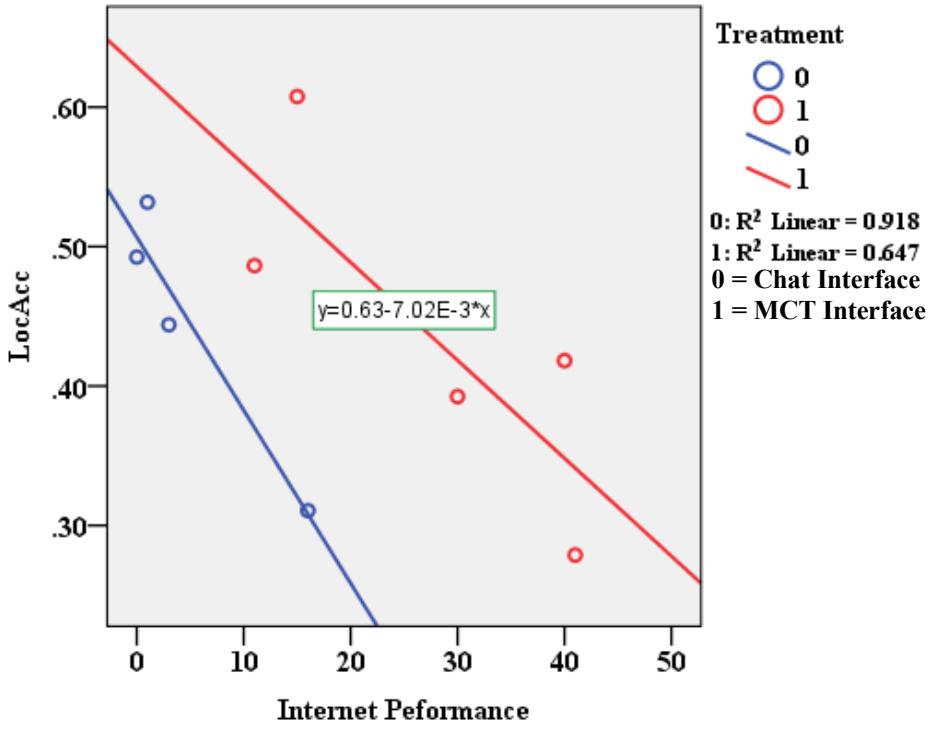


Figure 8. Effect of Internet Performance on Location Accuracy (LocAcc)

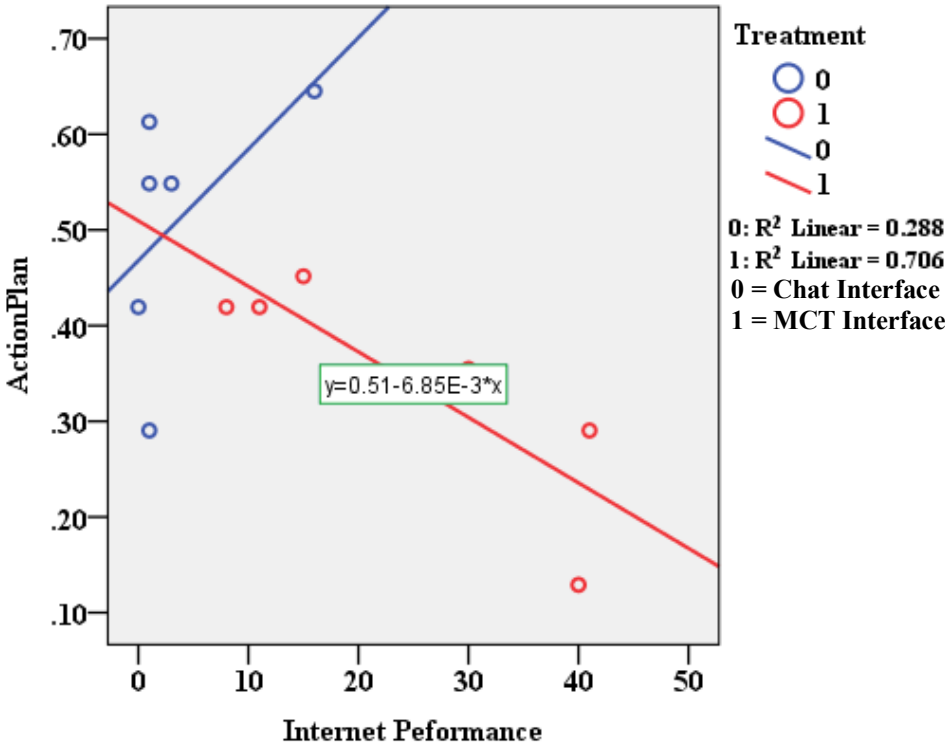


Figure 9. Effect of Internet Performance on Action Plan

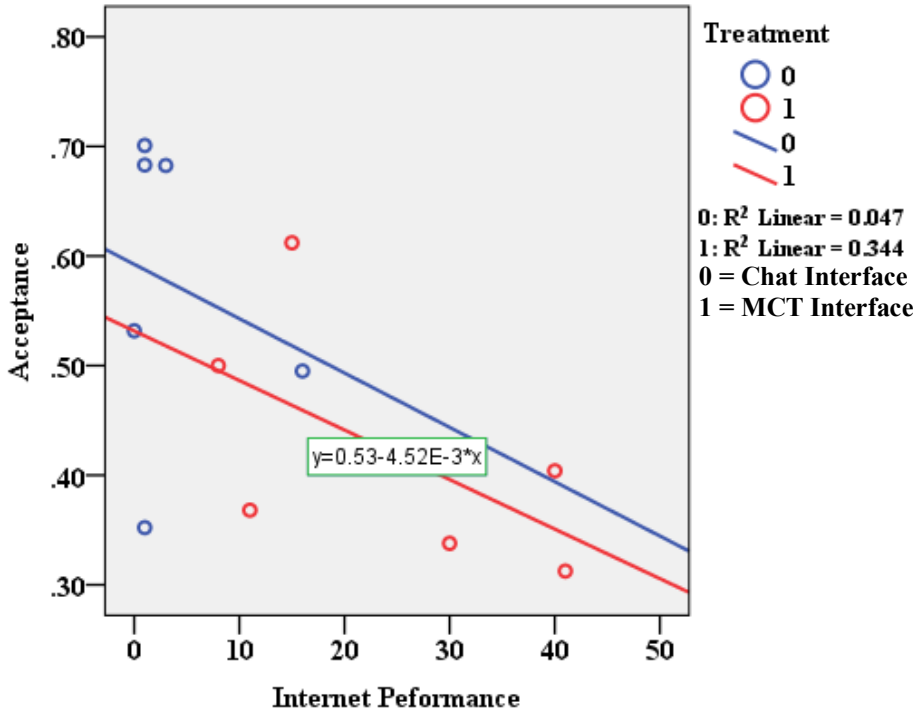


Figure 10. Effect of Internet Performance on Acceptance

These plots provide a picture of the influence a more supportive interface has on group cognition. As can be seen, the effects varied, depending both on the type of interface and on the performance of the Internet. The collaboration support interface is shown in red, and the chat-only interface in blue. In the area of information pooling to form group mental models, both CogSim and CogAcc were generally about the same for users of both the chat-only interface (Tr0) and the collaboration support interface (Tr1), but as the performance problems of the Internet increased, the CogSim and CogAcc of the Tr1 users degraded rapidly, while the CogSim and CogAcc of the Tr0 users seemed to actually improve slightly.

For transactive memory the results were more mixed. It can be seen from the plots that Internet performance problems had little effect on Tr1 users in regard to their knowledge stock (KnowlStock), degree of specialization (DegSpec), and location consensus (LocCon). By contrast, the Tr0 users seemed to actually improve in KnowlStock and LocCon as Internet performance problems increased, but their DegSpec decreased. Tr1 users were generally better at location accuracy (LocAcc), or knowing who had what information, than Tr0 users. As Internet performance problems increased, the LocAcc decreased for both the Tr1 users and the Tr0 users at about the same rate, so the Tr1 users remained better.

Finally, in the area of decision-making, the comprehensiveness of the group action plans (ActionPlan) was about equal for both Tr0 and Tr1 users. However, as Internet performance problems increased, the ActionPlan of the Tr1 users suffered, while the ActionPlan of the Tr0 users seemed to become better. Acceptance for both Tr0 and Tr1 users seemed to be entirely unaffected by the type of interface, and only weakly affected by Internet performance.

Based on the confounding effect that Internet performance problems clearly had on the test of interface treatments, it was necessary to control for this variable. Table 14 shows the results of ANCOVA run on each of the group cognition measures, examining the effect of the interface while controlling for Internet performance problems.

Table 14. *ANCOVA of Group Cognition by Treatment Controlled for Internet Performance*

Independent/Dependent	R^2 (Adj.)	*F*(d.f.)	*p*	Part Eta^2	Levene's Test	Homo Reg p
Treatment/CogSim	.17 (–.02)	0.91 (2, 9)	.428	.168	*F*=0.84	.366
Internet Perf	-	0.78 (1,9)	.400	.080	(1, 10)	
Treatment	-	0.01 (1,9)	.925	.001	*p*=.381	
Treatment/CogAcc	.32 (.17)	2.13 (2, 9)	.175	.321	*F*=0.12	.117
Internet Perf	-	0.72 (1, 9)	.418	.074	(1, 10)	
Treatment	-	0.54 (1, 9)	.482	.057	*p*=.737	
Treatment/KnowlStock	.02 (–.2)	0.10 (2, 9)	.910	.021	*F*=0.001	.644
Internet Perf	-	0.04 (1, 9)	.843	.005	(1,10)	
Treatment	-	0.18 (1, 9)	.685	.019	*p*=.975	
Treatment/DegSpec	.21 (.04)	1.21 (2,9)	.344	.211	*F*=3.08	.314
Internet Perf	-	0.03 (1,9)	.866	.003	(1, 10)	
Treatment	-	1.49 (1,9)	.255	.141	*p*=.110	
Treatment/LocCon	.32 (.10)	1.44 (2, 6)	.309	.324	*F*=0.56	.589
Internet Perf	-	0.35 (1, 6)	.578	.054	(1, 7)	
Treatment	-	2.28 (1, 6)	.182	.275	*p*=.478	
Treatment/LocAcc	.69 (.56)	6.65 (2,6)	.030	.689	*F*=3.46	.396
Internet Perf	-	13.26 (1,6)	.011	.689	(1, 7)	
Treatment	-	6.57 (1,6)	.043	.523	*p*=.105	
Treatment/ActionPlan	.43 (.30)	3.41 (2, 9)	.079	.431	*F*=2.48	.052
Internet Perf	-	1.41 (1, 9)	.266	.135	(1, 10)	
Treatment	-	0.66 (1, 9)	.438	.068	*p*=.146	
Treatment/Acceptance	.42 (.29)	3.20 (2, 9)	.089	.416	*F*=1.03	.967
Internet Perf	-	1.79 (1, 9)	.214	.166	(1, 10)	
Treatment	-	0.34 (1, 9)	.576	.036	*p*=.335	

Note. Homo Reg p = Probability that the homogeneity of the regression slopes is equal.

As can be seen from the ANCOVA results, no significant effect from the interface treatment was found for any group cognition variable except LocAcc, the transactive memory measure that indicates how well the group members know where knowledge is located. This indicates a finding that the collaboration support interface did not introduce enough cognitive load into the interaction to cause a significant negative effect on cognition.

It also indicates that there was at least one positive effect on group cognition, the significant effect on LocAcc. While the finding shows that 56-69% of the variance in LocAcc is predicted by the model, this includes effects from both the treatment and the Internet performance. Therefore, a linear regression analysis was run on this model to examine the coefficients (R^2 = .689, F (2, 6) = 6.647, p = .030). It was found that the interface treatment significantly predicted LocAcc (β = .863, p = .043), but so did Internet performance (β = –1.226, p = .011). The difference in the beta scores indicates that 59% of the effect was due to the Internet, rather than the interface. Therefore, the ultimate effect size for the interface was 23-29%, which is still bordering on what is considered a large effect (>25%).

As was noted in Chapter Three, these results could be questioned, based on the fact that the interface treatment and the Internet performance problems were not independent of each other. The collaboration support interface was more demanding of Internet bandwidth than the chat-only interface, so it was more likely to generate performance complaints. In fact, a linear regression analysis of the two variables indicates that the interface treatment predicted nearly 50% of the variation in Internet performance problems (R^2 = .497, F (1, 10) = 9.895, p = .010).

Because these test results indicate that the null hypothesis should be accepted that the interface type has little or no effect on the quality of the group cognition, the primary concern here is that the interaction between the independent variables has caused the null hypothesis to be accepted when it should have been rejected. Based on the graphics shown above, this does not appear to be the case. With the exception of LocAcc, the different treatment lines are very close together near the x-axis, where Internet problems are equal to zero. This confirms the non-significant statistical results when Internet performance is controlled.

Second Aim – Theory of Collaborative Information Sharing

The second aim of this study was to determine whether, as a forming group's shared data repository grows, the willingness of the group's members to contribute to the repository also grows. Therefore, changes in both repository size and sharing behavior over time were of interest. These could be examined because each session was divided into fixed tasks, which were performed in order during separate periods.

The participants were given a specific topic to work on during each of the first five periods, with the sixth period devoted to processing (or compiling) the information. Table 15 shows the topic for each of the first five periods.

Table 15. *Discussion Topic for Each of the Five Sections*

1	Get acquainted
2	The theme and venue you plan to use for the art auction.
3	Any enhancements that could raise more money.
4	Any local color you want included in the initial press announcement.
5	Any potential problems that our public relations office needs to handle, and any suggested solutions.

Independent Variables: The Size of the Data Repository

There were originally two possible independent variables that could be examined. These were as follows:

1. *Data1-5:* The amount of available new information in the data repository. This was obtained by counting the number of action comments for the period in question.
2. *CumData1-5:* The cumulative amount of available information in the data repository during each period. This was obtained by counting the number of action comments for the current period, and adding that total to the cumulative number from the previous period.

The assumption for this aim was that people would find working with the data repository to be more intrinsically motivating as the amount of data in it grew, leading to an increase in sharing behavior over the periods. This was not what we observed. Instead, an examination of the individual acts of sharing indicated that the motivation for sharing

was not the size of the repository, but the existence of contexts where sharing made a valuable contribution to the conversation. Based on this observation, the data was recompiled by act-of-sharing and two more independent variables were added:

3. *Context:* The situation that instigated the sharing behavior. There were only three contexts identified, and they were coded as follows: 1 = Spontaneous, with no known instigator, 2 = Called for by the current conversation, 3 = Called for by instructions from the interface.
4. *Apropos:* A condensed version of Context. It was coded as follows: 1 = Called for by the current conversation, 0 = Not called for by the current conversation. In the dataset aggregated by participant this added up to their total of Context 2 shares.

There was also a participant-level variable that was measured at the end of the trial, based on each participant's quiz scores. It was mentioned under Aim 1, because it serves as either a dependent variable or an independent variable, depending on what is being examined. It is defined as follows:

5. *DataPercept:* The participant's perceived overall size for the group's data repository. This was calculated by totaling the number of correct answers the participant got on the subset of questions that couldn't be answered from the private information for that participant's role. In other words, these were questions requiring answers that depended solely on information shared by other group members. This method of measurement insured that the participant drew from the shared repository, rather than the private cache of information.

Dependent Variable: Willingness to Share

There were three different ways to measure sharing behavior. These are described below:

1. *Share1-5:* The number of shares for a given period. This was measured by counting the instances of sharing (both formal and informal) during each period of the session.
2. *Shared:* The percentage of everything that a participant could have shared that actually was shared during the session. This was calculated by examining

whether each piece of private information the individual was given had been shared (either formally or informally) by the end of the session.

3. *ActsofSharing:* Number of individual posts a participant made that involved sharing information during the session. This was measured by totaling every individual instance of sharing (both formal and informal) across the entire session.

Table 16 shows the descriptive values measured for each of these variables for each participant. An outlier case was dropped to correct for skew in DataPercept. Data1-3 and Share1, 2, and 5 were also changed to logs of themselves to adjust for skew. Share3 and 4 had zero values changed to missing, because there weren't enough acts of sharing during these periods to balance the acts of not sharing. Even so, it was impossible to completely correct the skew in some of these variables, and the degrees of freedom were greatly reduced.

Table 16. *Cumulative Data Repository versus Information Sharing*

Descriptive Statistics

Variable	N	Min	Max	Mean	SE	SD	Skew	Z-Score
Data1	32	0	2	0.88	0.11	0.63	–0.55	–1.34
Data2	32	1	2	1.20	0.07	0.38	–0.39	–0.94
Data3	32	1	2	1.22	0.06	0.37	0.05	0.11
Data4	32	0	30	14.69	1.56	8.83	0.44	1.06
Data5	32	0	17	9.16	0.85	4.79	–0.09	–0.22
CumData1	32	0	35	14.06	2.26	12.80	0.33	0.81
CumData2	32	3	79	35.16	4.83	27.32	0.37	0.90
CumData3	32	12	147	57.28	7.79	44.05	0.75	1.81
CumData4	32	13	162	71.97	8.75	49.52	0.51	1.24
CumData5	32	13	177	81.13	9.44	53.41	0.46	1.11
Apropos	27	0	11	3.52	0.56	2.90	0.99	2.21
DataPercept	32	35	73	57.37	1.61	9.10	–0.30	–0.71
Share1	32	0	1	0.30	0.05	0.31	0.56	1.35
Share2	32	0	1	0.23	0.05	0.29	0.74	1.79

Descriptive Statistics								
Variable	N	Min	Max	Mean	SE	SD	Skew	Z-Score
Share3	13	1	6	2.23	0.50	1.79	1.66	2.70
Share4	10	1	3	1.70	0.21	0.67	0.43	0.63
Share5	32	0	1	0.18	0.04	0.23	0.94	2.26
Shared	32	0	1	0.51	0.05	0.29	–0.16	–0.39
ActsofSharing	31	0	14	4.90	0.64	3.58	0.70	1.66

Results of Analysis

Table 17 shows the results of linear regression analysis for these variables. As can be seen, data repository size only predicted variations in sharing behavior in the first and fifth periods of the trials. Data1 and 5 had significant results, as did CumData1 and 5, when compared with Share1 and 5. However, while Data1 predicted 48-50% of the variation in Share1, Data5 only predicted 13-16% of the variation in Share5. The cumulative figures were similar. CumData1 predicted 54-56% of the variation in Share1, while CumData5 predicted 18-20% of the variation in Share5. There were no significant relations between repository size and sharing in Periods 2, 3, or 4.

While sharing behavior didn't appear to be driven directly by the changing size of the group data repository, some portion of the final percentage shared was predicted by the ultimate perceived size of the data repository. The linear regression run on DataPercept and Shared (the measures tested at the end of the session) indicated that 12-15% of the variation in Shared was predicted by DataPercept. This leads into the consideration of intervening factors for this correlation in the next section.

Table 17. *Regression Analysis of Data versus Sharing*

Independent/Dependent	R^2 (Adj.)	F(d.f.)	p	Durbin-Watson
Data1/Share1	.500 (.484)	30.05 (1, 30)	<.001	2.35
Data2/Share2	.008 (–.025)	0.24 (1, 30)	,627	1.78
Data3/Shae3	.050 (–.036)	0.58 (1, 11)	.462	2.34
Data4/Share4	.001 (–.124)	0.01 (1, 8)	.943	1.71

Independent/Dependent	R^2 (Adj.)	F(d.f.)	p	Durbin-Watson
Data5/Share5	.158 (.130)	5.63 (1,30)	.024	1.64
CumData1/Share1	.556 (.541)	37.53 (1, 30)	<.001	2.54
CumData2/Share2	.008 (–.025)	0.25 (1, 30)	.622	1.77
CumData3/Share3	.056 (–.029)	0.66 (1, 11)	.435	2.40
CumData4/Share4	.043 (–.077)	0.36 (1,8)	.567	1.87
CumData5/Share5	.203 (.177)	7.65 (1, 30)	.010	1.53
DataPercept/Shared	.148 (.119)	5.20 (1, 30)	.030	2.05

Issue: Validation

From conversation analysis, it appeared that changes in sharing over the course of the trial were driven by the changing need for the information (i.e., its relevance), rather than by changes in the size of the data repository. As mentioned above, a review of the behavior yielded three different types of sharing contexts. Sometimes a participant shared information out of the blue, without any relation to the current conversation. These appeared to be attempts to broach a new subject, based on more global or visionary concerns that the participant had with the problem at hand. Much more frequent were sharing situations that arose directly from the current conversation, yielding information that was immediately relevant. A third type of sharing situation arose when information was elicited by the interface, itself.

Table 18 shows excerpts from a representative example of a sharing act in the context of the conversation as it developed. More examples can be found in Appendix H.

Table 18. *Examples of Sharing Acts in Context*

Act	Sect	Cntxt	Role Name	Message
-	3	2	Marley Winters	what about security for the celebrities and the event itself?
-	4	2	Taylor Jones	my security friends will assist
-	4	2	Marley Winters	Perhaps IMPD on site as well
-	4	2	Chandler Smythe	IMPD looped in would be a definite must

Act	Sect	Cntxt	Role Name	Message
-	5	2	Taylor Jones	yes. well most of the security guys are off duty IMPD anyway
-	5	2	Chandler Smythe	I can ask some of the local neighborhood association members to help patrol grounds too
58	5	2	Taylor Jones	Taylor Jones has shared the following item: 4. Email from two weeks ago: To Taylor Jones, Neighborhood CrimeWatch Captain I have been referred to you by your neighbor, Mel Brown. My firm, City Security, is available to provide security services to your neighborhood, either for temporary events, or in the form of ongoing patrols. In the case of the patrols, we give a substantial discount as more people within your neighborhood sign up for our service. These patrols are conducted in full cooperation with the city police department. In fact, most of our security workers are off-duty police officers. At the moment, the Brown residence is the only one within your neighborhood that is on our patrol list. Therefore, we would appreciate your consideration. If you have neighbors interested in joining, or if you know of events that could use a security presence, please pass our name along. Sincerely, Adam Kent, City Security
-	5	2	Chandler Smythe	sounds great Taylor
-	5	2	Taylor Jones	it all does

Context (Cntxt) 2 = Elicited by Current Conversation. See Table 15 for Section (Sect).

Summing the three different types of sharing (Context) yielded 40 instances of spontaneous sharing, 102 instances of sharing information relevant to the conversation at hand, and 19 instances of sharing initiated by a solicitation from the interface. This yields a ratio of sharing based on dynamic interactions with the building data repository versus any other type of sharing (Apropos) of 102:59.

The behavior of this new variable (Apropos) is examined in Table 19, which shows the ANOVA results with Apropos as the independent variable, and Shared as the dependent variable. It also shows the results with ActsofSharing as the dependent variable. As can be seen, being immediately relevant to the conversation at hand predicted 44-63% of the variation in whether the information was shared, and 87-92% of the variation in acts of sharing the information. (These dependent variables are not equivalent, because an item of information was frequently shared in several acts of sharing, rather than as a complete unit.)

Table 19. ANOVA of *Sharing in Context*

Independent/Dependent	R^2 (Adj.)	*F*(d.f.)	*p*	Levene's Test
Apropos/Shared	.634 (.440)	3.27 (9, 17)	.017	F=1.31 (9, 17), p=.301
Apropos/ActsofSharing	.917 (.874)	20.97 (9, 17)	<.001	F=1.05 (9, 17), p=.441

While distribution of this sharing behavior by circumstance is clear, the distribution across time is more difficult to characterize. Where a pattern could be discerned at all, it appeared to be bi-modal, with much sharing during the early periods, followed by a lull as the group discussed the previously shared information, followed by more targeted sharing, aimed at specific information gaps as the group's action plan emerged. See Figure 11.

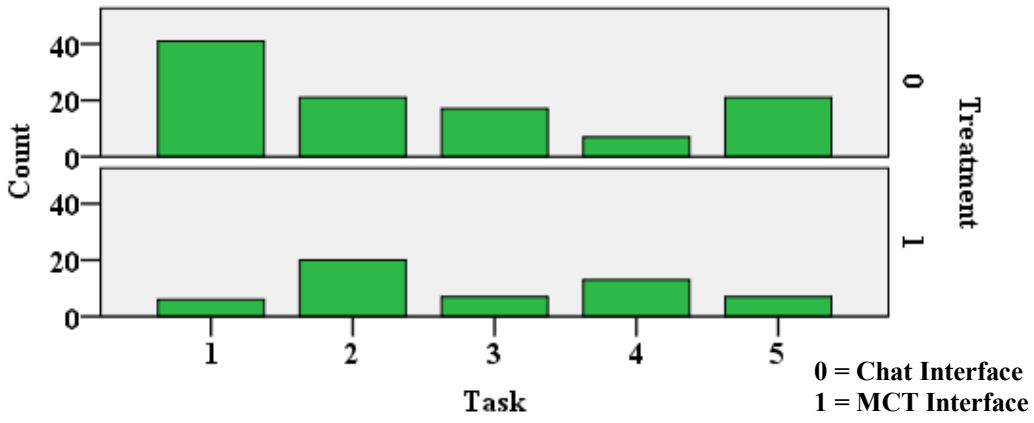


Figure 11. Distribution of Sharing Behavior across Time by Treatment

Third Aim – Characteristics of the Three Intervening Factors

The third aim of this study was to look at the intervening factors. Of specific interest was what effect the size of the group data repository had on commitment, motivation, and resistance to information bias. However, based on the findings for the second aim, we are now also interested in what effect relevance had on these intervening factors. The variables in question are described in Table 20.

Table 20. *Intervening Variables*

Descriptive Statistics								
Variable	N	Min	Max	Mean	SE	SD	Skew	Z-Score
Commitment	32	2	63	27.28	3.38	19.14	0.64	1.56
Motivation	29	0	1	0.61	0.02	0.13	0.41	0.95
Flow	29	0	1	0.55	0.02	0.12	0.58	1.34
Likes	32	0	1	0.70	0.06	0.36	–0.16	–0.38
Honesty	30	0	0	0.15	0.02	0.11	0.33	0.77
Trust	30	0	0	0.17	0.02	0.12	0.32	0.75

Independent Variables: Perceived Size of the Group's Data Repository and Relevance

The independent variables were both defined in the previous section, but are described again for clarity as follows:

1. *DataPercept:* As defined in the previous section, the participant's perceived overall size for the group's data repository was represented by the number of correct answers the participant got on the subset of questions that relied solely on information shared by other group members.
2. *Apropos:* As defined in the previous section, this represents the total number of sharing acts the individual made that were relevant to the current conversation at the moment they took place.

Dependent Variables: Commitment, Intrinsic Motivation, Information Bias

These dependent variables are all factors that are assumed to affect the sharing of information within the group. They are defined as follows:

1. *Commitment:* describes the level of dedication the participant demonstrated for the task at hand. This was measured by summing the total number of action comments by the individual for the entire session, and subtracting those comments that negotiated positions instead of adding new ideas.

There were three alternative indicators used for *intrinsic motivation*. They are as follows:

2. *Motivation:* describes the level of enthusiasm the participant claimed for the project on the post-test survey. This variable measured self-reported motivation based on the ratio of the summed Likert ratings from the Intrinsic Motivation Index.
3. *Flow:* describes the level of flow-state the individual experienced while working on the project. This was used as a supplement to self-reported motivation, because self-reports tend to be less sensitive as measures. Flow is also a self-reported measure, based on the ratio of the summed Likert ratings from the Flow State Scale. However, because it involves reports of the actual symptoms of high motivation (i.e. losing track of time), it is more sensitive than asking about motivation directly. (Most people don't like to report being unmotivated.)
4. *Likes:* behavioral evidence of reflective capacity and sense of self-efficacy. This was measured by summing the overall level of enthusiasm expressed during the project, (the number of *like* statements posted). Again, this was used as a supplement for the self-reported motivation measures. In theory, it was the most sensitive indicator of motivation, because it was a behavioral measure, rather than being a self-report.

The level of *information bias* was measured by finding the percentage of information that could be shared that actually was shared (defined as the variable *Shared* in the previous section) and comparing it with two possible sources of resistance to sharing. These are described as follows:

5. *Honesty:* sharing of information that is inconsistent with one's own preferences, goals, or desires.

6. *Trust:* sharing of information one believes to be inconsistent with the group's preferences, goals, or desires.

Because *resistance to sharing* was the measure of interest for both of these variables, it was obtained by weighting each act of sharing with the inverse of the appropriate "consistent with preference" rating, and then dividing by the number of resources shared. If every resource had been shared by that participant, and each act of sharing had been rated at 1 (the most inconsistent with preferences), the resistance score would be 100%. From there, any reduction in the number of items shared, or in the difficulty of sharing, reduced the score. It should be noted, however, that when only one item was shared, and the "consistent with preferences" rating was 5 (very consistent) this yielded a rating of 20%. One could only get a rating of 0% by not sharing at all.

The scores for sharing were originally intended to be controlled for the member's score on the Willingness to Self-Censor Scale (WTSC_Score), as discussed in Chapter Two. However, the version of this scale in the post-test survey turned out to have an unacceptably low Cronbach's Alpha, and the resulting score didn't demonstrate a high enough level of significance to justify including it the model.

In addition to examining the overall effects, the relative strengths of each factor were also of interest. These were examined by comparing the relative effects each variable had in the model.

Results of Analysis

Table 21 shows the results of linear regression analysis run on the various intervening variables. Some of the runs were conducted with only one independent variable, and some compared two.

Table 21. *Regression Results for the Intervening Variables*

Independent/Dependent	β	R^2 (Adj.)	*F(d.f.)*	*p*
DataPercept/Shared	.384 (p = .030)	.148 (.119)	5.20 (1, 30)	.030
DataPercept+Commitment/Shared		.172 (.115)	3.007 (2, 29)	.065
DataPercept	.303 (p = .123)			
Commitment	.176 (p = .365)			
DataPercept+Motivation/Shared		.181 (.118)	2.869 (2, 26)	.075

Independent/Dependent	β	R^2 (Adj.)	*F(d.f.)*	*p*
DataPercept	.438 (p = .025)			
Motivation	–.077 (p = .678)			
DataPercept+Flow/Shared		.175 (.112)	2.763 (2, 26)	.082
DataPercept	.417 (p = .036)			
Flow	.006 (p = .975)			
DataPercept+Likes/Shared		.333 (.286)	7.223 (2, 29)	.003
DataPercept	.178 (p = .299)			
Likes	.477 (p = .008)			
DataPercept+Honesty/Shared		.486 (.448)	12.775 (2, 27)	<.001
DataPercept	.166 (p = .264)			
Honesty	.626 (p = <.001)			
DataPercept+Trust/Shared		.418 (.375)	9.705 (2, 27)	.001
DataPercept	.143 (p = .381)			
Trust	.575 (p = .001)			
Apropos/Shared	.477 (p = .012)	.228 (.197)	7.366 (1, 25)	.012
Apropos +Commitment/Shared		.271 (.210)	4.461 (2, 24)	.023
Apropos	.555 (p = .006)			
Commitment	–.222 (p = .244)			
Apropos +Motivation/Shared		.286 (.221)	4.403 (2, 22)	.025
Apropos	.540 (p = .008)			
Motivation	–252 (p = .191)			
Apropos +Flow/Shared		.352 (.294)	5.988 (2, 22)	.008
Apropos	.662 (p = .002)			
Flow	–.400 (p = .051)			
Apropos +Likes/Shared		.285 (.226)	4.793 (2, 24)	.018
Apropos	.444 (p = .018)			
Likes	.243 (p = .176)			
Apropos +Honesty/Shared		.302 (.238)	4.752 (2, 22)	.019
Apropos	.365 (p = .055)			
Honesty	.357 (p = .060)			

Independent/Dependent	β	R^2 (Adj.)	*F(d.f.)*	*p*
Apropos +Trust/Shared		.339 (.279)	5.644 (2, 22)	.011
Apropos	.362 (p = .069)			
Trust	.332 (p = .094)			
DataPercept+Apropos/Shared		.260 (.198)	4.218 (2, 24)	.027
DataPercept	.208 (p = .315)			
Apropos	.373 (p = .078)			

Note. β compares model components. The other numbers describe the overall model.

The univariate models for DataPercept and Apropos show that they both had a moderate but significant effect on sharing. DataPercept predicts 12-15% of the variation in sharing, while Apropos predicts 20-23% of the variation in sharing. In theory, any variable that has an intervening effect on one of these relations should cause a decrease in the beta for the variable in question. For DataPercept, Commitment reduces the beta, but not to a significant amount. The intervening factors that cause significant reductions in the beta for DataPercept are Likes, Honesty, and Trust. Based on the amount by which they reduce the beta of DataPercept, Trust seems to have the greatest effect, followed by Honesty and Likes. This indicates that the effect of the perceived size of the group data repository on sharing behavior is caused, in part, by the positive effect it has on trust, honesty, and enthusiasm.

The effect of these intervening variables on the relation between sharing and relevance is not as large. Likes creates a small, but significant, decrease in the beta for Apropos, while Honesty and Trust create larger decreases, but their betas don't achieve a level of significance. This indicates that the effect relevance has on sharing behavior has at least a small component that is explained by the increase in enthusiasm it causes. However, whether relevance affects sharing behavior by increasing honesty and trust is less clear.

It is also possible that Apropos has an intervening effect on the relation between DataPercept and Sharing. Adding Apropos to the model did reduce the beta for DataPercept. This could indicate that the size of the group data repository affects sharing

behavior by increasing the relevant contexts for sharing. However, the beta for Apropos did not achieve a level of significance that would conclusively demonstrate this.

Fourth Aim – Characteristics of the Emergent Data Structure

The fourth aim of this study was to examine the resulting artifacts. In particular, the abstract categories that emerged during the model-building process were of interest. The following tables show examples of the various artifacts the participants created. Rather than run statistical analysis, each artifact's usage was simply described.

Each choice is color-coded based on the role its originator was playing during the session. Those that are red, were contributed by the participant who played Chandler Smythe, the green ones were contributed by the person assigned to the Marley Winters role, and those that are blue were contributed by the person playing Taylor Jones.

As discussed elsewhere, a step-by-step development process was facilitated by MCT. It involved having the participants first develop *thought cards* about discussion topics by entering a topic title, and conducting a discussion of the topic among the participants. They then identified relations among the defined topics by entering a relation title and also the titles of two of the topics linked by the relation. Following this, they chose which of the developed relations they wanted to use as categories for sorting. Finally, they sorted the topics into a matrix, where the categories chosen by the participants were listed down the side, and the four types of mental model were listed across the columns.

Relations and Categories

Table 22 shows one session's relations and categories, as identified by the participants during a session that used MCT. It shows each relation title along with the topic titles it links. It also shows who suggested each topic, who defined the relation linking the topics, whether that topic was chosen to be a category, and who chose it. A complete listing of the study's relations and categories can be found in Appendix J.

Table 22. *Relations and Categories*

Session	Definition	Relations	Categories
4	Title	Theme	
	Topic A	Theme	

Session	Definition	Relations	Categories
	Topic B	Indy 500 Theme	
	Title	Potential Bad Publicity	Potential Bad Publicity
	Topic A	Neighbor Complaint	
	Topic B	Gangs	
	Title	Theme Suggestions	Theme Suggestions
	Topic A	Indy 500 Theme	
	Topic B	The Race Towards Peace	
	Title	Solicit volunteers for event	
	Topic A	Solicit volunteers to help	
	Topic B	Engage Community Advocates	
	Title	Color Scheme	
	Topic A	Color scheme	
	Topic B	Color Scheme	
	Title	Volunteers	Volunteers
	Topic A	Engage Community Advocates	
	Topic B	Solicit volunteers to help	
	Title	Entertainment	Entertainment
	Topic A	Invite a celebrity	
	Topic B	Entertainers	
	Title	Funding Sources	Funding Sources
	Topic A	Hold a raffle	
	Topic B	Raffles	
	Title	Additional money makers	Additional money makers
	Topic A	Get some more expensive items for a silent auction	
	Topic B	Raffles	

As can be seen from Table 22, the resulting categories were situated, with only a few high-level abstractions. It can also be seen (by close examination of the mixture of colors) that contributions at the topic-step generally came from more of the participants than contributions at the category-step. An examination of the surrounding conversation indicated that differences in computer capabilities, and differences in comfort with the interface generally resulted in one participant assuming a leadership role in completing the more abstract categorization and sorting. As was discussed in Chapter Two, each contributor did appear to initially favor information he or she had submitted, but the interface also allowed and encouraged use of information submitted by others.

Thoughts on Topics

Another area of interest was the use of the *thought cards* by participants. This mechanism was intended to support dialogue threads that were presented by topic, while also being simultaneously inserted into the temporal conversation thread. Conversation analysis was conducted to determine if such a method encourages the participants to share their thoughts. Table 23 shows an example of the title and conversation stream for several topics. A complete listing of the study's thought cards can be found in Appendix K.

Table 23. *Thought Cards Submitted*

Session	Thought Topic	Thought Discussion
4	Engage Youth	Try to engage the young people in the crime emails to help clean up the old gymnasium building
	Let's host the auction at a fancy location.	Maybe we can host the auction somewhere classy.
	Indy 500 Theme	I liked your suggestion of an Indy 500 Theme unless you think it's been done to death
		Love this theme idea. It's special to Indy and appeals to many.
	Solicit volunteers to help	We could solicit community volunteers to help with the auction and the clean up of the community center
	IMA	Use an art museum to host the event.

Session	Thought Topic	Thought Discussion
	Engage Community Advocates	Invite community leaders who are advocates in the neighborhood and who enjoy working with the youth. I love this idea of inviting these leaders.
	Neighbor Complaint	So, reading between the lines, the neighbor who won the art contest was possibly involved in the Young Devils gang--this will definitely have the potential to be a PR problem

As can be seen from Table 23, the thought cards generated many ideas, but much less discussion about them. Only a few people seemed comfortable contributing to someone else's card, and there was only one occurrence of a follow-up response to a second author contribution.

The Sorting Matrix

A final area of interest was the sorting matrix. At the point where participants were encouraged to use this particular artifact, they had already been stepped through increasing levels of abstraction. The sorting matrix was the most abstract of all. It initially presented all of the thought cards to be sorted, along with a matrix that had participant-created (and chosen) categories down the side, and the types of mental models (taskwork, strategic, situation, and teamwork) across the top. Participants were encouraged to sort the thought cards into categories, and by type of mental model. Once the sorting was complete, the participants were encouraged to open each cell, and elaborate on the contents. The order of the user-created categories could also be changed in the matrix.

Examination of the artifacts, rather than compiled statistics, was the goal of this particular aim. However, of interest for this section were the number of group members who were willing to use this potentially intimidating artifact, whether they used the various types of mental models in the way expected, and the extent to which each cell's contents had been expanded upon in an organized and useful manner. Table 24 shows an example extracted from a sorting matrix. A complete compilation of the study's sorting matrices can be found in Appendix L.

Table 24. *Final Sorting Matrix*

Category	Situation	Strategy	Taskwork	Teamwork
Potential Bad Publicity	Gangs It's also possible that if word gets out about the gangs, that people won't want to attend an event held in that area Storm alert I received an email about a potential storm heading our way. Very windy. Neighbor Complaint So, reading between the lines, the neighbor who won the art contest was possibly involved in the Young Devils gang--this will definitely have the potential to be a PR problem		Contact PR friend to see if he will handle PR for us Contact security guy for assistance	
Funding Sources		Raffles We could ask locate businesses to donate goods/products that we can raffle throughout the auction. Love this idea! Get some more expensive items for a silent auction We could solicit businesses for donations for a silent auction.	Start soliciting donations from local businesses/wealthy people	

Category	Situation	Strategy	Taskwork	Teamwork
Theme Suggestions		The Race Towards Peace Perhaps we could play on words to incorporate the Indy 500 theme Indy 500 Theme I liked your suggestion of an Indy 500 Theme unless you think it's been done to death	Do we need to get permission from Indianapolis Speedway to use the Logo/theme of Indy 500? Check with someone.	

As is seen from the example in Table 24, most entries were done by a single person on each team. However, there were cases of two or even three participants contributing. Many of the entries had been edited for better readability, and most (but not all) of the resulting matrices seemed to correctly refer to externally controlled situations in the situation model column, general approaches to problems in the strategic model column, and more specific tasks in the taskwork model column. The teamwork model column was not used much, and what use there was didn't often correspond to information about teammates. However, these groups were only about two hours old at that point, so it was early to expect much information on teamwork to have evolved.

CHAPTER FIVE: DISCUSSION

Introduction

The goals of this research have always been practical. The world needs some way to conduct spontaneous, large-scale, intelligent conversations as hastily-formed networks of people attempt to collaborate across the Internet (Denning, 2006, 2009). The traditional, chat-based interfaces, while powerful in their simplicity, present problems when scaled to large size and used over extended periods. In addition to the difficulty in simply keeping track of what has been said or decided, both temporally and by topic (Darie & Brinzarea, 2006; Ramachandran et al., 2009), it is also difficult to keep the conversation grounded in reality due to biases in the way information is shared (Brodbeck et al., 2007; Wittenbaum et al., 2004). Therefore, a search is underway to find interface methods that can address these issues.

This search is taking place on two levels. Obviously, hands-on experience is needed to see if the proposed interface elements are usable by their targeted clients. However, a deeper understanding of the phenomena involved is also necessary. In addition to its immediate impact on MCT, development of a theoretical comprehension concerning the sharing of information has the potential for a much wider impact on future interface development (Wildman et al., 2011; Wittenbaum et al., 2004).

The approach MCT takes to the need for scalability is a modular one, the idea being to develop a basic platform that supports a small group, and then scale the conversation by coordinating among groups. Given the importance of its planned role in the wider conversation, it is critical that the basic group support platform meets the cognitive and collaborative needs of the group as well as possible. To this end, the currently proposed platform draws from research in collaboration engineering, using a series of small, focused interactions, known as thinkLets, to guide group members though a cognitive development cycle (Briggs et al., 2003). The specific aims of the study, therefore, were to see how well the various pieces of the interface performed, and to gain insight, on a theoretical level, on the effect the interface had on the sharing of information.

The theory proposed for the current study was that an interface supporting better collaborative cognition across a group (by facilitating the formation of collective mental

models and transactive memory structure) will increase the amount of information that the group's members share with each other because:

1. Each member will develop a greater sense of strategic commitment to the resulting knowledge structure as its acuity grows,
2. Each member will become more intrinsically motivated to contribute information to it as the member's reflective capacity and sense of efficacy is increased by access to the knowledge within it, and
3. Each member's resistance to sharing information will be reduced by the interface's initial effect on information bias and by the resulting increase in expertise among the group members as the transactive memory structure grows.

While all of these effects had been anecdotally observed in the past, they had never been examined together in a detailed field study (Wildman et al., 2011). So, it was hoped that undertaking such a study would yield benefits both in the area of guidance for further development of collaboration support tools, and in the area of developing theory.

For the sake of clarity, the findings of this study are summarized in Table 25, with pointers to the subsections in Chapter Four where they are described.

Table 25. *Findings Summary*

Findings	Significance	Subsection
Dynamics of Group Cognition 1. Cognitive similarity predicted 65-68% of the variation in cognitive accuracy. 2. Cognitive accuracy predicted 65-68% of the variation in cognitive similarity. 3. Cognitive accuracy predicted 95-96% of the variation in	Most of the elements of group cognition are interrelated, and have large effects on each other. In fact, probably all of them are interrelated, but the context of the study was too limited to	First Aim Results of Analysis

Findings	Significance	Subsection
perceived size of the data repository	demonstrate every relation.	
4. Cognitive similarity predicted only 75-78% of the variation in data repository size.	The mental model elements of cognitive similarity and accuracy dominated the group cognition observed in this study. This was probably because the study's short duration and limited context made information pooling the predominant activity. By contrast, transactive memory was not well developed in this study. As a result, the transactive memory elements of knowledge stock, degree of specialization, location consensus, and location accuracy played little observable role in the development of the group action plans. This understanding of the dynamics of the group cognition while using the interface will help to	
5. Cognitive accuracy predicted 54-73% of the variation in the completeness of the group action plan		
6. Cognitive similarity didn't significantly predict the action plan, though it did predict 26-33% of the variation in acceptance.		
7. Cognitive similarity and cognitive accuracy both predicted about 50% of the variation in flow state.		
8. Cognitive similarity predicted 26-33% of the variation in self-reported motivation.		
9. Cognitive accuracy predicted 38-44% of the variation in commitment.		
10. The completeness of the action plan predicted 49-54% of the variation in cognitive accuracy.		
11. The degree of specialization inversely predicted 44-49% of		

Findings	Significance	Subsection
the variation in cognitive accuracy. 12. The size of the group data repository predicted 41-46% of the variation in completeness of the group action plan. 13. The level of motivation predicted 67-70% of the level of acceptance. 14. The level of commitment predicted 39-44% of the level of acceptance.	identify which application features are important in supporting the group thought process. It will also help to identify design elements needed for future studies.	
Effect of the Interface on Group Cognition 1. No significant effect from the interface treatment was found for any group cognition variable except location accuracy, a transactive memory measure that indicates how well the group members know where knowledge is located. 2. Therefore, the collaboration support interface did not introduce enough cognitive load to cause a significant negative effect on group cognition. 3. There was one positive effect observed on group cognition.	Because the interface has passed the cognitive load test, it is ready to move to the next development level. The existing interaction elements are at least adequate. The first indication has been found of the potential the interface has to actually enhance group cognition, rather than just trying not to damage it. Because the only demonstrated effect the interface had on group cognition was on	Fist Aim Results of Analysis

Findings	Significance	Subsection
The interface predicted 23-29% of the variation in location accuracy, which borders on a large effect size (>25%).	transactive memory, future tests of the interface should specifically aim to study the transactive memory elements.	
Dynamics of Sharing Behavior 1. Data repository size only predicted variations in sharing behavior in the first and fifth periods of the trials. The prediction for the first period was much stronger (around 50%) than the prediction for the fifth period (20% or less). There were no significant correlations found between repository size and sharing in Periods 2, 3, or 4. 2. The measures tested at the end of the session indicated that 12-15% of the variation in sharing was predicted by data repository size. 3. Changes in sharing over the course of the trial were driven by the changing need for the information, rather than by changes in the size of the data repository.	The reward for giving people something they need was found to be a stronger motivator than interest in the group's data repository. Knowing this will help to identify which application features are important in supporting sharing.	Second Aim Results of Analysis

Findings	Significance	Subsection
4. Being immediately relevant to the conversation at hand predicted 44-63% of the variation in whether the information was shared, and 87-92% of the variation in acts of sharing the information.		
Effect of Mediators on Sharing Behavior 1. The effect of group data repository size on sharing behavior is caused, in part, by the positive effect it has on trust, honesty, and enthusiasm, in that order of importance. 2. The positive effect of data repository size on commitment did not appear to have a significant intervening effect on sharing. 3. Self-reported motivation and flow state did not demonstrate any intervening effect on sharing. 4. The effect of commitment, motivation, and resistance to bias on the relation between relevance and sharing is not as	This understanding of the intervening variables involved in sharing behavior, and the effect of both relevance and data repository size on the process, will help to identify which application features are important in supporting sharing. In particular, it is helpful to know that relevance does not have as strong a relation to the intervening variables as that of data repository size. While relevance clearly has a stronger effect on sharing than data repository size has, it	Third Aim Results of Analysis

Findings	Significance	Subsection
strong as that observed for data repository size. 5. The effect relevance has on sharing behavior has at least a small component that is explained by the increase in enthusiasm that relevance causes. 6. Whether relevance affects sharing behavior by increasing honesty and trust is less clear. 7. The size of the group data repository could affect sharing behavior by increasing the relevant contexts for sharing. But the results did not achieve a level of significance that would conclusively demonstrate this.	seems to act primarily through a different mechanism. This suggests a topic for future study.	
Effect of the Categorization thinkLet 1. The categories developed by the groups were highly situated, containing only a few high-level abstractions. 2. Contributions at the topic-step generally came from more of the participants than contributions at the category-step.	The categorization feature was demonstrated to be adequate for its intended purpose. It also demonstrated the need for categories to be user-defined, rather than rigid and predefined.	Fourth Aim Relations and Categories

Findings	Significance	Subsection
3. Differences in computer capabilities and comfort with the interface generally resulted in one participant assuming a leadership role in completing the categorization and sorting. 4. Each contributor initially favored information he or she had submitted. 5. The interface successfully encouraged use of information submitted by others.		
Effect of the Topic Generation thinkLet 1. The thought cards generated many ideas, but much less discussion about them. 2. Only a few people seemed comfortable contributing to someone else's card. 3. There was only one occurrence of a follow-up response to a second author contribution.	The topic generation feature performed adequately. However, it did not generate as much targeted discussion as envisioned. More incentives to contribute to each other's thought cards may be required.	Fourth Aim Thoughts on Topics
Effect of the Matrix-Sort thinkLet 1. Most sorting matrix entries were done by a single person on each team. However, there were cases of two or even three participants contributing.	The matrix sort feature worked moderately well. The fact that most groups were able to sort by mental model type indicates that these	Fourth Aim The Sorting Matrix

Findings	Significance	Subsection
2. Many of the sorting matrix entries had been edited for better readability. 3. Most of the matrices were correctly sorted by mental model types as follows: a. Externally controlled situations were placed in the situation model column. b. General approaches to problems were placed in the strategic model column. c. More specific tasks were placed in the taskwork model column. d. The teamwork model column was not correctly used, but it was too early for information on teamwork to have evolved.	categories can be used to organize collaboration across groups. Whereas the situated nature of user-defined categories makes them unsuitable for organization across groups.	

Answers to the Research Questions

Does the interface support better collaborative cognition?

For the first aim, a detailed, item by item examination of the effect of the interface on measures of collaborative cognition revealed that under perfect conditions the MCT interface performed as well as the chat-only interface in most areas, and noticeably better in its users' ability to identify who had which information. So, the short answer to this

research question is yes. However, greater insight into this question was gained by running the study over the Internet, using typical host company servers. This was important because the general goal of the research was to examine what factors would affect behavior in the field. As a result, it became clear that the performance of the MCT interface was differentially impacted by how well the Internet was running during its use.

It was always expected that the MCT interface would impose a greater cognitive load than the chat-only interface, given that MCT groups were forced to learn complex new functions on the fly, while the chat-only groups got to use familiar ones. This is not just a temporary problem. Use of the MCT interface will always require additional analytical thinking. If the tool is to be successful, it must make up for the added cognitive load of its operation by reducing the cognitive load of the conversation it supports as it helps its users organize and analyze better.

It is encouraging that this appears to be happening under ideal conditions. What is disturbing, however, is that MCT groups were much more dramatically impacted by the behavior of the Internet than the chat-only groups were. The additional cognitive load that a balky Internet connection imposes on the conversation may swamp any reduction in cognitive load from the tool. This is important information to have while developing such interfaces. Clearly, MCT must be made more robust under these conditions.

Does increasing the size of the shared data repository increase the amount of information shared?

Based on measurements taken at the end of the session, there was an observed positive linear relation between the perceived size of the group's data repository (based on correctly answered questions about it) and the amount of information shared. From analysis of the conversation surrounding each act of sharing, it was clear that, as the individuals realized the relevance of the private information they had, they became more likely to share it. Acts of sharing as a response to situated discussion outnumbered both spontaneous acts, and acts that responded to solicitation from the interface, by nearly two to one (102 to 59). This implies that, as such discussions add to the data repository, the amount of sharing should grow.

That said, however, there wasn't a demonstrated linear correspondence between the cumulative length of the discussion (the size of the data repository) and the amount of

sharing at any given point, except during the initial and final stages. Instead, sharing seemed to follow a somewhat bimodal pattern, with much initial sharing during the get-acquainted period, followed by a lull as the participants processed what had already been shared, followed by more targeted sharing aimed at filling in specific information gaps as the plan of action was developed.

Therefore, experimental results gave a positive answer to this research question overall, but the process of sharing was clearly more complex than the question suggests. When directly comparing the respective impacts on sharing, it was clear that the impact of relevance on sharing is much greater than the impact of the data repository size.

Does the group member experience greater commitment, increased motivation, and reduced resistance to sharing, based on the size of the data structure?

This question sought to determine whether these variables were truly intervening factors in the relation between the size of the data structure and the amount of information shared (as described in the second research question). Regression analysis examined the reduction in impact that data repository size had on sharing as the impact from each of these other factors was explained. It indicated that the increasing size of the group data repository does increase motivation (as measured by observed demonstrations of enthusiasm) and reduce resistance to sharing (as measured by increased honesty and trust). In fact, it indicates that data repository size impacts sharing by increasing trust, increasing honesty, and increasing enthusiasm, in that order of importance. The effect of commitment on the relation between repository size and sharing is not as clear, as it did not rise to the level of significance.

The other two indicators of motivation, self-reported flow state, and self-reported motivation did not demonstrate any intervening effect on the relation between repository size and sharing. This followed the general pattern that the greatest insights came from observed behavior, and quizzing for remembered information, rather than gathering self-reports. This has also been documented elsewhere, with correlations between self-reports and behavioral indices of the same dimensions being typically around 0.4 ("Intrinsic Motivation Inventory," 2011).

In sum, therefore, the answer to this research question for the motivation and information bias portions is yes, but the answer for commitment is not clear.

What does the emergent data structure look like?

Prior work had shown that the standard abstract categories defined in the literature (events, goals, tasks, roles, actors, and resources) were too rigid to meet the users' cognitive development needs (Newlon, 2008; van der Veer & van Welie, 2000). However, an understanding of participants' common abstract data structures will eventually be necessary for design of MCT's business logic and its database of screen components. By examining the categories created and chosen by the participants using the collaboration-support interface, it was hoped that insights would be gained that would help increase the flexibility of MCT's modeling support.

In addition, there haven't been many examples of studies that use thinkLets across the Internet, so the data structure that emerged from use of several well-known thinkLets (as well as one newly invented one) seemed likely to be of general value (Briggs & De Vreede, 2009; de Vreede et al., 2009; de Vreede et al., 2006; Kamal et al., 2007; Kolfschoten & de Vreede, 2009; Newlon et al., 2009).

The experimental results indicate that use of an adapted version of a well-known brainstorming thinkLet led to the generation of many new ideas, though a less than expected amount of discussion about them. Apparently, the platform must do more to break down the territoriality that people have about their own ideas to generate a wider-ranging discussion of them.

The relation and category-building thinkLets seemed to work well, and could be seen to encourage group members to reach beyond their own contributions in developing a picture of the problem, thus resisting information bias. Examination of the developed categories revealed that they were highly situated in nature, rather than being based on abstract concepts. This leads to the conclusion that user-developed categories are internally important to the group, but will be much less useful as organizational mechanisms in inter-group settings.

Finally, the new matrix-sort thinkLet worked better than expected, with at least one group member willing to undertake it in each session.[5] Most of the groups managed to produce intelligible entries, and most of them also successfully segregated the

[5] One exception to this was that the final MCT-based group experienced an Internet lock-up during the category formation stage and therefore had no matrix to use.

information into the expected mental model categories. This implies that MCT can be organized across groups based on mental model types, while a mechanism to allow users to define their own categories will give them the flexibility they require. It also implies that thinkLets can be successfully implemented in an Internet setting.

Unexpected insight

The most unexpected insight to emerge from this study resulted from the various problems encountered during its course. These included both problems with scheduling sessions, and problems with Internet performance on busier nights. Upon reflection, it was clear that most of these problems were either caused by, or exacerbated by, the necessity for synchronous action of the group.

The power of the Internet has always been its asynchronous nature, so this should have been expected. However, the history of Collaboration Engineering was based on people who were meeting face-to-face. Apparently, the requirement for synchronous action has carried over from that time.

So, the biggest potential game-changer to come from this study is the idea that thinkLets need to be adapted to become asynchronous if they are to be successful in an Internet environment. This will certainly change the future direction of development for this tool.

Consideration of Findings in the Context of Current Knowledge

As discussed in Chapter Two, the individual constructs of group knowledge are well known, but more research is needed to determine what processes are influenced by the group's knowledge, and how this affects performance (Wildman et al., 2011). In particular, it is not a foregone conclusion that group members will share information they have with their group (Brodbeck et al., 2007; Wittenbaum et al., 2004).

Prior research on the Mega-Collaboration concept has indicated that the incorporation of information from collaborators into a group mental model results in a dramatic increase in structure as the negotiated content grows (Newlon, 2008). This process of structural elaboration can be observed not only in task work information but also in the teamwork behaviors, such as emergent leadership and specialization (Newlon et al., 2009). This gives rise to the possibility that the increase in the content and structure

of the group mental model might be a motivation in itself. If so, it could potentially be used to overcome this resistance to sharing.

It was hoped that examination of the group members' interaction with the group's mental model, as represented by this complex data structure, would offer insight into the underlying mental process of the group. The ability of the interface to support formation of a dynamic understanding of the situation faced by the group should have, and did, affect this interaction in measurable ways.

In theory, this ability should have been facilitated by a tool that helps the group member link similar concepts to higher-level abstractions (Newlon et al., 2009; Pfaff et al., 2010). It could be seen that the increased supportiveness of the tool on nights when the Internet was running well resulted in dramatically better group cognition than on nights when the Internet was performing poorly. MCT matched or exceeded the chat-only interface on those nights. However, the learning effects of the new interface made it difficult to determine how much better its performance was, compared with that of the more familiar chat interface. It would be interesting to do a side-by-side comparison with groups that are equally experienced with their respective interfaces, and also to look at the effects of different information loads and information distributions.

While there was an observable process of information pooling and cognitive consensus, specialization and transmission of information to the appropriate expert was observed only in developing expertise with components of the new tool. Probably an experiment of longer than two hours would have been needed to see much transactive memory development. To compensate for the short time frame, the study attempted to simulate a pre-existing transactive memory structure by giving each role its own area of specialization, along with a specialized cache of private information. This made it possible to test the group cognition on accurately knowing who had what information.

Changes in the intrinsic motivation to contribute to (and use) the information in the shared data repository were also measurable.[6] One major result of this study was the discovery that, while the increasing structure and content of the data repository did seem to be a source of motivation, it was not the strongest of the motivators when it came to

[6] However, it was necessary to employ a performance-based indicator of motivation, because the self-report measures were not sensitive enough.

sharing information. The strongest motivator was relevance, or the reward received when giving someone a much-needed piece of knowledge.

All in all, these findings will undoubtedly be most useful in the future development track for this particular tool. Success of the matrix-sort feature provides a new structural backbone for organization of the interface, based on mental model types. Success of the category-development thinkLet sequence provides a new way to create situated data structures. The insight on synchronicity will eventually lead to more forgiving and convenient methods of interaction. The study has also cast light on the continued strength of the chat interface, however. Its resistance to cognitive degradation under conditions of poor Internet performance indicates that it will always be an important component of a supportive interface.

These findings also have significant potential value in collaboration engineering. Many papers have been written about adapting thinkLets for use in ad hoc collaboration across the Internet (Appelman & van Driel, 2005; de Vreede et al., 2009; Hoppenbrouwers & van Stokkum, 2011, 2013; Kamal et al., 2007; Kolfschoten & de Vreede, 2009; Newlon et al., 2009). However this new example of an implementation, especially one resulting in documented behaviors and data structures that can be examined, should be of importance to other developers in this field. The new insight that thinkLets need to be asynchronous, in particular, may lead to many new implementations.

The linkage of interface performance with improved collaborative cognition, and of perceived repository size with sharing, motivation, and reduced information bias, will certainly add experimental observations in the area of information theory (Wildman et al., 2011). It will also help elucidate some of the dynamics behind the phenomenon of mega-collaboration (Pfaff et al., 2010). In particular, the acts of sharing recorded in their contexts help shed some light on the elusive concept of relevance. It is a difficult thing to measure, as discussed in Chapter Two, but the conversations leading up to each sharing act clearly show its development as a decision-making factor (González-Ibáñez & Shah, 2010).

Theoretical Implications of the Findings

To recap, the theory proposed for the current study was that an interface supporting better collaborative cognition across a group (by facilitating the formation of collective mental

models and transactive memory structure) would increase the amount of information that the group's members were willing to share with each other because each member developed a greater sense of strategic commitment to the resulting knowledge structure as its acuity grew, each member became more intrinsically motivated to contribute information to it as the member's reflective capacity and sense of efficacy was increased by access to the knowledge within it, and each member's resistance to sharing information was reduced by the interface's initial effect on information bias and by the resulting increase in expertise among the group members as the transactive memory structure grew.

The data collected in this study has shown that better support of mental models and transactive memory structures led to better collaborative cognition. It was also demonstrated that enthusiasm, trust, and sharing grew as the acuity of the knowledge structure grew. However, the study did not demonstrate that strategic commitment had a significant effect on the sharing process.

CHAPTER SIX: CONCLUSIONS

Summary of Contributions

A number of specific insights were gained from this study. The most basic of these is that it demonstrated the value of linking HCI with cognitive science. By delineating the cognitive process we developed a better understanding of the interactions that drive it. This, in turn, led to interaction design specifications, thus advancing the HCI development. Figures 12 and 13 illustrate this insight. Figure 12 shows the theory we started with. Figure 13 shows what was achieved by the study. Each confirmed relation is shown in red, along with the specific insights gained, and what they each suggest in the way of interface design.

While this first, overarching insight is generally applicable throughout the field of HCI, the rest of the contributions from this study pertain specifically to the area of collaboration support interfaces. Most of these more specific insights are the ones shown in Figure 13. They are as follows:

1. People are busy. When establishing and supporting a communication channel between them, it is important to give them flexibility in their time. That is why asynchronous communication is better. This is currently a problem because thinkLets were designed to be synchronous. So, the thinkLets in this application will need to be redesigned. An asynchronous "pushed" communication method, such as text messages, will probably work the best.
2. It is a challenge to keep the conversation going. Group members were reluctant to "trespass" on other people's thought cards to comment on each other's thoughts. But they were willing to draw from each other's thoughts while defining categories. By redesigning the interface to allow access to the original thought cards during and after formation of the categories, it should be possible to encourage a deeper discussion.
3. We can forget about basing the interface design on abstract categories developed by the users. Not only did the users insist on defining their own categories, the categories they created weren't abstract, but practical, based on the situation at hand. However, in successfully creating their own sorting matrices, the users demonstrated that they can think abstractly about mental

model types. So interfaces should be designed based on those. For example, they could include entry and display options for the situation information, in addition to options for the planned strategy, the tasks to be done, and the information about group members.

4. The relation between the size of the data repository and the amount of sharing at any point in time is complicated. The primary motivation for sharing turned out to be the incentives provided by the conversation partners. Supplying relevant information brings an immediate reward of admiration, appreciation, or prestige. This type of interaction predicted about half of the variation in sharing. Clearly, an interface that supports giving rewards will encourage this type of activity. In addition to being driven by rewards, however, sharing behavior can be expected to increase as the data repository increases because the growing repository helps the group members determine the relevance of the information they hold. But the pattern of that sharing over time will always be unpredictable, because it is based on the detailed needs of the ongoing conversation. Therefore, the interface must be designed to allow flexibility, so that sharing opportunities are not lost as the collaborative process moves forward. The interface should also make it easy for users to reward people, providing such things as emoticons, and buttons for likes and/or thanks.
5. Of the intervening factors driven by the size of the repository, trust was shown to have the greatest impact on sharing. So, supporting its development should make a difference in sharing behavior. As we have defined it here, trust is the willingness to share information believed to be unwelcome to the group. One possible way the interface can support the development of trust is by encouraging a tolerant environment, for instance, by displaying forum rules to remind people that all information is welcome, even if it is bad news.

There were also several insights that were more general:

1. Group cognition, as it has been defined, has two sides – the social side that pertains to group norms (cognitive similarity in mental models, knowledge location consensus in transactive memory, and acceptance in decision-

making), and the objective side that pertains to group achievement (cognitive accuracy in mental models, knowledge location accuracy in transactive memory, and completeness of the action plan in decision-making). It was possible to actually see this division in the data (i.e. cognitive accuracy leads to a better action plan, while cognitive similarity leads to better acceptance). This demonstrates that these needs are real, not just some abstraction, and that the interface design must meet them, supporting both the formation of social norms and the objective achievement of the group.

2. It was determined that intrinsic motivation (as measured by expressed enthusiasm) and resistance to information bias (as measured by increased honesty and trust) are intervening factors in the relation between data repository size and sharing. As the data repository grows, it increases trust, honesty, and enthusiasm which, in turn, increase the amount of sharing. However, relevance (the other motivator of sharing behavior) does not seem to have the same intervening factors, and must act through a different mechanism. In addition, the fact that the increase of trust, honesty, and motivation were mechanisms through which the size of the data repository increased the amount of information shared, but the increase in commitment was not, implies that interfaces to increase sharing should be designed to facilitate trust, honesty, and motivation, rather than commitment. It is quite possible that increased sharing and increased commitment are both results, rather than causes.
3. Finally, from the study, it was determined that group cognition can be enhanced by a supportive interface, without an unacceptable amount of cognitive load. This can, in turn, enhance sharing of information. But it was also determined that interfaces requiring abstract thought need to be more bulletproof than interfaces requiring only chat. When faced with Internet functionality issues, group performance using such an interface degraded much more rapidly than performance using a chat interface. Therefore, building resilience into a cognitive support interface is especially important.

In sum, very little was originally known about the dynamics of collaborative cognition (Wildman et al., 2011). So the chance to look at the details has been valuable in many ways.

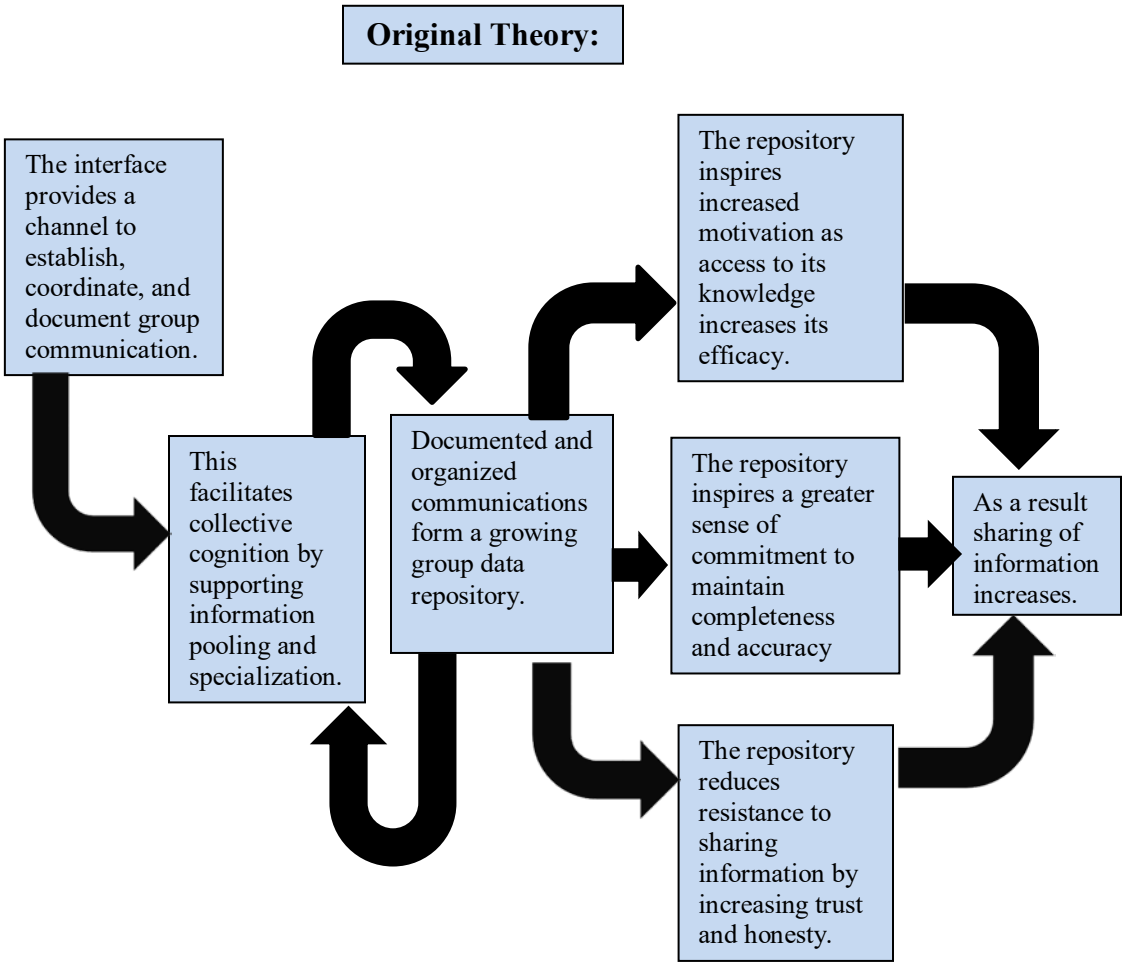


Figure 12. Relations Assumed by the Original Theory

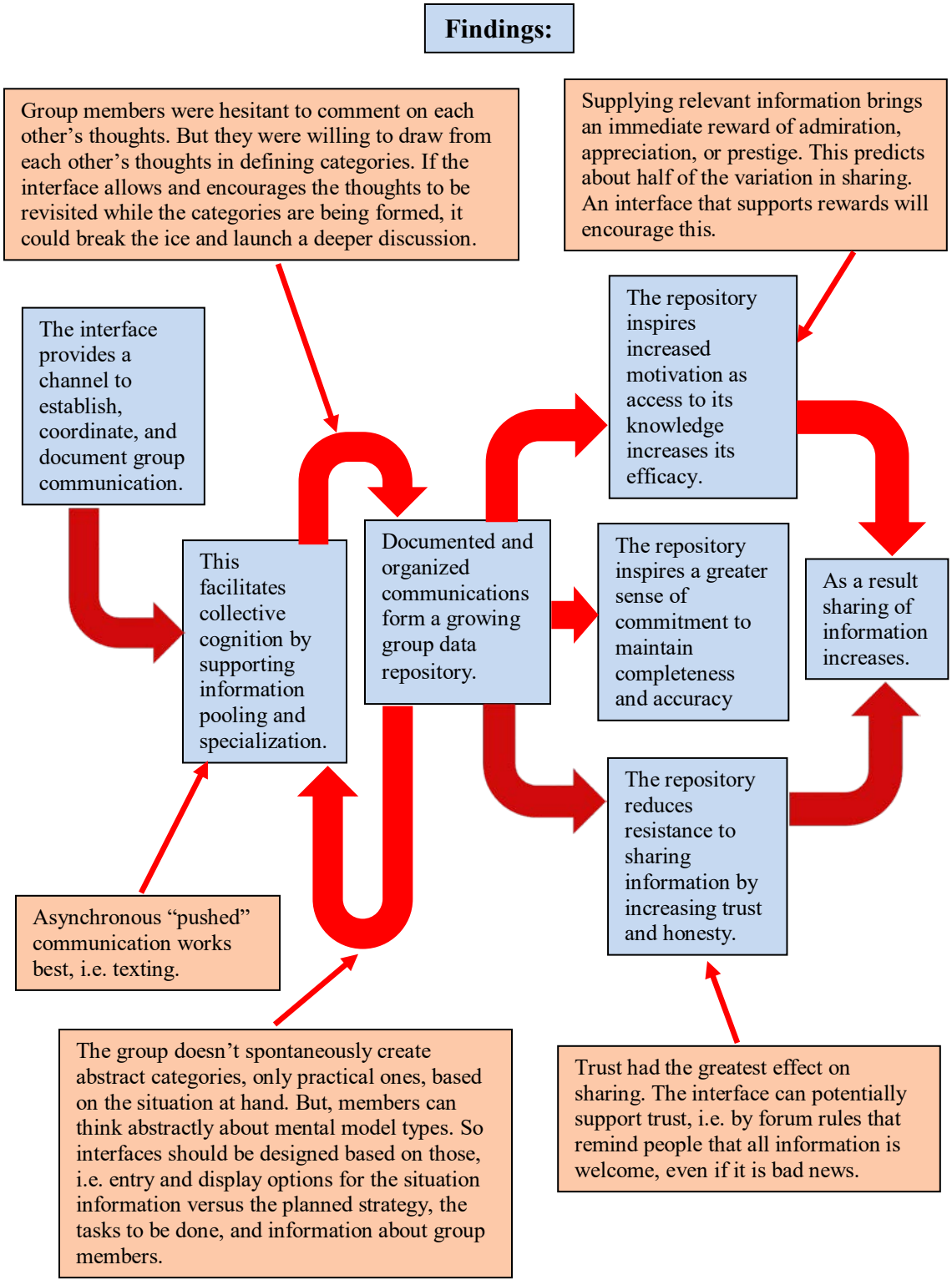


Figure 13. Relations Found by the Study

Limitations of the Study

While this study achieved relatively good external validity through being conducted across the Internet from standard FreeHostia servers, it had a number of problems that could affect its ultimate usefulness.

The first limitation is the obvious problem of small sample size. Recruitment was difficult, not because it was hard to find interested individuals, but because it turned out to be almost impossible to schedule three people to an online meeting. It seemed to be an order of magnitude more difficult to schedule for each additional person who was involved. Eventually, it was decided that each three participants should be put in touch with each other directly, and coordinate the timing amongst themselves, thus removing the fourth person (the scheduler) from the troublesome scheduling equation. While this recruitment difficulty was frustrating, it did have important implications, because it suggested that scheduling real collaborations would also be extremely difficult. It ultimately led to one of the major insights of the study – that an asynchronous tool would not have such a problem.

While small sample size had some impact on the study, examination of the various measures of behavior turned up few correlations that seemed to just miss significance due to the small sample. For the most part, these behaviors were either shown to be significantly correlated, or were shown to have no correlation at all.

A second limitation is that, while a more supportive interface was shown to promote better collaborative cognition than a less supportive one, the study gave no indication of how the two interfaces would compare under identical learning conditions. The chat interface is stable and well known, while the experimental interface had to be learned on the spot. Presumably, more familiarity with the experimental interface would have improved performance. However, we don't know that. While the chat-only trend lines didn't all reach a level of significance, they suggested that users of the chat interface might be exhibiting a boredom effect on nights of good Internet performance. One possible explanation might be that the participants were web surfing while they collaborated. So, more familiarity might not necessarily lead to better performance.

One solution to this might have been to have a learning task before starting on the test task. However, past studies have shown significant differences in the behavior of

teams that have become used to working together (Farnham et al., 2000) – effects that can overshadow the differential effects of the interface. Therefore, we had to make a choice in study design, and chose to capture performance during the group-formation phase, rather than during some undefined (and possibly differing) later phase. This means that we can't know what effect equal familiarity would have.

A third limitation is that these results also do not tell us what differential effect the two interfaces will have on cognitive performance at different data loads. The performance of the Internet served as a sort of proxy for this, because less conversation flowed on nights when it was performing poorly. However, the study was designed to deal with a fixed amount of information in the underlying scenario. So, while signs point toward the desired trend in comparatively better cognitive performance at higher loads, this aspect was not adequately tested with the current study design.

Recommendations for Further Research

One of the big achievements of this study is that MCT is ready to move to the next level of development. ThinkLets have been shown to be effective at supporting increased cognition without too much additional cognitive load. Mental model types have been shown to serve as an intuitive organizational structure. This means that a basic platform can be built that will serve as the anchor for an interface that coordinates between groups, rather than just within a group.

At the between-groups level, entirely different research tracks become relevant, because we will be dealing with multi-team mental models. This is already an area of active research. Luciano, DeChurch, and Mathieu (2015) have been working on a meso-theory of how multi-team systems (MTSs) function. Murase, Carter, DeChurch, and Marks (2014) and Sullivan, Lungeanu, DeChurch, and Contractor (2015) have looked at the effect of leadership networks in guiding MTSs through the divergent and convergent mental model negotiation processes. Building a mixed-initiative interface to support this activity will be the next challenge.

Another area of HCI research that will become more relevant at the next level is how to build an incentive structure that attempts to stabilize mega-collaborative activity (Cebrian et al., 2016). Nguyen and colleagues (2015) have proposed a model for participant engagement, along with a set of definitions and equations, that can be used to

standardize the measurement of participant contributions. Such a model could form the backbone of a participant incentive system.

Still on the within-group level, the current study has turned up several questions that will need to be resolved as the next platform is developed. How well the interface performs at different data loads will need to be explored. With the prospect of more long-term use, a longitudinal study of MCT will be needed to gain a clearer picture of how the interface performance changes with increased expertise. Most importantly, however, the major and unexpected finding that thinkLets need to be asynchronous must generate additional research into how to create asynchronous versions, and what difference they make to performance. This must include studying what factors determine whether participants will even return to an asynchronous collaboration.

In addition to continuing research on the MCT concept, it is also recommended that the issue of Internet performance having a differential impact on applications with a greater cognitive load should be examined in a broader context. This may have wider resource policy ramifications.

In the area of cognitive theory, it was clear from this study that the major motivation for sharing was the reward of being able make relevant contributions to the group. Additional research into how relevance is defined, and/or discerned, would help to further understanding of how information comes to be pooled.

APPENDIX A – APPROVED IRB MATERIALS

Informed Consent Disclosure

INDIANA UNIVERSITY INFORMED CONSENT STATEMENT FOR THE EFFECT OF A SUPPORT INTERFACE ON COLLABORATIVE OUTCOMES

You are invited to participate in a research study of a web-based collaborative interface, intended to support a forming group as it explores the problem it is trying to solve. You were selected as a possible subject because you have access to the Internet and are over the age of 18. We ask that you read this form to answer any questions you may have before agreeing to be in the study.

The study is being conducted by Christine Newlon, a PhD student in the Indiana University School of Informatics.

STUDY PURPOSE

The purpose of this study is to explore the information needs of a forming, web-based group and test various hypotheses concerning these needs.

NUMBER OF PEOPLE TAKING PART IN THE STUDY

If you agree to participate, you will be one of approximately 501 subjects who will be participating in this research.

PROCEDURES FOR THE STUDY

If you agree to be in the study, you will do the following things:

Once you have agreed to participate in the study you will be asked to fill out a short demographic survey to provide some general information about yourself. Then you will spend approximately 90 minutes working online with a group of other participants in a role-playing context, attempting to solve problems within a social scenario that you have been provided. During this time, you will occasionally be asked to fill out brief surveys about your current status or actions. At the end of the study session you will be asked to fill out two longer questionnaires to provide details about your experience and opinions. Following that, depending on the course of the study, you may be asked to participate in a chat session about any problems you may have encountered with the study apparatus while participating.

Please remember that you are not being tested by this study, but rather the application you are testing is what is under examination.

The total amount of time you will spend on this study is expected to be approximately two hours.

RISKS OF TAKING PART IN THE STUDY

While on the study, the risks (while extremely minimal) are:

- A small to zero chance of muscle pain (from repetitive motion) is possible as a result of interacting with the computer interface.
- The likelihood that an adverse effect will occur from any of the study activities is low. Prior experience and scores of past studies show that this type of experiment will produce minimal psychological risk from the experiment activities, the questionnaires and the chat session. At most, there may be some risk of frustration or discomfort when interacting with the group or completing the questionnaires. All survey responses, chat, and group interactions will be performed on a completely voluntary basis. The participant may simply skip over any questions that cause frustration or discomfort, and may stop participating in the experiment at any time, as noted below.
- There is always the possibility of loss of confidentiality.

In sum, there are no known health risks for the participants of this study. Any unexpected problems will be reported in accordance with University policy.

BENEFITS OF TAKING PART IN THE STUDY

The benefits to participation that are reasonable to expect include the chance to participate in research on collaboration, and the chance to collaborate with a group of people while solving a fun and challenging problem.

ALTERNATIVES TO TAKING PART IN THE STUDY

Instead of being in the study, you have the option of deciding not to participate.

CONFIDENTIALITY

Efforts will be made to keep your personal information confidential. We cannot guarantee absolute confidentiality. Your personal information may be disclosed if required by law. Your identity will be held in confidence in reports in which the study may be published and in databases in which the results may be stored.

Organizations that may inspect and/or copy your research records for quality assurance and data analysis include groups such as the study investigator and her research

associates, the Indiana University Institutional Review Board or its designees, faculty from the Indiana University School of Informatics, and (as allowed by law) state or federal agencies, specifically the Office for Human Research Protections (OHRP), who may need to access your research records.

COSTS

As a study participant, you will be responsible for providing your own computer and Internet access.

PAYMENT

You will receive an incentive payment to encourage participation in (and completion of) this study in the form of a $20 Amazon gift certificate. This payment will be given to those who complete the post-session questionnaires. The opportunity to complete the post-session questionnaires will depend on completing the group formation process, as described in the section on withdrawal and partial completion.

NO COMPENSATION FOR INJURY

Because participants are responsible for providing their own participation sites, in the event of physical injury resulting from your participation in this research, costs not covered by your health care insurer will be your responsibility. Also, it is your responsibility to determine the extent of your health care coverage. There is no program in place for other monetary compensation for such injuries. However, you are not giving up any legal rights or benefits to which you are otherwise entitled. Since you are participating in research which is not conducted at a medical facility, you will be responsible for seeking medical care and for the expenses associated with any care received.

CONTACTS FOR QUESTIONS OR PROBLEMS

For questions about the study or a research-related problem, contact the researcher Christine Newlon. If you cannot reach the researcher during regular business hours (i.e. 8:00AM-5:00PM), please call the IU Human Subjects Office at (317) 278-3458 [for Indianapolis] or (812) 856-4242 [for Bloomington] or (800) 696-2949.

In the event of an emergency (i.e. inappropriate online behavior by a fellow participant) you may contact Christine Newlon.

For questions about your rights as a research participant or to discuss problems, complaints or concerns about a research study, or to obtain information, or offer input, contact the IU Human Subjects Office at (317) 278-3458 or [for Indianapolis] or (812) 856-4242 [for Bloomington] or (800) 696-2949.

VOLUNTARY NATURE OF STUDY

Taking part in this study is voluntary. You may choose not to take part or may leave the study at any time. Leaving the study will not result in any penalty or loss of benefits to which you are entitled. Your decision whether or not to participate in this study will not affect your current or future relations with Indiana University or the School of Informatics. Withdrawal from the study before completion will not result in any risk to the participant.

WITHDRAWAL AND PARTIAL COMPLETION

You will be considered to have withdrawn from this study if you navigate away from the application at any point between the time you have pressed the "Agree" button below, and the time you have joined a group. Once you have joined a group, if you leave before completing the scenario it will be considered a partial completion, and you will be able to return later and re-enter your email address to complete the post-session questionnaires and become eligible to receive your gift certificate. All records for those who withdraw from the study will be destroyed. The records for those who choose partial completion will remain as part of the study results.

INVOLUNTARY TERMINATION

Your participation may be terminated by the investigator without regard to your consent in the following circumstances:

Members of your group complain that you have exhibited inappropriate online behavior when interacting with them, including:

- Personal attacks on others,
- Comments that are needlessly aggressive or rude,
- Comments that are abusive, or incite hatred,
- Defamatory and potentially defamatory comments,
- Offensive language,
- Comments advertising businesses or products, or promoting other websites

Termination will be treated in the same way as a voluntary withdrawal. If you have not yet joined a group, your records will be destroyed and you will be considered withdrawn. If you have joined a group, you will be considered a partial completion, and given the opportunity to complete the post-test questionnaires to receive your gift certificate.

SUBJECT'S CONSENT

In consideration of all of the above, I give my consent to participate in this research study.

I certify that I am at least 18 years of age, therefore, old enough to give my consent without supervision.

If I desire, I will print a copy of this informed consent document to keep for my records. I understand that by pressing the *Agree* button below, I agree to take part in this study.

Agree

Name of Person Obtaining the Consent: Christine M. Newlon

Study Advertisement

Help Needed for Game Simulation Research Study

Dear Students,

I'm a Ph.D. student studying online collaboration for my doctoral dissertation and need volunteers to test a new collaborative interface by completing a role-playing game simulation. Here are the details:

How long will it take?

Approximately 90 minutes in the simulation plus a few minutes completing questionnaires.

What will you do?

You will play an assigned role while working online with two partners to plan a neighborhood event. Your partners will also be playing assigned roles, and your only interaction with them will be via your online text-based dialogue.

What are the conditions? None. Your participation is completely voluntary; and you can quit at any point, if you prefer to leave early.

What is the compensation for your time?

If you complete the game simulation and post-test questionnaire, you can receive a **$20 Amazon Gift Certificate**.

What technology do you need?

You must have a browser that supports HTML5, such as Internet Explorer 9 & 10, Firefox 7 or higher, Chrome 14 or higher, Safari 5 or higher, or Opera 11 or higher. You must also have JavaScript enabled in your browser.

When can you start the game simulation?

As soon as you find two other game partners and you all agree on the best time to start and complete the simulation, you can begin anytime. The simulation test site is ready when you are.

Has this study been approved by the IU Institutional Review Board and Office of Human Research Protections?

Yes. Please find the IRB study number and all other information related to human subjects protection at this website:

http://megacollaborator.com/StudyInformationSheet

Who do you contact if you are interested in participating for this study?

Chris Newlon, Ph.Dc, or Dr. Faiola,

Study Information Sheet

IRB STUDY #1209009652

INDIANA UNIVERSITY STUDY INFORMATION SHEET FOR THE EFFECT OF A SUPPORT INTERFACE ON COLLABORATIVE OUTCOMES

You are invited to participate in a research study of a web-based collaborative interface, intended to support a forming group as it explores the problem it is trying to solve. You were selected as a possible subject because you have access to the Internet and are over the age of 18. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

The study is being conducted by Christine Newlon, a PhD student in the Indiana University School of Informatics. The principle investigator registered with the Indiana University Institutional Review Board (IRB) is Dr. Anthony Faiola

STUDY PURPOSE

The purpose of this study is to explore the information needs of a forming, web-based group and test various hypotheses concerning these needs.

PROCEDURES FOR THE STUDY

If you agree to be in the study, you will do the following things:

- Once you have agreed to participate in the study you will be asked to fill out a short demographic survey to provide some general information about yourself.
- Then you will spend approximately 90 minutes working online with a group of other participants in a role-playing context, attempting to solve problems within a social scenario that you have been provided. During this time, you will occasionally be asked to fill out brief surveys about your current status or actions.
- At the end of the study period you will be asked to fill out a longer questionnaire to provide details about your experience and opinions.

CONFIDENTIALITY

Every effort will be made to keep your personal information confidential. We cannot guarantee absolute confidentiality, because your personal information may be disclosed if required by law. Your identity will be held in confidence in reports in which the study may be published and in databases in which the results may be stored. Also, organizations

that may inspect and/or copy your research records for quality assurance and data analysis include groups such as the study investigator and her research associates, the Indiana IU IRB or its designees, faculty from the Indiana University School of Informatics and Computing, and (as allowed by law) state or federal agencies, specifically the Office for Human Research Protections (OHRP), who may need to access your research records.

VOLUNTARY NATURE OF STUDY

Taking part in this study is voluntary. You may choose not to take part or may leave the study at any time. Leaving the study will not result in any penalty or loss of benefits to which you are entitled. Your decision whether or not to participate in this study will not affect your current or future relations with Indiana University or the School of Informatics. Withdrawal from the study before completion will not result in any risk to the participant.

PAYMENT

You will receive payment for completing this study in the form of a $20 Amazon gift certificate.

CONTACTS FOR QUESTIONS OR PROBLEMS

For questions about the study, contact:

Christine Newlon

For questions about your rights as a research participant or to discuss problems, complaints or concerns about a research study, or to obtain information, or offer input, contact the IU Human Subjects Office at (317) 278-3458 or [for Indianapolis] or (812) 856-4242 [for Bloomington] or (800) 696-2949.

APPENDIX B – DEMOGRAPHICS

Table 26. *Pre-Test Questionnaire*

Demographic Data		
1.	Age	18-20 21-23 24-30 31-40 41-50 51-60 61-70 71+
2.	Gender	Female Male
3.	Occupation	Student Business Construction Education Foodservice Healthcare
		Maintenance Manufacturing Police/Fire/Military Regulation
		Other
4.	Ethnic Group	Hispanic or Latino Not Hispanic or Latino
5.	Racial Group	Asian Black Hawaiian Native American White Other
6.	Location	Africa Asia Europe South America North America
	Other	
Computer Experience		
6.	How many years have you been using computers?	
	<1 1-5 6-10 11-20 21+	
7.	How many hours a day do you spend using the Internet?	
	<1 1-2 3-5 6-8 9+	
8.	How many times a week do you visit social networking sites?	
	<1 1-2 3-10 11-20 21+	
Volunteer Experience		
9.	How many hours of volunteer work have you performed in the past three months?	
	<1 1-10 11-20 21-40 41+	
10	How many different volunteer groups have you worked for, or contributed to, in the past two years?	
	none 1-5 6-10 11-20 21+	
Team Experience		
11.	How many teams have you been a member of in the past two years?	
	none 1-5 6-10 11-20 21+	

Table 27. *Demographics*

Age	18-20	21-23	24-30	31-40	41-50	51-60	61-70	71+	Total
	1	3	10	6	8	4	3	1	36
Gender	Male	Female	Total						
	12	24	36						
Occupation	Student	Business	Education	Healthcare	Manufacturing	Other	Missing	Total	
	15	4	4	4	1	7	1	36	
Ethnic	Hispanic or Latino	Not Hispanic or Latino	Total						
	1	35	36						
Racial	Asian	Black	White	Total					
	8	5	23	36					
Location	Asia	North America	Total						
	1	35	36						
Years on Computers	1-5	6-10	11-20	21+	Total				
	2	1	15	18	36				
Hours on Internet	1-2	3-5	6-8	9+	Total				
	5	7	14	10	36				

Weekly Socialnet	<1	1-2	3-10	11-20	21+	Total	
	3	6	13	7	7	36	
Volunteer Hours	<1	1-10	11-20	21-40	41+	Missing	Total
	9	16	5	1	4	1	36
Volunteer Groups	none	1-5	6-10	11-20	21+	Missing	Total
	3	23	7	0	2	1	36
Teams	none	1-5	6-10	11-20	21+	Total	
	2	14	10	4	6	36	

APPENDIX C – TEST SCENARIO INFORMATION

Table 28. *Test Scenario Public Information*

Synopsis
You are a member of a restored urban neighborhood, inhabited by a mixture of young upwardly-mobile professionals, and longer-term residents, who tend to be lower income working-class. A young woman from one of the working class families has recently auditioned for, and won a place on, a new reality show called "Who Wants to be an Artist?" Now, after having watched all the canned episodes that were filmed six months ago, many of the neighborhood residents are gathered to watch the live finale that determines who will win the ultimate prize, an artist-in-residence scholarship at a prestigious art school. Much to the delight of the neighborhood, your young neighbor is declared the winner! As you and your fellow neighbors celebrate at the viewing party, a call comes to the cell phone of the young woman's best friend. It is the winning contestant herself! When she can make herself heard over the shouts of congratulation, she explains to her friend that the show's producers have made her an additional offer. They will sponsor a 1-day charity auction of all the artwork that has been produced during the competition with the proceeds going to fund an outreach art program for low income children in her hometown. The catch is that she has to find local volunteers to plan and host the event. Until the winner was determined, the producers had no idea where this auction would be held, so they have some funding for it, but no pre-planning done. Due to the production schedule of the show, the event must be held live in one weeks' time. In the heat of the moment, you are part of a group of neighbors who offer to help her plan and stage this event. Once you have volunteered, you then have a planning session, working with your fellow volunteers and using a planning tool supplied by the reality show production company to tack down plans for this event.
Kick-Off Message
Congratulations, friends of the winner! As you know, you have volunteered to help your friend host a charity auction. This will raise money from the sale of the art objects created during this season's competition to fund an art outreach program for needy

young people within your city. The number of students the program will support depends on the amount of money you raise, so do your best! Of course, we have certain production needs, since we will be televising your event. We require an auction grand finale that we can air live in one week's time. Within those parameters, you have great flexibility. You can have just a small auction, using only what the show generated; have a huge day-long event selling everything imaginable; or do anything in between. You will have to provide most of the resources, however, including the local venue and volunteer workers. We have a planning tool that will help you coordinate your plans with us, and we will work with you on publicity and supply a limited budget for staging. Anything more than that will have to be supplied by your creativity and enthusiasm. So have at it and best of luck!

Examples of Prior Events

Season 1 – New York: Parisian Fantasy - This group staged an exclusive "night in Paris" auction, with an Eifel Tower ice sculpture made by one of the group members. It was held in an apartment overlooking Central Park, which was borrowed from one of the members' relatives. While this made for a good showing on live television, the group had trouble finding celebrities who were willing to come to the auction and buy the artwork. They did eventually recruit 50 minor celebrities who were willing to participate for the television exposure; but the income from the auctioned items was somewhat of a disappointment at $50,000 - only enough to sponsor 10 young people. Several of the items were later resold by their buyers at much higher prices in the after-market.

Season 2 – Minneapolis: Tahitian Paradise - It is hard to succeed when staging a social event in Minnesota in the middle of the winter, but this group had moderate success with an emulation of a Tahitian cruise. The event was held at a borrowed mansion in the upper crust district of Minneapolis, and provided some television exposure for a number of locally prominent citizens. The auction of the art objects brought reasonably good prices for that market, with the event raising half a million dollars for the outreach program. The local group is now thinking about using artwork produced by the outreach program to repeat the event and possibly establish an annual cycle.

Resources We Provide

1. Publicity Agent – This person will handle all public announcements to market your event and handle any bad press. You will have to provide information and a sense of what will play well locally as part of the planning process.

2. Auctioneer – This person is an expert at auctioning products on live television while providing humor and color. Any locally relevant humor or peeves that you can supply during the planning process will help add to the material.

3. Budget – The production company can supply money for miscellaneous use in staging, decorating, providing refreshments, etc. This doesn't generally cover much. The venue and most of the work will have to be provided by volunteers.

4. Planning Tool – This tool will help you make decisions concerning each of the major issues (what venue will be provided, what risks must be managed, and what local color we can use), so you can keep us informed of the things we need to know to support your efforts.

5. Communication Interface – As part of the planning tool, the application will provide a common area in which shared information will be kept by the group for reference during group discussions. The tool will also provide an email portal. We ask that each group member use the "Share with Group" button to upload any private information he or she decides to share with the group into the group's common area.

Interaction Guidelines

1. Feel free to communicate openly, but respect people's privacy and don't repeat their comments elsewhere. Be supportive and nonjudgmental, since a healthy respect for differences of opinion fosters cooperation. With this in mind, its best to avoid shooting down other people's ideas. Instead, handle disagreements openly and positively. Criticize ideas, not people.
2. Include everyone in the discussion. But if someone just wants to listen in, that's okay too, because people often need time to think and digest before giving comment. Share the limelight, and avoid interrupting people. Anyone who feels cut out of the discussion should address their concerns in a positive fashion with the group.

3. Acknowledge problems and deal with them. Listen to people, keeping the focus on the current topic without sidetracking. Give feedback directly, openly, and in a timely fashion. Provide specific information that is relevant to the task.
4. If in a multi-person setting, turn off cell phones and pagers. Don't make phone calls or interrupt the group unless an emergency arises.
5. If you have to leave for a minute during the group discussion, use the chat window to coordinate your absence with the group.

Table 29. *Private Information for Each Role*

Chandler Smythe's Private Information

1. Email from a month ago:

Chan,

I have exciting news for those of you on the neighborhood board. The Foundation has finally been given title to the old School 9 property over on Park Avenue. Now the street's name has come true, because the old school grounds will make a wonderful neighborhood park. There's plenty of room, and even a playground! As you recall, the main school building was demolished several years ago after we complained about its condition, and the city removed the foundation and closed the hole with fill and topsoil. They even put in grass and flowers as part of the maintenance we requested back then, so our new park already has a good base of established plantings.

The city offered to tear down the old gymnasium building before the property transfer. But, since it's still in fairly good shape, we've decided to keep it and convert it into a community center. It has a good roof and intact windows, but it's very dirty inside. It will need a lot of volunteers and several days of cleaning before it can be used for community events. We did buy the event insurance for it, though.

One idea the Foundation has is that we could offer use of the building for free to the first event sponsor, with the building clean-up being their rent. Do you know of anyone who might be interested? I know the neighborhood association sometimes sponsors events, so be sure to keep us in mind if you are planning anything.

Terry

2. Email from two weeks ago:

Chandler,

I am writing to let you know that Rory and I have finally finished our renovation of the Ellingham mansion. We tried to remain true to its Victorian character, and we're thrilled with the result! We want to volunteer to be on the next home tour, now that the house is ready.

Also, while it is primarily our residence, we plan to offer the Ellingham mansion as an event site for our catering business. It will make a wonderful venue for

upscale functions of up to a hundred people. So, if you know of anyone with a wedding or celebration in their plans, you might mention to them that we can provide both the location and the food for a lavish affair.

Also, if the neighborhood has any event coming up, we would be willing to host it for free to get people acquainted with what we have to offer.

Yours truly,

Gwen

3. Email from this morning:

Hey Chan!

How about that blowout yesterday! I've posted the pics on Facebook. You don't look too wasted -- afraid I can't say the same for me. The DJ was a fellow I heard of from that guy who ran the taco truck. (Weren't those tacos awesome?) I thought about getting a couple of other trucks to come, since I know all the drivers in town, but I was afraid it would be too much food. This wasn't the sort of big rave I usually handle, but I think it turned out about right.

At least we finally got Mickey through graduate school!

Reece

4. Email from this morning:

Chandler,

Do you know if Reece is through with the tent from yesterday's party? I've been hired to plan a last-minute wedding, and all of the tent rentals in town are completely booked up for the weekend. If only they could have waited until next week, there would be plenty of tents available. But now I'm reduced to beating the bushes for one that can do double duty.

I don't even know why this couple wants a wedding planner, given the "spontaneous" nature of the event. I guess they heard that I'm good at arranging for the decorations at a moment's notice. All those college happenings are coming back to haunt me. Still, I guess I can't complain about the money…

Cory

5. Email from yesterday:

Chan, you're not going to believe this! I just found out my brother is handling the publicity on that big Hollywood scandal! He's always been so good at putting the right spin on everyone's dirty little secrets. Remember that time we got caught with the goats? I still ROFL every time I think about it.

I just wish they didn't make it so hard for him. Imagine calling in the publicity expert after your laundry has already been airing in public for a week! We'll have to see what he pulls off this time!

– JL

6. Email from last week:

To Chandler Smythe:

Since you are the president of the neighborhood association, I assume you are the right person to complain to. I am referring to the embarrassment of having one of this neighborhood's young thugs on national TV. They seem to think that she is some wonderful artist, but I know all about her past, and I assure you no good can come of this. You must make sure the media knows that this neighborhood in no way supports her. Otherwise she could drag us down with her when the truth becomes known.

Sincerely,

Mel Brown

Marley Winters' Private Information

1. Email from last week:

Marley,

Isn't it wonderful to watch Bell on TV? Her grandfather worked so hard to teach her his craft. She sure is making us all proud now. It's like a miracle to watch the beauty springing from her hands.

I hate to even think what direction she might have gone if he hadn't stepped in to mentor her. She and her brother really had us scared for a while. Now he's in college and she's on TV!

Do you suppose her fame might finally bring her grandfather some recognition? He's a wonderful artist himself, but no one has ever seemed to notice. The church has bought so many of his works to support him over the years that our attic is full of them. Do you think we could raise money for charity by selling them?
Reverend Clark, Mt. Hope Church

2. Email from last week:
Marley,
It's great to see Bell make a name for herself, but I'm so sad when I think about her mother. If only Rose had been willing to stay and raise her babies, she would have been so happy at how they turned out. It's terrible enough to die a drug addict on the streets of New York, but even more terrible to miss seeing your daughter become a star! And to think that just five years ago, when Bell and her brother joined that gang, we thought they were going to follow in their mother's footsteps. Do you worry that it might hurt Bell if people found out about her past?
Adel

3. Email from yesterday:
Marley,
Could you ask Reverend Clark to talk to our boy? I don't know of anyone in the neighborhood who the kids look up to more. We're trying to persuade them to disband that kiddie gang they started. They're getting old enough now that we're worried they'll be getting in worse trouble than just with the firecrackers and the fights at school. Last time Reverend Clark worked with them, they cleaned out every storm drain in the neighborhood, and were so proud of themselves! If we could just get them involved in some fun community effort, we could surely turn them to the right path.
Lizzie

4. Email from this morning:
Hey Marley!

How's the sax? A few of us are getting together for some improv tomorrow and could really use your horn in the mix. I know you've been watching that artist gal on TV, but there's lots of other action in the hood! Stevie's boy is trying to sell some of his wire sculptures down at the café, and his girlfriend does portrait sketches. We thought if we made a little joyful noise it might attract some buyers for the kids. If it works, several of the other locals might try selling their stuff this way.

Just come by after your show is over and you can tell us what happened.

Jive

5. Email from last month:

To Marley Winters:

We are looking for a saxophonist to complete a jazz quartet at a wedding reception. Your name was recommended to us by one of the other musicians. If you are interested in auditioning, please respond to this message. We might also like to discuss your availability for future engagements. We prefer to book for small, upscale events, in and around the downtown area.

Sidney Porter, Blue Note Venues

6. Email from two weeks ago:

Marley, guess what! I just got back from an art rave in Melbourne! It's like a food rave, but add in artwork from all the local underground artists. It was huge! There were people there from all walks of life. And the take was great! All I had to do was set out my cup and start in on my fiddle. I made enough in one night to pay my hotel bill for the whole time I was there. Why don't we do stuff like that? All our artists are so prissy. It's like only rich people care about art. I can't imagine playing the fiddle at one of their hoity-toity gallery openings. – Storm

Taylor Jones' Private Information

1. Email from three months ago:

To CrimeWatch Captain Jones:

We want to pass along some information that was developed by our local gang taskforce concerning a youth gang that has been operating in your area. The gang "Young Devils" formed about five years ago with members that were then pre-teens. Its members have been periodically arrested for the following activities: 1) graffiti (tagging activities significantly diminished over the past two years), 2) assault (charges involved fights on public school property), 3) illegal use of fireworks (last offense two summers ago). None of these cases was referred to adult court, but several of the gang members remain on probation as juveniles. Community intervention work two years ago, by Reverend Clark of Mount Hope Church, resulted in a significant (and continuing) reduction in incidents; but the passage of these young people into adulthood as they reach the age of 18 has initiated renewed scrutiny by our gang taskforce. Some attrition of the original gang composition has been noted as members move on, but many original members remain involved. It is the opinion of our gang experts that this gang has a high potential for generating hardcore criminals as its members leave high school and fail to integrate with society. We would appreciate hearing about any problems, issues, or changed circumstances that you become aware of as a concerned neighbor.
Bud Stevens, CrimeWatch Liaison, Police Department

2. Email from last month:
To CrimeWatch Captain Jones:
We would like to update you on the situation concerning the Young Devils youth gang that we wrote to you about last month. While no additional incidents have been noted concerning any of the individual gang members, there has, nonetheless, been a disturbing development. The Federal Gang Taskforce has notified us that the Young Devils was found on a list of gangs potentially available for recruitment in this area that was obtained from a drug gang informant in Los Angeles. Based on this, our gang experts feel that it is extremely likely that the Young Devils members will soon be involved in dealing drugs. Please keep your eyes open for any hint of this type of activity. If you see any of the Young Devils dealing, please notify us immediately.
Bud Stevens, CrimeWatch Liaison, Police Department

3. Email from last week:

Tay,

I heard something disturbing at the grocery store last night that I wanted to make sure you knew about. There was a group of kids hanging out around the vending machines next to the store, and as I walked by they were having an argument about that girl, Bell, who's in that TV art competition. One of the boys was angry about her leaving their gang and pretending that she was too good for them. But one of the girls was saying that Bell was still their friend and wanted to share her good luck. The last thing I heard as I went in the store was that angry young man threatening to make trouble with Bell and her brother if they didn't shape up. Do you know Bell's family? Maybe you could warn them.

Sidney Tamar

4. Email from two weeks ago:

To Taylor Jones, Neighborhood CrimeWatch Captain

I have been referred to you by your neighbor, Mel Brown. My firm, City Security, is available to provide security services to your neighborhood, either for temporary events, or in the form of ongoing patrols. In the case of the patrols, we give a substantial discount as more people within your neighborhood sign up for our service. These patrols are conducted in full cooperation with the city police department. In fact, most of our security workers are off-duty police officers. At the moment, the Brown residence is the only one within your neighborhood that is on out patrol list. Therefore, we would appreciate your consideration. If you have neighbors interested in joining, or if you know of events that could use a security presence, please pass our name along.

Sincerely, Adam Kent, City Security

5. Email from yesterday:

Tay,

Do you want to go fishing next week? The weather forecast says the eight-day outlook is beautiful! I found a new fishing hole I want to try, so I say let's go while we have the chance.

What do you say?

Erin

6. Email from this morning

Taylor,

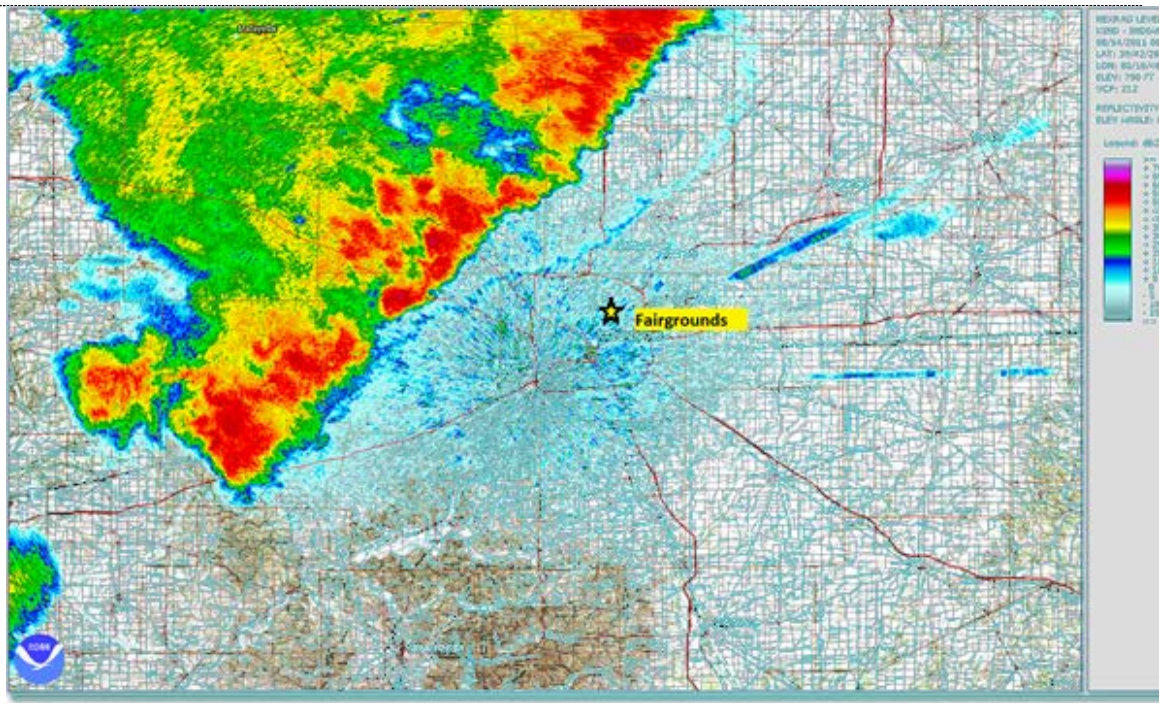
It's been an interesting morning. When we first met at that weather emergency conference I told you that I'd already seen it all, but the storm that went through today was something else again! It really crept up on us. The cold front itself is a slow-mover, and the storms rolling along it don't seem all that bad when you look at the radar. But they're very windy, even though there isn't much rain.

If we had looked at the radar closer, we would have noticed the gust front that preceded the rain by a full half hour. But it caught us flat-footed when it hit. Several of the tents blew down at the fairgrounds, and there were injuries and a bit of damage to the exhibits.

I'm writing to you because I hear the storm front is headed your way, though it's moving so slow it will probably take a week to get there. I've attached a picture with the gust front showing on the radar so you'll know what to watch for.

Just a heads up!

Steve Cooper, Fellow CrimeWatch Captain


Fairgrounds

APPENDIX D – POST-TEST QUIZ

Table 30. *Post-Test Quiz (Chandler Smythe Version)*

Question	Your answer (T/F)	Marley Winters would know this (Y/N)	Taylor Jones would know this (Y/N)
Potentially Available Resources			
The following venues are known to members of your group to be potentially available for the art auction:	1		
Neighborhood park	T		
County fairground	F		
Neighborhood community center	T		
Frey Lewis House	F		
Ellingham mansion	T		
Walmart parking lot	F		
Mount Hope Church	T		
Local masonic lodge	F		
Neighborhood café	T		
Hotel banquet hall	F		
Rented tent	T		
Convention center	F		
The following human resources are known to members of your group to be potentially available to help at the art auction:	2		
A catering company	T		
A construction company	F		
A rave producer	T		
An art appraiser	F		
An event planner	T		
An accountant	F		

Question	Your answer (T/F)	Marley Winters would know this (Y/N)	Taylor Jones would know this (Y/N)
Someone good with rush decorations	T		
Someone good at internet advertising	F		
Local artists	T		
Local comedians	F		
The grandfather of Bell	T		
The mother of Bell	F		
Local musicians	T		
Local dancers	F		
Food truck drivers	T		
Local bakery	F		
A friend who is a spin doctor	T		
A friend on the city council	F		
A publicity agent supplied by show	T		
A fashion consultant supplied by show	F		
An auctioneer supplied by show	T		
An art director supplied by the show	F		
A plan coordinator supplied by show	T		
A makeup artist supplied by the show	F		
Neighborhood security patrollers	T		
A bouncer	F		
Event security guards	T		

Question	Your answer (T/F)	Marley Winters would know this (Y/N)	Taylor Jones would know this (Y/N)
A city garbage crew with a truck	F		
A youth clean-up crew of former gang members	T		
An expert at soliciting donations	F		
A minister who is good at mentoring young people	T		
An expert in charitable corporations	F		
The following items are known to members of your group to be potentially available for sale at the auction:	3		
Artwork produced by the contestants during the filming of "So You Want to Be an Artist"	T		
Antiques from a local antique mall	F		
Artwork by a grandfather of Bell	T		
Performance art from a local troupe	F		
Artwork by a neighborhood wire sculptor	T		
Rescue dogs from a local shelter	F		
Artwork by a neighborhood portrait sketcher	T		
Donated items from various celebrities	F		
Artwork by other neighborhood artists	T		
Lessons from a local art school	F		

Question	Your answer (T/F)	Marley Winters would know this (Y/N)	Taylor Jones would know this (Y/N)
Musical performance dates by local music groups	T		
Lessons from a local piano teacher	F		
Potential Approaches – Advantages and Disadvantages			
Group members know the following about potential approaches to this art sale:	4		
One possible venue known to the group members is very exclusive, like a gallery opening, with only a few select artists, catered food, and a posh location, such as a rented mansion.	T		
One possible venue known to the group members is very inclusive, like an art fair, where each artist has an individual booth and sells directly to the buyers, while the charity collects part of the take of the fair food vendors.	F		

Question	Your answer (T/F)	Marley Winters would know this (Y/N)	Taylor Jones would know this (Y/N)
One possible venue known to the group members is very inclusive, like an art rave, where the work of many different artists is auctioned, while numerous other offerings of food, music, and other types of improve performance are simultaneously available in a large, inclusive public space.	T		
One possible venue known to the group members is somewhat exclusive, like a silent auction, where the artwork is laid out on tables, and a select group of people make bids on a bid sheet next to each piece, with the highest bid winning at the end of the bidding period.	F		
One sign of success of the art sale is that people want to repeat the event in the future.	T		
One sign of the success of the art sale is when the purchased artwork is immediately sold again at a much higher price.	F		

Question	Your answer (T/F)	Marley Winters would know this (Y/N)	Taylor Jones would know this (Y/N)
Group members know the following about the advantages and disadvantages of the various approaches:	5		
The gallery-opening type of venue has been tried on this show in the past with disappointing results.	T		
The gallery-opening type of venue has been tried on this show in the past with good results.	T		
The art-fair type of venue has been tried on this show in the past with excellent results.	F		
The art-fair type of venue has never been tried on this show in the past.	T		
The art-rave type of venue has been tried on this show in the past with very bad results.	F		
The art-rave type of venue has never been tried on this show in the past.	T		
The producers are encouraging a silent-auction type of venue to save on the cost of the auctioneer.	F		
The silent-auction type of venue has never been tried on this show in the past.	T		

Question	Your answer (T/F)	Marley Winters would know this (Y/N)	Taylor Jones would know this (Y/N)
If the entire profit from the auction goes towards current scholarships, there are still ways that scholarships from it can be awarded in future years.	T		
Based on all the information the group members have, appealing to the elite collectors is the best way to make lots of money from the artwork.	F		
Risk Assessment			
The following facts are known to the group members about Bell:	6		
Her mother was a drug addict who left family and died on the streets of New York.	T		
Her father was a minister.	F		
She belonged to a gang.	T		
She belonged to Girl Scouts.	F		
She is friendly with gang members.	T		
She is a Baptist.	F		
Some of her neighbors are hostile toward her.	T		
The entire neighborhood loves her.	F		
Some gang members dislike her.	T		
She is the girlfriend of the gang leader.	F		

Question	Your answer (T/F)	Marley Winters would know this (Y/N)	Taylor Jones would know this (Y/N)
Her grandfather is a wonderful artist.	T		
Her grandfather abused her mother.	F		
Her brother is in college.	T		
Her brother is in jail.	F		
The following facts are known to the group members about the Young Devils gang:	7		
Some gang members are on juvenile probation.	T		
Half the gang members are in jail.	F		
The crimes of the gang have been graffiti, fights, and fireworks violations.	T		
The crimes of the gang have been dealing drugs, robbery, and car theft.	F		
The police gang task force is concerned that members of the gang will leave high school without integrating into society.	T		
The police gang task force is concerned that the gang is running an extortion racket in the neighborhood.	F		

Question	Your answer (T/F)	Marley Winters would know this (Y/N)	Taylor Jones would know this (Y/N)
The police gang task force is concerned about the gang's potential to generate hardcore criminals.	T		
The police gang task force is concerned that the gang is behind several murders.	F		
The gang members consider Reverend Clark of Mount Hope Church to be their mentor.	T		
The gang members consider Reverend Clark of Mount Hope Church to be a police informant.	F		
The police gang taskforce is concerned that the gang will be recruited to deal drugs.	T		
The police gang taskforce is concerned that the gang has a secret meth lab.	F		
The neighbors are concerned because gang members have threatened Bell.	T		
The neighbors are concerned because Bell has threatened them.	F		
The parents of the gang members are trying to persuade them to disband.	T		

Question	Your answer (T/F)	Marley Winters would know this (Y/N)	Taylor Jones would know this (Y/N)
The parents of the gang members are mostly addicts or in jail.	F		
Gang members cleaned out the neighborhood's storm drains two years ago.	T		
Gang members were arrested in a neighborhood drug house two years ago.	F		
The following facts are known to the group members about the weather risk:	8		
The forecast for the eight-day weather outlook is beautiful.	T		
The forecast for the eight-day weather outlook is for possible tornados.	F		
A storm with a gust front is approaching.	T		
There is no sign of any bad weather approaching.	F		
Because it is moving slowly, the next storm is due in one week.	T		
Because it is moving quickly, the next storm is due in 5 hours.	F		

APPENDIX E – POST-TEST QUESTIONNAIRE

Table 31. *The Willingness to Self-Censor Scale (Hayes et al., 2005b)*

Instructions: For each statement, please check or mark with an X only one box per statement that reflects whether you strongly disagree with the statement, disagree with the statement, neither agree nor disagree with the statement, agree with the statement, or strongly agree with the statement. Don't spend too much time on any question. Simply record your first impression.
1. It is difficult for me to express my opinion if I think others won't agree with what I say.
2. There have been many times when I have thought others around me were wrong but I didn't let them know.
3. When I disagree with others, I'd rather go along with them than argue about it.
4. It is easy for me to express my opinion around others who I think will disagree with me. (R)
5. I'd feel uncomfortable if someone asked my opinion and I knew that he or she wouldn't agree with me.
6. I tend to speak my opinion only around friends or other people I trust.
7. It is safer to keep quiet than publicly speak an opinion that you know most others don't share.
8. If I disagree with others, I have no problem letting them know it. (R) Pearson correlation with scale scores after removing each item from the scale varied from .48 to .65. (p. 306)

This scale typically has a Cronbach's alpha of around .82. Principal axis factor analysis gave a single factor solution, with the Kaiser criterion (eigenvalue > 1), explaining 38% of the response variance. Each question in the scale has a factor loading of over 0.40, and a large item-corrected correlation with the scale score.

Table 32. *Intrinsic Motivation Inventory ("Intrinsic Motivation Inventory," 2011)*

Participants' interest/enjoyment [considered the self-report measure of intrinsic motivation]
1. I enjoyed doing this activity very much.
2. This activity was fun to do.
3. I thought this was a boring activity. (R)
4. This activity did not hold my attention at all. (R)
5. I would describe this activity as very interesting.
6. I thought this activity was quite enjoyable.
7. While I was doing this activity, I was thinking about how much I enjoyed it.

Perceived competence [positive predictor of self-report and behavioral measure of intrinsic motivation]

1. I think I am pretty good at this activity.
2. I think I did pretty well at this activity, compared to other students.
3. After working at this activity for a while, I felt pretty competent.
4. I am satisfied with my performance at this task.
5. I was pretty skilled at this activity.
6. This was an activity that I couldn't do very well. (R)

Effort [relevant to some motivation questions]

1. I put a lot of effort into this.
2. I didn't try very hard to do well at this activity. (R)
3. I tried very hard on this activity.
4. It was important to me to do well at this task.
5. I didn't put much energy into this. (R)

Value/usefulness [used in internalization studies because people internalize and become self-regulating with respect to activities that they experience as useful or valuable for themselves]

1. I believe this activity could be of some value to me.
2. I think that doing this activity is useful for _____
3. I think this is important to do because it can _____
4. I would be willing to do this again because it has some value to me.
5. I think doing this activity could help me to _____
6. I believe doing this activity could be beneficial to me.
7. I think this is an important activity.

Felt pressure and tension [a negative predictor of intrinsic motivation]

1. I did not feel nervous at all while doing this.
2. I felt very tense while doing this activity. (R)
3. I was very relaxed in doing these.
4. I was anxious while working on this task. (R)
5. I felt pressured while doing these. (R)

Perceived choice while performing a given activity [positive predictor of self-report and behavioral measure of intrinsic motivation]

1. I believe I had some choice about doing this activity.
2. I felt like it was not my own choice to do this task. (R)
3. I didn't really have a choice about doing this task. (R)
4. I felt like I had to do this. (R)
5. I did this activity because I had no choice. (R)
6. I did this activity because I wanted to.
7. I did this activity because I had to. (R)

Experiences of relatedness [used in studies having to do with interpersonal interactions, friendship formation, and so on (Validity of this subscale has yet to be established.)]

1. I felt really distant to this person. (R)
2. I really doubt that this person and I would ever be friends. (R)
3. I felt like I could really trust this person.
4. I'd like a chance to interact with this person more often.

5. I'd really prefer not to interact with this person in the future. (R)
6. I don't feel like I could really trust this person. (R)
7. It is likely that this person and I could become friends if we interacted a lot.
8. I feel close to this person. (pp. 4-5)

The items on the subscales shown in Table 32 are usually scored from one to seven, with the items having an "R" reversed. The subscale scores are reached by averaging across all the items within each subscale. These items have been shown to be stable across a variety of tasks and contexts, with a factor loading of at least 0.6 and no cross loadings above 0.4. Order effects have, in the past, been negligible, with no impact from inclusion or exclusion, allowing use of only the relevant subscales, given the context. In each case, the item can be altered to specify the activity without affecting either its reliability or its validity ("Intrinsic Motivation Inventory," 2011).

Table 33. *Flow State Scales (Jackson & Marsh, 1996)*

Flow State (similar to intrinsic motivation, to be used to measure interface efficacy both as an outcome, and as a factor in willingness to share information.)

1. Challenge questions:

a. I was challenged, but I believed my skills would allow me to meet the challenge.
b. My abilities matched the high challenge of the situation.
c. I felt I was not competent enough to meet the high demands of the situation. (Reverse)

2. Awareness questions:

a. I made the correct moves without thinking about trying to do so.
b. Things just seemed to be happening automatically.

3. Goals questions:

a. I had a strong sense of what I wanted to do.
b. I did not know what I wanted to achieve. (Reverse)
c. My goals were not clearly defined. (Reverse)

4. Feedback question:

a. I had a good idea while I was performing about how well I was doing.

5. Concentration questions:

a. My attention was focused entirely on what I was doing.
b. It was an effort to keep my mind on what was happening. (Reverse)

6. Control questions:

a. I felt in total control of what I was doing.
b. I felt like I could not control what I was doing. (Reverse)

7. Loss-of-self questions:

a. I was concerned with what others may have been thinking of me. (Reverse)
b. I was not concerned with how I was presenting myself.

8. Time perception questions:

a. Time seemed to alter (either slowed down or speeded up).
b. The way time passed seemed to be different from normal.
c. It felt like time stopped while I was performing.
d. At times, it almost seemed like things were happening in slow motion.

9. Autotelic questions:

a. I really did not enjoy the experience. (Reverse)
b. The experience left me feeling great.
c. I found the experience extremely rewarding.

Excerpted from Jackson and Marsh (pp. 34-35).

Table 34. *Acceptance Scales (Sundaravej, 2006)*

Seven constructs
Performance expectancy (PE) [the degree to which an individual believes that using a particular system would improve his or her job performance (independent)]
PE1: I find MyApp useful in my work.
PE2: Using MyApp enables me to accomplish tasks more quickly.
PE3: Using MyApp increases my productivity.
PE4: Using MyApp increases my chances of getting a good grade.
Effort expectancy (EE) [the degree of simplicity associated with the use of a particular system (independent)]
EE1: My interaction with MyApp is clear and understandable.
EE2: It is easy for me to become skillful at using MyApp.
EE3: I find MyApp easy to use.
EE4: Learning to operate MyApp is easy for me.
Attitude toward using technology (AT) [the degree to which an individual believes he or she should use a particular system (independent) drops out when usage is utilitarian?]
AT1: Using MyApp is a good idea.
AT2: MyApp makes work more interesting.
AT3: Working with MyApp is fun.
AT4: I like working with MyApp.
Social influence (SI) [the degree to which an individual perceives that others believe he or she should use a particular system (independent) drops out when there is no social pressure for use?]
SI1: People who influence my behavior think that I should use MyApp.
SI2: People who are important to me think that I should use MyApp.
SI3: My supervisors have been helpful in the use of MyApp.
SI4: In general, the company has supported the use of MyApp.

Facilitating conditions (FC) [the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of a particular system (independent) drops out when infrastructure support isn't in question?]

FC1: I have the resources necessary to use MyApp.

FC2: I have the knowledge necessary to use MyApp.

FC3: MyApp is not compatible with other systems I use.

FC4: A specific person (or group) is available for assistance with MyApp difficulties.

Self-efficacy (SE) [the degree to which an individual judges his or her ability to use a particular system to accomplish a particular job or task (independent)]

SE1: I can complete a job or task using MyApp, if there is no one around to tell me what to do as I go.

SE2: I can complete a job or task using MyApp, if I can call someone for help if I get stuck.

SE3: I can complete a job or task using MyApp, if I have a lot of time to complete the job for which the software is provided.

SE4: I can complete a job or task using MyApp, if I have just the built-in help facility for assistance.

Anxiety (AX) [the degree of anxious or emotional reactions associated with the use of a particular system (independent)]

AX1: I feel apprehensive about using MyApp.

AX2: It scares me to think that I could lose a lot of information using MyApp by hitting the wrong key.

AX3: I hesitate to use MyApp for fear of making mistakes I cannot correct.

AX4: MyApp is somewhat intimidating to me.

Intention to Use

Behavioral Intention to Use the System (BI) [the degree of intention for information technology usage (dependent)]

BI1: I intend to use MyApp in the near future.

BI2: I predict I will use MyApp in the near future.

BI3: I plan to use MyApp in the near future. (pp. 6-7)

Note: All items were measured on a seven point Likert scale, where 1 = completely disagree, 2 = moderately disagree, 3 = somewhat disagree, 4 = neutral (neither disagree nor agree), 5 = somewhat agree, 6 = moderately agree, and 7 = completely agree.

Table 35. *Post-Test Questionnaire Used in Study*

The following questions (all using a 1-5 Likert-type scale of agreement) were presented on the post-test questionnaire in randomized order:

1. Willingness to Self-Censor Scale (to be used to control for this individual personality trait that may be a confounding factor in willingness to share information.)
    a. It is difficult for me to express my opinion if I think others won't agree with what I say.
    b. There have been many times when I have thought others around me were wrong but I didn't let them know.
    c. When I disagree with others, I'd rather go along with them than argue about it.
    d. It is easy for me to express my opinion around others who I think will disagree with me. (Reverse)
    e. I feel uncomfortable if someone asks my opinion and I know that he or she won't agree with me.
    f. I tend to speak my opinion only around friends or other people I trust.
    g. It is safer to keep quiet than publicly speak an opinion that you know most others don't share.
    h. If I disagree with others, I have no problem letting them know it. (Reverse)
2. Intrinsic Motivation Inventory (to be used to measure intrinsic motivation both as an outcome, and as a factor in willingness to share information.)
    a. Interest/enjoyment questions:
        i. I enjoyed doing this activity very much.
        ii. This activity was fun to do.
        iii. This activity did not hold my attention at all. (Reverse)
        iv. I would describe this activity as very interesting.
    b. Competence questions:
        i. I think I did pretty well at this activity, compared to others.
        ii. After working at this activity for a while, I felt pretty competent.
        iii. I am satisfied with my performance at this task.
        iv. This was an activity that I couldn't do very well. (Reverse)
    c. Willingness to expend effort questions:

i. I put a lot of effort into this.
ii. It was important to me to do well at this task.

d. Perceived value questions:
    i. I think this is important to do because it can help people collaborate.
    ii. I would not be willing to do this again because it has no value to me. (Reverse)
    iii. I think doing this activity could help me to collaborate better.
    iv. I think this is not an important activity. (Reverse)

e. Lack of pressure questions
    i. I did not feel nervous at all while doing this.
    ii. I felt very tense while doing this activity. (Reverse)
    iii. I was anxious while working on this task. (Reverse)

f. Choice question
    i. I did this activity because I wanted to.

g. Social-relatedness questions
    i. I felt really distant from the other group members. (Reverse)
    ii. I really doubt that the other group members and I would ever be friends. (Reverse)
    iii. I'd like a chance to interact with the other group members more often.
    iv. I'd really prefer not to interact with the other group members in the future. (Reverse)
    v. I feel like I could really trust the other group members.
    vi. It is likely that the other group members and I could become friends if we interacted a lot.
    vii. I feel close to the other group members.

3. Unified Theory of Acceptance and Use of Technology Model (to be used to measure how well the interface supports collaboration, both as an outcome, and as a factor in willingness to share information)
    a. Performance questions:

i. I found the interface useful in solving the problem.
ii. Using the interface enabled me to accomplish tasks more quickly.
iii. Using the interface increased my productivity.
iv. Using the interface increased my chances of success.

b. Ease-of-use questions:
i. My interaction with the interface was clear and understandable.
ii. It was easy for me to become skillful at using the interface.
iii. Learning to operate the interface was easy for me.

c. Attitude questions:
i. Using the interface was a good idea.
ii. The interface made solving the problem more interesting.
iii. Working with the interface was fun.
iv. I liked working with the interface.

d. Facilitation questions:
i. I had the resources necessary to use the interface.
ii. I had the knowledge necessary to use the interface.
iii. The interface was not compatible with other systems I use. (Reverse)
iv. Someone was available for assistance with interface difficulties.

e. Self-efficacy questions:
i. I could solve the problem using the interface, if there was no one around to tell me what to do.
ii. I could solve the problem using the interface, if I could call someone for help if I got stuck.
iii. I could solve the problem using the interface, if I had a lot of time to complete it.
iv. I could solve the problem using the interface, with just the built-in help menu for assistance.

f. Lack of anxiety questions:

i. It scared me that I could lose a lot of information using the interface by hitting the wrong key. (Reverse)
ii. I hesitated to use the interface for fear of making mistakes I could not correct. (Reverse)
iii. The interface was somewhat intimidating to me. (Reverse)

g. Intent question:
i. I predict I will use the interface if it becomes available.

4. Flow State (similar to intrinsic motivation, to be used to measure interface efficacy both as an outcome, and as a factor in willingness to share information.)
a. Challenge questions:
i. I was challenged, but I believed my skills would allow me to meet the challenge.
ii. My abilities matched the high challenge of the situation.
iii. I felt I was not competent enough to meet the high demands of the situation. (Reverse)
b. Awareness questions:
i. I made the correct moves without thinking about trying to do so.
ii. Things just seemed to be happening automatically.
c. Goals questions:
i. I had a strong sense of what I wanted to do.
ii. I did not know what I wanted to achieve. (Reverse)
iii. My goals were not clearly defined. (Reverse)
d. Feedback question:
i. I had a good idea while I was performing about how well I was doing.
e. Concentration questions:
i. My attention was focused entirely on what I was doing.
ii. It was an effort to keep my mind on what was happening. (Reverse)
f. Control questions:

i. I felt in total control of what I was doing.
ii. I felt like I could not control what I was doing. (Reverse)

g. Loss-of-self questions:
    i. I was concerned with what others may have been thinking of me. (Reverse)
    ii. I was not concerned with how I was presenting myself.

h. Time perception questions:
    i. Time seemed to alter (either slowed down or speeded up).
    ii. The way time passed seemed to be different from normal.
    iii. It felt like time stopped while I was performing.
    iv. At times, it almost seemed like things were happening in slow motion.

i. Autotelic questions:
    i. I really did not enjoy the experience. (Reverse)
    ii. The experience left me feeling great.
    iii. I found the experience extremely rewarding.

Cronbach's Alpha for this version of the Willingness to Self-Censor Scale was fairly low, at .609. The highest alpha that could be obtained by dropping a variable was .635. One possible source of the lower reliability was the narrowing of the scale choices from 1-7 to 1-5. Another possible source was the small sample size.

Cronbach's Alpha for this version of the Intrinsic Motivation Index was acceptable, at .788. There were 8 variables that would have given a higher alpha score if they had been left out. Neither the reduction in scale choices nor the small sample size caused any apparent reduction in reliability.

Cronbach's Alpha for this version of the Acceptance Scale was fairly high at .909. There were 6 questions that would have given a higher alpha if they were dropped. However, the score was already high enough that there was some question of redundancy in what it was measuring. Reducing the scale choices from 1-7 to 1-5 didn't seem to hurt the reliability in this case, nor did the small sample size.

Cronbach's Alpha for this version of the Flow Scale was slightly low at .696. Dropping any of the questions about time would have resulted in an alpha of over .700. One possible source of the lower reliability was the reduction of the scale choices from 1-7 to 1-5. Another possible source was the small sample size.

APPENDIX F – MEGA-COLLABORATION TOOL SPECIFICATIONS

Concept and Scope of the MCT

The core concept of the Mega-Collaboration Tool (MCT) is that it should be possible to conduct large-scale conversations among people on the Internet by breaking them into many smaller conversations that are managed in an organized fashion with the help of the computer platform. There are two possible ways in which a conversation on the Internet can grow to be unmanageably large. The first way is that too many people want to talk about the same narrow topic, with the result that the same things get said over and over, and the thread becomes difficult to follow. The second way is that, as people are added to the conversation, the topic broadens so much that it becomes difficult to know who is discussing what. Both of these phenomena tend to happen at the same time during an especially lively conversation thread.

One solution to the first problem is to break the participants into groups, have them all discuss the same topic, and then flow the resulting thoughts among the groups. This can be done either by each group having members in common with other groups, or by having sequential joint discussions between pairs of groups. Either way, a more-or-less complete set of thoughts can be shared by everyone in a way in which it is easier to follow, and easier to participate (Newlon, 2007).

A similar solution to the second problem is also to break the participants into groups, but have each group discuss a slightly different, though related, topic. In this case, information is flowed among groups in a hierarchical fashion, by having members representing each group bring that group's thoughts to a higher-level group that considers the topic on a broader scale, and passes its ideas back down the chain to the original groups. This hierarchy can grow to as many levels as necessary for a complete discussion, as long as each group remains at a manageable size (Newlon, 2007).

It follows that a tool to support both of these solutions must provide a robust conversation platform for the small group discussions, and the ability to easily create and link the small groups in the ways described above. This is where the MCT comes in.

To meet its design goals, the MCT must allow individuals to come together on the Internet and form groups to discuss and address issues. To provide the necessary robust support for the conversation, once each group is formed, the interface must support the development of both individual and group mental models, including goals and action

plans that relate to the common interest of the group members. The interface must provide input, output, and group management mechanisms to support this. The tool's interface must enable mega-collaborating groups to form a robust picture of their data, while automatically creating a data structure to manage it. Based on the results of a study by Farnham (2000), a key assumption of the MCT is that the ability to explore this picture together as a team-building exercise will encourage groups to move from competitive to cooperative behavior.

However, this kind of tool faces several constraints. The users must have the ability to gain access to the tool. They must develop sufficient interest in joining a group and in helping each other. They must understand both the interface and the subject matter well enough to develop and negotiate data models and action plans. This means that they must be able to learn the interface quickly and under stressful conditions.

Use Cases

To elaborate on the MCT concept, we developed a number of theoretical user profiles and use cases for a crisis-management scenario. These were drawn from users and events documented in the wake of Hurricane Katrina (Newlon, Faiola, et al., 2008). Table 36 shows the representative users for which we developed profiles.

Table 36. *User Profiles*

Type	User	Motivating Goal for Use
Local Emergency Responders	District Fire Superintendent	Determination of Priorities
Volunteer Labor Organizations	Firefighters' Union Coordinator	Resource Coordination
Non-Profit Aid Organizations	Red Cross Coordinator	Resource Coordination
Military Organizations	National Guard Coordinator	Response Activity Tracking
Federal Emergency Responders	FEMA Coordinator	Jurisdiction Coordination

Concerned Common Citizens	Store Manager	Resource Donation
Volunteer Workers	Social Worker	Resource Donation
Volunteer Experts	Computer Expert	Technology Donation
Affected Individuals	Relative	Rescue of Family Members

The user profiles in Table 23 demonstrate the diversity of needs generated by a major disaster. The use cases envision the ways in which technology could help meet those needs. They reveal that mega-collaboration must provide interrelated solutions to different responders. Therefore, one critical feature of these solutions is that they all draw from the same database, which provides customized interfaces to each user and to each group. Another feature is the use of software agents to act independently in coordinating the data definition process among the various groups.

Required Features

In addition to basic security, account management, and data architecture considerations, mega-collaboration must support a number of different interactions among users. These are listed in Table 37.

Table 37. *Supported Interaction Requirements of Ideal MCT Platform*

ID	Interaction	ID	Interaction
1	Find Site	10	Provide Help
2	Use Site	11	Develop Mental Models
3	Find Area of Interest	12	Negotiate Group Models
4	Participate	13	Vote
5	Converse	14	Take Turns
6	Create Group	15	Exchange Information and Resources
7	Join Group	16	Form Groups of Agents
8	Leave Group	17	Agent-Mediated Playoffs
9	Disband Group	18	Inter-Group Negotiation

Proposed Architecture

The architecture proposed for this application is 3-tiered, with an intelligent front end on the user's local device managing the user interface, a middle-tier on a web server containing the business logic, and a set of back end functions in the cloud for handling the collaboration output (initially developed in PHP to store the data in a MySQL database). The basic PHP code and MySQL tables that serve the application (supply the business logic, screens, and collaboration timers) will reside on an account with a hosting service. These components are not expected to experience uncontrolled growth, because the code and screen tables will not be changed by the application's use, and the timer tables will only hold the timers for currently active collaborative sequences. Eventually, the plan is to use a cloud data storage mechanism, such as Facebook or Google, for most user-generated topic-specific data, taking advantage of mass-scaling methodologies (Hamilton 2009; Lakshman 2008).

Cloud Application

The future version of the MCT application will be developed as a cloud application. As discussed above, the architecture proposed will be 3-tiered, with the intelligent front end developed in JavaScript, or an equivalent language, managing the user interface, the middle-tier developed in PHP, or an equivalent language, containing the business logic that is drawn from a database, and the back end developed in a cloud environment storing the data in a NoSQL database. A more detailed description of the proposed design is as follows:

Base Functionality Provided by the Cloud Environment

A significant amount of the functionality described above in the section on MCT specifications will be achieved through use of a cloud development environment. The features to be achieved in this way are described in this section to convey an understanding of the tool. However, they are not considered part of the current research design, but as a future goal that will allow examination of the current research platform to be placed in context.

Space and Security Considerations

Some of the anticipated space and security considerations for this tool are related to the envisioned method of deployment. Use of the proposed tool by individuals will

presumably be intermittent, as situations that need collaboration come and go. So, the original plan was to maintain only a small implementation of the tool along with a protocol established for growth. The initial step in creating each new module would have required arrangements for server space in which to install the new module's initial database.

However, it is hoped that deployment on a cloud platform will obviate this requirement. It should be possible to maintain the basic PHP code that serves the application, and the MySQL tables that supply the screens and run the user-driven collaboration timers, on an account with a hosting service, such as FreeHostia. These components are not expected to experience uncontrolled growth, because the code and screen tables won't be changed by the application's use, and the timer tables will only hold the timers for currently active collaborative sequences. The plan is to use the cloud service's data storage for all other user-generated data, thus taking advantage of its Cassandra-type (or equivalent) scaling methodology (Hamilton, 2009; Lakshman, 2008).

Therefore, the proposed method of situation-conditional expansion and contraction will be the addition and removal of entities, such as Facebook's public profiles and groups. Each public profile will serve as the root of a specific mega-collaboration project, while each group will support a team of people working on that project. This approach will require identification of an individual who will act as the chief administrator for each public profile or group, but the administration function will be handled through the cloud service (i.e. Facebook). It will be the task of the administration group to maintain the security level for their particular profile or group using the range of security options that the cloud service provides. The administration group will also be responsible for removal of the profile or group after completion of the collaboration (Maver & Popp, 2010).

Cloud Group and Public Profile Management

As part of this tool's basic approach to collaboration management, all groups within a project will be created as children of other groups, except for the original root group of a new project (which is associated with a public profile). Each group will have part of the overall project data model associated with it, such that a concept at one level is expanded into a data subdivision and an associated group at the next level. Every group-associated

division in the overall model will have a defined theme describing the general purpose of that division and its associated group.

This necessitates the ability to divide the data model and to assign the pieces to new groups. If it is necessary to divide a topic in the data model because there are too many participants wanting to discuss it, the divisions will remain at the same conceptual node of the model and have identical themes. If it is necessary to divide a topic because it has become too broad, the divisions will become separate conceptual nodes, and their themes will be updated to reflect their new areas of focus. If it is necessary to introduce a new topic, a new conceptual node will be created in the model, with a new theme. In each case, a new cloud group will be created.

The person proposing a division in the data model will also propose the theme for that division, and will set the initial join policy, work methods, size limit, etc. for the group associated with that division and become the initial administrator for the group. A default set of these parameters will be provided to this person, for ease of use. Also, depending on the work-method chosen by a group's creator (i.e. allowing self-organization), group members may later vote to change the group's parameters, thus customizing the group according to their own needs and preferences. To the extent possible these functions will use features of the cloud service's API, with any needed additions supplied through external coding.

User Account Management

It is essential that the Mega-Collaboration groups recruit their members through discovery when potential users search for information about a disaster or other topic of concern. Therefore, these users must be able to find the groups that are actively working on their topics of interest by using a general search engine, such as Google. During the recruitment process, a prospective group member must be able to watch the activities of the group before making any commitment, to decide whether participation is desirable. Therefore, it is important that the application not require identity information until a user commits to participate in a group's endeavors. It should be possible for an individual to view any unsecured resource, chat, or model information without establishing an account or logging into one.

This will be accomplished by creating each new collaboration project on its own public profile page that is accessible via search engines (Maver & Popp, 2010). The cloud groups established for each topic will, by default, publish their ongoing activities to a stream that can be viewed on the public profile for that project. Each set of such posts will carry a "participate" button, allowing viewers to assume an active role. Once that button is pushed, a combination of routines and application filters will determine if the user needs to set up a cloud account, or log in, or if the group the user wants to participate in has grown too large, and needs to be divided.

The cloud service will handle all of the routine account functions, such as setting up new accounts, logging users in and out, resetting lost passwords, access and/or update to users' personal profiles, and access and/or update to the activities in which users are involved. There will be no additional identity information required to establish an account.[7] Users that have not been active in a group for some group-specified time span will be automatically dropped from the group in question. Any group that has been inactive for a year will have its data archived, and be removed. The archived data will be kept for some period of time afterward.

Support for Mash-Ups

The MCT will provide a certain amount of native functionality, and will be customizable to create even more functionality. However, rather than try to define all possible features within the tool, it is important that the tool be designed to interface closely with outside applications, thus forming mash-ups. This will allow it to make use of externally developed functionality. Zhao and colleagues (2008) suggest that a component model be used for mash-ups that separates the service from the user interface. This, for example, is what Facebook offers. The Facebook interface can be used to integrate Facebook-compatible applications of many different types. It is necessary to develop the MCT in a way that welcomes this integration, with easy access to other applications and the ability to move data from one application to another. For example, a list of the outside interfaces

[7] It might, however, be necessary to write a customized account management function for the Mega-Collaboration application that allows access and/or update to user contribution scores. These scores would allow the users to accumulate social recognition for the collaborative contributions they have made over time.

to be supported might include such popular applications as Google Maps, Wikipedia, and YouTube.

Peer Support Groups

The MCT will be required to provide considerable, context-sensitive help to the users. Help with the basic functionality of the tool will be covered via a sequence of instruction boxes. In addition to the instructions, a list of frequently asked questions (FAQ's) will be made available to the users. However, due to the widely-varying nature of the problems to be dealt with, such as in a disaster situation, it will also be necessary to create a formal, peer-support group within the cloud service for this application. The system must allow the users to score each other based on the usefulness of the advice they have received. It must also allow the users to shadow each other for the purpose of learning. A version of the application may also be made available in a sandbox, to be used for the purposes of demonstration and practice. Some of these features are already a part of cloud peer support groups. Any specialized functions will be supplied by externally developed code.

General Functionality Goals for the Current Research Track

While group management functionality is expected to be supported by the cloud platform, certain mega-collaboration functions will have to be supplied by the external part of the application. In particular, the robust platform for support of small group conversations must be externally developed within the MCT. This includes the parts of the interface that facilitate collaboration through the creation of collaborative sequences, the development of explicit group mental models, and the input and output functions required to support such activities. These are the components of the application under specific study by the current research track. They are described below.

Support for Group-Selected Collaboration Sequences

The major difference between a basic conversational interface and a collaborative interface is that, in a collaborative interface, the interactions have some type of organization. For example, with parliamentary procedure there is a fairly rigid protocol dictating who can speak, how long they can speak, what topic they can speak about, and how decisions can be made as a result of their speech. Collaboration engineering is similar in that it uses formalized collaborative protocols that are assembled in segments, for instance brainstorming, followed by categorization, followed by voting on priorities.

These protocols can easily be administered by computer. It requires an interface with a database that is set up to do such things as track access rights for the "speakers", and set and update the appropriate timers. Because the MCT will be used in many different circumstances, however, it is not possible to determine ahead of time just which sequence of collaboration protocols will be appropriate for any given situation. For this reason, an important part of the eventual MCT function is that individual groups will be able to dynamically create their own collaboration protocol sequences.

The protocol sequences will follow the general example of de Vreede's thinkLets (de Vreede et al., 2006), each with a unique pattern of interaction components. For example, groups may need a voting component for group decisions. (Such a voting component would be used for the m-ThinkLet-type interactions of *agree/disagree* and *accept/reject*.) The voting component will require a voting interface that shows the vote status, the current count, and the amount of time left. While each vote will have a default vote time, it will also be possible for the group to have a consensus vote on ending the main vote early or on delaying the end time of the main vote to allow additional negotiation. Because users may be participating in several groups simultaneously, a vote alert method will be needed. An individual user should have a choice of notification methods for impending votes via email, text message, or computer pop-up screen.

Another commonly used component will be some form of turn-taking for such m-ThinkLet-type interactions as *propose* and *negotiate*. The support of turn-taking will require the same notification methods required by the support of voting. There will be a default response time during which the user must begin inputting data, or forfeit the turn. Warnings will be sent before this happens, however. The individual user will be able to exert some control over a turn through the use of options such as *finished*, *pass*, and *extend*. In addition, the group as a whole will be able to vote on ending turn-taking early or taking another round. As a group defines a component that requires turn-taking as part of its planned collaborative sequence, it should set its turn-taking parameters, including the default turn length, the timing of warnings, the ability to ask for extensions, and the policy for determining turn order (i.e. random, seniority, expertise, or by vote).

These are just two examples of the types of functionality that will need to be integrated into collaborative interaction segments that can be offered to users for building

their collaboration sequences. The MCT version used in this particular study had just enough of these components to support a basic progression from data-gathering to decision-making.

The Negotiation of Group Mental Models

One of the planned products of the group's collaboration process is the negotiation of an explicit group mental model of the problem at hand. The MCT will be designed to encourage the users to develop permanent individual models that can be stored in their personal profiles, updated either during collaboration or privately, and carried from one group to the next. The users will be able to upload from their personal models into the group model during the group-selected collaboration sequences, and to download from the group model into their personal models at any time.

The tool will also enable them to view and discuss the contents of each other's personal models, and even to borrow each other's ideas directly through data transfer from one personal model to another. However, because the personal models may become large and diverse as individuals work on many problems with many groups, the tool must allow the users to pick and choose which parts of their personal models are visible to group members in each group context in which they are participating.

As mentioned above, the tool must support collaboration sequences that involve such things as turn-taking, chat, and voting for the building of the group's model. It must also support views of both the group model, and of group members' models. In some cases, two groups will be working together to synchronize models. This will require an interface to support views of both models, and to support the communication of the groups' representatives, both with each other, and with their original groups.

Input and Output Considerations

A final category of functions that must be developed externally is the general area of input and output. To encourage development of the models, the tool must be as input-friendly as possible. In addition to easy internal transfer, the tool should support the easy upload and download of data from and to external sources.

The tool must also provide access to a standard set of input and output methods, including address book, calendar, schedule book, map, email, and SMS text messaging. While these interfaces will not be an explicit part of this study, they will have to be

created and tested for usability at some point to provide adequate support for the collaboration and model-building.

Data Management Considerations

Given the level of intelligence possible on the front end – with JavaScript and PHP passing business objects back and forth, rather than passing piecemeal data streams – the database design on the back end can be kept ruthlessly simple and generic. It should be possible to design a data structure with no business logic at all, thus allowing all business logic to be defined within the middle tier, rather than the database tier. Each item of data can be treated as an entity, with a unique, non-situational identifier, along with any number of in situ identifiers. The relations between different entities will then be defined in a relation triad, each record of which links one entity to one other entity via some type of relation. The goal is to format these user-generated entity records as text to keep them in a cloud-based data store associated with each user and group. It should then be possible to translate this data to integrate user-developed data structures and collaboration sequences with the MCT's native functionality.

Therefore, the business-logic tier of the application will contain a number of its own layers. At the lowest level will be a class of objects that read and write the raw data into the appropriate profile. The next level will reconstruct and/or deconstruct between the basic business entities and the cloud data. It will manage more complex data types, such as map coordinates, security constraints, time-slots, scores, and URL links. This layer will define the methods and properties of such basic business objects as events, goals, tasks, actions, roles, actors, players, teams, and resources. The highest level of the middle tier will define the complex interactive behavior of these objects to coordinate the activities of the application's users as they collaborate on a problem. In the future, this level will also generate and manage the various autonomous agents that will provide coordination for the project.

The user-interface tier, located on each workstation, will receive the data from the business-logic tier as a series of very detailed data models. Because of the need for user-defined functionality, much of the screen interface will have to be defined at runtime, with extensive use of binding to draw information dynamically from the models. It is

here in the user-interface tier that additional functionality for the tool must be created using such things as entry windows, drop-down menus, and drag-and-drop actions.

Also, because of the amount of data manipulation the MCT will be performing, the database will keep source and edit history for every data item accessible to the user. In the interest of efficient data storage, whenever information is duplicated within different models via uploading, downloading, or direct transfer, the new records in the database will point to the original ones, rather than duplicating them. Also, whenever information is consolidated via the combination of entities, this action will be tracked with the use of the history log, rather than continuing to carry the outdated entities within the database.

Using this type of structure for the data will require several types of data-entry interfaces. In addition to one or more interfaces for adding children, attributes, and instances to existing entity nodes within a model tree, a specialized interface will also be needed when different nodes are found to represent the same entity, which has been defined in different situations. It must be possible to discuss this problem, and to create a linkage between the two in situ entities, showing that they are really the same thing, without losing the contextual information from the different situations in which they are defined. In navigating through the model tree, it must also be possible to display and navigate these in situ linkages (thus converting the tree to a network).

It should be noted that in addition to the interface provided to the users, and to the user-administrators, a root-level administrative interface will also be needed for general database management. This interface will respect the cloud-service security rules maintained for each data item.

Functionality to Be Saved for Future Research

A number of other features are planned for the fully developed MCT. However, these will not be implemented as part of this research track. For the most part, these are features that will require large-scale use of the tool before they can be effectively used. Because there will be no way to test them, given the planned scale of the current research, they will be left for future development. These features are described below for future reference.

User-Defined Input and Output

In the fully developed MCT, the user will have the ability to choose and/or develop custom methods for both input and output, and to save and publish these developed I/O methods for use by others. This will create economies of scale, where the system learns and becomes more capable as it is used. This development process will be driven by the use of templates and pick lists, with each list having an "other" option leading to a method for adding a new entry or option. However, it is first necessary to develop the MCT's basic methods before custom methods can be made available. Therefore this feature will be left for future development.

Teams of Agents

A planned core function of the MCT will be its ability to autonomously coordinate the synchronization of information. The tool will eventually accomplish this by creating a separate autonomous agent to represent each active group. Each of these agents will keep track of the data input into its group model and communicate this information to other agents for the purpose of comparison.

Each agent will attempt to establish permanent linkages with neighbors by linking to the agents of the parents and children of its group, and by searching for siblings with similar themes or similar data models. Each agent will also attempt to establish a more diverse set of permanent linkages, following methods established by Scerri's group (Glinton et al., 2010; Scerri et al., 2010; Velagapudi et al., 2009), by searching for non-neighboring agents with similar data items, and by establishing at least one linkage completely at random. These agent networks and the history of their interactions will be both viewable and searchable by the users of the MCT.

Agent-Mediated Playoffs

Once the autonomous agents have formed agent teams, and started comparing the developing group models, they will periodically notify their respective human groups when it is necessary to synchronize the developing models. The intervals of these notifications may be determined by group model rates of growth, group model sizes, changes in rates of growth, where group models are on log growth curves, or criticality of decisions (a critical decision point being identified by the group).

Inter-Group Negotiation

Once notified, the groups will require a specialized interface to negotiate the synchronization of their models. Interfaces will be developed to support same-conceptual-node synchronization and hierarchical-conceptual-node synchronization. The form of each interface will be determined by the type of synchronization that is necessary.

If the groups are at different nodes on the model tree – discussing different, though related, topics – all groups at the relevant nodes will be formed into one or more playoff groups, depending on how many lower-level groups there are. Each group will be represented by a single member, who will act as the group's representative on the playoff group. The other members of the original groups will be able to watch the playoff group, but not participate. They will conduct all discussions about the playoff in the forums of their original groups. Each group representative will use the original group's model as an individual model for the purposes of the playoff. The playoff group will then build a playoff model via uploads from these individual group models, and new entries. Each representative will initially decide what to download from the playoff model back to the individual group model. However, because turn-taking and model-building will continue in the original groups, their members will vote on whether to accept these downloads. Any additional changes in the lower-level group models will also be reflected back up to the individual models used by the playoff group.

A more conservative type of synchronization will take place in the cases where groups are on the same node in the data structure, working on the same topic. In these cases, the groups will conduct a sequential, pair-wise synchronization with one or more other groups. Such synchronizations will be conducted one pair at a time, either directly with each other, or through a sequence of parent-child pairings.

It will be necessary to first synchronize all groups at the same node in a data model before conducting any pair-wise synchronization with parent or child groups. Therefore, all same-topic synchronization rounds must be completed before starting any similar-topic rounds.

Depending on what is discovered while attempting to synchronize among different groups, it may be decided to restructure the groups or to re-allocate data models among the groups rather than change the information inside the model.

As can be seen, each of these agent-driven features will require a significant amount of complexity within the developing project. For this reason, they are beyond the scope of the current research track.

Exchange of Information and Resources

Another core function of the MCT in the future will be to support the ad hoc exchange of information and resources. This should take place in a more open forum than the structured model-building activities. Rather than being structured by group, this forum must be structured by broad topic, but the information in this forum should still be linked to information in the model-building process. Essentially, this forum will allow an unlimited number of people to join in each topic's discussion, but will limit the format of the inputs. The users should be able to add to an "I need" section, and to a linked "I can supply" section. In both cases, it should be possible to input a general location for physical items.

The MCT itself should support the calculation of overall supply and demand figures, broken down by general location, and should provide routing algorithms to assist in the coordination of pickups and deliveries. The MCT must also provide some method of managing contact information for those concerned about privacy.

While such a function is expected to be well within the parameters of cloud support, it is again beyond the scope of this research track. The MCT will have to be widely available before a simplified exchange interface such as this becomes practical. In fact, it may be better to supply this sort of functionality through a mash-up with an external application, such as Craigslist or the Sahana and Ushahidi applications mentioned in Chapter Two, because the interactions described are not especially unique.

Specific Functionality Developed to Support this Study

The version of the MCT platform developed for the current study was designed to help determine the specific set of functionalities that the "robust conversation platform for small group discussions" must provide. It was intended to allow individuals to come together in an Internet-based discussion that addressed a specific set of assigned issues,

and to provide a supporting interface for the resulting deliberative process. There were a number of features in its design that were driven by the research background areas described in Chapter Two.

Rather than becoming involved with the MCT via spontaneously-formed, and randomly sized groups, participants were instead deliberately recruited and formed into three-member groups for the purpose of working with this experimental version of the MCT interface. Once each group was formed, the interface was intended to support the development of a group mental model, with goals and an action plan. A basic set of input and output mechanisms was provided to support this. The study measured how robust a picture, of a supplied set of data, the group members formed. It also stored the participant-created data structures in a database for the purposes of display, manipulation, and future study.

The interface stepped each role-playing group through an interaction process that was structured using thinkLets. It explicitly asked the group's members to give their thoughts on a set of topics. This was intended to subtly encourage them to share private information they had been given as part of their roles. The interface also organized the different thinkLets in a step-by-step manner that was intended to separate the task of gathering information from the tasks of evaluating it and of making final decisions. The interface's interaction process structured the evaluation task to encourage consideration of all information by guiding the group through the process of abstract reasoning. This was accomplished by requesting that the group consider the relations between their various thoughts and use these relations to create categories into which they could sort their ideas and expand upon them.

In addition to the interaction process, the interface directly supported the required tasks by providing a series of buttons, input boxes, and input templates that made it easier for the group members to share what they knew, and link it to input from the other group members. By storing their input (and preserving its structure) in a back-end database, the interface automatically created a shared data repository that served as a memory aid (and template for further information entry) during the group's discussion. The ability of the interface to draw user-provided information from this shared repository and arrange it into information-entry templates made it easier for group members to manipulate it. This

particular interface wasn't specifically designed to develop transactive memory structures, however, because the roles already had a transactive memory structure built into them.

It was hoped that this interface would be user-friendly enough to effectively capture the group's developing mental models. The interface was specifically intended to support the model-building process by converting the thoughts of the group members into representations that could be compared with those of other group members to build common ground (Convertino et al., 2008; Crapo et al., 2000).

Because usability testing of the previous version of the interface had determined the need for more flexibility, the users were allowed to enter, and elaborate upon, every different type of entity as a *thought*, and then to define their own relations among the thoughts that had been entered. This was much more flexible than making the users fill in a previously-defined structure of entities, such as the events, goals, tasks, roles, actors, and resources of the previous MCT version (Farnham, Chesley, McGhee, Kawal, & Landau, 2000; Newlon & Faiola, 2006; Newlon, Faiola, & MacDorman, 2008; van der Veer & van Welie, 2000). Instead, external structure was offered to the group at the point where the members were sorting the gathered information into categories. Rather than a simple sort, the users were offered a matrix, with the categories they had defined running down the side, and a series of columns, each representing one of the types of mental model. (These types of mental models are *taskwork models* containing process-related knowledge, *strategic models* containing goal-related knowledge, *situation models* containing situation background and awareness knowledge, and *teamwork models* containing knowledge about other group members.) The idea was to encourage the group members to consider which type of information each recorded thought represented as they chose a column for it, and also to consider what additional information was needed in the other columns, based on that thought.

To facilitate the model-negotiation process in a dispersed and heterogeneous group, the interface supported the dialogue among the members both through an unstructured chat window, as well as through the more structured *thought card* that users could create for each chain of ideas. This allowed the online conversation surrounding the collaboration to be captured and preserved in its context (Newlon, 2007).

The subset of the overall MCT interaction requirements met by this particular platform is shown in Table 38.

Table 38. *Supported Interaction Requirements of Current MCT Platform*

ID	Interaction	ID	Interaction
1	Converse	4	Develop Mental Models
2	Create Group	5	Negotiate Group Models
3	Join Group	6	Vote
		7	Take Turns

Interaction Flow

As mentioned above, the platform's functionality included the parts of the interface that facilitate collaboration through the development of explicit group mental models, and the input and output functions required to support such activities, because these components were under specific study by the current research track. To examine the differences between a basic conversational interface and a collaborative interface, two different versions of the platform were created. To track access rights for the group members using the collaborative interface, and to manage the assignment of tasks in both interfaces, a set of timers was created, running their timing from the central server to increase synchronicity.

Timers

The timers used by the application are shown in Table 39.

Table 39. *Timer Types and Intervals*

Timer	Minutes
getAcquainted	20
themeGenTest	5
themeElabTest	5
enhanceGenTest	5
enhanceElabTest	5
colorGenTest	5

Timer	Minutes
colorElabTest	5
problemGenTest	5
problemElabTest	5
relationSetTest	5
relationRoundVote	1
categoryTurn	1
popcornCountdown	1
cleanupCountdown	1
cleanupRoundVote	1
themeChatControl	15
themeRoundVote	1
enhanceChatControl	15
enhanceRoundVote	1
colorChatControl	15
colorRoundVote	1
problemChatControl	15
problemRoundVote	1
repVote	1
repRunoff	1
actionPlan	10
endTimer	0

Treatment 1 – The Collaboration Interface

The collaborative interface version used a specific set of thinkLets (de Vreede et al., 2006) to provide organization to the interactions. There are different types of thinkLets that support different patterns within the decision-making process, these patterns being divergence, reduction, clarification, organization, evaluation, and consensus-building. The original MCT prototype contained several primitive thinkLet-type interaction supports. It was hoped that computer-driven versions of a more standard

set of thinkLets could be substituted to add support for a brainstorming, categorizing, ranking, and decision-making sequence.

In fact, the MCT version used in this particular study had just enough thinkLet-based collaboration components to support a basic progression from data-gathering to decision-making via the negotiation of an explicit group mental model of the problem at hand. The thinkLets provided included a data-gathering component, a discussion and elaboration component, a relation-building component, a categorization component, a matrix-sorting component, a turn-taking component, and voting components that allowed the choice to end timers early, the choice to move on at the end of a timer, or extend the segment, and the choice of a group leader. The voting interface showed the vote status, the current count, and the amount of time left. HTML and CSS functionalities were used to provide the input and output needed. These supported upload and download of data via cut and paste.

The approach to the interactive process was developed based on differences in the complexity of concepts between the test and control teams that was discovered in Phase 1 testing of the original interface design. However, the specific layout of the new interface was based on the recommended layout that emerged from Phase 2 testing. Entries to individual models on the test teams tended to be unorganized lists of ideas, but the act of consolidating these ideas into the group model tended to force hierarchical organization, resulting in a more complex group model.

Users wanted cut-and-paste capabilities, the ability to enter large pools of existing data, and the free-form manipulation of the data after entry. Post-test interviews in the follow-up study revealed a desire to reorganize, attach, and detach partial data hierarchies (Newlon, Faiola, et al., 2008). It was clear that, to move to the next level, both the data categorization and the manipulation abilities of the prototype MCT needed to be improved to make it more flexible.

The ability to categorize and manipulate concepts is expected to have a major impact on the success of negotiation among members of large and dispersed groups. The first group captured information through a test interface that supported formalized modeling and a managed interaction process, producing hierarchical sets of concepts, categories, and facts, the structure of which, at any given point in the development process, could be

displayed and examined. The second group shared information through a traditional chat interface and stored it in traditional message and reply hierarchies.

The lesson learned here is that a collaboration support tool should never fail to support conversations among the collaborators.

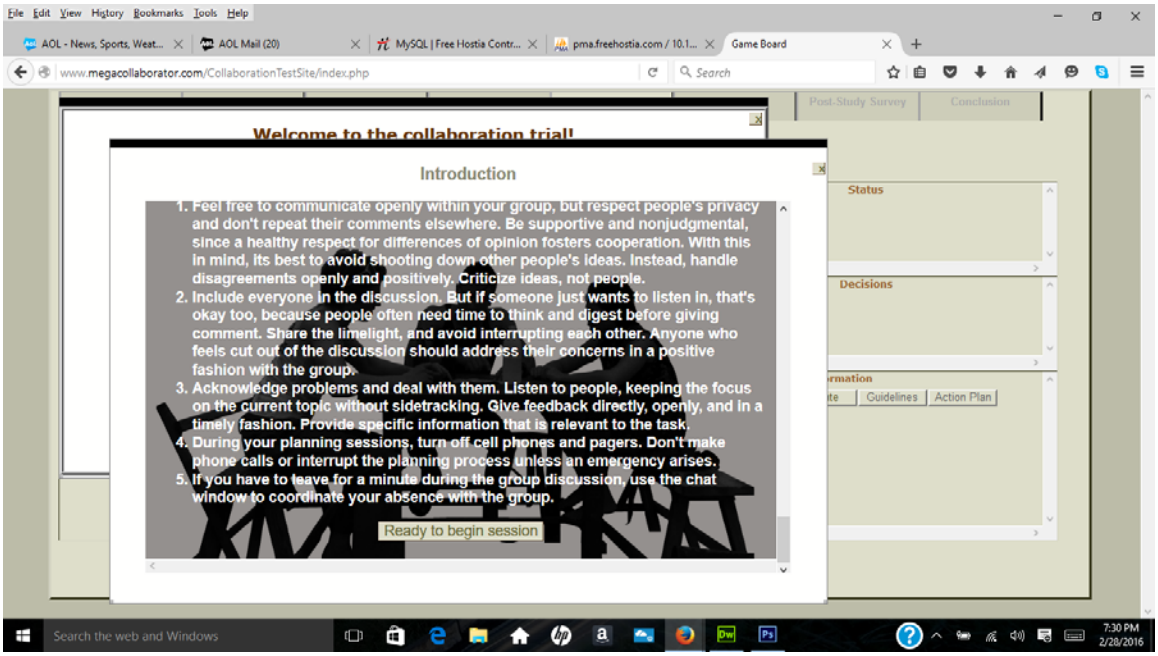
Treatment 2 – The Conversation Interface

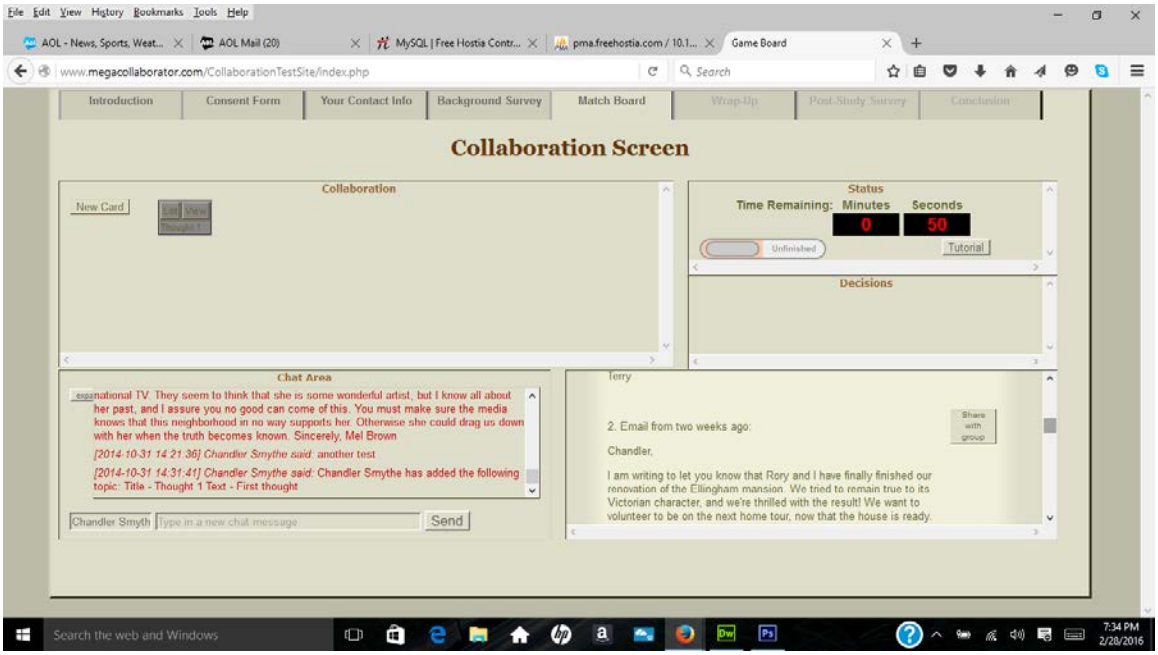
Architecture

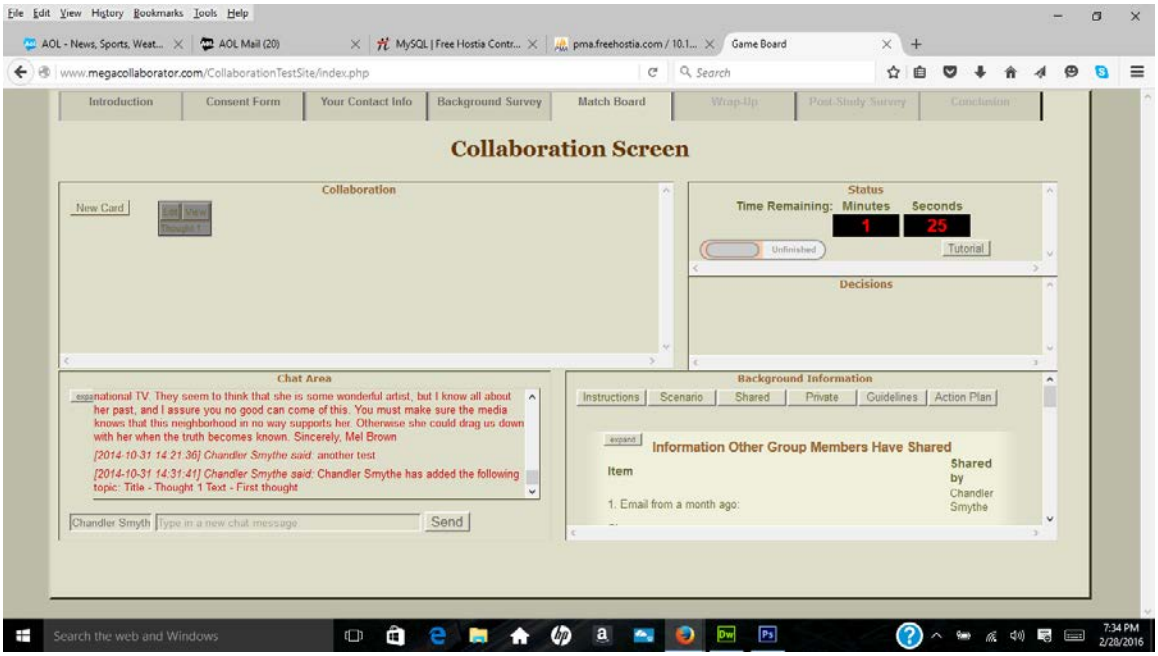
The architecture used for this application was 3-tiered, with an intelligent front end managing the user interface that was written in JavaScript, and both middle-tier and back end functions developed in PHP on a FreeHostia server. The middle tier and back end functions stored and/or retrieved data using a MySQL database on a FreeHostia database server.

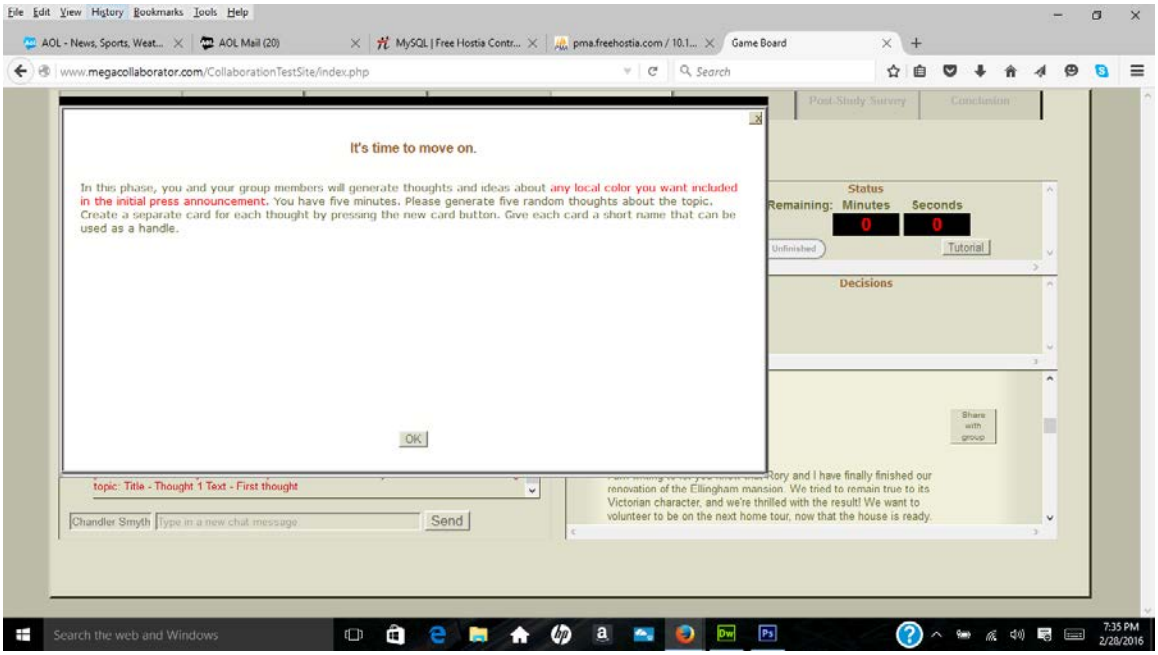
The database design on the back end had a number of static tables from which the middle tier of the application managed the application flow. There were also a number of tables that gathered data as the participants generated it. The majority of the front-end logic for generating screens, however, was stored locally in JavaScript routines to reduce the amount of data sent to the server. AJAX was used as the communication method between the front and back ends.

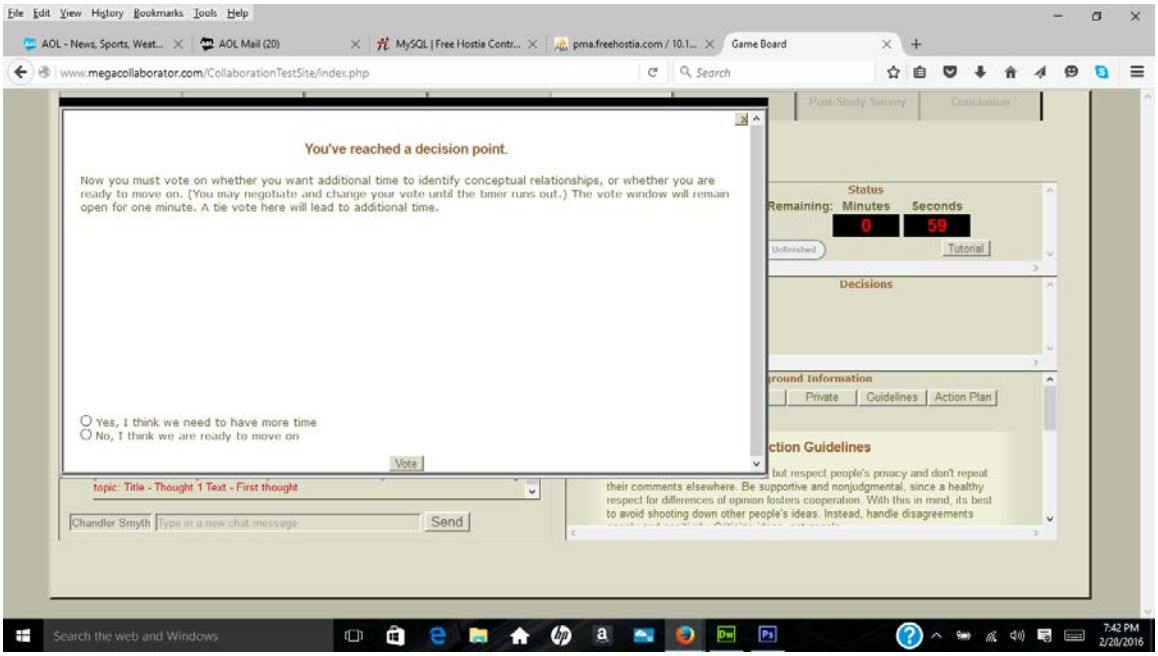
APPENDIX G – REPRESENTATIVE SCREEN SEQUENCE

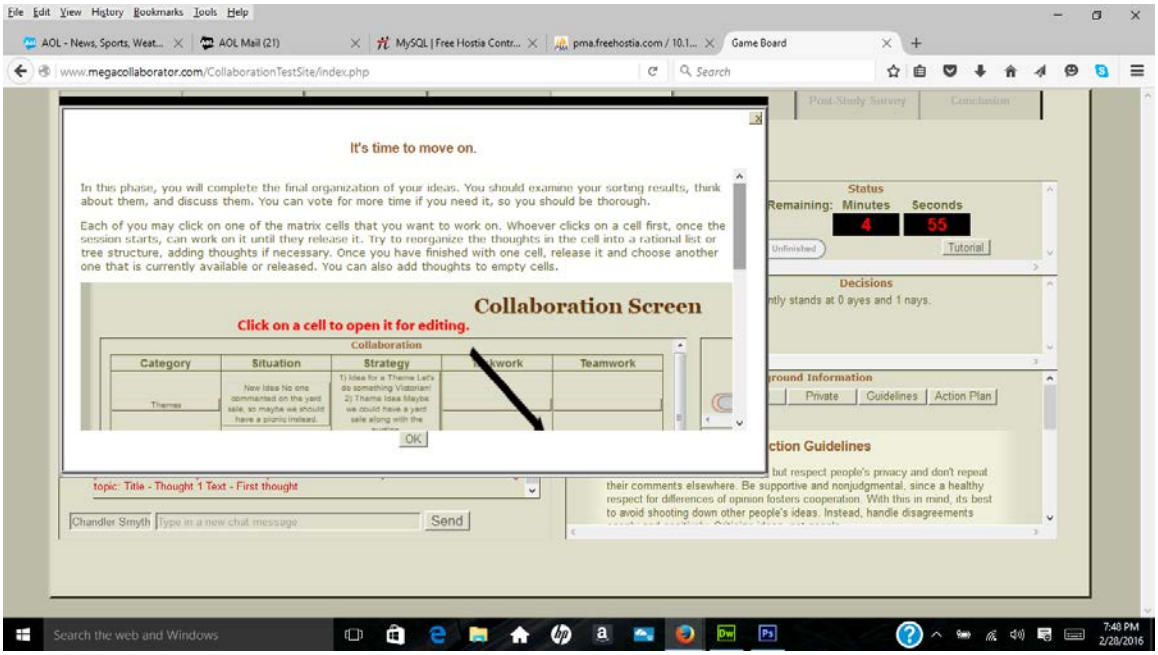

Welcome to the collaboration trial!
Introduction
1. Feel free to communicate openly within your group, but respect people's privacy and don't repeat their comments elsewhere. Be supportive and nonjudgmental, since a healthy respect for differences of opinion fosters cooperation. With this in mind, its best to avoid shooting down other people's ideas. Instead, handle disagreements openly and positively. Criticize ideas, not people.
2. Include everyone in the discussion. But if someone just wants to listen in, that's okay too, because people often need time to think and digest before giving comment. Share the limelight, and avoid interrupting each other. Anyone who feels cut out of the discussion should address their concerns in a positive fashion with the group.
3. Acknowledge problems and deal with them. Listen to people, keeping the focus on the current topic without sidetracking. Give feedback directly, openly, and in a timely fashion. Provide specific information that is relevant to the task.
4. During your planning sessions, turn off cell phones and pagers. Don't make phone calls or interrupt the planning process unless an emergency arises.
5. If you have to leave for a minute during the group discussion, use the chat window to coordinate your absence with the group.
Ready to begin session
Status
Decisions
Guidelines
Action Plan


Introduction
Consent Form
Your Contact Info
Background Survey
Match Board
Collaboration Screen
Collaboration
New Card
Status
Time Remaining: Minutes Seconds
0
50
Tutorial
Decisions
Chat Area
Send
Terry
2. Email from two weeks ago:
Chandler,


Game Board
www.megacollaborator.com/CollaborationTestSite/index.php
Introduction
Consent Form
Your Contact Info
Background Survey
Match Board
Wrap-Up
Post-Study Survey
Conclusion
Collaboration Screen
Collaboration
New Card
Status
Time Remaining: Minutes Seconds
1
25
Unfinished
Tutorial
Decisions
Chat Area
Background Information
Instructions
Scenario
Shared
Private
Guidelines
Action Plan
Information Other Group Members Have Shared
Item
Shared by
1. Email from a month ago:
Chandler Smyth
Type in a new chat message
Send
Search the web and Windows
7:34 PM
2/28/2016


Game Board
www.megacollaborator.com/CollaborationTestSite/index.php
It's time to move on.
In this phase, you and your group members will generate thoughts and ideas about any local color you want included in the initial press announcement. You have five minutes. Please generate five random thoughts about the topic. Create a separate card for each thought by pressing the new card button. Give each card a short name that can be used as a handle.
OK
Post-Study Survey
Conclusion
Status
Remaining: Minutes Seconds
0
0
Unfinished
Tutorial
Decisions
Share with group
topic:: Title - Thought 1 Text - First thought
Chandler Smyth
Type in a new chat message
Send
Rory and I have finally finished our renovation of the Ellingham mansion. We tried to remain true to its Victorian character, and we're thrilled with the result! We want to volunteer to be on the next home tour, now that the house is ready.
Search the web and Windows
7:35 PM
2/28/2016


Game Board
You've reached a decision point.
Now you must vote on whether you want additional time to identify conceptual relationships, or whether you are ready to move on. (You may negotiate and change your vote until the timer runs out.) The vote window will remain open for one minute. A tie vote here will lead to additional time.
Yes, I think we need to have more time
No, I think we are ready to move on
Vote
Status
Remaining: Minutes Seconds
0 59
Tutorial
Decisions
Private
Guidelines
Action Plan
topic: Title - Thought 1 Text - First thought
Chandler Smyth
Type in a new chat message
Send
Search the web and Windows
7:42 PM
2/28/2016


Game Board
It's time to move on.
In this phase, you will complete the final organization of your ideas. You should examine your sorting results, think about them, and discuss them. You can vote for more time if you need it, so you should be thorough.
Each of you may click on one of the matrix cells that you want to work on. Whoever clicks on a cell first, once the session starts, can work on it until they release it. Try to reorganize the thoughts in the cell into a rational list or tree structure, adding thoughts if necessary. Once you have finished with one cell, release it and choose another one that is currently available or released. You can also add thoughts to empty cells.
Collaboration Screen
Click on a cell to open it for editing.
Collaboration
Category
Situation
Strategy
Teamwork
OK
Status
Remaining: Minutes Seconds
4 55
Tutorial
Decisions
Private
Guidelines
Action Plan
topic: Title - Thought 1 Text - First thought
Chandler Smyth
Type in a new chat message
Send
Search the web and Windows
7:48 PM
2/28/2016

APPENDIX H – REPRESENTATIVE SHARING CONTEXTS

Table 40. *Acts of Sharing in Context*

Context 1 = Spontaneous

Context 2 = Elicited by Current Conversation

Context 3 = Elicited by the Interface

act	section	context	partic	type	matchID	role name	message
1	2	1	3	test	1	Taylor Jones	Taylor Jones has added the following topic: Title - Security for the event Text - Ask the security company of they would like to patrol the event gratis, as a way to introduce their service to the neighborhood.
1	2	1	2	test	1	Marley Winters	Marley Winters has updated the following topic: Title - Security for the event Text - I'm not sure what security company, but that sounds good to me.
5	2	2	3	test	1	Taylor Jones	Taylor was contacted by a security company that wished to gain clients in this neighborhood.
5	2	2	2	test	1	Marley Winters	I don't have all the information...apparently each of our roles was given other information
2	2	2	2	test	1	Marley Winters	Marley Winters has added the following topic: Title - Celebrities Text - Does anyone know celebrities that we can invite to host the auction?
2	2	2	3	test	1	Taylor Jones	Taylor Jones has added the following topic: Title - Celebrity Access Text - Are

act	section	context	partic	type	matchID	role name	message
							there any local celebrities that have moved into this revitalized area? Or, can we ask residents if they know someone who may qualify in this role?
2	2	2	2	test	1	Marley Winters	Sounds good to me, I
2	2	2	2	test	1	Marley Winters	I am not sure if I know any celebrities...I'm a musician though...I play the sax
3	2	1	2	test	1	Marley Winters	Marley Winters has added the following topic: Title - Give the troublemaking kids jobs Text - Give the kids something to be in charge of so they can take ownership of the event/neighborhood...they'll likely cause less trouble then
3	2	1	3	test	1	Taylor Jones	I like the idea of giving the trouble making kids a responsibility during the event.
4	2	1	3	test	1	Taylor Jones	Taylor Jones has added the following topic: Title - Local law enforcement Text - Alert local law enforcement to the specific threat to the winning artist by her gang-related peers. (I thought we were supposed to toss out 5 topics. These are off the top of my head.)
6	3	1	3	test	1	Taylor Jones	I (Talor) received a warning that a storm front was headed toward the event.

act	section	context	partic	type	matchID	role name	message
							Heard from someone who overheard angry peers scheming to hurt the winning artist.
6	3	1	2	test	1	Marley Winters	What?
6	3	1	3	test	1	Taylor Jones	Taylor received 5 emails ahead of this event. Those were 2 topics covered. I am not sure how we develop an action plan from the various pieces of information we each received
6	3	1	2	test	1	Marley Winters	I recieved emails as well, but it was more about planning the event
7	3	2	3	test	1	Taylor Jones	Taylor is neighborhood watch captain. I guess that is why her emails were related to vulnerabilities.
8	3	2	2	test	1	Marley Winters	Marley Winters has shared the following item: 1. Email from last week: Marley, Isn't it wonderful to watch Bell on TV? Her grandfather worked so hard to teach her his craft. She sure is making us all proud now. It's like a miracle to watch the beauty springing from her hands. I hate to even think what direction she might have gone if he hadn't stepped in

act	section	context	partic	type	matchID	role name	message
							to mentor her. She and her brother really had us scared for a while. Now he's in college and she's on TV! Do you suppose her fame might finally bring her grandfather some recognition? He's a wonderful artist himself, but no one has ever seemed to notice. The church has bought so many of his works to support him over the years that our attic is full of them. Do you think we could raise money for charity by selling them? Reverend Clark, Mt. Hope Church
8	3	2	2	test	1	Marley Winters	I just shared an email...
25	1	2	7	control	20	Chandler Smythe	Hey Marley, do you have any emails to share?
25	1	2	8	control	20	Marley Winters	Marley Winters has shared the following item: 6. Email from two weeks ago: Marley, guess what! I just got back from an art rave in Melbourne! It's like a food rave, but add in artwork from all the local

act	section	context	partic	type	matchID	role name	message
							underground artists. It was huge! There were people there from all walks of life. And the take was great! All I had to do was set out my cup and start in on my fiddle. I made enough in one night to pay my hotel bill for the whole time I was there. Why don't we do stuff like that? All our artists are so prissy. It's like only rich people care about art. I can't imagine playing the fiddle at one of their hoity-toity gallery openings. - Storm
26	1	1	7	control	20	Chandler Smythe	What roll do you play in the neighborhood? I am the association president
28	1	2	8	control	20	Marley Winters	I am a musician, I play the sax.
27			7	control	20	Chandler Smythe	Interesting. Here is this as well
27	1	1	7	control	20	Chandler Smythe	Chandler Smythe has shared the following item: 1. Email from a month ago: Chan, I have exciting news for those of you on the neighborhood board. The Foundation has finally been given title to the old School 9 property over on Park Avenue. Now the street's

act	section	context	partic	type	matchID	role name	message
							name has come true, because the old school grounds will make a wonderful neighborhood park. There's plenty of room, and even a playground! As you recall, the main school building was demolished several years ago after we complained about its condition, and the city removed the foundation and closed the hole with fill and topsoil. They even put in grass and flowers as part of the maintenance we requested back then, so our new park already has a good base of established plantings. The city offered to tear down the old gymnasium building before the property transfer. But, since it's still in fairly good shape, we've decided to keep it and convert it into a community center. It has a good roof and intact windows, but it's very dirty inside. It will need a lot of volunteers and several days of cleaning before it can be used for community events. We did buy the event insurance for it, though.

act	section	context	partic	type	matchID	role name	message
							One idea the Foundation has is that we could offer use of the building for free to the first event sponsor, with the building clean-up being their rent. Do you know of anyone who might be interested? I know the neighborhood association sometimes sponsors events, so be sure to keep us in mind if you are planning anything. Terry
30	2	3	11	test	22	Marley Winters	Marley Winters has added the following topic: Title - Location of Auction Text - We need to find a place where we can hold an auction with little or no cost.
30	2	3	11	test	22	Marley Winters	Marley Winters has added the following topic: Title - Invitation List Text - We need to decide who to invite. People who will come and will have money or will attract others to the event.
30	2	3	10	test	22	Chandler Smythe	For the location, I have some information to share. I'll work on that now.
30	2	3	10	test	22	Chandler Smythe	Chandler Smythe has shared the following item: 1. Email from a month ago:

act	section	context	partic	type	matchID	role name	message
							Chan, I have exciting news for those of you on the neighborhood board. The Foundation has finally been given title to the old School 9 property over on Park Avenue. Now the street's name has come true, because the old school grounds will make a wonderful neighborhood park. There's plenty of room, and even a playground! As you recall, the main school building was demolished several years ago after we complained about its condition, and the city removed the foundation and closed the hole with fill and topsoil. They even put in grass and flowers as part of the maintenance we requested back then, so our new park already has a good base of established plantings. The city offered to tear down the old gymnasium building before the property transfer. But, since it's still in fairly good shape, we've decided

act	section	context	partic	type	matchID	role name	message
							to keep it and convert it into a community center. It has a good roof and intact windows, but it's very dirty inside. It will need a lot of volunteers and several days of cleaning before it can be used for community events. We did buy the event insurance for it, though. One idea the Foundation has is that we could offer use of the building for free to the first event sponsor, with the building clean-up being their rent. Do you know of anyone who might be interested? I know the neighborhood association sometimes sponsors events, so be sure to keep us in mind if you are planning anything. Terry
32	2	3	10	test	22	Chandler Smythe	Chandler Smythe has shared the following item: 2. Email from two weeks ago: Chandler, I am writing to let you know that Rory and I have finally finished our renovation of

act	section	context	partic	type	matchID	role name	message
							the Ellingham mansion. We tried to remain true to its Victorian character, and we're thrilled with the result! We want to volunteer to be on the next home tour, now that the house is ready. Also, while it is primarily our residence, we plan to offer the Ellingham mansion as an event site for our catering business. It will make a wonderful venue for upscale functions of up to a hundred people. So, if you know of anyone with a wedding or celebration in their plans, you might mention to them that we can provide both the location and the food for a lavish affair. Also, if the neighborhood has any event coming up, we would be willing to host it for free to get people acquainted with what we have to offer. Yours truly, Gwen

act	section	context	partic	type	matchID	role name	message
32	2	3	10	test	22	Chandler Smythe	I am trying to share another email regarding the location, but it doesn't appear to be sharing with you. I'll try one more time.
32	3	3	12	test	22	Taylor Jones	I am caught up now. I think that the former mansion would be the best venue, given the short lead time. Also, refreshments are available on site from the catering business.
32	3	3	10	test	22	Chandler Smythe	The other email did finally share, by the way. It's about a mansion that is available for free, but it is limited to 100 people, so likely not as big as the school.
37	1	1	13	control	23	Chandler Smythe	Hi, this is Chandler, I'm the neighborhood association president.
41	1	2	15	control	23	Taylor Jones	Hi team- I want to offer that I was co chair of the Crime Stoppers auction in 2013
41	1	2	13	control	23	Chandler Smythe	wonderful news Taylor. I am the Neighborhood Association President
42	1	2	14	control	23	Marley Winters	Chandler I am ready to help with the event. Taylor might be a good fit to work on event security -my background is primarily in the arts and working with youth
43	1	2	15	control	23	Taylor Jones	I am Crime Stopper Neighborhood Captain too

act	section	context	partic	type	matchID	role name	message
45	1	2	15	control	23	Taylor Jones	And I was a meteorologist before I retired
38	1	1	14	control	23	Marley Winters	Marley Winters has shared the following item: 5. Email from last month: To Marley Winters: We are looking for a saxophonist to complete a jazz quartet at a wedding reception. Your name was recommended to us by one of the other musicians. If you are interested in auditioning, please respond to this message. We might also like to discuss your availability for future engagements. We prefer to book for small, upscale events, in and around the downtown area. Sidney Porter, Blue Note Venues
39	1	1	13	control	23	Chandler Smythe	Email from a month ago: Chan, I have exciting news for those of you on the neighborhood board. The Foundation has finally been given title to the old School 9 property over on Park Avenue. Now the street's

act	section	context	partic	type	matchID	role name	message
							name has come true, because the old school grounds will make a wonderful neighborhood park. There's plenty of room, and even a playground! As you recall, the main school building was demolished several years ago after we complained about its condition, and the city removed the foundation and closed the hole with fill and topsoil. They even put in grass and flowers as part of the maintenance we requested back then, so our new park already has a good base of established plantings. The city offered to tear down the old gymnasium building before the property transfer. But, since it's still in fairly good shape, we've decided to keep it and convert it into a community center. It has a good roof and intact windows, but it's very dirty inside. It will need a lot of volunteers and several days of cleaning before it can be used for community events. We did buy the event insurance for it, though. One idea the Foundation has is

act	section	context	partic	type	matchID	role name	message
							that we could offer use of the building for free to the first event sponsor, with the building clean-up being their rent. Do you know of anyone who might be interested? I know the neighborhood association sometimes sponsors events, so be sure to keep us in mind if you are planning anything. Terry Email from two weeks ago: Chandler, I am writing to let you know that Rory and I have finally finished our renovation of the Ellingham mansion. We tried to remain true to its Victorian character, and we're thrilled with the result! We want to volunteer to be on the next home tour, now that the house is ready. Also, while it is primarily our residence, we plan to offer the Ellingham mansion as an event site for our catering business. It will make a wonderful venue for upscale functions of up to a hundred people. So, if you know of anyone with a weddin
63	1	2	18	test	24	Taylor Jones	Yes, Do you have any suggestions?

act	section	context	partic	type	matchID	role name	message
63	1	2	17	test	24	Marley Winters	Maybe we can plan to host the event in a well known venue
63	1	2	17	test	24	Marley Winters	something like the Indianapolis Museum of Art (IMA)
63	1	2	18	test	24	Taylor Jones	I was thinking maybe we could do something race themed..Indy car, Nascar, etc.
63	1	2	16	test	24	Chandler Smythe	I am not a terribly creative person, so I hope we don't have to come up with ideas. I think after this initial "get to know each other" time frame, different items will appear in the Collaborations or Decisions boxes.
63	1	2	18	test	24	Taylor Jones	I like the ideal of the IMA
63	1	2	16	test	24	Chandler Smythe	Chandler Smythe has shared the following item: 1. Email from a month ago: Chan, I have exciting news for those of you on the neighborhood board. The Foundation has finally been given title to the old School 9 property over on Park Avenue. Now the street's name has come true, because the old school grounds will make a wonderful neighborhood park. There's

act	section	context	partic	type	matchID	role name	message
							plenty of room, and even a playground! As you recall, the main school building was demolished several years ago after we complained about its condition, and the city removed the foundation and closed the hole with fill and topsoil. They even put in grass and flowers as part of the maintenance we requested back then, so our new park already has a good base of established plantings. The city offered to tear down the old gymnasium building before the property transfer. But, since it's still in fairly good shape, we've decided to keep it and convert it into a community center. It has a good roof and intact windows, but it's very dirty inside. It will need a lot of volunteers and several days of cleaning before it can be used for community events. We did buy the event insurance for it, though. One idea the Foundation has is that we could offer use of the building for free to the

act	section	context	partic	type	matchID	role name	message
							first event sponsor, with the building clean-up being their rent. Do you know of anyone who might be interested? I know the neighborhood association sometimes sponsors events, so be sure to keep us in mind if you are planning anything. Terry Chandler Smythe has shared the following item: 2. Email from two weeks ago: Chandler, I am writing to let you know that Rory and I have finally finished our renovation of the Ellingham mansion. We tried to remain true to its Victorian character, and we're thrilled with the result! We want to volunteer to be on the next home tour, now that the house is ready. Also, while it is primarily our residence, we plan to offer the Ellingham mansion as an event site for our catering business. It will
64	1	2	16	test	24	Chandler Smythe	make a wonderful venue for

act	section	context	partic	type	matchID	role name	message
							upscale functions of up to a hundred people. So, if you know of anyone with a wedding or celebration in their plans, you might mention to them that we can provide both the location and the food for a lavish affair. Also, if the neighborhood has any event coming up, we would be willing to host it for free to get people acquainted with what we have to offer. Yours truly, Gwen
64	2	2	17	test	24	Marley Winters	Should we use your emails to inform planning of the auction?
64	2	2	18	test	24	Taylor Jones	I'm thinking that's what we are suppose to do but I'm not certain. The email about the Ellingham mansion could be used for the venue and food.
64	2	2	18	test	24	Taylor Jones	Taylor Jones has added the following topic: Title - Let\'s host the auction at a fancy location. Text - Maybe we can host the auction somewhere classy.

act	section	context	partic	type	matchID	role name	message
73	1	2	21	control	25	Taylor Jones	Hello; we are planning an art-auction event, right? Ideas might be to have it outside in a local park, unless someone has access
73	1	2	21	control	25	Taylor Jones	to a large indoor venue
73	1	2	20	control	25	Marley Winters	A local park sounds great. I can find out if I would be able to access the Blue Note Venue facility.
73	1	2	21	control	25	Taylor Jones	We will need some way to display and protect the art, of course; what's the Blue Note facility like?
74	1	1	20	control	25	Marley Winters	Marley Winters has shared the following item: 5. Email from last month: To Marley Winters: We are looking for a saxophonist to complete a jazz quartet at a wedding reception. Your name was recommended to us by one of the other musicians. If you are interested in auditioning, please respond to this message. We might also like to discuss your availability for future engagements. We prefer to book for small, upscale events, in and around the downtown area.

act	section	context	partic	type	matchID	role name	message
							Sidney Porter, Blue Note Venues
74	1	1	21	control	25	Taylor Jones	small upscale events sounds good but possibly expensive. Perhaps since this is a charity fundraiser we could work something out with the Blue Note venue
74	1	1	20	control	25	Marley Winters	I will offer my saxophone service for the upcoming wedding reception in exchange for using their venue for a charity fundraiser.
74	1	1	21	control	25	Taylor Jones	we'll need to encourage people to come. Free food and music will work, as well as the charity angle, and we can get our local winner to talk it up among her friends.
74	1	1	21	control	25	Taylor Jones	We are planning to hold an art auction for charity at the Blue Note venue. We will offer free music and food to attract buyers. I think the supplied advertisting/admin person can handle setting that up
74	1	1	20	control	25	Marley Winters	My bandmates play jazz and could help play for the event for a few hours. This may help entice some buyers too. Perhaps a theme surrounding jazz and art?

act	section	context	partic	type	matchID	role name	message
74	1	1	21	control	25	Taylor Jones	Jazz and art would be good. We could perhaps do a New Orleans jazz theme for the event Taylor Jones has shared the following item: 3. Email from last week: Tay, I heard something disturbing at the grocery store last night that I wanted to make sure you knew about. There was a group of kids hanging out around the vending machines next to the store, and as I walked by they were having an argument about that girl, Bell, who's in that TV art competition. One of the boys was angry about her leaving their gang and pretending that she was too good for them. But one of the girls was saying that Bell was still their friend and wanted to share her good luck. The last thing I heard as I went in the store was that angry young man threatening to make trouble with Bell and her brother if they didn't shape up. Do you know Bell's family? Maybe
75	1	1	21	control	25	Taylor Jones	you could warn them.

act	section	context	partic	type	matchID	role name	message
							Sidney Tamar I am not sure that this would affect our charity event at the Blue Note, but we should be aware that there might be some personal interactions
75	1	1	21	control	25	Taylor Jones	with a gang
75	1	1	21	control	25	Taylor Jones	so we need to make sure that the event and Bell are safe
76	2	2	20	control	25	Marley Winters	Reverend Clark is well respected with the kids of the neighborhood and volunteer with them to clean storm drains in the neighborhood. It would be great to involve them in any cleanup efforts and positive actions to make them feel proud of themselves too.
76	2	2	21	control	25	Taylor Jones	That's a good idea
77	2	2	20	control	25	Marley Winters	One of the musician's son creates wire sculptures and his girlfriend does portrait sketches. A little joyful noise may attract buyers for the kids.
85	1	1	23	test	26	Marley Winters	Marley Winters has shared the following item: 1. Email from last week: Marley, Isn't it wonderful to watch

act	section	context	partic	type	matchID	role name	message
							Bell on TV? Her grandfather worked so hard to teach her his craft. She sure is making us all proud now. It's like a miracle to watch the beauty springing from her hands. I hate to even think what direction she might have gone if he hadn't stepped in to mentor her. She and her brother really had us scared for a while. Now he's in college and she's on TV! Do you suppose her fame might finally bring her grandfather some recognition? He's a wonderful artist himself, but no one has ever seemed to notice. The church has bought so many of his works to support him over the years that our attic is full of them. Do you think we could raise money for charity by selling them? Reverend Clark, Mt. Hope Church
86	1	2	25	control	27	Chandler Smythe	so, we sgould plan the event, right?
86	1	2	26	control	27	Marley Winters	I think so

act	section	context	partic	type	matchID	role name	message
86	1	2	25	control	27	Chandler Smythe	o, first of all, we need a place to host the event. Chandler Smythe has shared the following item: 1. Email from a month ago: Chan, I have exciting news for those of you on the neighborhood board. The Foundation has finally been given title to the old School 9 property over on Park Avenue. Now the street's name has come true, because the old school grounds will make a wonderful neighborhood park. There's plenty of room, and even a playground! As you recall, the main school building was demolished several years ago after we complained about its condition, and the city removed the foundation and closed the hole with fill and topsoil. They even put in grass and flowers as part of the maintenance we requested back then, so our new park already has a good base of established plantings.
86	1	2	25	control	27	Chandler Smythe	

act	section	context	partic	type	matchID	role name	message
							The city offered to tear down the old gymnasium building before the property transfer. But, since it's still in fairly good shape, we've decided to keep it and convert it into a community center. It has a good roof and intact windows, but it's very dirty inside. It will need a lot of volunteers and several days of cleaning before it can be used for community events. We did buy the event insurance for it, though. One idea the Foundation has is that we could offer use of the building for free to the first event sponsor, with the building clean-up being their rent. Do you know of anyone who might be interested? I know the neighborhood association sometimes sponsors events, so be sure to keep us in mind if you are planning anything. Terry
86	1	2	25	control	27	Chandler Smythe	this old school looks a good idea.
86	1	2	26	control	27	Marley Winters	what's the other options? gym?

act	section	context	partic	type	matchID	role name	message
87	1	2	25	control	27	Chandler Smythe	I have I renewed mansion i think an open place in the community will be
88	1	1	27	control	27	Taylor Jones	dangerous.
88	1	1	27	control	27	Taylor Jones	Remember the mail that was sent about the gang activity?
88	1	1	27	control	27	Taylor Jones	A place that will have some security will be preferred
88	1	1	25	control	27	Chandler Smythe	sure... in this case we should be more carefull...
88	1	1	27	control	27	Taylor Jones	an enclosed place preferably
89	1	2	25	control	27	Chandler Smythe	Chandler Smythe has shared the following item: 2. Email from two weeks ago: Chandler, I am writing to let you know that Rory and I have finally finished our renovation of the Ellingham mansion. We tried to remain true to its Victorian character, and we're thrilled with the result! We want to volunteer to be on the next home tour, now that the house is ready. Also, while it is primarily our residence, we plan to offer the Ellingham mansion as an event site for our catering business. It will make a wonderful venue for upscale functions of up to a hundred people. So, if you

act	section	context	partic	type	matchID	role name	message
							know of anyone with a wedding or celebration in their plans, you might mention to them that we can provide both the location and the food for a lavish affair. Also, if the neighborhood has any event coming up, we would be willing to host it for free to get people acquainted with what we have to offer. Yours truly, Gwen
89	1	2	25	control	27	Chandler Smythe	we can talk rory to use the place
89	1	2	27	control	27	Taylor Jones	sounds great!
89	1	2	25	control	27	Chandler Smythe	are you all ok with that?
89	1	2	26	control	27	Marley Winters	Yes.
106	1	1	29	test	28	Marley Winters	apparently I play the saxaphone anyone need a lesson?
107	2	1	30	test	28	Taylor Jones	Taylor Jones has shared the following item: 3. Email from last week: Tay, I heard something disturbing at the grocery store last night

act	section	context	partic	type	matchID	role name	message
							that I wanted to make sure you knew about. There was a group of kids hanging out around the vending machines next to the store, and as I walked by they were having an argument about that girl, Bell, who's in that TV art competition. One of the boys was angry about her leaving their gang and pretending that she was too good for them. But one of the girls was saying that Bell was still their friend and wanted to share her good luck. The last thing I heard as I went in the store was that angry young man threatening to make trouble with Bell and her brother if they didn't shape up. Do you know Bell's family? Maybe you could warn them. Sidney Tamar
108	2	2	29	test	28	Marley Winters	Marley Winters has added the following topic: Title - Venues Text - Venues for the auction: On the beach at night
108	2	2	29	test	28	Marley Winters	Marley Winters has added the following topic: Title - Venue 2 Text -

act	section	context	partic	type	matchID	role name	message
108	2	2	28	test	28	Chandler Smythe	Casino.....this is a venue where people do not mind spending money. Plus if you get a place where the drinks are free... Chandler Smythe has added the following topic: Title - Somewhere indoors Text - since it is almost winter
108	2	2	30	test	28	Taylor Jones	Taylor Jones has shared the following item: 6. Email from this morning Taylor, It's been an interesting morning. When we first met at that weather emergency conference I told you that I'd already seen it all, but the storm that went through today was something else again! It really crept up on us. The cold front itself is a slow-mover, and the storms rolling along it don't seem all that bad when you look at the radar. But they're very windy, even though there isn't much rain. If we had looked at the radar closer, we would have noticed the gust front that preceded the rain by a full half hour. But it caught us

act	section	context	partic	type	matchID	role name	message
							flat-footed when it hit. Several of the tents blew down at the fairgrounds, and there were injuries and a bit of damage to the exhibits. I'm writing to you because I hear the storm front is headed your way, though it's moving so slow it will probably take a week to get there. I've attached a picture (link) with the gust front showing on the radar so you'll know what to watch for. Just a heads up! Steve Cooper, Fellow CrimeWatch Captain
116	1	3	31	control	29	Chandler Smythe	I am associated with a group that has a great place to organize weddings and other social events.
116	1	3	32	control	29	Marley Winters	That is wonderful news!
117	1	2	31	control	29	Chandler Smythe	The venue is beautiful and the pricing is reasonable.
117	1	2	32	control	29	Marley Winters	We are looking for a venue to host a charity auction
117	1	2	31	control	29	Chandler Smythe	Wow! Thats great. I can put you in touch with them
117	1	2	31	control	29	Chandler Smythe	The pictures of the venue are up on their Facebook page
117	1	2	32	control	29	Marley Winters	Yes please!
117	1	2	32	control	29	Marley Winters	I will be very greatful!

act	section	context	partic	type	matchID	role name	message
117	1	2	32	control	29	Marley Winters	Could you give me the name of the place so that I can look it up?
117	1	2	31	control	29	Chandler Smythe	Yeah Sure. This place is over the Park Avenue. The group is called the Foundation.
117	1	2	32	control	29	Marley Winters	I am part of a group that is planning to host a charity auction
118	1	2	31	control	29	Chandler Smythe	By the way Marley, I must tell you that this venue is also called the Ellingham Mansion.
118	1	2	32	control	29	Marley Winters	I looked it up Chandler and we would love to have the event at your place
118	1	2	32	control	29	Marley Winters	So what do you do Taylor?
118	1	2	31	control	29	Chandler Smythe	Cool! That sounds great. I am glad you liked it.
118	1	2	32	control	29	Marley Winters	:)
119	1	2	31	control	29	Chandler Smythe	Chandler Smythe has shared the following item: 2. Email from two weeks ago: Chandler, I am writing to let you know that Rory and I have finally finished our renovation of the Ellingham mansion. We tried to remain true to its Victorian character, and we're thrilled with the result! We want to volunteer to be on the next home tour, now

act	section	context	partic	type	matchID	role name	message
							that the house is ready. Also, while it is primarily our residence, we plan to offer the Ellingham mansion as an event site for our catering business. It will make a wonderful venue for upscale functions of up to a hundred people. So, if you know of anyone with a wedding or celebration in their plans, you might mention to them that we can provide both the location and the food for a lavish affair. Also, if the neighborhood has any event coming up, we would be willing to host it for free to get people acquainted with what we have to offer. Yours truly, Gwen
119	1	2	31	control	29	Chandler Smythe	This is the email from the owners of the place.
119	1	2	31	control	29	Chandler Smythe	Check it out
119	1	2	32	control	29	Marley Winters	Looks amazing Chandler
119	1	2	32	control	29	Marley Winters	Sounds like they can take care of the food as well

act	section	context	partic	type	matchID	role name	message
119	1	2	31	control	29	Chandler Smythe	You can get in touch with them and see if they can host the event free of cost :)
119	1	2	32	control	29	Marley Winters	That would be great because we are running short of time
119	1	2	32	control	29	Marley Winters	Yes I will definitely do that
119	1	2	32	control	29	Marley Winters	Thank you so much for telling me about this Chandler!
120	2	1	33	control	29	Taylor Jones	I got a mail regarding Bill, looks like she might get into trouble soon
120	2	1	33	control	29	Taylor Jones	Here is the email i recieved
121	2	2	33	control	29	Taylor Jones	I heard something disturbing at the grocery store last night that I wanted to make sure you knew about. There was a group of kids hanging out around the vending machines next to the store, and as I walked by they were having an argument about that girl, Bell, who's in that TV art competition. One of the boys was angry about her leaving their gang and pretending that she was too good for them. But one of the girls was saying that Bell was still their friend and wanted to share her good luck. The last thing I heard as I went in the store was that angry young man threatening to make trouble with Bell and her brother if

act	section	context	partic	type	matchID	role name	message
							they didn't shape up. Do you know Bell's family? Maybe you could warn them.
121	2	2	32	control	29	Marley Winters	This sounds bad. Lets try to include her gang in organizing the auction so that they dont feel left out
121	2	2	31	control	29	Chandler Smythe	This sounds scary. We must do that.
121	2	2	33	control	29	Taylor Jones	I dont think they will be interested in being a part of the auction
121	2	2	32	control	29	Marley Winters	We could give it a shot. At the very least it might make them think twice about sabotaging her good luck
138	1	1	36	control	30	Taylor Jones	Taylor Jones has shared the following item: 1. Email from three months ago: To CrimeWatch Captain Jones: We want to pass along some information that was developed by our local gang taskforce concerning a youth gang that has been operating in your area. The gang "Young Devils" formed about five years ago with members that were then pre-teens. Its members have been periodically arrested for the following activities: 1) graffiti (tagging activities

act	section	context	partic	type	matchID	role name	message
							significantly diminished over the past two years), 2) assault (charges involved fights on public school property), 3) illegal use of fireworks (last offense two summers ago). None of these cases was referred to adult court, but several of the gang members remain on probation as juveniles. Community intervention work two years ago, by Reverend Clark of Mount Hope Church, resulted in a significant (and continuing) reduction in incidents; but the passage of these young people into adulthood as they reach the age of 18 has initiated renewed scrutiny by our gang taskforce. Some attrition of the original gang composition has been noted as members move on, but many original members remain involved. It is the opinion of our gang experts that this gang has a high potential for generating hardcore criminals as its members leave high school and fail to integrate with society. We would appreciate hearing about any problems, issues, or changed

act	section	context	partic	type	matchID	role name	message
							circumstances that you become aware of as a concerned neighbor. Bud Stevens, CrimeWatch Liaison, Police Department
139	1	1	35	control	30	Marley Winters	It seems like our task is to plan an auction, right? I'd say we get to that and ignore some of the off-topic emails.
139	1	1	36	control	30	Taylor Jones	Right, to plan an auction and raise money for an event
139	1	1	35	control	30	Marley Winters	If this was real life, I'd be a terrible person for this -- I've never planned an event like this. Have you?
139	1	1	36	control	30	Taylor Jones	I've planned an event, personally (I wrote up and am teaching a class)
139	1	1	36	control	30	Taylor Jones	but I've never had to raise funds for it!
139	1	1	35	control	30	Marley Winters	What would you advise?
139	1		34	control	30	Chandler Smythe	Hello, "president of the nieghborhood association" here.
139	1	1	36	control	30	Taylor Jones	Hi Chandler. We could use your advice -- We need to sell art objects and have a bunch of kids who are doing harm to themselves by doing criminal graffiti
139	1	1	34	control	30	Chandler Smythe	Last known activity?
139	1	1	34	control	30	Chandler Smythe	They seem to be relevant insofar that they can

act	section	context	partic	type	matchID	role name	message
							potentially interfere with the auction we have to plan.
140	1	2	34	control	30	Chandler Smythe	I got some personal emails regarding some venues.
140	1	2	36	control	30	Taylor Jones	On the other hand, they could create the art if we don't have any art on hand.
141	1	1	35	control	30	Marley Winters	I'm going to share all the emails I was provided in case they are of use. Apparently my character is a musician. And is being bugged to add other artwork to the auction by a pastor trying to get rid of it lol.
141	1	1	36	control	30	Taylor Jones	Oy. Information overload.
141	1	1	34	control	30	Chandler Smythe	Right, they could be for whom our art nonprofit can help.
142	1	1	34	control	30	Chandler Smythe	Maybe we can recruit them in rennovating this old gymnasium being turned into a community center.
143	1	1	35	control	30	Marley Winters	Marley Winters has shared the following item: 4. Email from this morning: Hey Marley! How's the sax? A few of us are getting together for some improv tomorrow and could really use your horn in the mix. I know you've been watching that artist gal on TV, but there's lots of other

act	section	context	partic	type	matchID	role name	message
							action in the hood! Stevie's boy is trying to sell some of his wire sculptures down at the cafe, and his girlfriend does portrait sketches. We thought if we made a little joyful noise it might attract some buyers for the kids. If it works, several of the other locals might try selling their stuff this way. Just come by after your show is over and you can tell us what happened. Jive
143	1	1	36	control	30	Taylor Jones	I think it's fairly obvious we should create a workshop for troubled youth to not just do renovations, but also create legal graffiti for auction
144	1	2	34	control	30	Chandler Smythe	" The city offered to tear down the old gymnasium building before the property transfer. But, since it's still in fairly good shape, we've decided to keep it and convert it into a community center. It has a good roof and intact windows, but it's very dirty inside. It will need a lot of volunteers and several days of cleaning before it

act	section	context	partic	type	matchID	role name	message
							can be used for community events. We did buy the event insurance for it, though."
144	1	2	35	control	30	Marley Winters	That sounds like a cool idea.
							" One idea the Foundation has is that we could offer use of the building for free to the first event sponsor, with the building clean-up being their
145	1	2	34	control	30	Chandler Smythe	rent."
145	1	2	35	control	30	Marley Winters	That email above shared some other kids we could get involved.
146	1	2	34	control	30	Chandler Smythe	I got this email a month ago from "Terry."
							I think that these high school 'gangsters' might be a good resource then to help with the renovations. However (this my personal knowledge and not something I have been given by this system) we need to keep everything
146	1	2	36	control	30	Taylor Jones	up to code
147	1	2	34	control	30	Chandler Smythe	There's also a mansion that can act as an event site.
							" Also, if the neighborhood has any event coming up, we would be willing to host it for free to get people acquainted with what we
148	1	2	34	control	30	Chandler Smythe	have to offer."
149	1	2	34	control	30	Chandler Smythe	But it's more for upscale events.
150	1	1	35	control	30	Marley Winters	Marley Winters has shared the following item: 3. Email

act	section	context	partic	type	matchID	role name	message
							from yesterday: Marley, Could you ask Reverend Clark to talk to our boy? I don't know of anyone in the neighborhood who the kids look up to more. We're trying to persuade them to disband that kiddie gang they started. They're getting old enough now that we're worried they'll be getting in worse trouble than just with the firecrackers and the fights at school. Last time Reverend Clark worked with them, they cleaned out every storm drain in the neighborhood, and were so proud of themselves! If we could just get them involved in some fun community effort, we could surely turn them to the right path. Lizzie
150	1	1	36	control	30	Taylor Jones	I have to agree with what Lizzie said to Marley Sounds like this neighborhood kid gang
150	1	1	35	control	30	Marley Winters	would be good at helping

act	section	context	partic	type	matchID	role name	message
							clean up a venue from that email.
150	1	1	34	control	30	Chandler Smythe	Makes for a great conversion story.
150	1	1	36	control	30	Taylor Jones	I say recruit the gang -- we could even do minimum wage to help them a bit financially -- and renovate the venue
150	1	1	35	control	30	Marley Winters	Yeah, I'm for that idea.
150	1	1	36	control	30	Taylor Jones	We can also give them scraps to do legal graffiti art upon -- and auction it
150	1	1	34	control	30	Chandler Smythe	Then it's settled?
151	2	2	35	control	30	Marley Winters	Marley Winters has shared the following item: 6. Email from two weeks ago: Marley, guess what! I just got back from an art rave in Melbourne! It's like a food rave, but add in artwork from all the local underground artists. It was huge! There were people there from all walks of life. And the take was great! All I had to do was set out my cup and start in on my fiddle. I made enough in one night to pay my hotel bill for the whole time I was there. Why don't we do stuff like that? All our artists are so prissy. It's like only rich people care about art. I can't imagine

act	section	context	partic	type	matchID	role name	message
							playing the fiddle at one of their hoity-toity gallery openings. - Storm
151	2	2	35	control	30	Marley Winters	This one seems to support the idea of doing something offbeat in a rough space, that helps get these kids involved.
151	2	2	35	control	30	Marley Winters	Maybe that could be the theme -- street level art.

APPENDIX I – REPRESENTATIVE ACTION COMMENTS

Table 41. *Examples of Action Comments*

chatID	participant	team type	matchID	role name	message
543	11	test	22	Marley Winters	Marley Winters has added the following topic: Title - Location of Auction Text - We need to find a place where we can hold an auction with little or no cost.
544	11	test	22	Marley Winters	Marley Winters has added the following topic: Title - Invitation List Text - We need to decide who to invite. People who will come and will have money or will attract others to the event.
547	11	test	22	Marley Winters	Marley Winters has added the following topic: Title - Local Artist Text - The church pastor has a large collection of art work it purchased from a local artist. We could have that art to sell at the event.

chatID	participant	team type	matchID	role name	message
554	12	test	22	Taylor Jones	I am caught up now. I think that the former mansion would be the best venue, given the short lead time. Also, refreshments are available on site from the catering business.
555	10	test	22	Chandler Smythe	The other email did finally share, by the way. It's about a mansion that is available for free, but it is limited to 100 people, so likely not as big as the school.
556	11	test	22	Marley Winters	Marley Winters has added the following topic: Title - Fundraising Ideas Text - We could sell the church artwork at the event.
557	10	test	22	Chandler Smythe	I agree with selling the church artwork. I am not sure about using the mansion vs. the school because we are not sure yet how many

chatID	participant	team type	matchID	role name	message
558	11	test	22	Marley Winters	people we can invite/expect. Marley Winters has added the following topic: Title - Entertainment Text - Blue Note Venues is a small jazz quartet we could get for low cost for the event.
559	10	test	22	Chandler Smythe	I'll share an email about Bell, the artist, and some publicity help we may be able to leverage.
560	12	test	22	Taylor Jones	Taylor Jones has added the following topic: Title - Proposed Expense Text - If we are going to use the school, we should spend part of our budget to bring in professional cleaners, in addition to our volunteers. (I know that does not directly raise revenue, but I am afraid we won\'t finish, otherwise.)

chatID	participant	team type	matchID	role name	message
561	11	test	22	Marley Winters	We don't have a lot of time, so I think finding 100 people will be a challenge.
562	11	test	22	Marley Winters	I would vote for the mansion - that way the venue and food can be taken care of for us. If they are willing to give us the space for the a neighborhood event - even better.
563	10	test	22	Chandler Smythe	I'm good with using the mansion.
564	10	test	22	Chandler Smythe	I also like the idea of hiring the Blue Note Venues jazz quartet.
565	12	test	22	Taylor Jones	Taylor Jones has added the following topic: Title - Local Color Theme Text - If we have local Jazz musicians, we could use a Jazz Age Theme. We are closer to Chicago than any other major Jazz center -- perhaps we could go with a gangster theme?

chatID	participant	team type	matchID	role name	message
566	11	test	22	Marley Winters	Maybe throw in some Dilinger-related themes? Marley Winters has added the following topic: Title - TV personalities Text - We should invite the local TV news personalities. We might get some free publicity on their shows. Maybe one would agree to Emcee the event.
567	12	test	22	Taylor Jones	Ask the reality show's local network affiliate -- use that publicity person they're sending us.
569	10	test	22	Chandler Smythe	We can use a publicity person to help with the complaint above from a concerned neighbor.
570	12	test	22	Taylor Jones	Taylor Jones has updated the following topic: Title - TV personalities Text - Well, see my e-mail -- use the local network

chatID	participant	team type	matchID	role name	message
					affiliate of the reality show, through their provided publicity person.
575	10	test	22	Chandler Smythe	Using the local network affiliate's publicity person is a good idea. I'll share another email with a lead for additional publicity help we could leverage.
577	11	test	22	Marley Winters	We might be able to easy Mel Brown's concerns if we explain how Bell's grandfather worked hard to keep her from making bad choices.
580	12	test	22	Taylor Jones	Taylor Jones has added the following topic: Title - Mel Brown\'s Concerns Text - I agree with Marley Winters about using Mel\'s grandfather for a
581	11	test	22	Marley Winters	Marley Winters has added the following topic: Title - Neighbor

chatID	participant	team type	matchID	role name	message
					Concerns Text - We need to make sure that he knows that Bell wasn\'t always the perfect child, but that through the effort of her grandfather both she and her brother were helped to make the right choices for their future. It would be a great message to attract important donors.
582	10	test	22	Chandler Smythe	Great idea
583	12	test	22	Taylor Jones	Taylor Jones has added the following topic: Title - No Scandal Mongering Text - No offence, but I am opposed to nepotism on principle. I am sorry, but somebody\'s brother from a Hollywood scandal show does not seem appropriate to me.
584	12	test	22	Taylor Jones	Taylor Jones has added the following

chatID	participant	team type	matchID	role name	message
585	12	test	22	Taylor Jones	topic: Title - Recruit the Renovator\'s Text - We should ask the Mansion owner\'s (assuming we go that route) to put together a little YouTube tour of their place, with some history of their renovations -- 5 minutes or less. Taylor Jones has added the following topic: Title - Recruitment Text - I think it was correct when we said that 100 people on short notice will be difficult. We need to try to reach a target audience that will come and bid. Again, we can use the network coordinator, but we really need to find a local charity event planner for them to coordinate with.
586	11	test	22	Marley Winters	Marley Winters has updated the following

chatID	participant	team type	matchID	role name	message
587	10	test	22	Chandler Smythe	topic: Title - No Scandal Mongering Text - It isn\'t Chandler\'s brother, and the guy is an expert, so we could benefit from his skills. Sounds like he is pretty busy though. Good idea, Taylor, the video will help promote the mansion as well. Seems like a win-win.
588	12	test	22	Taylor Jones	Taylor Jones has added the following topic: Title - Publicity Text - Again, use the provided resource. Paper, internet, tv, etc. Blast the message out quick.
589	10	test	22	Chandler Smythe	Right, it sounds like it's the brother of one of Chandler's friends. If he is available, I think we could use his expertise to handle Bell's past and address her in a positive light

chatID	participant	team type	matchID	role name	message
					considering her present accomplishments and potential in the future. I'm ready to log some
590	10	test	22	Chandler Smythe	decisions!
					Marley Winters has updated the Cell R1-C4 with the following contents: Publicity Again, use the provided resource. Paper, internet, tv, etc. Blast the message out
605	11	test	22	Marley Winters	quick.
					Chandler Smythe has updated the Cell R1-C3 with the following contents: Location of Auction We need to find a place where we can hold an auction with little or no cost. Proposed Expense If we are going to use the school, we should spend part of our budget to bring in professional cleaners,
606	10	test	22	Chandler Smythe	in addition to our

chatID	participant	team type	matchID	role name	message
					volunteers. (I know that does not directly raise revenue, but I am afraid we won\'t finish, otherwise.) Recruit the Renovator\'s We should ask the Mansion owner\'s (assuming we go that route) to put together a little YouTube tour of their place, with some history of their renovations -- 5 minutes or less. Chandler Smythe has updated the Cell R1-C2 with the following contents: TV personalities We should invite the local TV news personalities. We might get some free publicity on their shows. Maybe one would agree to Emcee the event. Use the local network
607	10	test	22	Chandler Smythe	affiliate of the reality

chatID	participant	team type	matchID	role name	message
					show, through their provided publicity person.
608	11	test	22	Marley Winters	Marley Winters has updated the Cell R2-C3 with the following contents: We\'re going to use the mansion, not the school.
609	11	test	22	Marley Winters	Marley Winters has updated the Cell R3-C1 with the following contents: We should ask the Mansion owner\'s (assuming we go that route) to put together a little YouTube tour of their place, with some history of their renovations -- 5 minutes or less.
610	10	test	22	Chandler Smythe	Chandler Smythe has updated the Cell R4-C1 with the following contents: We can invite up to 100 people, but we need to allow sufficient room

chatID	participant	team type	matchID	role name	message
					for staff working the event.
612	11	test	22	Marley Winters	Reserve the mansion
613	10	test	22	Chandler Smythe	got that as #1
614	12	test	22	Taylor Jones	Concur on the mansion.
615	11	test	22	Marley Winters	Choose the menu
616	12	test	22	Taylor Jones	Book the Jazz group -- do we want to go with the ganster theme?
617	11	test	22	Marley Winters	Hire the band
618	11	test	22	Marley Winters	Gangster Theme is good.
619	10	test	22	Chandler Smythe	band/jazz group is #3
620	11	test	22	Marley Winters	Find an Emcee
621	11	test	22	Marley Winters	Send out invitations
622	11	test	22	Marley Winters	Publicize the event
623	10	test	22	Chandler Smythe	invitations is #2.
627	11	test	22	Marley Winters	Acquire the auction items
632	11	test	22	Marley Winters	Sell tickets through neighborhood volunteers.
633	11	test	22	Marley Winters	i hope the mansion has heat.
634	10	test	22	Chandler Smythe	haha, i added a note regarding the mansion's utilities.
635	12	test	22	Taylor Jones	So add an inspection task. Also, maybe half

chatID	participant	team type	matchID	role name	message
					neighborhood, half celebrities? Or 3 to 1? (Only 100 seats.)
646	13	control	23	Chandler Smythe	I have been tasked with finding a venue to host the Charity Auction, and while there are 2 possibilities, there is also some neighborhood concern about the past of the winner of the show
655	14	control	23	Marley Winters	Chandler I am ready to help with the event. Taylor might be a good fit to work on event security -my background is primarily in the arts and working with youth
659	13	control	23	Chandler Smythe	We have 2 possible event sites: the old gym of the school and a local mansion. The school would provide opportunity to have more people come.

chatID	participant	team type	matchID	role name	message
					The home would be more intimate
663	15	control	23	Taylor Jones	I like the home
					We can get some IndyCar drivers if it sounds exclusive
664	15	control	23	Taylor Jones	enough
					Well Taylor in light of what Chandler said about venues-maybe your meteorology skills can help with a venue choice! what's safer in a storm?
665	14	control	23	Marley Winters	mansion or gym?
666	15	control	23	Taylor Jones	mansion
					I like the home idea also--sounds like a better place to get people with money to
668	14	control	23	Marley Winters	donate
					either IRL Drivers or perhaps a member or 2
669	13	control	23	Chandler Smythe	of the Colts?
670	15	control	23	Taylor Jones	yes, great thought
					We should cast a wide professional sports
671	15	control	23	Taylor Jones	net.

chatID	participant	team type	matchID	role name	message
					maybe a Pacer?
					Peyton Manning? he
672	14	control	23	Marley Winters	loves charities
					so we are agreed on contacting the owners of the Ellingham Mansion for use of their home for the
673	13	control	23	Chandler Smythe	Charity Auction
					Yes I am in favor of
674	14	control	23	Marley Winters	the mansion location
					What theme would we
675	13	control	23	Chandler Smythe	like to go with?
					Yes. Please remind me if they are Art supporters in general-
676	15	control	23	Taylor Jones	the owners
					They are. They also own a local catering
677	13	control	23	Chandler Smythe	business
					The venue can handle
679	13	control	23	Chandler Smythe	up to 100 people
					They are willing to host the event for free, in part to showcase the
680	13	control	23	Chandler Smythe	venue
					The theme could be Paint the Town Green
681	15	control	23	Taylor Jones	-(green for money)?

chatID	participant	team type	matchID	role name	message
682	14	control	23	Marley Winters	so they've had Parisian Fantasy and Tahitian Paradise...what about all day telethon effort featuring acts by local artists along with a silent auction?
683	15	control	23	Taylor Jones	Does all day mean like 10 am- 6 pm? I was unsure.
684	15	control	23	Taylor Jones	I was thinking this would be a fancy evening event.
685	14	control	23	Marley Winters	uuuh I was thinking like the Labor Day telethon or Riley telethon we have locally--since we have tv coverage
686	14	control	23	Marley Winters	oh okay Taylor-that is also a great idea
687	15	control	23	Taylor Jones	For Crime Stoppers we had a Roaring 20's once and a Oscar themed event
689	13	control	23	Chandler Smythe	Could we do it in 2 parts? With the live TV auction in the evening?

chatID	participant	team type	matchID	role name	message
690	15	control	23	Taylor Jones	Do we have to ask the producers about that?
691	14	control	23	Marley Winters	I was thinking that the telethon would also generate local small business and every day people support to contribute
692	13	control	23	Chandler Smythe	It would be great to showcase the city and what we're known for
693	15	control	23	Taylor Jones	Yes Chandler, we need to do that.
694	15	control	23	Taylor Jones	Yes, local businesses would like to be associated with this. The State Fair and IUPUI jumped on board when the local guy Josh won the Voice.
695	13	control	23	Chandler Smythe	similar to what the city did for the Superbowl
696	14	control	23	Marley Winters	yes- a great way to generate some social media attention to a wider audience -in addition to the event

chatID	participant	team type	matchID	role name	message
					but realizing we have $5k from the producers to cover staging and decorations and some
697	13	control	23	Chandler Smythe	refreshments
					ok so we would need to ask for in-kind donations- and they could be featured on
698	15	control	23	Taylor Jones	the show
					doesn't this project have a planner that
699	14	control	23	Marley Winters	can help with budget?
700	15	control	23	Taylor Jones	yes
					#4 on the list of information from the planner was the
701	13	control	23	Chandler Smythe	amount available
					Budget The production company can supply $5,000 for miscellaneous use in staging, decorating, providing refreshments, etc. This doesn't generally cover much. The venue and most of the
702	13	control	23	Chandler Smythe	work will have to be

chatID	participant	team type	matchID	role name	message
					provided by volunteers.
703	14	control	23	Marley Winters	Who is it :) (the plan coordinator)-maybe next segment?
704	15	control	23	Taylor Jones	at least we get a free publicity agent
705	13	control	23	Chandler Smythe	have we decided on a theme yet?
706	13	control	23	Chandler Smythe	true. the marketing person will be a big help
707	13	control	23	Chandler Smythe	it also looks like the Auctioneer is provided as well
708	15	control	23	Taylor Jones	Do we want a general sports theme?
709	14	control	23	Marley Winters	hmmm - we said sports presence, at a mansion, some telethon aspects, upper crust attendees-- Taylor said paint the town green I think that's a good start with a tie in to the cause (paint the town green for...)
710	13	control	23	Chandler Smythe	that would be fun. football, basketball,

chatID	participant	team type	matchID	role name	message
					car racing, soccer, baseball
					as the auction and tv show are for local artists, an arts program to give kids an
711	13	control	23	Chandler Smythe	alternative
712	15	control	23	Taylor Jones	yes
					so: Paint the Town
713	13	control	23	Chandler Smythe	Green for Art?
					and a Sports Theme?
714	13	control	23	Chandler Smythe	within it
715	15	control	23	Taylor Jones	yes
716	15	control	23	Taylor Jones	yes
					telethon for the live auction -- call in
717	13	control	23	Chandler Smythe	bidding?
					well now we use a bidding app- it is
718	15	control	23	Taylor Jones	easier
					We can raise more money by getting people to pay the celebrities to take pics with them. Like $10
721	15	control	23	Taylor Jones	per pic
					okay so to tie in the sports themes and rasie cash I was
722	14	control	23	Marley Winters	thinking shoot hoops

chatID	participant	team type	matchID	role name	message
					for $, race a lap with Jeff Gordon for $, tackle Andrew Luck for $ (?)
723	15	control	23	Taylor Jones	We can also have a rolling powerpoint with pictures of paints, brushes, easels and the auction app lets people do a "mission bid"
724	14	control	23	Marley Winters	the picture Idea is great too-people love mementos with celebrities
726	13	control	23	Chandler Smythe	a bunch of the Indy Drivers live or have homes in town, how about seeing if Dalara will chip in for a lap or two around the track?
727	14	control	23	Marley Winters	how do we get some focus on the needy children?
728	15	control	23	Taylor Jones	you can bid (donate) like $10-$20 to help buy art supplies
729	13	control	23	Chandler Smythe	and someone like Graham Rahal or

chatID	participant	team type	matchID	role name	message
					Charlie Kimball to drive?
731	15	control	23	Taylor Jones	Marley- please be more specific about the needy children
732	13	control	23	Chandler Smythe	a lot of the drivers and football players support either Riley or local kids organizations
733	15	control	23	Taylor Jones	Yes Charlie has done a lot of charity work for JDRF
734	13	control	23	Chandler Smythe	thinking of Andrew Luck and Tony Kanaan
735	14	control	23	Marley Winters	tthe scenario says "with the proceeds going to fund an outreach art program for low income children in her hometown."
736	13	control	23	Chandler Smythe	also, while not in Indy, Jay Cutler is a local Indiana boy
737	15	control	23	Taylor Jones	Yes to both of you thanks
739	13	control	23	Chandler Smythe	how about a tie-in with one of the local

chatID	participant	team type	matchID	role name	message
					IPS schools or something with either the Art Museum or the Children's Museum?
740	13	control	23	Chandler Smythe	I think the IMA would be a good sounding board on this
741	15	control	23	Taylor Jones	So we are agreed to ask those sports figures to attend the event and allow us to raise funds
742	13	control	23	Chandler Smythe	I think so. How about some of the local TV personalities too?
743	15	control	23	Taylor Jones	by selling picures of them with attendees and for them to offer experiences for the highest bidder
744	13	control	23	Chandler Smythe	or Bob and Tom?
745	13	control	23	Chandler Smythe	perhaps have some local kids or young artists there working on pieces too?
746	15	control	23	Taylor Jones	I think the media personalities should be TV people as this is I am assuming a network reality show,

chatID	participant	team type	matchID	role name	message
					so they would want us to use
					seeing the youth who will benefit I think
					will help with the $$
747	13	control	23	Chandler Smythe	and the celebrity
					I was thinking like the art in a day concept --
					but instead art in an evening with the
					finished works being
748	14	control	23	Marley Winters	featured
					the personalities of that TV news network.
					Like if NBC then
749	15	control	23	Taylor Jones	Chuck Lofton or Julia
750	13	control	23	Chandler Smythe	or Dan Dakich?
751	13	control	23	Chandler Smythe	Marley, good idea
					when does the plan coordinator come in to
752	14	control	23	Marley Winters	help with budget?
					We should have kids working on art at the
					event, but with
					finished works there
753	15	control	23	Taylor Jones	(the majority)
					yes, most definitely
754	13	control	23	Chandler Smythe	Taylor
					so to re-confirm: 1.
764	13	control	23	Chandler Smythe	Venue: local mansion

chatID	participant	team type	matchID	role name	message
					2. Sports Theme (Paint the Town Green) 3. local color (sports figures, TV and RAdio personalities and 4. local kids
					I was just thinking we should start tallying a list of descisions and expenses- I assume celebrities will donate, the venue is free, the televised portion is donated, the young artists would volunteer --but what about food,
765	14	control	23	Marley Winters	music, decor?
766	15	control	23	Taylor Jones	yes
					food is donated or in the $$ budget given (the owners of the mansion are willing to donate their time and
767	13	control	23	Chandler Smythe	catering to the event
					I play the saxophone and have some musician friends- I could probably rally
769	14	control	23	Marley Winters	some entertainment-

chatID	participant	team type	matchID	role name	message
					just low key classy jazz
					food would be from local businesses we would allow their signs at the venue so
770	15	control	23	Taylor Jones	free advertising
					decor is within the
771	13	control	23	Chandler Smythe	budget given
					the paintings can be
772	15	control	23	Taylor Jones	decor!
					oh okay- well that makes planning a lot
773	14	control	23	Marley Winters	easier
					that sounds like a
774	13	control	23	Chandler Smythe	great idea Marley]
775	15	control	23	Taylor Jones	yes, we are lucky
					perhaps items too other than paintings,
776	13	control	23	Chandler Smythe	pottery, jewelry, etc
					Yes. We could get them to donate
777	15	control	23	Taylor Jones	autographed jerseys.
					and having some of the local kids/youth who will benefit present will be
778	13	control	23	Chandler Smythe	decor/celebrities

chatID	participant	team type	matchID	role name	message
779	14	control	23	Marley Winters	what about security for the celebrities and the event itself?
780	15	control	23	Taylor Jones	I am happy to assist with that. But I know Luck has his own minimal security will
783	13	control	23	Chandler Smythe	be needed
786	13	control	23	Chandler Smythe	Local Color to be included in the Press Release
787	13	control	23	Chandler Smythe	Andrew Luck, Tony Kanaan, Charlie Kimball, Dan Dakich?
788	13	control	23	Chandler Smythe	local TV too?
789	14	control	23	Marley Winters	What about a feature on Bell who won the rality show?
790	14	control	23	Marley Winters	*reality
791	13	control	23	Chandler Smythe	definitely included in the press release
792	15	control	23	Taylor Jones	Well we would just discuss how the local arts programs are underfunded and we are the Crossroads of America
793	15	control	23	Taylor Jones	and our home teams (insert all, even Indy 11 and Fever) are

chatID	participant	team type	matchID	role name	message
					helping to put the art programs for low income kids
					do we want to be specific for each
794	15	control	23	Taylor Jones	celebrity?
					both great ideas to make sure make it into
795	13	control	23	Chandler Smythe	the press release
					Bell's father was an artist and prominent in the local church community--maybe we could feature some of his art/have him speak about lcoal work with the youth and what these sports mentors and donations mean to helping kids
796	14	control	23	Marley Winters	achieve their dreams?
					if we say we're able to contact them within the week's allotment we should be able to include at least one or
797	13	control	23	Chandler Smythe	two names
					Marley is on the best path and yes we
800	15	control	23	Taylor Jones	should be able to get

chatID	participant	team type	matchID	role name	message
					some confirmations quickly
					what about parking/traffic
804	14	control	23	Marley Winters	control?
					the mansion should
806	15	control	23	Taylor Jones	have tons of parking
					but just to direct
					people in and out and
807	14	control	23	Marley Winters	ease congestion
					potential problems and
					solutions is up:
808	13	control	23	Chandler Smythe	parking, security, etc
					my security friends
809	15	control	23	Taylor Jones	will assist
					how about having
					some of the local kids
					help to do parking
810	13	control	23	Chandler Smythe	patrol?
					I will closely monitor
					the storm leaving the
					Rockies headed for us
811	15	control	23	Taylor Jones	later this week.
					also ensuring the
					neighbors know about
					the event taking place
					for the extra traffic in
812	13	control	23	Chandler Smythe	the neighborhood
					Chandler, if these are
814	15	control	23	Taylor Jones	not kids making art,

chatID	participant	team type	matchID	role name	message
					then yes they should assist us.
					Yes, I will see who the Crime Stopper President is over there
815	15	control	23	Taylor Jones	and alert them
816	14	control	23	Marley Winters	Perhaps IMPD on site as well
					they could be local artists too -- like greeters in the street, directing traffic and showcasing
817	13	control	23	Chandler Smythe	themselves
					IMPD looped in would be a definite
818	13	control	23	Chandler Smythe	must
819	15	control	23	Taylor Jones	what a neat idea
820	14	control	23	Marley Winters	Mimes! kidding but it would be funny to see perhaps have some of the kids outside working on art (of whatever kind) as people come? kinda
821	13	control	23	Chandler Smythe	like a Red Carpet
822	15	control	23	Taylor Jones	yes. well most of the security guys are off duty IMPD anyway

chatID	participant	team type	matchID	role name	message
823	14	control	23	Marley Winters	other potential problems-do we serve alcohol-and if so what's our liability (we don't want over indulgers at the party)
824	14	control	23	Marley Winters	Maybe do drink tickets and have a limit?
825	15	control	23	Taylor Jones	Chandler yes, kids can be painting or drawing. Yes, you have to get a charity servers license $15
827	15	control	23	Taylor Jones	Drink tickets are best way to control
828	14	control	23	Marley Winters	Also general safety-lighting on the grounds, groundskeeper to keep sidewalks clear (if weather issues)
829	13	control	23	Chandler Smythe	I've got friends who can bartend
830	14	control	23	Marley Winters	I'd bartend but I'll be playing in the band
832	15	control	23	Taylor Jones	are they servers in real life? that would be convenient

chatID	participant	team type	matchID	role name	message
833	14	control	23	Marley Winters	maybe a different entrance and exit for celebs
834	13	control	23	Chandler Smythe	I can ask some of the local neighborhood association members to help patrol grounds too
835	13	control	23	Chandler Smythe	the mansion is well-lit and has ample indoor and outdoor movement
836	15	control	23	Taylor Jones	Chandler- does this Mansion have a huge front door?
838	14	control	23	Marley Winters	thanks Chandler-just checking- we don't want the event liable for someone slipping and breaking an ankle
839	13	control	23	Chandler Smythe	it has a nice size front
840	13	control	23	Chandler Smythe	it is also a residence, so some rooms will be off limits
841	13	control	23	Chandler Smythe	Victorian home remodeled
842	14	control	23	Marley Winters	So other concerns? maybe have some medics on hand in

chatID	participant	team type	matchID	role name	message
					case of emergency medical needs
					don't forget the owners have their own catering business, so that will help on food
843	13	control	23	Chandler Smythe	and cost
845	13	control	23	Chandler Smythe	someone from IU Health EMT
846	15	control	23	Taylor Jones	I suppose we could get them or Eskenazi to do it
853	13	control	23	Chandler Smythe	sounds great Taylor
854	15	control	23	Taylor Jones	it all does
					there was a concern from a local resident about the winner's past life growing up and how we address supporting her and not
858	13	control	23	Chandler Smythe	her past
859	15	control	23	Taylor Jones	we will not dwell on her past at all
					that was my thought too. focus on future and the good that will come from her art and
860	13	control	23	Chandler Smythe	winning to the town
864	14	control	23	Marley Winters	A friend of mine told me it was Bell's

chatID	participant	team type	matchID	role name	message
874	13	control	23	Chandler Smythe	mother who had a problem-but I think that's a strength when someone comes from a troubled background and rises above 1. Local Venue: Ellingham Mansion 2. Theme: "Paint the Town Green .... " (general Sports Theme) 3. Local Sports Figures (across the genres) with tie in to autographs, the Track, and TV and Radio personalities 4. Taylor will coordinate Security and watch the weather forecasts to ensure safety of all guests 5. Have telephone bidding available live -- as a kind of telethon 6. Use local kids/young artists as talent: producing art or various media at the event itself, both

chatID	participant	team type	matchID	role name	message
					inside and outside; perhaps also a short video of local artists and the work being done and the support this Charity Auction will provide 7. For auction: not only artwork of various styles and media but also Celebrity items (Dalara and track time, Colts, Fever, Pacers, Indy 11, etc) 8. Food/Catering provided by the owners of the home/venue
875	15	control	23	Taylor Jones	does 8 include booze?
876	13	control	23	Chandler Smythe	yes
877	15	control	23	Taylor Jones	yahoo
883	13	control	23	Chandler Smythe	9. music by Marley

APPENDIX J – RELATIONS AND CATEGORIES

Table 42. *Relations and Categories Created*

Session	Definition	Relations	Categories
1	Title	Potential Venues	Potential Venues
	Topic A	Venue	
	Topic B	Venue B	
	Title	Volunteer Recruitment	Volunteer Recruitment
	Topic A	Give the troublemaking kids jobs	
	Topic B	Volunteer Recruitment	
2	Title	site of weveent	
	Topic A	Theme an venue	
	Topic B	this is a rain or shine venue?	
	Title	safty issue resolution	
	Topic A	Condition of community center	
	Topic B	security	
	Title	Rebuilding them and generate money	Rebuilding them and generate money
	Topic A	Theme and venue	
	Topic B	Pay to paint?	
	Title	ssafety of event	ssafety of event
	Topic A	security	
	Topic B	youth involvement	
	Title	Have youth involved in providing music to get cooperation	Have youth involved in providing music to get cooperation
	Topic A	Music	
	Topic B	youth involvement	
	Title	donations	donations
	Topic A	Donated building supplies	

Session	Definition	Relations	Categories
	Topic B	supply donations	
	Title	See if need public relations to deal with any problem related to artrists relationship with gang	
	Topic A	public relations	
	Topic B	Selected artist related to gang?	
	Title	entertainment	entertainment
	Topic A	Music	
	Topic B	youth involvement	
	Title	fund raiser	
	Topic A	Pay to paint?	
	Topic B	Selected artist related to gang?	
	Title	donations to pursue	
	Topic A	supply donations	
	Topic B	Advertising	
	Title	Safety	safety
	Topic A	Security	
	Topic B	public relations	
3	Title	Venue History	Venue History
	Topic A	Location of Auction	
	Topic B	Recruit the Renovators	
	Title	Maximum Size Constraint and Targeted Audience	Maximum Size Constraint and Targeted Audience
	Topic A	Location of Auction	
	Topic B	Invitation List	
	Title	Complementarity	

Session	Definition	Relations	Categories
	Topic A	Local Color Theme	
	Topic B	Entertainment	
	Title	Bell's History	
	Topic A	Mel Brown's Concerns	
	Topic B	Neighbor Concerns	
	Title	Who to Invite	Who to Invite
	Topic A	Local Color Theme	
	Topic B	TV personalities	
	Title	Cost of Venue	Cost of Venue
	Topic A	Location of Auction	
	Topic B	Proposed Expense	
	Title	Part-Of	
	Topic A	Neighbor Concerns	
	Topic B	No Scandal Mongering	
4	Title	Theme	
	Topic A	Theme	
	Topic B	Indy 500 Theme	
	Title	Potential Bad Publicity	Potential Bad Publicity
	Topic A	Neighbor Complaint	
	Topic B	Gangs	
	Title	Theme Suggestions	Theme Suggestions
	Topic A	Indy 500 Theme	
	Topic B	The Race Towards Peace	
	Title	Solicit volunteers for event	
	Topic A	Solicit volunteers to help	
	Topic B	Engage Community Advocates	
	Title	Color Scheme	
	Topic A	Color scheme	

Session	Definition	Relations	Categories
	Topic B	Color Scheme	
	Title	Volunteers	Volunteers
	Topic A	Engage Community Advocates	
	Topic B	Solicit volunteers to help	
	Title	Entertainment	Entertainment
	Topic A	Invite a celebrity	
	Topic B	Entertainers	
	Title	Funding Sources	Funding Sources
	Topic A	Hold a raffle	
	Topic B	Raffles	
	Title	Additional money makers	Additional money makers
	Topic A	Get some more expensive items for a silent auction	
	Topic B	Raffles	
5	Title	brainstorming	
	Topic A	show ansd tell	
	Topic B	Church chat	
	Title	brainstorming	brainstorming
	Topic A	Volunteer Day	
	Topic B	Church chat	
6	Title	Location	
	Topic A	Mansion	
	Topic B	How about the gymnasium?	
	Title	Potential problem	
	Topic A	Potential problem	
	Topic B	Potential Problem 3	

APPENDIX K – THOUGHT CARDS

Table 43. *Thought Cards Created*

Session	Thought Topic	Thought Discussion
1	Venue vs Online	I'm wondering if the auction can be held online, rather than have a venue.
	Celebrities	Does anyone know celebrities that we can invite to host the auction?
	Celebrity Access	Are there any local celebrities that have moved into this revitalized area? Or, can we ask residents if they know someone who may qualify in this role?
	Security for the event	Ask the security company of they would like to patrol the event gratis, as a way to introduce their service to the neighborhood. I'm not sure what security company, but that sounds good to me.
	Give the troublemaking kids jobs	Give the kids something to be in charge of so they can take ownership of the event/neighborhood...they'll likely cause less trouble then
	Local law enforcement	Alert local law enforcement to the specific threat to the winning artist by her gang-related peers. (I thought we were supposed to toss out 5 topics. These are off the top of my head.)

Session	Thought Topic	Thought Discussion
	Reverend Clark as Speaker	Marley to ask the good Reverend to speak at the event
	Venue	Possibly the Church as a venue
		Check with Sidney Porter / Blue
	Venue B	Note Venues too
	Volunteer Recruitment	Ask Rev Clark to work on the kids
2		From the earlier emails, I like the offer of using the newly acquired park property as the venue.
	Theme and venue	If we decided to use the new park property as the venue, one possibility for the theme would be related to cleaning up or rebuilding, since cleaning up the property is a condition of using it.
	Theme an venue	
	I am unaware of the park	I would learn more
	Theme and venue food	From the earlier emails, the Taco Trucks have potential for taking care of the food, since the community center, if used as the venue, will likely not have a functioning kitchen.
	this is a rain or shine venue?	Is this weather dependant ?
	Theme	Taking back our city. Focus on art in our community. Nurturing our creativity in restoring our neighborhood.
	Pay to paint?	Sell tickets that give holder right to paint a certain part of the community center.

Session	Thought Topic	Thought Discussion
	money maker	I do like the Huck Finn approach to painting the gym. Maybe we could approach a well known graffiti artist to do an outline and establish a color palate for the pay to paint.
	Donated building supplies	While it wouldn't directly bring in money, people could be encouraged to donate building supplies
	Rebuilding	Could sell old fashioned cooking (rebuilding theme)
	supply donations	Maybe groups that would like to use the facility for groups or classes would volunteer supplies with condition that this would be an in-kind fee payment for use later. We should encourage the function of the building as a community center.
	Advertising	Charge local merchants to advertise in a flyer, etc, advertising the event
	Music	We should be able to find some way to use music to, if not generate money at least bring in more people
	advertising donation	approach a local magazine to do an article about the mural project and do art photographs as the

Session	Thought Topic	Thought Discussion
		project develops to sell at the fund raiser. Perhaps some including the participants in the photos.
	Neighborhood history	From the emails it sounds like the process to obtain the title to the park was length. That story could be used for local color--either text, or multimedia.
	Taco trucks	Taco trucks mentioned in the emails may have something to do with the neighborhood.
	JL's brother	JL's email says her brother is involved in publicity, so he is probably very aware of a lot of local color
		Always best to take advantage and involve young members of the neighborhood. We need to have a planning meeting to bring everyone up to speed and get feed back on the ideas we've come up with and to hear from the community?
	youth involvement	I have received some information that a local youth gang, which our young artist was peripherally involved with may be hostile. I suggest we approach them to participate in the project in some way to waylay negative response.

Session	Thought Topic	Thought Discussion
		I didn't get back in time to respond. THe gym would be the essential part of the event and outside activities could be provided the weather is going to be good.
	weather dependent	
	Selected artist related to gang?	See what the story is with the selected artist and relation to gang members, if any, and how to address any facts.
	Condition of community center	The community should be aware of the condition of the community center they are coming to visit and why it is like it is, and future plans for it.
	am i visible	am I visible as yet
	security	In the event we are concerned about any gang activity problems, there is a local security business that we may want to approach about volunteering their services as a way to introduce themselves to the neighbors who may want to enroll the security services privately after the fund raiser. Should I give them a call?
	public relations	We have the offer of some profession help. We should meet with them to get suggestions from their experience. They may have

Session	Thought Topic	Thought Discussion
		good ideas they've seen used at other fund-raisers.
	time frame	are we under a time constraiint and should we have a limit/// I like the idea of professional help if volunteered
3	Location of Auction	We need to find a place where we can hold an auction with little or no cost.
	Invitation List	We need to decide who to invite. People who will come and will have money or will attract others to the event.
	Local Artist	The church pastor has a large collection of art work it purchased from a local artist. We could have that art to sell at the event.
	Fundraising Ideas	We could sell the church artwork at the event.
	Entertainment	Blue Note Venues is a small jazz quartet we could get for low cost for the event.
	Proposed Expense	If we are going to use the school, we should spend part of our budget to bring in professional cleaners, in addition to our volunteers. (I know that does not directly raise revenue, but I am afraid we won't finish, otherwise.)

Session	Thought Topic	Thought Discussion
	Local Color Theme	If we have local Jazz musicians, we could use a Jazz Age Theme. We are closer to Chicago than any other major Jazz center -- perhaps we could go with a gangster theme? Maybe throw in some Dilinger-related themes?
	TV personalities	We should invite the local TV news personalities. We might get some free publicity on their shows. Maybe one would agree to Emcee the event. Well, see my e-mail -- use the local network affiliate of the reality show, through their provided publicity person.
	Mel Brown's Concerns	I agree with Marley Winters about using Mel's grandfather for a
	Neighbor Concerns	We need to make sure that he knows that Bell wasn't always the perfect child, but that through the effort of her grandfather both she and her brother were helped to make the right choices for their future. It would be a great message to attract important donors.
	No Scandal Mongering	No offence, but I am opposed to nepotism on principle. I am sorry, but somebody's brother from a

Session	Thought Topic	Thought Discussion
		Hollywood scandal show does not seem appropriate to me.
		It isn't Chandler's brother, and the guy is an expert, so we could benefit from his skills. Sounds like he is pretty busy though.
		We should ask the Mansion owner's (assuming we go that route) to put together a little YouTube tour of their place, with some history of their renovations -- 5 minutes or less.
	Recruit the Renovator's	
		I think it was correct when we said that 100 people on short notice will be difficult. We need to try to reach a target audience that will come and bid. Again, we can use the network coordinator, but we really need to find a local charity event planner for them to coordinate with.
	Recruitment	
		Again, use the provided resource. Paper, internet, tv, etc. Blast the message out quick.
	Publicity	
4		Try to engage the young people in the crime emails to help clean up the old gymnasium building
	Engage Youth	
	Let's host the auction at a fancy location.	Maybe we can host the auction somewhere classy.

Session	Thought Topic	Thought Discussion
		I liked your suggestion of an Indy 500 Theme unless you think it's been done to death
	Indy 500 Theme	Love this theme idea. It's special to Indy and appeals to many.
	Indy 500 Theme	I liked your suggestion of an Indy 500 Theme unless you think it's been done to death
	Indy 500 Theme	I liked your suggestion of an Indy 500 Theme unless you think it's been done to death
	Solicit volunteers to help	We could solicit community volunteers to help with the auction and the clean up of the community center
	IMA	Use an art museum to host the event.
	Engage Community Advocates	Invite community leaders who are advocates in the neighborhood and who enjoy working with the youth.
		I love this idea of inviting these leaders.
	Theme	This is the only theme that I can think of at the moment, but we don't have to use it.
	The Race Towards Peace	Perhaps we could play on words to incorporate the Indy 500 theme

Session	Thought Topic	Thought Discussion
	Invite a celebrity	We could solicit the help of a celebrity to donate in some form to generate more donations.
	Entertainers	We can solicit the help of local artists (i.e, singers, dancers, etc.) This would enhance attendance. This would be a great way to showcase the local talent. It would provide entertainment for the guests as well. It could also be used as an example to the youth who we are trying to assist.
	Get some more expensive items for a silent auction	We could solicit businesses for donations for a silent auction.
	Hold a raffle	Just throwing out ideas. We could host a raffle for maybe a wine/draw party.
	Raffles	We could ask locate businesses to donate goods/products that we can raffle throughout the auction. Love this idea!
	Food	Provide food with admission.
	Color scheme	If we went with the Indy 500 theme, we would need some black and white in the press announcement
	Color Scheme	We could always use the blue and white.
	Neighbor Complaint	So, reading between the lines, the neighbor who won the art contest

Session	Thought Topic	Thought Discussion
		was possibly involved in the Young Devils gang--this will definitely have the potential to be a PR problem
	Storm alert	I received an email about a potential storm heading our way. Very windy.
	Gangs	It's also possible that if word gets out about the gangs, that people won't want to attend an event held in that area
5	Important People	Send invitation to important people who are willing to work for a good cause, like maybe a famous write who could sell their books at the even.
	Volunteer Day	Maybe a fun approach would be to suggest the prominent become clowns at scheduled events
	Church chat	Maybe there at church parking lot be chidren events and/or adult only crowd games
	show ansd tell	Playing on differences ask everybody to bring anthing they would comment about
6	Venues	Venues for the auction: On the beach at night
	Venue 2	Casino.....this is a venue where people do not mind spending

Session	Thought Topic	Thought Discussion
		money. Plus if you get a place where the drinks are free...
		since it is almost winter
		Good idea but depending on when this is, the Fall's air might make it nice...
	Somewhere indoors	
		RIverboat -- This locks people down to the boat unless they can swim well
		Well, unless the boat doesn't sail and is at the dock. But I guess that would take away the idea of riverboat.
	Venue 3	
		Barn -- Depending on the theme of the artwork. this may provide a backdrop
		This sounds interesting. How do you propose we find one?
	Venue 4	
		Because I am running out of time
		Haha...not a good idea. It can't fit more than 6 people :)
	[de-identified]'s House	
		If we can arrange for a sponsor to clean it up
	How about the gymnasium?	
		That would be an idea
		This doesn't sound like a bad idea. But the email mentioned wedding as an option. I am not sure if they would still be interested with an auction for art?
	Mansion	

Session	Thought Topic	Thought Discussion
	Some place where we could watch from all directions	So they can't make trouble.
	How to raise money 1	Bake sales are alway fun but they don't raise too much. Would have to be in conjuction with something else Always over-priced Donations from attics? what about having people upscale them?
	Vintage clothing and accessories	Or we could have a pre-auction where people re-furbish them?
	How to raise money 2	Ask the Young Devils for sponsorship and then don't invite them. Or ask for sponsorship from businesses in the area
	How to raise money 3	Musicians on the street asking for donations and advertising the auction
	How to raise money 4	Hold a preauction. Auctioning off donations from businesses -- I know its redundant Make the young devils do a metal concert I like it. even if they can't play. maybe we can get them to do the bake sale.....lots of devil food cake I bet
	How to raise money color other than the Young Devils color	because they might shoot first

Session	Thought Topic	Thought Discussion
	Young Devils	Potential interferance from the local wanna be gangs
	Potential problem	Ad might not interest local businesses. Needs to be in a major newspaper in the area
	Potential Problems	Auction may only attract people who cannot afford any art
	Potential Problem 3	the mansion may not attract the right clientele. May attract people who would not buy art locally

APPENDIX L – SORTING MATRICES

Table 44. *Matrices Created*

Trial	Matrix				
	Category	Situation	Strategy	Taskwork	Teamwork
1	Potential Venues Volunteer Recruitment	Determine venue for event Arrange with neighborhood folks	Budget for Venue, Availability Ask neighbors, family, friends to volunteer for the event. Ask Rev Clark to assign jobs to engage local youth.		
2	Category	Situation	Strategy	Taskwork	Teamwork
	Rebuilding them and generate money	Theme and venue From the earlier emails, I like the offer of using the newly acquired park property as the venue. Theme an venue If we decided to use the new park property as the venue, one possibility for the theme would be related to cleaning up or rebuilding,	Theme and venue From the earlier emails, I like the offer of using the newly acquired park property as the venue.	advertising donation approach a local magazine to do an article about the mural project and do art photographs as the project develops to sell at the fund raiser. Perhaps some including the participants in the photos.	

Trial	Matrix				
	Category	Situation	Strategy	Taskwork	Teamwork
		since cleaning up the property is a condition of using it.			
	Have youth involved in providing music to get cooperation	Theme and venue From the earlier emails, I like the offer of using the newly acquired park property as the venue.	Theme and venue food From the earlier emails, the Taco Trucks have potential for taking care of the food, since the community center, if used as the venue, will likely not have a functioning kitchen. Theme and venue food From the earlier emails, the Taco Trucks	Donated building supplies While it wouldn't directly bring in money, people could be encouraged to donate building supplies	

Trial	Matrix				
	Category	Situation	Strategy	Taskwork	Teamwork
			have potential for taking care of the food, since the community center, if used as the venue, will likely not have a functioning kitchen.		
	entertainment safety	security In the event we are concerned about any gang activity problems, there is a local security business that we may want to approach about volunteering their services as a way to introduce themselves to the neighbors who may want to enroll the security services privately			

Trial	Matrix				
	Category	Situation	Strategy	Taskwork	Teamwork
		after the fund raiser. Should I give them a call?			
	ssafety of event donations				
3	Category	Situation	Strategy	Taskwork	Teamwork
	Who to Invite	Publicity Again, use the provided resource. Paper, internet, tv, etc. Blast the message out quick.	TV personalities We should invite the local TV news personalities. We might get some free publicity on their shows. Maybe one would agree to Emcee the event.	Location of Auction We need to find a place where we can hold an auction with little or no cost. Proposed Expense If we are going to use the school, we should spend part of our budget to bring in professional cleaners, in addition to our volunteers. (I know	Publicity Again, use the provided resource. Paper, internet, tv, etc. Blast the message out quick.

Trial Matrix					
	Category	Situation	Strategy	Taskwork	Teamwork
			Use the local network affiliate of the reality show, through their provided publicity person.	that does not directly raise revenue, but I am afraid we won't finish, otherwise.) Recruit the Renovator's We should ask the Mansion owner's (assuming we go that route) to put together a little YouTube tour of their place, with some history of their renovations -- 5 minutes or less.	
	Cost of Venue			We're going to use the mansion, not the school.	
	Venue History	We should ask the Mansion owner's (assuming we go that route) to put together a little YouTube tour of their place, with some history of their renovations -- 5 minutes or less.		Invitation List We need to decide who to invite. People who will come and will have money or will attract others to the event.	

Trial	Matrix				
	Category	Situation	Strategy	Taskwork	Teamwork
	Maximum Size Constraint and Targeted Audience	We can invite up to 100 people, but we need to allow sufficient room for staff working the event.			
4	Category	Situation	Strategy	Taskwork	Teamwork
	Potential Bad Publicity	Gangs It's also possible that if word gets out about the gangs, that people won't want to attend an event held in that area Storm alert I received an email about a potential storm heading our way. Very windy. Neighbor Complaint So, reading between the lines, the neighbor who won the art contest was possibly		Contact PR friend to see if he will handle PR for us Contact security guy for assistance	

Trial Matrix					
	Category	Situation	Strategy	Taskwork	Teamwork
		involved in the Young Devils gang--this will definitely have the potential to be a PR problem			
	Volunteers		Solicit volunteers to help We could solicit community volunteers to help with the auction and the clean up of the community center Engage Youth Try to engage the young people in the crime emails to help clean up the old gymnasium building Solicit volunteers to help We could solicit	Contact Reverend Clark of Mount Hope Church to see if he can assist us in engaging local gang members/ youths/ volunteers to help clean up gymnasium (even if we don't use it for the venue)	

Trial Matrix					
	Category	Situation	Strategy	Taskwork	Teamwork
			community volunteers to help with the auction and the clean up of the community center		
	Funding Sources		Raffles We could ask locate businesses to donate goods/products that we can raffle throughout the auction. Love this idea! Get some more expensive items for a silent auction We could solicit businesses for donations for a silent auction.	Start soliciting donations from local businesses/wealthy people	
	Theme Suggestions		The Race Towards Peace Perhaps we could play on words to	Do we need to get permission from Indianapolis Speedway to use the Logo/theme of	

Trial Matrix					
	Category	Situation	Strategy	Taskwork	Teamwork
			incorporate the Indy 500 theme Indy 500 Theme I liked your suggestion of an Indy 500 Theme unless you think it's been done to death	Indy 500? Check with someone.	
	Entertainment		Invite a celebrity We could solicit the help of a celebrity to donate in some form to generate more donations.	Contact Food Truck friend to see if he will contact city Food truck drivers to attend our event (although if there is bad weather we might need some way to protect folks from the weather--or just schedule a different date)	
	Additional money makers		Raffles We could ask locate businesses to donate goods/products that we can		

Trial	Matrix				
	Category	Situation	Strategy	Taskwork	Teamwork
			raffle throughout the auction. Love this idea! Get some more expensive items for a silent auction We could solicit businesses for donations for a silent auction.		
5	Category	Situation	Strategy	Taskwork	Teamwork
	brainstorming	Volunteer Day Maybe a fun approach would be to suggest the prominent become clowns at scheduled events Volunteer Day Maybe a fun approach would be to suggest the prominent become clowns at	show ansd tell Playing on differences ask everybody to bring anthing they would comment about	Church chat Maybe there at church parking lot be chidren events and/or adult only crowd games Church chat Maybe there at church parking lot be chidren events and/or adult only crowd games	Volunteer Day Maybe a fun approach would be to suggest the prominent become clowns at scheduled events

Trial	Matrix				
	Category	Situation	Strategy	Taskwork	Teamwork
		scheduled events			

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Conference on Autonomous Agents and Multiagent Systems - Volume 2, New York, New York.

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Vieweg, S., Hughes, A., Starbird, K., & Palen, L. (2010). *Microblogging During Two Natural Hazards Events: What Twitter May Contribute to Situational Awareness.* Paper presented at the Proceedings of the 28th international conference on human factors in computing systems, Atlanta, GA, USA.

Vieweg, S., Palen, L., Liu, S., Hughes, A., & Sutton, J. (2008, May, 2008). *Collective Intelligence in Disaster: An Examination of the Phenomenon in the Aftermath of the 2007 Virginia Tech Shooting.* Paper presented at the Procedings of the 5th International ISCRAM Conference, Washington DC, USA.

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Zhu, S., Abraham, J., Paul, S., Reddy, M., Yen, J., Pfaff, M., & DeFlitch, C. (2007). *R-CAST-MED: Applying Intelligent Agents to Support Emergency Medical Decision-making Teams.* Paper presented at the Proceedings of the 11th conference on Artificial Intelligence in Medicine, Amsterdam, The Netherlands

CURRICULUM VITAE

Christine Mae Newlon

EDUCATION

Indiana University, Indianapolis, IN
PhD **2016**
Dissertation: The Effect of Shared Dynamic Understanding on Willingness to Contribute Information: Design and Analysis of a Mega-Collaborative Interface

Indiana University, Indianapolis, IN
M.S. in Human-Computer Interaction **2008**
Thesis: Supporting Mega-Collaboration – An Interface for Public Response to Disasters
Honors: Student Showcase Award 2005

Purdue University, West Lafayette, IN
M.S. in Public Policy and Public Administration **1982**
Area of Concentration: Computerization of government functions
Masters Project: County Government IT Foundational Assistance - Studied interfaces and data flows of various county offices, served on search committee for county CIO.
Honors: Director's List 1980-81

Montana State University, Bozeman, MT
B.S. in Botany **1976**
B.S. in Microbiology **1976**
Area of Concentration: Environmental Health
Graduated with Highest Honors

AWARDS

Research Fellowship **2007 – 2009**
Research Fellowship **1980 – 1982**
Alpha Gamma Delta Award **1975**
Frank B. Cotner Award **1974**
University Honors Scholarship **1973 – 1976**

TEACHING EXPERIENCE

Indiana University School of Informatics, Indianapolis, IN
Associate Teacher
Graduate Level – "HCI I – Interaction Design Practice" (I541) **2009-12**
Graduate Level – "HCI II – Meaning and Form in HCI" (I561) **2010-13**
Graduate Level – "Usability and Evaluative Methods" (I543) **2010-12**
Graduate Level – "Data Analysis for Clinical Decision-Making" (I578/L650) **2011-13**
Undergraduate Level – "Information Infrastructure I" (I210) **2009**

Undergraduate Level – "Information Infrastructure II" (I211) **2010**

State of Indiana Division of Information Technology, Indianapolis, IN
Trainer – "Microsoft Project Server End User Training" **2004**

RELATED EXPERIENCE

Indiana University-Purdue University at Indianapolis, IN
Research Associate **2008 –2013**
Worked as a graduate-level instructor and as a researcher, programmer, and usability manager on the Knowledge Sifter Project, the Cancer Portal Project, and the MIVA Project. This included usability research, information architecture design, and usability testing of a web application for data mining, a website for general information on cancer, a web-based tool for management of cancer treatment symptoms, and a visualization interface for medical monitoring. It also included teaching graduate level online courses in human-computer interaction. Specialties were MySQL database design and query language, SPSS, PHP, AJAX, Flash, Actionscript, and Object Oriented Design. Also worked extensively with PowerPoint, AVS Video Editor, Photoshop, Dreamweaver, and Eclipse.

Indiana University-Purdue University at Indianapolis, IN
Research Assistant **2007 – 2008**
Worked 20 hours per week as usability manager on the Cancer Portal Project. This included usability research, information architecture design, and usability testing of a website for general information on cancer and a web-based tool for management of cancer treatment symptoms.

Indiana University-Purdue University at Indianapolis, IN
IT Contract Work **2005 – 2006**
Recruited to work on various IT projects for IUPUI Solution Center

State of Indiana Division of Information Technology, Indianapolis, IN
Senior Business Systems Consultant – Office of Strategic Support **2004 – 2005**
Worked on multiple simultaneous projects for various IT sections, including:

- Disaster recovery and business continuity planning – worked on all aspects of central IT disaster plan
- Groupware development – managed implementation of MS Project Server and served as subject-matter expert in Project, developed portal pages for various sections and cross-disciplinary teams

State of Indiana Division of Information Technology, Indianapolis, IN

Metrics and Measurements Consultant **2000 – 2004**

- Led interdisciplinary measurements group, which researched and successfully justified installation of network probes
- A major contributor to interdisciplinary group developing project management methodology

State of Indiana Division of Information Technology, Indianapolis, IN

Desktop Support Services Manager **1998 – 2000**

- Managed a staff of five

State of Indiana Division of Information Technology, Indianapolis, IN

Information Center Manager **1994 – 1998**

- Managed a staff of up to fifteen
- Was responsible for the provision of LAN and desktop support services

PUBLICATIONS, PAPERS, AND PRESENTATIONS

Faiola, A., Newlon, C., Pfaff, M., Smyslova, O. (2013). Correlating the effects of flow and telepresence in virtual worlds: Enhancing our understanding of user behavior in game-based learning. Computers in Human Behavior. 29(3) pp. 1113-1121.

Newlon, C. (2011) Teaming Up on Cancer: Serving the Diverse Needs of the Users. Poster session presented at the World Usability Day Conference, Indianapolis, IN.

Newlon, C., Comer, R., Ziner, K., McDaniel, A. (2011) Design of a Paired Patient-Caregiver Support Application for People Coping with Cancer. In Proceedings of Human Computer Interaction International 2011.

Faiola, A. and Newlon, C. (2011) Advancing Critical Care in the ICU: A Human-Centered Biomedical Informatics Approach to Designing Data Visualization Systems. In Proceedings of Human Computer Interaction International 2011.

McDaniel, A., Newlon, C., Schilling, K., Wagler-Ziner, K., Comer, R., Given, B., Given, C. (2011) Seminar 02 - Using the Internet to Translate Evidence-Based Interventions and Self-Management Information for Cancer Patients: Lessons from the Field. Society of Behavioral Medicine.

Faiola, A. and Newlon, C. (2011, March) Medical Information Visualization Assistant - MIVA. Poster session presented at the Indiana University Research Day, Indianapolis, IN.

Pfaff, M. S., Newlon, C. M., Patel, H., & MacDorman, K. F. (2010). Information fusion for civilians: The prospects of Mega-collaboration. In D. L. Hall & J. Jordan (Eds.), Human centered information fusion. Norwood, Mass.: Artech House.

Dixon, B. and Newlon, C. (2010). How Do Future Nursing Educators Perceive Informatics? Advancing the Nursing Informatics Agenda through Dialogue. Journal of Professional Nursing. 26(2) pp. 82-89.

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Interface for Large-Scale Disaster Response. Paper accepted by the ISCRAM 2009 Conference.

Newlon, C. M., Hu, C. A., Stratton, R. M. & McDaniel, A. M. (2009). Design of a Web-based Symptom Management Intervention for Cancer Patients. Paper accepted by HCI International 2009 Conference.

Newlon, C. M., Faiola, A., & MacDorman, K. F. (2008). Building the Mega-Collaboration Interface: Behavioral, Cultural, and Cognitive Factors in Visualization Support. In Information Visualisation, 2008. IV '08. 12th International Conference, 0, 509-514.

Newlon, C, MacDorman, K, and Scerri, P. (2008) A New Model for Mega-Collaboration. Presented at First International Workshop on HCI for Emergencies, CHI 2008, Florence, Italy.

Newlon C. Developing a Tool for Mega-Collaboration. (2007) Presented at Five Minutes of Fame, New Media Consortium Summer Conference. Indianapolis, Indiana. http://archive.nmc.org/events/2007summerconf/materials/Mega-Collaboration.pdf.

Newlon C, Faiola A. (2006) Support for mega-team collaboration with cultural tools: Providing a framework for the dynamic development of team culture. In Proc Cultural Attitudes towards Communication and Technology. 235-254, Tartu, Estonia.

MEMBERSHIPS

ACM

IEEE

Golden Key International Honor Society

Montana State University Alumni Association